US012391055B2

(12) **United States Patent**
Ikeya

(10) **Patent No.: US 12,391,055 B2**
(45) **Date of Patent: Aug. 19, 2025**

(54) **PRINTING APPARATUS AND CONTROL METHOD FOR PRINTING APPARATUS**

(71) Applicant: **SEIKO EPSON CORPORATION**, Tokyo (JP)

(72) Inventor: **Taichi Ikeya**, Azumino (JP)

(73) Assignee: **Seiko Epson Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 198 days.

(21) Appl. No.: **18/447,172**

(22) Filed: **Aug. 9, 2023**

(65) **Prior Publication Data**

US 2024/0051315 A1 Feb. 15, 2024

(30) **Foreign Application Priority Data**

Aug. 10, 2022 (JP) 2022-127862

(51) **Int. Cl.**

B41J 15/04	(2006.01)
B41F 17/13	(2009.01)
B41J 11/42	(2006.01)
B41J 15/00	(2006.01)
B65H 20/24	(2006.01)
B41F 13/02	(2006.01)
B41F 33/16	(2006.01)

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

CPC ***B41J 15/042*** (2013.01); ***B41F 17/13*** (2013.01); ***B41J 11/42*** (2013.01); ***B41J 11/425*** (2013.01); ***B41J 15/005*** (2013.01); ***B65H 20/24*** (2013.01); *B41F 13/02* (2013.01); *B41F 33/16* (2013.01); *B65H 2801/03* (2013.01)

(58) **Field of Classification Search**

CPC B41J 15/042; B41J 11/42; B41J 11/425; B41J 15/005; B41F 17/13; B41F 13/02; B41F 33/16; B65H 20/24; B65H 2801/03

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,412,902	B2 *	7/2002	Matsumoto	B41J 2/01 347/19
9,487,037	B2 *	11/2016	Shiode	B41J 13/0009
2021/0339541	A1 *	11/2021	Takahashi	B41J 11/0095
2023/0126527	A1 *	4/2023	Shimizu	B41J 3/4078 73/584
2023/0302832	A1 *	9/2023	Kojima	B41J 11/007

FOREIGN PATENT DOCUMENTS

JP 2013-028415 A 2/2013

* cited by examiner

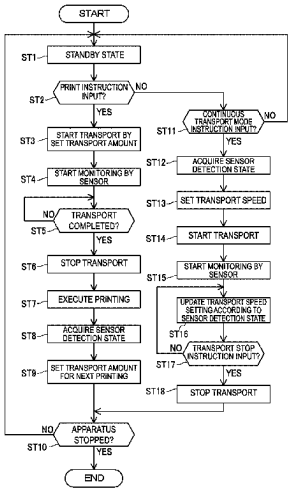
Primary Examiner — Henok D Legesse

(74) *Attorney, Agent, or Firm* — WORKMAN NYDEGGER

(57) **ABSTRACT**

A printing apparatus includes: a printing unit; a feeding roller that feeds a print medium; a feeding-side movable roller that applies tension to the print medium, in a feeding-side buffer region positioned between the feeding roller and the printing unit; a front drive roller that is positioned between the feeding-side buffer region and the printing unit and with which the print medium is intermittently transported; and a control unit that controls feeding by the feeding roller. Control amounts controlled by the control unit include a feeding amount and a feeding speed of the feeding by the feeding roller. The control unit is configured to execute and switch between a print mode and a continuous transport mode, controls the feeding amount of the feeding roller when the print mode is executed, and controls the feeding speed of the feeding roller when the continuous transport mode is executed.

11 Claims, 9 Drawing Sheets



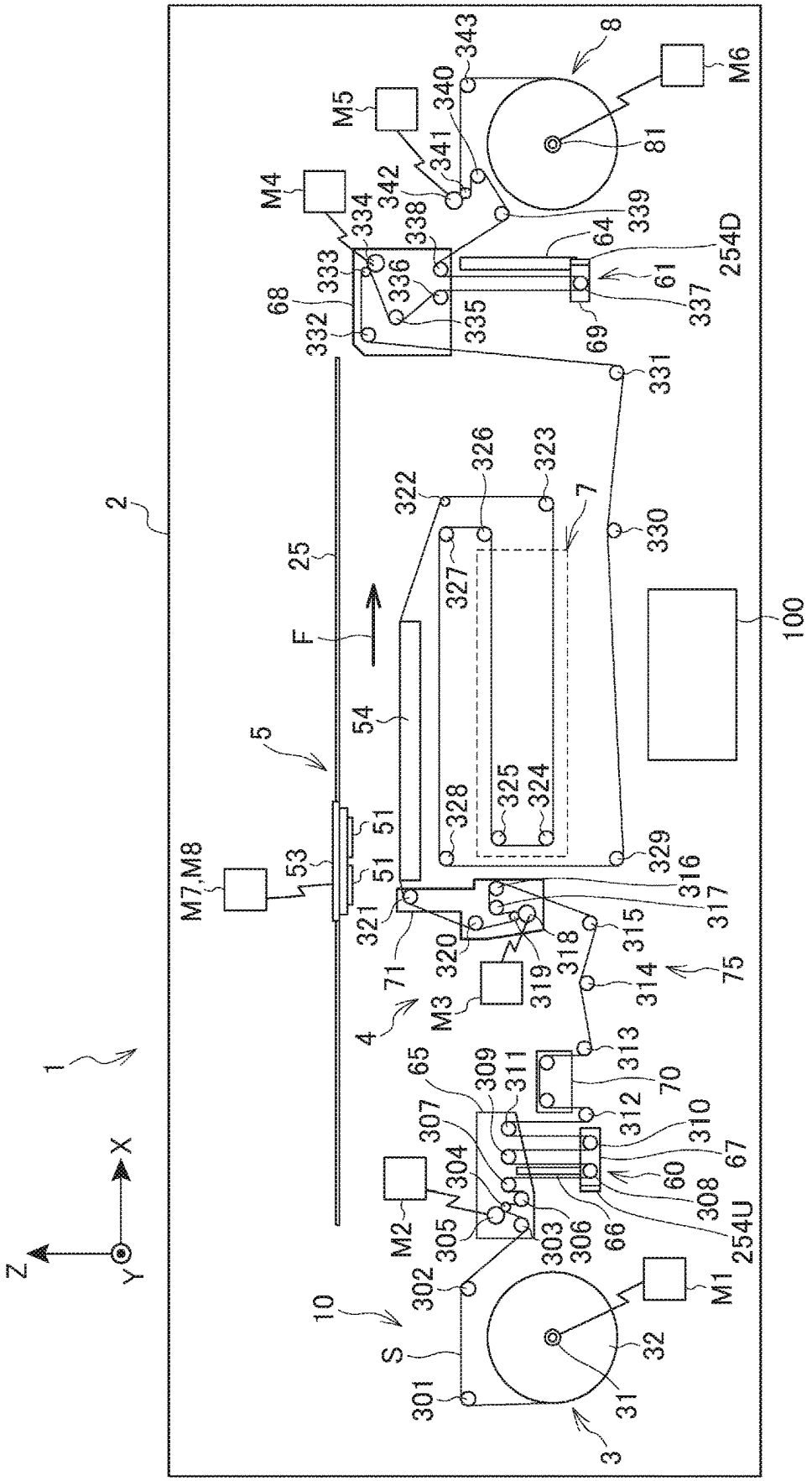

1
2
3
4
5
7
8
10
25
31
32
51
53
54
61
64
65
66
67
68
69
70
71
75
81
100
254D
254U
301
302
303
304
305
306
307
308
309
310
311
312
313
314
315
316
317
318
319
320
321
322
323
324
325
326
327
328
329
330
331
332
333
334
335
336
337
338
339
340
341
342
343
M1
M2
M3
M4
M5
M6
M7,M8
F
S
X
Y
Z

FIG. 1

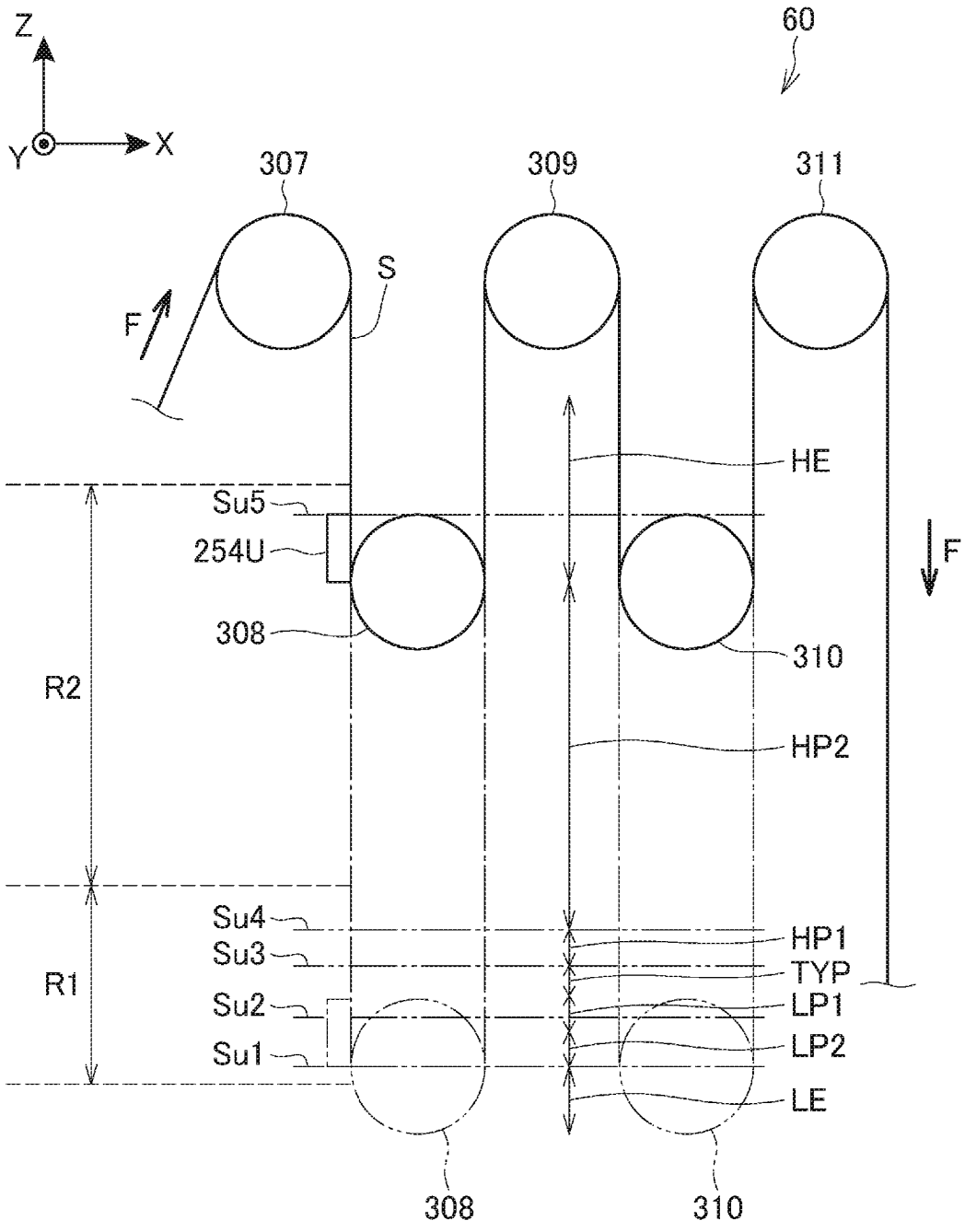

Z
Y
X
60
307
309
311
S
F
HE
Su5
254U
308
310
F
R2
HP2
Su4
Su3
Su2
Su1
R1
HP1
TYP
LP1
LP2
LE
308
310

FIG. 2

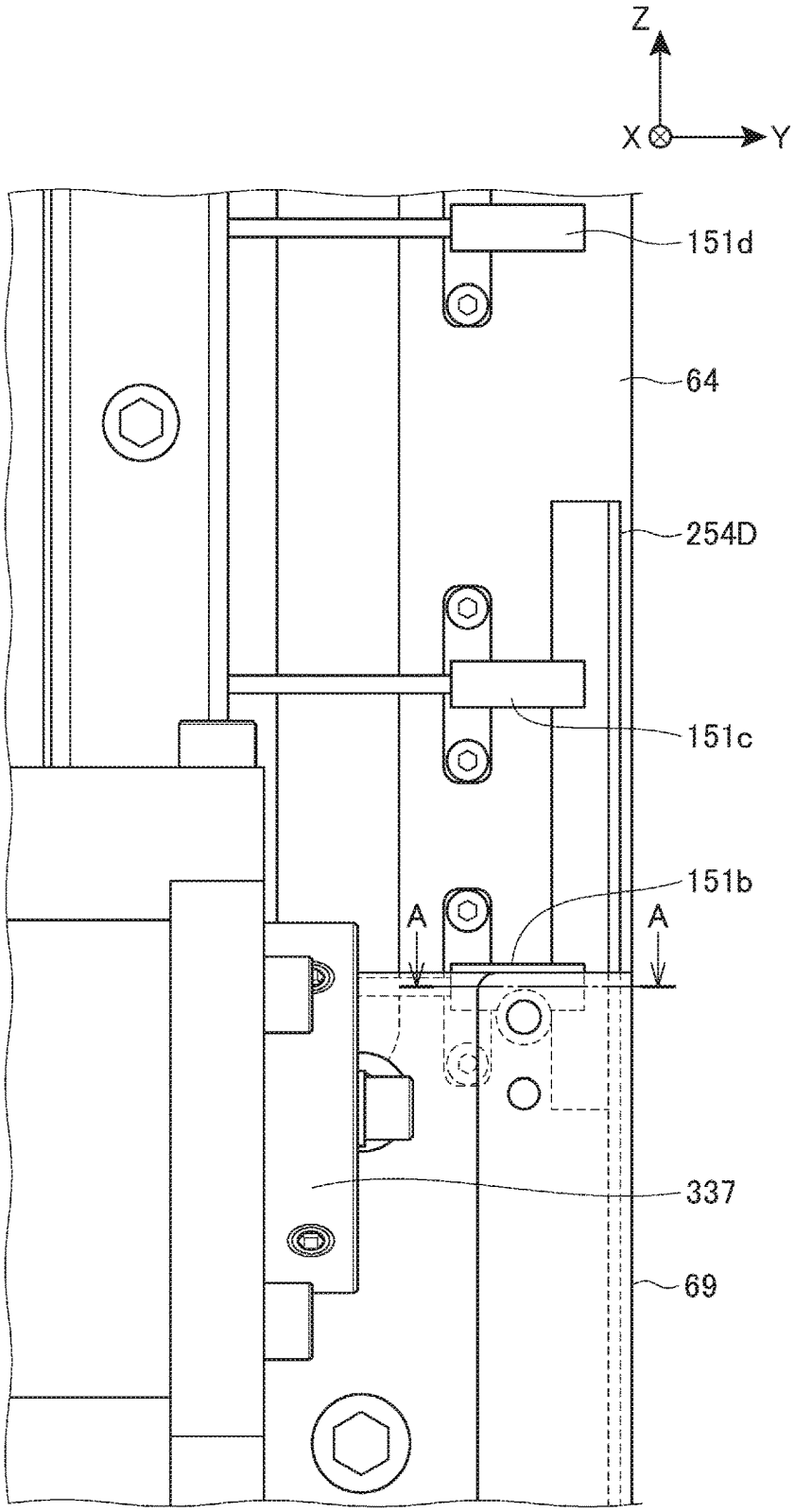


FIG. 3

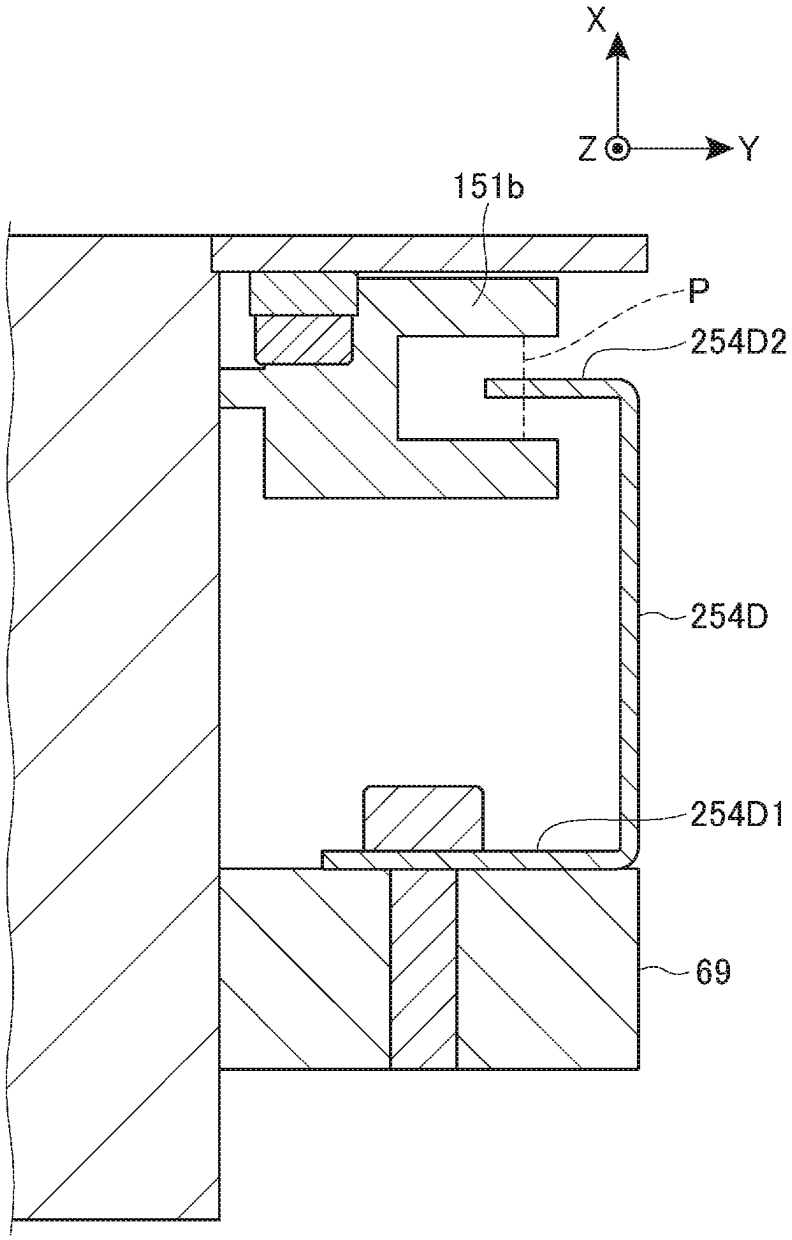


FIG. 4

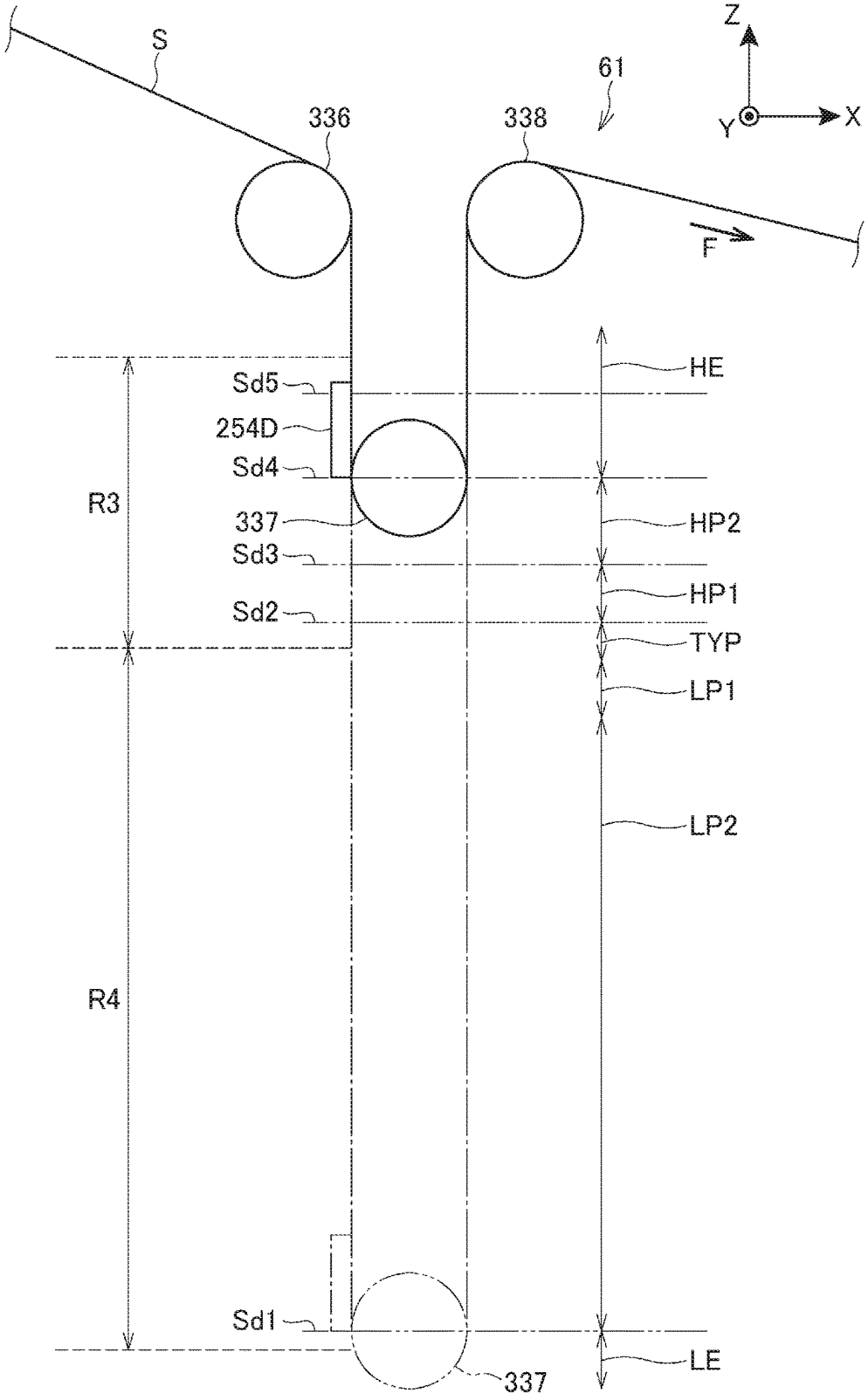

S
336
338
61
Z
Y
X
F
HE
Sd5
254D
Sd4
R3
337
HP2
Sd3
HP1
Sd2
TYP
LP1
LP2
R4
Sd1
337
LE

FIG. 5

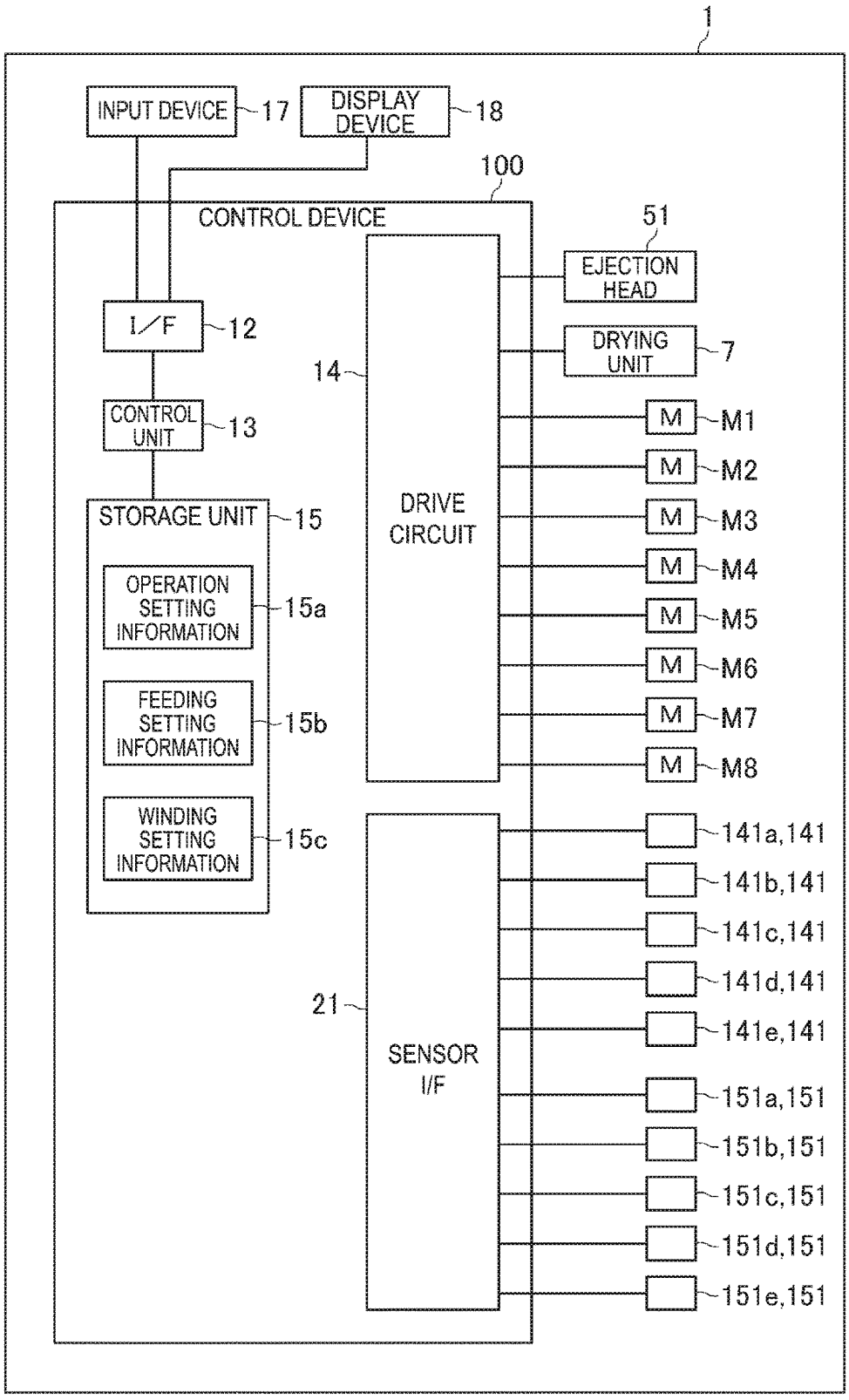

1
INPUT DEVICE
17
DISPLAY DEVICE
18
100
CONTROL DEVICE
51
EJECTION HEAD
I/F
12
DRYING UNIT
7
14
CONTROL UNIT
13
M
M1
M2
M3
M4
M5
M6
M7
M8
STORAGE UNIT
15
DRIVE CIRCUIT
OPERATION SETTING INFORMATION
15a
FEEDING SETTING INFORMATION
15b
WINDING SETTING INFORMATION
15c
141a,141
141b,141
141c,141
141d,141
141e,141
21
SENSOR I/F
151a,151
151b,151
151c,151
151d,151
151e,151

FIG. 6

15b

POSITION	DETECTION STATE	CONTROL VALUE OF FEEDING AMOUNT	CONTROL VALUE OF FEEDING SPEED
HE	Su5_ON	TRANSPORT STOP	TRANSPORT STOP
HP2	None	+ 200 [mm]	+ 10 [%]
HP1	Su4_ON	+ 100 [mm]	+ 5 [%]
TYP	Su4_ON	0 [mm]	0 [%]
	Su3_ON		
LP1	Su3_ON	− 100 [mm]	− 5 [%]
LP2	Su2_ON	− 200 [mm]	− 10 [%]
LE	Su2_ON	TRANSPORT STOP	TRANSPORT STOP
	Su1_ON		

FIG. 7

15c

POSITION	DETECTION STATE	CONTROL VALUE OF WINDING AMOUNT	CONTROL VALUE OF WINDING SPEED
HE	Sd5_ON	TRANSPORT STOP	TRANSPORT STOP
HP2	Sd4_ON	− 200 [mm]	− 10 [%]
HP1	Sd4_ON	− 100 [mm]	− 5 [%]
	Sd3_ON		
TYP	Sd3_ON	0 [mm]	0 [%]
	Sd2_ON		
LP1	Sd2_ON	+ 100 [mm]	+ 5 [%]
LP2	None	+ 200 [mm]	+ 10 [%]
LE	Sd1_ON	TRANSPORT STOP	TRANSPORT STOP

FIG. 8

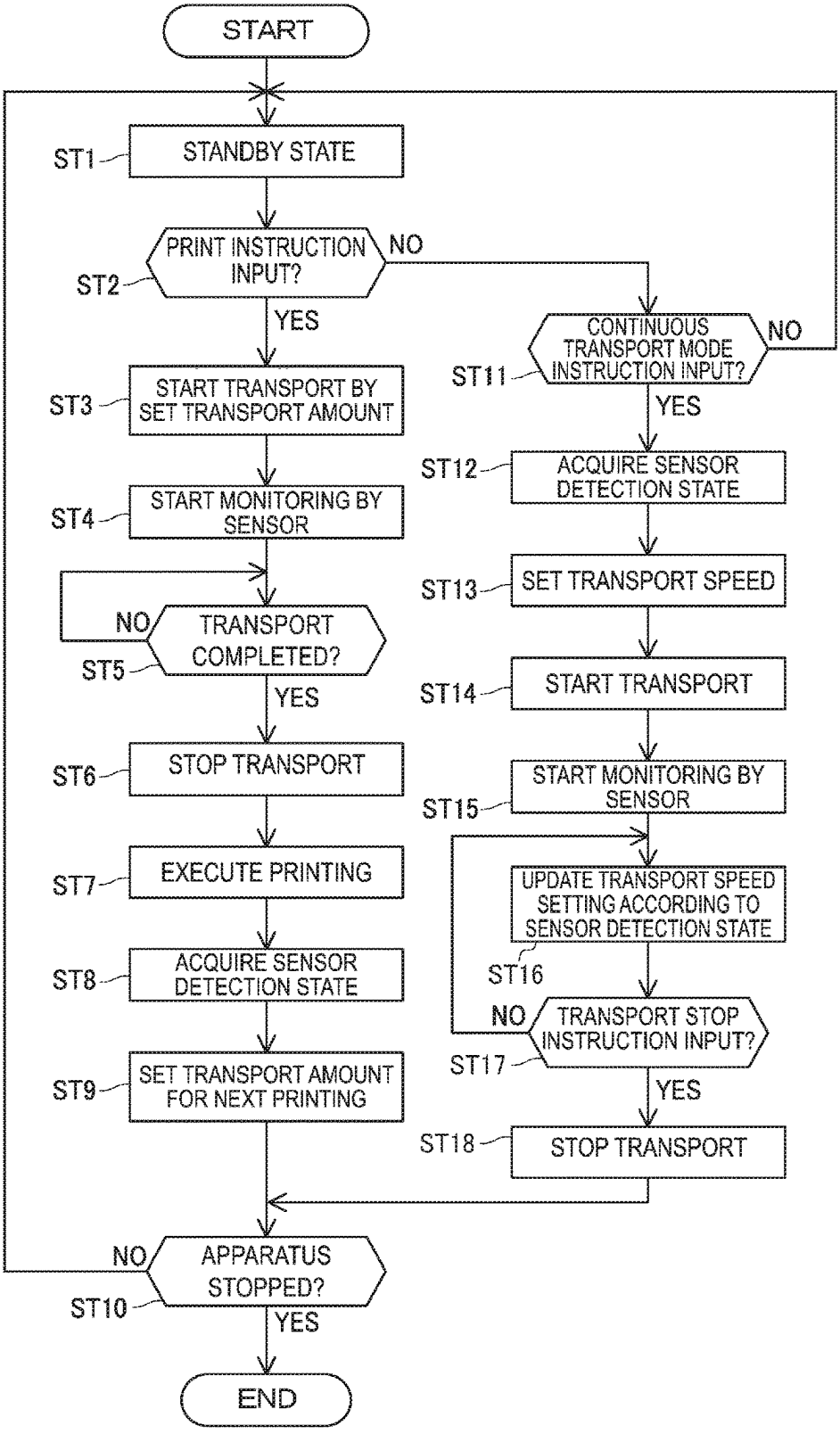

START
ST1
STANDBY STATE
ST2
PRINT INSTRUCTION INPUT?
NO
YES
ST3
START TRANSPORT BY SET TRANSPORT AMOUNT
ST4
START MONITORING BY SENSOR
NO
ST5
TRANSPORT COMPLETED?
YES
ST6
STOP TRANSPORT
ST7
EXECUTE PRINTING
ST8
ACQUIRE SENSOR DETECTION STATE
ST9
SET TRANSPORT AMOUNT FOR NEXT PRINTING
ST11
CONTINUOUS TRANSPORT MODE INSTRUCTION INPUT?
NO
YES
ST12
ACQUIRE SENSOR DETECTION STATE
ST13
SET TRANSPORT SPEED
ST14
START TRANSPORT
ST15
START MONITORING BY SENSOR
UPDATE TRANSPORT SPEED SETTING ACCORDING TO SENSOR DETECTION STATE
ST16
NO
ST17
TRANSPORT STOP INSTRUCTION INPUT?
YES
ST18
STOP TRANSPORT
NO
ST10
APPARATUS STOPPED?
YES
END

FIG. 9

PRINTING APPARATUS AND CONTROL METHOD FOR PRINTING APPARATUS

The present application is based on, and claims priority from JP Application Serial Number 2022-127862, filed Aug. 10, 2022, the disclosure of which is hereby incorporated by reference herein in its entirety.

BACKGROUND

1. Technical Field

The present disclosure relates to a printing apparatus and a control method for a printing apparatus.

2. Related Art

In the related art, with respect to a recording apparatus that performs recording on a medium with a recording unit, a configuration in which a buffer region is provided on the path through which a recording medium wound in a roll shape is supplied to the recording unit is known (for example, refer to JP-A-2013-28415). The configuration disclosed in JP-A-2013-28415 includes a dancer roller that applies tension to a sheet as a recording medium, and the dancer roller is displaced in accordance with a change in the length of the sheet in the buffer region.

Apparatuses that perform recording or printing are required to be improved in printing speed. As one method for improving the printing speed, it is conceivable to increase a medium transport speed. However, if a transport speed is increased for an apparatus including such a dancer roller as disclosed in JP-A-2013-28415, there is concern that the responsiveness of the dancer roller will become lower. In order to prevent such a situation, the transport speed needs to be finely controlled in accordance with positions of the dancer roller, and thus an action such as increasing the number of sensors need to be taken.

SUMMARY

An aspect of the disclosure is a printing apparatus including: a printing unit configured to form an image on a print medium, a feeding roller configured to feed the print medium toward the printing unit, a feeding-side movable roller in a feeding-side buffer region positioned between the feeding roller and the printing unit, the feeding-side movable roller being configured to apply tension to the print medium, a front drive roller that is positioned between the feeding-side buffer region and the printing unit and with which the print medium is intermittently transported, and a control unit configured to control feeding by the feeding roller, in which control amounts controlled by the control unit include a feeding amount and a feeding speed of the feeding by the feeding roller, and the control unit is configured to execute and switch between a print mode and a continuous transport mode, controls the feeding amount of the feeding roller when the print mode is executed, and controls the feeding speed of the feeding roller when the continuous transport mode is executed.

Another aspect of the disclosure is a control method for controlling a print apparatus, the print apparatus including: a printing unit configured to form an image on a print medium, a feeding roller configured to feed the print medium toward the printing unit, a feeding-side movable roller in a feeding-side buffer region positioned between the feeding roller and the printing unit, the feeding-side movable roller being configured to apply tension to the print medium, and a front drive roller that is positioned between the feeding-side buffer region and the printing unit and with which the print medium is intermittently transported, the control method including: executing and switching between a print mode and a continuous transport mode, controlling a feeding amount in feeding by the feeding roller when the print mode is executed, and controlling a feeding speed in the feeding by the feeding roller when the continuous transport mode is executed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram illustrating an overview of a printing apparatus according to the present embodiment.

FIG. **2** is a schematic diagram illustrating a configuration of the main part of a feeding-side buffer unit.

FIG. **3** is a side view illustrating a configuration of the main part of a winding-side buffer unit.

FIG. **4** is a cross-sectional view taken along line A-A in FIG. **3**.

FIG. **5** is a schematic diagram illustrating a configuration of the main part of the winding-side buffer unit.

FIG. **6** is a block diagram illustrating a configuration of a control system of the printing apparatus.

FIG. **7** is a schematic diagram showing an example of information stored in a control device.

FIG. **8** is a schematic diagram showing an example of information stored in the control device.

FIG. **9** is a flowchart illustrating an operation of the printing apparatus.

DESCRIPTION OF EMBODIMENTS

1. Overall Configuration of Printing Apparatus

Embodiments of the disclosure will be described below with reference to the accompanying drawings.

FIG. **1** is a schematic diagram illustrating an overall configuration of a printing apparatus **1**. In FIG. **1** and the drawings described below, XYZ orthogonal coordinates are illustrated in order to describe directions in a state in which the printing apparatus **1** is installed. The Z axis indicates a vertical direction in the state in which the printing apparatus **1** is installed, and can be referred to as a height direction. The X axis indicates a left-right direction of the printing apparatus **1**. The Y axis is a direction orthogonal to the X axis, and can be referred to as a front-rear direction.

The printing apparatus **1** performs printing on a print medium S with a printing unit **5**. Various types of sheets can be used as the print medium S used in the printing apparatus **1**. The following description introduces a configuration in which label paper formed by placing labels with an adhesive backing on release paper and winding the paper in a roll shape is used as the print medium S. Although a printing method of the printing apparatus **1** is not limited, in the embodiment, an inkjet printer that ejects ink to the print medium S with the printing unit **5** is described as an example of the printing apparatus **1**.

The printing apparatus **1** has a configuration in which a medium supply unit **3**, the printing unit **5**, a drying unit **7**, a medium collection unit **8**, and a control device **100** are disposed in a housing **2**. The housing **2** is attached to a frame of the printing apparatus **1**, which is not illustrated, and accommodates the above-described units.

The print medium S is transported between the medium supply unit **3** and the medium collection unit **8**, and a

transport path of the print medium S is indicated by reference sign **10**. A plurality of transport rollers **301** to **343** that come into contact with the print medium S are disposed in the transport path **10**. The print medium S supplied from the medium supply unit **3** is transported in the transport direction indicated by the arrow F in the drawing in the transport path **10**. The transport rollers **301** to **321** are positioned upstream of the printing unit **5** in the transport path **10**. On the other hand, the transport rollers **322** to **343** are positioned downstream of the printing unit **5**.

The printing apparatus **1** includes motors M**1** to M**6**, and the motors M**1** to M**6** generate a driving force for transporting the print medium S. The feeding motor M**1** drives the supply shaft **31** of the medium supply unit **3**, the feeding nip motor M**2** drives the transport roller **305**, and the supply nip motor M**3** drives the transport roller **318**. These motors M**1**, M**2**, and M**3** are for supply-side power for supplying the print medium S from the medium supply unit **3** to the printing unit **5**. On the other hand, a discharge nip motor M**4** drives the transport roller **334**, the winding nip motor M**5** drives the winding transport roller **342**, and the winding motor M**6** drives a winding shaft **81** of the medium collection unit **8**. These motors M**4**, M**5**, and M**6** are for collection-side power for collecting the print medium S on which printing was performed by the printing unit **5** to the medium collection unit **8**.

The medium supply unit **3** includes the cylindrical or columnar supply shaft **31**. A roll body **32** on which the print medium S is wound in a roll shape can be mounted on the supply shaft **31**, and the medium supply unit **3** supports the roll body **32** with the supply shaft **31**. The supply shaft **31** is rotated by the power of the motor M**1** to feed the print medium S from the roll body **32** toward the printing unit **5**.

The printing unit **5** prints characters and images on the label of the print medium S by ejecting ink toward the print medium S. These characters and images are collectively referred to as images. The printing unit **5** includes a platen **54**, a plurality of ejection heads **51** that eject ink, and a carriage **53** that holds the ejection heads **51**. An image is formed at the print surface of the print medium S with ink ejected to the print medium S by the ejection head **51**. The platen **54** includes a rectangular surface arranged to be parallel to the XY plane. The platen **54** includes, for example, a rectangular flat surface and is parallel to the XY plane in the installation state of the printing apparatus **1**. The platen **54** supports the print medium S from below. A suction hole or the like for holding the print medium S on the platen **54** by applying suction force to the print medium S may be formed in the platen **54**. The platen **54** corresponds to an example of a support part.

The carriage **53** is disposed above the platen **54** to face the platen **54**. The carriage **53** is capable of reciprocating in the X-axis direction along a first guide rail **25** installed in the printing apparatus **1** in the X-axis direction. The carriage **53** is capable of reciprocating in the Y-axis direction along a second guide rail, which is not illustrated, installed in the Y-axis direction. The printing apparatus **1** includes a first carriage motor M**7** that moves the carriage **53** along the first guide rail **25** and a second carriage motor M**8** that moves the carriage **53** along the second guide rail. The printing apparatus **1** moves the ejection head **51** in the X-axis direction and the Y-axis direction with power of the motors M**7** and M**8**. With this configuration, the ejection head **51** can move over the print medium S supported by the platen **54** in the X-axis direction and the Y-axis direction to eject ink to the entire print medium S.

When printing is performed on the print medium S, the printing apparatus **1** intermittently transports the print medium S. That is, the printing apparatus **1** transports the print medium S to the platen **54** and stops the transport of the print medium S in a state in which the print medium S is disposed in a predetermined region of the platen **54**. Here, the printing unit **5** causes the ejection head **51** to eject ink while moving the ejection head **51** in the X-axis direction and the Y-axis direction to perform printing on the print medium S. After printing, the printing apparatus **1** transports the print medium S until the printed portion of the print medium S moves downstream of the platen **54**. Then, the printing apparatus **1** stops the transport of the print medium S and performs printing with the printing unit **5**.

A feeding-side buffer unit **60** and a meandering correction unit **70** that corrects meandering of the print medium S are disposed between the medium supply unit **3** and the printing unit **5** in the transport path **10**. A configuration of the feeding-side buffer unit **60** will be described later.

The meandering correction unit **70** includes transport rollers **312** and **313**, and corrects meandering of the print medium S between the transport rollers **312** and **313**. Meandering of the print medium S is a phenomenon in which the transport direction of the print medium S is inclined from the transport path **10** to a direction along the Y axis. An ideal transport state is, for example, a state in which the print medium S is transported from the medium supply unit **3** to the platen **54** without moving in a direction along the Y axis. In this state, the print medium S fed out from the medium supply unit **3** moves along the X axis and reaches the platen **54**, without moving in a direction along the Y axis. However, the print medium S may be inclined with respect to the X axis due to the influence of an inclination of the transport rollers **303** to **311**, or the like. The state of such an inclination is called meandering. When the movement direction of the print medium S is a direction in which the print medium is inclined with respect to the X axis, the meandering correction unit **70** corrects the movement direction. The print medium S transported from the meandering correction unit **70** toward the platen **54** is in a state in which meandering is substantially eliminated.

A meandering accuracy maintenance region **75** for maintaining the meandering accuracy of the print medium S is provided between the meandering correction unit **70** and the platen **54**. The meandering accuracy indicates a degree of meandering of the print medium S, that is, a degree of movement thereof in a direction intersecting the X axis, and may be referred to as transport accuracy. The transport rollers **313**, **314**, **315**, **316**, **317**, **318**, **319**, **320**, and **321** are disposed in the meandering accuracy maintenance region **75**.

The transport rollers **313** and **314** are directly or indirectly attached to the frame of the printing apparatus **1**. The transport rollers **313** and **314** are rotatably supported. A vertical plate **71** fixed directly or indirectly to the frame of the printing apparatus **1** is disposed in the meandering accuracy maintenance region **75**. The transport roller **315** is rotatably supported at a lower end part of the vertical plate **71**. In addition, the six transport rollers **316**, **317**, **318**, **319**, **320**, and **321** are disposed at the central and upper parts of the vertical plate **71**. Each of the transport rollers **316** to **321** is rotatably supported by the vertical plate **71**. In the meandering accuracy maintenance region **75**, tension is applied to the print medium S being transported. This tension prevents the print medium S from wrinkling or sagging. The print medium S is transported to the platen **54** through the meandering accuracy maintenance region **75**. A

configuration including the first transport rollers **313** to **321** and the vertical plate **71** disposed in the meandering accuracy maintenance region **75** is referred to as a first transport roller unit **4**. A configuration of the first transport roller unit **4** will be described below.

The transport rollers **316** to **321** disposed in the meandering accuracy maintenance region **75** transport the print medium S while maintaining the meandering accuracy corrected by the meandering correction unit **70**.

The drying unit **7** is disposed downstream of the printing unit **5** in the transport path **10**. Transport rollers **322**, **323**, **324**, **325**, and **326** are disposed in the drying unit **7**. The drying unit **7** includes a heater that heats the printing surface and/or the back of the printing surface of the print medium S, and dries the ink ejected by the printing unit **5**.

Transport rollers **327**, **328**, **329**, and **330** are disposed downstream of the drying unit **7** in the transport path **10**. These transport rollers **327** to **330** are disposed in a winding-side buffer unit **61**. The winding-side buffer unit **61** will be described below.

2. Configuration of Feeding-Side Buffer Unit

The feeding-side buffer unit **60** includes a feeding-side fixed plate **65** that is directly or indirectly fixed to the frame of the printing apparatus **1** and a feeding-side movable plate **67** that can move up and down. The seven transport rollers **303**, **304**, **305**, **306**, **307**, **309**, and **311** are rotatably supported by the feeding-side fixed plate **65**. The two transport rollers **308** and **310** are rotatably supported by the feeding-side movable plate **67**. These transport rollers **308** and **310** correspond to examples of a feeding-side movable roller. The feeding-side buffer unit **60** corresponds to an example of a feeding-side buffer region.

In the feeding-side buffer unit **60**, the print medium S is wound around each of the transport rollers **303** to **311**.

The transport rollers **303**, **304**, **305**, **306**, **307**, **309**, and **311** are supported by the feeding-side fixed plate **65** not to move in the transport path **10**. On the other hand, the transport rollers **308** and **310** are movable up and down together with the feeding-side movable plate **67**. The transport rollers **308** and **310** and the feeding-side movable plate **67** are in a state of being suspended from the feeding-side fixed plate **65** by the print medium S.

The feeding-side buffer unit **60** applies tension to the print medium S in the direction of gravity due to the weights of the feeding-side movable plate **67** and the transport rollers **308** and **310** attached to the feeding-side movable plate **67**.

When slack occurs in the print medium S between the medium supply unit **3** and the platen **54**, the feeding-side movable plate **67** is lowered by an amount corresponding to the slack of the print medium S, thereby absorbing the slack of the print medium S. In addition, when strong tension is applied to the print medium S in the transport direction between the medium supply unit **3** and the platen **54**, the print medium S is fed from the feeding-side buffer unit **60** by the feeding-side movable plate **67** being raised by the tension. In this way, the feeding-side buffer unit **60** absorbs or alleviates the extra portion of the print medium S and excessive tension attributable to a shortage of the print medium S between the medium supply unit **3** and the platen **54**.

Slack of the print medium S in the feeding-side buffer unit **60** varies depending on the difference between the rotation amount and the rotation speed of the transport roller **318** and the rotation amount and the rotation speed of feeding-side transport rollers that feed the print medium S from the medium supply unit **3**. The feeding-side transport rollers may include at least the supply shaft **31** out of the supply shaft **31** and the transport roller **305**, and may be both the supply shaft **31** and the transport roller **305**. The feeding-side transport rollers are an example of a feeding roller.

A length of the print medium S that is supplied to the platen **54** at one transport operation in intermittent transport by the printing apparatus **1** is determined in accordance with the specification of the printing apparatus **1**. For this reason, a rotation amount by which the transport roller **318** operates is determined in one transport operation of the intermittent transport. In addition, a rotation speed of the transport roller **318** is determined in accordance with the printing speed of the printing apparatus **1**. Thus, the transport amount and the transport speed of the transport roller **318**, that is, the operation amount and the rotation speed of the supply nip motor M**3**, are determined in advance. The transport roller **318** corresponds to an example of a front drive roller.

On the other hand, a rotation amount of the feeding-side transport rollers and a rotation speed of the feeding-side transport rollers can be changed by control of the control device **100**. Hereinafter, a rotation amount of the feeding-side transport roller will be referred to as a feeding amount, and a rotation speed of the feeding-side transport roller will be referred to as a feeding speed. When the printing apparatus **1** performs printing, if the feeding amount is larger than the transport amount of the transport roller **318** in intermittent transport, slack of the print medium S in the feeding-side buffer unit **60** is large, and thus the feeding-side movable plate **67** is lowered. In addition, if the feeding amount is smaller than the transport amount of the transport roller **318**, the feeding-side movable plate **67** is raised. In addition, in a state in which the feeding-side movable plate **67** is at a proper position in the up-down direction, the amount of slack of the print medium S is appropriate, and thus the print medium S can be stably transported.

The printing apparatus **1** controls the rotation amount and/or the rotation speed of the feeding motor M**1** that drives the supply shaft **31** and the feeding nip motor M**2** that drives the transport roller **305** so that the amount of slack of the print medium S in the feeding-side buffer unit **60** becomes appropriate. In addition, the printing apparatus **1** includes a plurality of feeding-side sensors **141** for detecting the height of the feeding-side movable plate **67** in order to maintain the proper amount of slack of the print medium S in the feeding-side buffer unit **60**. The feeding-side sensors **141** correspond to an example of first sensors.

FIG. **2** is a schematic diagram illustrating a configuration of the main part of the feeding-side buffer unit **60**. In FIG. **2**, the transport rollers **307**, **308**, **309**, **310**, and **311** and detection positions of the feeding-side sensors **141** installed in the feeding-side buffer unit **60** are illustrated. The printing apparatus **1** according to the present embodiment includes five feeding-side sensors **141***a*, **141***b*, **141***c*, **141***d*, and **141***e* in the feeding-side buffer unit **60**, and the feeding-side sensors will be referred to as feeding-side sensors **141** when there is no need to distinguish them from each other.

In FIG. **2**, reference sign Su**1** indicates a detection position of the feeding-side sensor **141***a*, and reference sign Su**2** indicates a detection position of the feeding-side sensor **141***b*. Reference sign Su**3** indicates a detection position of the feeding-side sensor **141***c*, reference sign Su**4** indicates a detection position of the feeding-side sensor **141***d*, and reference sign Su**5** indicates a detection position of the feeding-side sensor **141***e*.

Of the feeding-side sensors **141***a* to **141***e*, the feeding-side sensor **141***a* detects the feeding-side movable plate **67** at the

lowest detection position Su1 in the movable range of the feeding-side movable plate **67** as illustrated in FIG. **2**. On the other hand, the feeding-side sensor **141***e* detects the feeding-side movable plate **67** at the highest detection position Su**5** in the movable range of the feeding-side movable plate **67**. The detection positions Su**2**, Su**3**, and Su**4** of the feeding-side sensors **141***b*, **141***c*, and **141***d* are between the detection position Su**1** and the detection position Su**5**. The installation positions of the feeding-side sensors **141***a* to **141***e* are positions corresponding to the detection positions Su**1** to Su**5**.

As will be described below, the proper position of the feeding-side movable plate **67** is a position where the feeding-side movable plate **67** is detected at both the detection position Su**3** and the detection position Su**4**. A larger number of feeding-side sensors **141** are disposed in a range R**1** including the proper position than in a range R**2** outside the range R**1**. The range R**1** is an example of a first range, and a range R**4** is an example of a second range.

The feeding-side sensors **141** are for detecting the presence or absence of the feeding-side movable plate **67**, and for example, transmission-type optical sensors or reflection-type optical sensors can be used. Switch-type sensors that come in contact with the feeding-side movable plate **67** may be used as the feeding-side sensors **141**. Each of the feeding-side sensors **141***a* to **141***e* outputs a detection signal indicating whether the feeding-side movable plate **67** has been detected to the control device **100**.

FIG. **2** illustrates a detection object **254**U. The detection object **254**U is a plate member for detection fixed to the feeding-side movable plate **67**. The detection object **254**U moves up and down together with the feeding-side movable plate **67** and passes through a position at which the detection light of the feeding-side sensors **141***a* to **141***e* is incident. In other words, the feeding-side sensors **141***a* to **141***e* detect the feeding-side movable plate **67** by detecting the detection object **254**U.

When the interval between the adjacent feeding-side sensors **141** is shorter than the size of the detection object **254**U in the up-down direction, the two feeding-side sensors **141** may simultaneously detect the detection object **254**U. The control device **100** can acquire the detection state of each of the five feeding-side sensors **141***a* to **141***e*. Thus, the printing apparatus **1** can detect the position of the feeding-side movable plate **67** in many stages using the five feeding-side sensors **141***a* to **141***e*. The control device **100** can detect the position of the feeding-side movable plate **67** at five positions where any one of the feeding-side sensors **141***a* to **141***e* detects the detection object **254**U. In addition, the position of the feeding-side movable plate **67** can be detected at a position where two adjacent feeding-side sensors **141** detect the detection object **254**U. In addition, the position of the feeding-side movable plate **67** can be detected at one or two positions where none of the feeding-side sensors **141** detect the detection object **254**U. In order to enable this fine detection, the interval between the feeding-side sensors **141** may be narrow; however, an increase in the number of the feeding-side sensors **141** leads to an increase in cost and the number of manufacturing steps of the printing apparatus **1**. For this reason, a large number of feeding-side sensors **141** are disposed in the range R**1** in the printing apparatus **1**. Thus, the intervals between the adjacent feeding-side sensors **141** are narrow and the two adjacent feeding-side sensors **141** can simultaneously detect the feeding-side movable plate **67** in the range R**1**, and thus a fine position of the feeding-side movable plate **67** can be detected.

3. Configuration of Winding-Side Buffer Unit

Returning to FIG. **1**, the winding-side buffer unit **61** includes a winding-side fixed plate **68** that is directly or indirectly fixed to the frame of the printing apparatus **1**, and a winding-side movable plate **69** that can move up and down. Transport rollers **336** and **338** are rotatably supported by the winding-side fixed plate **68**. A transport roller **337** is rotatably supported by the winding-side movable plate **69**. The winding-side buffer unit **61** corresponds to an example of a winding-side buffer region.

The print medium S is wound around each of the transport rollers **336**, **337**, and **338** in the winding-side buffer unit **61**. The transport rollers **336** and **338** are supported by the winding-side fixed plate **68** not to move in the transport path **10**. On the other hand, the transport roller **337** can move up and down together with the winding-side movable plate **69**. The transport roller **337** and the winding-side movable plate **69** are in a state of being suspended from the winding-side fixed plate **68** by the print medium S.

The winding-side buffer unit **61** applies tension to the print medium S in the direction of gravity by the weights of the winding-side movable plate **69** and the transport roller **337** attached to the winding-side movable plate **69**. The transport roller **337** corresponds to an example of a winding-side movable roller.

When slack occurs in the print medium S between the platen **54** and the medium collection unit **8**, the winding-side movable plate **69** is lowered by the amount of the slack of the print medium S to absorb the slack of the print medium S. In addition, when strong tension is applied to the print medium S in the transport direction between the platen **54** and the medium collection unit **8**, the winding-side movable plate **69** is raised by the tension, and thus the print medium S is fed out from the winding-side buffer unit **61**. In this way, the winding-side buffer unit **61** absorbs or alleviates the extra portion of the print medium S and excessive tension attributable to a shortage of the print medium S between the platen **54** and the medium collection unit **8**.

Slack of the print medium S in the winding-side buffer unit **61** varies depending on the difference between the rotation amount and the rotation speed of the transport roller **334** and the rotation amount and the rotation speed of a winding-side transport rollers that wind the print medium S around the medium collection unit **8**. The winding-side transport rollers may include at least the winding shaft **81** out of the winding shaft **81** and the winding transport roller **342**, and may be both the winding shaft **81** and the winding transport roller **342**. The winding-side transport rollers are an example of a winding roller.

A length of the print medium S that is supplied to the platen **54** at one transport operation in intermittent transport by the printing apparatus **1** is determined in accordance with the specification of the printing apparatus **1** as described above. For this reason, the rotation amount of the transport roller **334**, which is the transport roller closest to the platen **54** downstream of the platen **54** in the transport path **10**, is determined by one transport operation in the intermittent transport. The rotation speed of the transport roller **334** is determined in the same manner as the transport roller **318**. Thus, the transport amount and the transport speed of the transport roller **334**, that is, the operation amount and the rotation speed of the discharge nip motor M**4**, are determined in advance.

On the other hand, a rotation amount of the winding-side transport rollers and a rotation speed of the winding-side transport rollers can be changed by control of the control

device **100**. Hereinafter, a rotation amount of the winding-side transport rollers will be referred to as a winding amount, and a rotation speed of the winding-side transport rollers will be referred to as a winding speed. If a winding amount of the transport roller **334** is greater than a transport amount thereof in the intermittent transport when the printing apparatus **1** performs printing, the amount of slack of the print medium S in the winding-side buffer unit **61** is small, and thus the winding-side movable plate **69** is raised. In addition, if a winding amount of the transport roller **334** is smaller than a transport amount thereof, the winding-side movable plate **69** is lowered. In addition, in a state in which the winding-side movable plate **69** is at a proper position in the up-down direction, the amount of slack of the print medium S is appropriate, and thus the print medium S can be stably transported.

The printing apparatus **1** controls the rotation amount and/or the rotation speed of the winding motor M**6** that drives the winding shaft **81** and the winding nip motor M**5** that drives the winding transport roller **342** so that the amount of slack of the print medium S in the winding-side buffer unit **61** becomes appropriate. In addition, the printing apparatus **1** includes a plurality of winding-side sensors **151** for detecting the height of the winding-side movable plate **69** in order to maintain the proper amount of slack of the print medium S in the winding-side buffer unit **61**. The winding-side sensors **151** correspond to an example of a second sensor.

FIG. **3** is a side view illustrating a configuration of the main part of the winding-side buffer unit **61**. FIG. **4** is a cross-sectional view taken along line A-A in FIG. **3**. In addition, FIG. **5** is a schematic diagram illustrating a configuration of the main part of the winding-side buffer unit **61**. FIG. **5** illustrates the transport rollers **336**, **337**, and **338** and detection positions of the winding-side sensors **151** installed in the winding-side buffer unit **61**.

The printing apparatus **1** according to the present embodiment includes five winding-side sensors **151***a*, **151***b*, **151***c*, **151***d*, and **151***e* in the winding-side buffer unit **61**, and the winding-side sensors will be referred to as winding-side sensors **151** when there is no need to distinguish them from each other.

In FIG. **5**, reference sign Su**1** indicates a detection position of the winding-side sensor **151***a*, and reference sign Su**2** indicates a detection position of the winding-side sensor **151***b*. Reference sign Su**3** indicates a detection position of the winding-side sensor **151***c*, reference sign Su**4** indicates a detection position of the winding-side sensor **151***d*, and reference sign Su**5** indicates a detection position of the winding-side sensor **151***e*.

The winding-side sensors **151** are for detecting the presence or absence of the winding-side movable plate **69**, and for example, transmission-type optical sensors or reflection-type optical sensors can be used. Switch-type sensors that come in contact with the winding-side movable plate **69** may be used as the winding-side sensors **151**. Each of the winding-side sensors **151***a* to **151***e* outputs a detection signal indicating whether the winding-side movable plate **69** has been detected to the control device **100**.

FIG. **3** illustrates the vicinity of the winding-side sensors **151***b*, **151***c*, and **151***d*. The winding-side sensors **151***a* to **151***e* are fixed to a winding-side sensor mounting bar **64** which is fixed to the frame or the like of the printing apparatus **1**. The winding-side sensors **151***a* to **151***e* are disposed at appropriate intervals in the up-down direction.

Furthermore, a detection object **254**D is attached to the winding-side movable plate **69**. The detection object **254**D is a detection member fixed to the winding-side movable plate **69**. The detection object **254**D moves up and down together with the winding-side movable plate **69** and passes through a position P at which detection light of the winding-side sensors **151***a* to **151***e* is incident. That is, the winding-side sensors **151***a* to **151***e* detect the winding-side movable plate **69** by detecting the detection object **254**D.

The configuration of the detection object **254**D illustrated in FIG. **4** is an example, and this configuration can also be applied to the detection object **254**U. The detection object **254**D is a member having a C-shaped cross section, in which one side **254**D**1** of the detection object **254**D is fixed to the winding-side movable plate **69** by a bolt. In addition, the other side **254**D**2** of the detection object **254**D fits into a recess through which the detection light of the winding-side sensors **151** passes. When the side **254**D**2** fits into the recess of the winding-side sensors **151**, the detection state of the winding-side sensors **151** is an ON state, and the winding-side movable plate **69** is detected.

In FIG. **5**, reference sign Sd**1** indicates a detection position of the winding-side sensor **151***a*, and reference sign Sd**2** indicates a detection position of the winding-side sensor **151***b*. Reference sign Sd**3** indicates a detection position of the winding-side sensor **151***c*, reference sign Sd**4** indicates a detection position of the winding-side sensor **151***d*, and reference sign Sd**5** indicates a detection position of the winding-side sensor **151***e*.

Of the winding-side sensors **151***a* to **151***e*, the winding-side sensor **151***a* detects the winding-side movable plate **69** at the lowest detection position Sd**1** in the movable range of the winding-side movable plate **69** as illustrated in FIG. **5**. On the other hand, the winding-side sensor **151***e* detects the winding-side movable plate **69** at the highest detection position Sd**5** in the movable range of the winding-side movable plate **69**. The detection positions Sd**2**, Sd**3**, and Sd**4** of the winding-side sensors **151***b*, **151***c*, and **151***d* are between the detection position Sd**1** and the detection position Sd**5**. The installation positions of the winding-side sensors **151***a* to **151***e* are positions corresponding to the detection positions Sd**1** to Sd**5**.

As will be described later, the proper position of the winding-side movable plate **69** is a position at which the winding-side movable plate **69** is detected at both the detection position Sd**2** and the detection position Sd**3**. A larger number of winding-side sensors **151** are disposed in a range R**3** including the proper position than in a range R**4** outside the range R**3**. The range R**3** is an example of a first range, and the range R**4** is an example of a second range.

When the interval between the adjacent winding-side sensors **151** is shorter than the size of the detection object **254**D in the up-down direction, the two winding-side sensors **151** may simultaneously detect the detection object **254**D. The control device **100** can acquire the detection state of each of the five winding-side sensors **151***a* to **151***e*. Thus, the printing apparatus **1** can detect the position of the winding-side movable plate **69** in many stages using the five winding-side sensors **151***a* to **151***e*. The control device **100** can detect the position of the winding-side movable plate **69** at five positions when any one of the winding-side sensors **151***a* to **151***e* detects the detection object **254**D. In addition, the position of the winding-side movable plate **69** can be detected at a position where two adjacent winding-side sensors **151** detect the detection object **254**D. In addition, the position of the winding-side movable plate **69** can be detected at one or two positions where none of the winding-side sensors **151** detect the detection object **254**D. In order to enable this fine detection, the interval between the wind-

ing-side sensors **151** may be narrow; however, an increase in the number of the winding-side sensors **151** leads to an increase in cost and the number of manufacturing steps of the printing apparatus **1**. For this reason, a large number of winding-side sensors **151** are disposed in the range R**3** in the printing apparatus **1**. Thus, the intervals between the adjacent winding-side sensors **151** are narrow and the two adjacent winding-side sensors **151** can simultaneously detect the winding-side movable plate **69** in the range R**3**, and thus a fine position of the winding-side movable plate **69** can be detected.

4. Configuration of Control System

FIG. **6** is a block diagram illustrating the control system of the printing apparatus **1**.

The printing apparatus **1** includes an input device **17** and a display device **18**, which are coupled to the control device **100**. The input device **17** is a device through which an operator who operates the printing apparatus **1** inputs printing conditions and the like, and is, for example, an operation panel including switches. The input device **17** may be an input device such as a keyboard or a mouse, or may be a tablet computer, a portable terminal, or the like that is a separate body from the printing apparatus **1**. The input device **17** outputs information input by the operator to the control device **100**. The display device **18** includes a display screen such as a liquid crystal display panel, and displays various types of information under control of the control device **100**. The printing apparatus **1** may include a touch panel in which the input device **17** and the display device **18** are integrated.

The control device **100** includes an interface unit **12**, a control unit **13**, a drive circuit **14**, a storage unit **15**, and a sensor interface **21**. The control unit **13** includes a processor such as a CPU and causes the processor to execute a program to control each unit of the printing apparatus **1** in cooperation of software and hardware. CPU is an abbreviation for central processing unit. In the drawing, interface is abbreviated as I/F.

The interface unit **12** is coupled to the input device **17** and the display device **18**, and transmits and receives data to and from these devices.

The drive circuit **14** is coupled to the feeding motor M**1**, the feeding nip motor M**2**, the supply nip motor M**3**, the discharge nip motor M**4**, the winding nip motor M**5**, and the winding motor M**6**. In addition, a first carriage motor M**7** and a second carriage motor M**8** are coupled to the drive circuit **14**. The drive circuit **14** supplies a drive current to each of the motors M**1** to M**6** under control of the control unit **13** to cause the motors M**1** to M**6** to operate and transport the print medium S. In addition, the drive circuit **14** moves the carriage **53** by supplying a driving current to the first carriage motor M**7** and the second carriage motor M**8** according to control of the control unit **13**.

The ejection head **51** and the drying unit **7** are coupled to the drive circuit **14**. The drive circuit **14** outputs a control signal under control of the control unit **13** to cause the ejection head **51** to operate and form an image on the print medium S. In addition, the drive circuit **14** causes the heater of the drying unit **7** to operate to dry the print medium S according to control of the control unit **13**.

The sensor interface **21** is coupled to the feeding-side sensors **141***a*, **141***b*, **141***c*, **141***d*, and **141***e* and the winding-side sensors **151***a*, **151***b*, **151***c*, **151***d*, and **151***e*. The sensor interface **21** acquires detection states of the feeding-side sensors **141** and the winding-side sensors **151** according to control of the control unit **13**. For example, the sensor interface **21** supplies electric power for operation to each of the feeding-side sensors **141** and the winding-side sensors **151**, and acquires a detection signal output by each of the feeding-side sensors **141** and the winding-side sensors **151**. The sensor interface **21** outputs a detection state of each of the feeding-side sensors **141** and the winding-side sensors **151** to the control device **100**.

The control device **100** controls the drive circuit **14** to drive the ejection head **51** and discharge the ink toward the print medium S. The control device **100** drives the first carriage motor M**7** to move the carriage **53** in the X-axis direction. The control device **100** drives the second carriage motor M**8** to move the carriage **53** in the Y-axis direction. The control device **100** repeatedly performs main scanning with the first carriage motor M**7**, the second carriage motor M**8**, and the ejection head **51**, and sub-scanning with a transport motor **153**, and intermittently transports the print medium S. In the main scanning, the control device **100** causes the carriage **53** to move while causing the ejection head **51** to eject ink while the transport of the print medium S is stopped. In the sub-scanning, the transport motor **153** is controlled such that the print medium S is transported in the transport direction F. With this control, an image is formed at the print medium S.

The control device **100** causes the drive circuit **14** to operate the motors M**1** to M**6** to intermittently drive the print medium S during printing. After transporting the print medium S by a preset transport amount, the control device **100** stops the print medium S and drives the first carriage motor M**7**, the second carriage motor M**8**, and the ejection head **51** to perform printing.

The control device **100** controls operation amounts and operation speeds of the motors M**1** to M**6** by adjusting the drive current supplied to the motors M**1** to M**6** by the drive circuit **14**.

The storage unit **15** includes a semiconductor storage device and a magnetic recording device, and stores in a non-volatile manner programs to be executed by the processor of the control unit **13** and data to be processed by the control unit **13**. The storage unit **15** stores operation setting information **15***a*, feeding setting information **15***b*, and winding setting information **15***c*.

The operation setting information **15***a* is information including settings related to an operation of each driving unit coupled to the drive circuit **14**. The operation setting information **15***a* includes information indicating set values of the feeding amount and the feeding speed at which the print medium S is sent to the platen **54**. That is, the operation setting information includes, for at least one of the feeding motor M**1** or the feeding nip motor M**2**, the rotation speed and the rotation amount of the motors equivalent to the amount of one transport operation when the print medium S is intermittently transported. In addition, the operation setting information **15***a* includes information indicating set values of the winding amount and the winding speed at which the print medium S is wound from the platen **54**. That is, the operation setting information includes, for at least one of the winding nip motor M**5** or the winding motor M**6**, the rotation speed and the rotation amount of the motors equivalent to the amount of one transport operation when the print medium S is intermittently transported. The operation setting information **15***a* may include information indicating setting values of a rotation amount and a rotation speed of another motor.

The feeding setting information **15***b* is information in which the detection states of the feeding-side sensors **141***a*,

141*b*, 141*c*, 141*d*, and 141*e* are associated with the control amount of the feeding amount of the print medium S. In addition, the winding setting information 15*c* is information in which the detection states of the winding-side sensors 151*a*, 151*b*, 151*c*, 151*d*, and 151*e* are associated with a control amount of a winding speed.

FIG. 7 is a schematic diagram illustrating an example of information stored in the control device 100, and illustrates a configuration example of the feeding setting information 15*b*.

In the example illustrated in FIG. 7, the detection states of the feeding-side sensors 141*a* to 141*e* are indicated by the detection positions Su1 to Su5 being "ON". For example, detection of the feeding-side movable plate 67 by the feeding-side sensor 141*a* is expressed as Su1_ON. The case in which none of the feeding-side sensors 141*a* to 141*e* detect the feeding-side movable plate 67 is expressed as "None". In the feeding setting information 15*b*, positions of the winding-side movable plate 69 are divided into seven stages corresponding to the detection states of the feeding-side sensors 141*a* to 141*e*. These are the positions LE, LP2, LP1, TYP, HP1, HP2, and HE in ascending order.

The position LE is a position at which the detection position Su1 and the detection position Su2 are "ON". The position LP2 is a position at which only the detection position Su2 is "ON", and the position LP1 is a position at which only the detection position Su3 is "ON". The position TYP indicates a standard position of the feeding-side movable plate 67 and can be referred to as a reference position. The position TYP is a position at which the detection position Su3 and the detection position Su4 are "ON". The position HP1 is a position at which only the detection position Su4 is "ON", and the position HP2 is a position at which none of the detection positions Su detect the feeding-side movable plate 67. The position HE is a position at which only the detection position Su5 is "ON". The control device 100 can determine which of the positions LE, LP2, LP1, TYP, HP1, HP2, and HE the position of the feeding-side movable plate 67 is based on the detection states of the feeding-side sensors 141*a* to 141*e*.

The feeding setting information 15*b* includes, as a control value of the feeding amount, a value for adjusting the length of the print medium S transported in one transport operation in the intermittent transport. For example, when the feeding-side movable plate 67 is at the position LP2, the control device 100 reduces the feeding amount by 200 mm from the standard value or the current set value.

The feeding setting information 15*b* includes a value for adjusting the transport speed of the print medium S when intermittent transport is not performed as a control value of the feeding speed. For example, when the feeding-side movable plate 67 is at the position LP2, the control device 100 sets the feeding speed to be 10% slower than the standard value or the current set value. Here, the case in which intermittent transport is not performed is, for example, a case in which only transport of the print medium S is continuously performed for a predetermined time without performing printing on the print medium S, such as a case in which the roll body 32 of the medium supply unit 3 is replaced. An operation state in which this operation is performed is referred to as a continuous transport mode. On the other hand, an operation state in which the print medium S is intermittently transported in order to perform printing by the printing unit 5 is referred to as a print mode.

Furthermore, according to the feeding setting information 15*b*, a transport stop is set in association with each of the position LE and the position HE. A transport stop indicates that transport is immediately stopped during execution of the print mode or the continuous transport mode. For example, the feeding-side movable plate 67 is at an end of the movement range at the position LE or the position HE. In this case, even if the control device 100 adjusts the feeding amount or the feeding speed, there is concern that damage or contamination of the print medium S may occur before the effect of the adjustment is exhibited, and thus the transport of the print medium S may be stopped. In the feeding setting information 15*b*, transport is set to be stopped in any of the print mode and the continuous transport mode when the feeding-side movable plate 67 is at the position LE and it is at the position HE.

FIG. 8 is a schematic diagram illustrating an example of information stored in the control device 100, and illustrates a configuration example of the winding setting information 15*c*.

In the example illustrated in FIG. 8, the detection states of the winding-side sensors 151*a* to 151*e* are indicated by the detection positions Sd1 to Sd5 being "ON". For example, detection of the winding-side movable plate 69 by the winding-side sensor 151*a* is expressed as Sd1 ON. The case in which none of the winding-side sensors 151*a* to 151*e* detect the winding-side movable plate 69 is expressed as "None". In the winding setting information 15*c*, positions of the winding-side movable plate 69 are divided into seven stages corresponding to the detection states of the winding-side sensors 151*a* to 151*e*. These are the positions LE, LP2, LP1, TYP, HP1, HP2, and HE in ascending order.

The position LE is a position at which only the detection position Sd1 is "ON". The position LP2 is a position at which none of the detection positions Sd detect the winding-side movable plate 69. The position LP1 is a position at which only the detection position Sd2 is "ON", and the position TYP indicates a standard position of the winding-side movable plate 69 and can be referred to as a reference position of the winding-side movable plate 69. The position TYP is a position at which the detection position Sd2 and the detection position Sd3 are "ON". The position HP1 is a position at which the detection position Sd3 and the detection position Sd4 are "ON", and the position HP2 is a position at which only the detection position Sd4 is "ON". The position HE is a position at which only the detection position Sd5 is "ON". The control device 100 can determine which of the positions LE, LP2, LP1, TYP, HP1, HP2, and HE the position of the winding-side movable plate 69 is, based on the detection states of the winding-side sensors 151*a* to 151*e*.

The winding setting information 15*c* includes, as a control value of the winding amount, a value for adjusting the length of the print medium S transported in one transport operation in the intermittent transport. For example, when the winding-side movable plate 69 is at the position LP2, the control device 100 adds 200 mm to the standard value or the current set value for the winding amount.

The winding setting information 15*c* includes, as a control value of the winding speed, a value for adjusting the transport speed of the print medium S in the continuous transport mode. For example, when the winding-side movable plate 69 is at the position LP2, the control device 100 sets the winding speed to be 10% faster than the standard value or the current set value.

Furthermore, according to the winding setting information 15*c*, a transport stop is set in association with the position LE and the position HE. Specifically, in the winding setting information 15*c*, transport is set to be stopped in any

of the print mode and the continuous transport mode when the winding-side movable plate **69** is at the position LE and it is at the position HE.

5. Operation of Printing Apparatus

FIG. **9** is a flowchart illustrating an operation of the printing apparatus **1**. The operation of FIG. **9** is executed under control of the control unit **13**.

In a standby state, the printing apparatus **1** stands by for an input from the input device **17** (step ST**1**). The printing apparatus **1** determines whether a print instruction, that is, an instruction to start the print mode, has been input by the input device **17** (step ST**2**).

If a print instruction has been input (Step ST**2**; YES), the printing apparatus **1** starts the print mode and starts transporting the print medium S by the amount set in the operation setting information **15***a* (step ST**3**). In step ST**3**, one transport operation of intermittent transport is started. Here, the printing apparatus **1** starts monitoring by the feeding-side sensors **141** and the winding-side sensors **151** (step ST**4**). After step ST**4**, the printing apparatus **1** stops the transport of the print medium S when the detection state of the feeding-side sensors **141** is the state set to the transport stop in the feeding setting information **15***b*. Since this stop processing is realized as interrupt processing, it is not illustrated in the flowchart. When the transport of the print medium S is stopped, the control device **100** stops all of the motors M**1** to M**6** related to the transport of the print medium S.

The printing apparatus **1** determines whether one transport operation of the intermittent transport has been completed (step ST**5**), and continues the transport of the print medium S while the transport is not completed (step ST**5**; NO). When the transport is completed (step ST**5**; YES), the printing apparatus **1** stops the motors M**1** to M**6** to stop the transport of the print medium S (step ST**6**).

The printing apparatus **1** causes the ejection head **51**, the first carriage motor M**7**, and the second carriage motor M**8** to operate to perform printing (step ST**7**). In step ST**7**, an image is formed at the print medium S by the ejection head **51**.

After formation of the image by the ejection head **51** is completed, that is, after printing is completed, the printing apparatus **1** acquires the detection states of the feeding-side sensors **141** and the detection states of the winding-side sensors **151** (step ST**8**). The printing apparatus **1** sets the transport amount of at least one of the feeding motor M**1** or the feeding nip motor M**2** and at least one of the winding nip motor M**5** or the winding motor M**6** when the next transport operation in the intermittent transport is performed based on the detection states acquired in step ST**8** (step ST**9**).

In step ST**9**, the printing apparatus **1** refers to the feeding setting information **15***b* based on the detection states of the feeding-side sensors **141** and specifies the position of the feeding-side movable plate **67**. The printing apparatus **1** acquires the control value of the feeding amount associated with the position of the feeding-side movable plate **67**, adds or subtracts the control value to or from the set value of the operation setting information **15***a*, and updates the feeding amount of the operation setting information **15***a*.

Furthermore, in step ST**9**, the printing apparatus **1** refers to the winding setting information **15***c* based on the detection states of the winding-side sensors **151** and specifies the position of the winding-side movable plate **69**. The printing apparatus **1** acquires the control value of the winding amount associated with the position of the winding-side movable plate **69**, adds or subtracts the control value to or from the set value of the operation setting information **15***a*, and updates the winding amount of the operation setting information **15***a*.

The printing apparatus **1** determines whether to stop the printing apparatus **1** (step ST**10**). For example, when a stop of the printing apparatus **1** is instructed by the input device **17** (step ST**10**; YES), the operation is stopped. When the printing apparatus **1** is not stopped (step ST**10**; NO), the printing apparatus **1** returns to step ST**1**.

If no print instruction is input in the standby state (step ST**2**; NO), the printing apparatus **1** determines whether an instruction to start the continuous transport mode has been input (step ST**11**). Here, if no instruction to start the continuous transport mode has been input (step ST**11**; NO), the printing apparatus **1** returns to step ST**1**.

If an instruction to start the continuous transport mode has been input (step ST**11**; YES), the printing apparatus **1** acquires the detection states of the feeding-side sensors **141** and the detection states of the winding-side sensors **151** (step ST**12**). The printing apparatus **1** sets the transport speed in the continuous transport mode based on the detection states acquired in step ST**12** (step ST**13**).

In step ST**13**, the printing apparatus **1** refers to the feeding setting information **15***b* based on the detection states of the feeding-side sensors **141** and specifies the position of the feeding-side movable plate **67**. The printing apparatus **1** acquires the control value of the feeding speed associated with the position of the feeding-side movable plate **67**, adds or subtracts the control value to or from the set value of the operation setting information **15***a*, and updates the feeding speed of the operation setting information **15***a*.

Furthermore, in step ST**13**, the printing apparatus **1** refers to the winding setting information **15***c* based on the detection states of the winding-side sensors **151** and specifies the position of the winding-side movable plate **69**. The printing apparatus **1** acquires the control value of the winding amount associated with the position of the winding-side movable plate **69**, adds or subtracts the control value to or from the set value of the operation setting information **15***a*, and updates the winding speed of the operation setting information **15***a*.

The printing apparatus **1** starts transporting the print medium S at the transport speed set in the operation setting information **15***a* (step ST**14**). In Step ST**14**, the printing apparatus **1** operates the feeding motor M**1**, the feeding nip motor M**2**, the winding nip motor M**5**, and the winding motor M**6** at the feeding speed and the winding speed updated in step ST**13**. Furthermore, the supply nip motor M**3** and the discharge nip motor M**4** are operated at a predetermined speed.

The printing apparatus **1** starts monitoring with the feeding-side sensors **141** and the winding-side sensors **151** at the timing when the transport of the print medium S is started (step ST**15**). The printing apparatus **1** updates the settings of the transport speed based on the detection states of the feeding-side sensors **141** and the winding-side sensors **151** (Step ST**16**). After step ST**14**, the printing apparatus **1** stops the transport of the print medium S when the detection states of the feeding-side sensors **141** is the state set to the transport stop in the feeding setting information **15***b*. When the transport of the print medium S is stopped, the control device **100** stops all of the motors M**1** to M**6** related to the transport of the print medium S.

The printing apparatus **1** determines whether the instruction to stop the transport of the print medium S has been input by the input device **17** (step ST**17**), and if no instruc-

tion to stop the transport has been input (step ST17; NO), the printing apparatus continues the transport while updating the transport speed of the print medium S. That is, in the continuous transport mode, while the transport is continued so that the feeding-side movable plate **67** is positioned at the position TYP, the printing apparatus **1** acquires the detection states of the feeding-side sensors **141** at a preset cycle and refers to the feeding setting information **15***b* based on the acquired detection states to update the feeding speed in the operation setting information **15***a*. In addition, while the transport is continued so that the winding-side movable plate **69** is positioned at the position TYP, the printing apparatus **1** acquires the detection states of the winding-side sensors **151** at a preset cycle and refers to the feeding setting information **15***b* based on the acquired detection states to update the winding speed in the operation setting information **15***a*. This processing is executed in the same manner as in steps ST12 and ST13.

When the instruction to stop the transport is input (step ST17; YES), the printing apparatus **1** stops the motors M1 to M6 to stop the transport of the print medium S (step ST18), and proceeds to step ST10.

As described above, the printing apparatus **1** controls the feeding amount in the print mode and the feeding speed in the continuous transport mode based on the detection states of the feeding-side sensors **141**. For this reason, it is possible to appropriately adjust the amount of slack of the print medium S in the feeding-side buffer unit **60** in accordance with the position of the feeding-side movable plate **67** in the feeding-side buffer unit **60**. In the print mode, since the transport roller **318** transports the print medium S by a fixed amount in accordance with the print length in the printing unit **5**, the feeding amount of the print medium S of the feeding-side roller strongly affects the amount of slack of the print medium S in the feeding-side buffer unit **60**. In the continuous transport mode, the transport speed of the feeding-side roller with respect to the transport speed of the transport roller **318** strongly affects the amount of slack of the print medium S in the feeding-side buffer unit **60**. Thus, by making the control target different in between the print mode and the continuous transport mode, the feeding amount in the print mode is controlled, the feeding speed in the continuous transport mode is controlled, and thus the amount of slack of the print medium S in the feeding-side buffer unit **60** can be efficiently adjusted. For example, when it is intended to speed up the transport speed of the print medium S in order to raise the printing speed of the printing apparatus **1**, the ability of the feeding-side buffer unit **60** to keep up with operations of the feeding-side movable plate **67** is a task. According to the configuration of the printing apparatus **1**, by controlling the transport amount of the print medium S in the print mode in which intermittent transport is performed, the position of the feeding-side movable plate **67** after the intermittent transport can be adjusted to an appropriate position. This control is simpler than a case in which the feeding speed is adjusted in accordance with the transport roller **318** and advantageous in that the ability of the feeding-side movable plate **67** to keep up with the feeding-side movable plate is not a large problem. Therefore, the printing speed of the printing apparatus **1** can be increased.

In the print mode, the control unit **13** detects displacement of the feeding-side movable plate **67** at a predetermined timing using the feeding-side sensors **141**. The predetermined timing is, for example, a period from when the transport of the print medium S is stopped in step ST6 to when the print mode or the continuous transport mode is started next time, and is specifically step ST8. In addition, the predetermined timing is a timing at which the operation of forming an image on the print medium S by the printing unit **5** in step ST7 is completed. Accordingly, the feeding amount can be appropriately adjusted based on the detection states of the feeding-side sensors **141** with the displacement of the feeding-side movable plate **67** in the feeding-side buffer unit **60** being stopped.

In the continuous transport mode, the control unit **13** monitors the displacement of the feeding-side movable plate **67** using the feeding-side sensors **141** during the transport of the print medium S. For example, when the position of the feeding-side movable plate **67** is the position LE or the position HE, the transport of the print medium S can be stopped.

The printing apparatus **1** has a configuration in which the detection object **254**D is attached to the feeding-side movable plate **67**. By disposing the feeding-side sensors **141** on the feeding-side sensor mounting bar, the displacement of the feeding-side movable plate **67** can be reliably detected by the feeding-side sensors **141**. The feeding-side sensor mounting bar may be configured similar to the winding-side sensor mounting bar **64** of FIG. **3**, for example.

Since the feeding-side sensors **141** include the range R1 and the range R2, and more of feeding-side sensors **141** are disposed in the range R1 than in the range R2, a fine position of the feeding-side movable plate **67** can be detected in a range including an appropriate position of the feeding-side movable plate **67**.

The printing apparatus **1** controls the winding amount in the print mode and the winding speed in the continuous transport mode based on the detected values of the winding-side sensors **151** in the winding-side buffer unit **61**. Thus, the amount of slack of the print medium S can be appropriately adjusted also in the winding-side buffer unit **61**.

6. Other Embodiments

The above embodiment is merely a specific example to which the present disclosure is applied. The present disclosure is not limited to the configuration of the above embodiment, and can be implemented in various aspects without departing from the gist of the disclosure.

For example, although the printing apparatus **1** has been described as having a configuration including the drying unit **7** in the above-described embodiment, the disclosure is also applicable to the printing apparatus **1** not having such a configuration. In addition, the printing apparatus **1** is not limited to an apparatus in which a continuous sheet wound around the roll body **32** is used as the print medium S, and an aspect of the continuous sheet can be arbitrarily changed.

In addition, although the inkjet printing apparatus **1** has been described in the above-described embodiment, this is an example, and the disclosure can be applied to printing apparatuses adopting other printing methods.

In addition, the numbers of transport rollers, first transport rollers, and second transport rollers, and the number of motors that drive the transport rollers described in the above embodiment are merely examples, and can be arbitrarily changed.

Although the ejection head **51** illustrated in the above embodiment is configured to move in the X-axis direction and the Y-axis direction on the print medium S supported by the platen **54** and eject ink to the entire print medium S, a so-called single-pass printing method in which the ejection head **51** has a length longer than the print medium S in the width direction, i.e., in the Y-axis direction and an image is

formed by moving the ejection head **51** only once in the X-axis direction may be adopted.

7. Configurations Described Based on Embodiments

The following configurations are described based on the above embodiment.

Configuration 1

A printing apparatus including: a printing unit configured to form an image on a print medium, a feeding roller configured to feed the print medium toward the printing unit, a feeding-side movable roller in a feeding-side buffer region positioned between the feeding roller and the printing unit, the feeding-side movable roller being configured to apply tension to the print medium, a front drive roller that is positioned between the feeding-side buffer region and the printing unit and with which the print medium is intermittently transported, and a control unit configured to control feeding by the feeding roller, in which control amounts controlled by the control unit include a feeding amount and a feeding speed of the feeding by the feeding roller, and the control unit is configured to execute and switch between a print mode and a continuous transport mode, controls the feeding amount of the feeding roller when the print mode is executed, and controls the feeding speed of the feeding roller when the continuous transport mode is executed.

According to the printing apparatus of Configuration 1, the feeding amount of the feeding roller in the print mode and the feeding speed of the feeding roller in the continuous transport mode are controlled such that displacement of the feeding-side movable roller in the feeding-side buffer region is in an appropriate state. Thus, even when the transport speed of the print medium is increased, the amount of slack of the print medium in the transport path of the print medium can be appropriately adjusted with a simple configuration.

Configuration 2

The printing apparatus according to Configuration 1, in which a plurality of first sensors configured to detect displacement of the feeding-side movable roller are disposed in the feeding-side buffer region, and the control unit changes, of the control amounts, a control amount of the feeding roller based on a detection result of the first sensors.

According to the printing apparatus of Configuration 2, since the displacement of the feeding-side movable roller in the feeding-side buffer region is detected by the first sensors, the amount of slack of the print medium in the transport path of the print medium can be more appropriately adjusted.

Configuration 3

The printing apparatus according to Configuration 2, in which, in the print mode, the control unit detects the displacement of the feeding-side movable roller at a predetermined timing using the plurality of first sensors. According to the printing apparatus of Configuration 3, the displacement of the feeding-side movable roller is detected by the first sensors after the feeding-side movable roller is positioned at a stable position. Thus, the displacement of the feeding-side movable roller can be detected more accurately.

Configuration 4

The printing apparatus according to Configuration 3, in which the predetermined timing is a timing from when the displacement of the feeding-side movable roller is stopped to when the next transport of the print medium is started.

According to the printing apparatus of Configuration 4, since the displacement of the feeding-side movable plate is detected after the feeding-side movable plate is positioned at a stable position, the displacement of the feeding-side movable plate can be detected more accurately.

Configuration 5

The printing apparatus according to Configuration 3, in which the predetermined timing is a timing at which formation of the image by the printing unit is completed.

According to the printing apparatus of Configuration 5, since the displacement of the feeding-side movable roller is detected after the feeding-side movable roller is positioned at a stable position, the displacement of the feeding-side movable roller can be detected more accurately.

Configuration 6

The printing apparatus according to any one of Configurations 2 to 5, in which, in the continuous transport mode, the control unit monitors the displacement of the feeding-side movable roller using the plurality of first sensors during transport of the print medium.

According to the printing apparatus of Configuration 6, by monitoring the state of the slack of the print medium in the continuous transport mode, a situation that may cause contamination or the like of the print medium can be detected.

Configuration 7

The printing apparatus according to any one of Configurations 1 to 6, in which the feeding-side buffer region includes a feeding-side movable plate rotatably supporting the feeding-side movable roller, a detection object is attached to the feeding-side movable plate, and the plurality of first sensors are disposed at a feeding-side sensor mounting bar.

According to the printing apparatus of Configuration 7, since the detection object provided on the feeding-side movable plate is detected by the first sensors, the displacement of the feeding-side movable roller can be detected with a simple configuration.

Configuration 8

The printing apparatus according to Configuration 7, in which a first range including a proper position of the feeding-side movable roller and a second range outside the first range are set in the feeding-side buffer region, and more of the plurality of first sensors are disposed in the first range than in the second range.

According to the printing apparatus of Configuration 8, the displacement of the feeding-side movable roller can be detected more accurately in a configuration with a reduced number of first sensors.

Configuration 9

The printing apparatus according to any one of Configurations 1 to 8, further including: a winding roller configured to collect the print medium, a winding-side buffer region positioned between the winding roller and the printing unit, and a winding-side movable roller in the winding-side buffer region, the winding-side movable roller being configured to apply tension to the print medium, in which the control amounts controlled by the control unit include a winding amount and a winding speed in winding by the winding roller, and the control unit controls the winding amount when the print mode is executed and controls the winding speed when the continuous transport mode is executed.

According to the printing apparatus of Configuration 9, by controlling the winding amount in the print mode and the winding speed in the continuous transport mode based on the state of the amount of slack of the print medium in the winding-side buffer region, the amount of slack of the print medium on the winding side of the printing unit can be appropriately adjusted.

Configuration 10

The printing apparatus according to Configuration 9, in which a plurality of second sensors configured to detect displacement of the winding-side movable roller are disposed in the winding-side buffer region, and the control unit changes, of the control amounts, a control amount of the winding roller based on a detection result of the plurality of second sensors. According to the printing apparatus of Configuration 10, the state of the amount of slack of the print medium in the winding-side buffer region can be accurately determined and the amount of slack of the print medium can be adjusted.

Configuration 11

A control method for controlling a printing apparatus, the print apparatus including: a printing unit configured to form an image on a print medium, a feeding roller configured to feed the print medium toward the printing unit, a feeding-side movable roller in a feeding-side buffer region positioned between the feeding roller and the printing unit, the feeding-side movable roller being configured to apply tension to the print medium, and a front drive roller that is positioned between the feeding-side buffer region and the printing unit and with which the print medium is intermittently transported, the control method including: executing and switching between a print mode and a continuous transport mode, controlling a feeding amount in feeding by the feeding roller when the print mode is executed, and controlling a feeding speed in the feeding by the feeding roller when the continuous transport mode is executed.

According to the control method for a printing apparatus of Configuration 11, the feeding amount of the feeding roller in the print mode and the feeding speed of the feeding roller in the continuous transport mode are controlled such that displacement of the feeding-side movable roller in the feeding-side buffer region is in an appropriate state. Thus, even when the transport speed of the print medium is increased, the amount of slack of the print medium in the transport path of the print medium can be appropriately adjusted with a simple configuration.

What is claimed is:

1. A printing apparatus comprising:
- a printing unit configured to form an image on a print medium;
- a feeding roller configured to feed the print medium toward the printing unit;
- a feeding-side movable roller in a feeding-side buffer region positioned between the feeding roller and the printing unit, the feeding-side movable roller being configured to apply tension to the print medium;
- a front drive roller that is positioned between the feeding-side buffer region and the printing unit and with which the print medium is intermittently transported; and
- a control unit configured to control feeding by the feeding roller, wherein
- control amounts controlled by the control unit include a feeding amount and a feeding speed of the feeding by the feeding roller and
- the control unit is configured to execute and switch between a print mode and a continuous transport mode, controls the feeding amount of the feeding roller when the print mode is executed, and controls the feeding speed of the feeding roller when the continuous transport mode is executed.

2. The printing apparatus according to claim **1**, wherein
- a plurality of first sensors configured to detect displacement of the feeding-side movable roller are disposed in the feeding-side buffer region and
- the control unit changes, of the control amounts, a control amount of the feeding roller based on a detection result of the plurality of first sensors.

3. The printing apparatus according to claim **2**, wherein
- in the print mode, the control unit detects the displacement of the feeding-side movable roller at a predetermined timing using the plurality of first sensors.

4. The printing apparatus according to claim **3**, wherein
- the predetermined timing is a timing from when the displacement of the feeding-side movable roller is stopped to when the next transport of the print medium is started.

5. The printing apparatus according to claim **3**, wherein
- the predetermined timing is a timing at which formation of the image by the printing unit is completed.

6. The printing apparatus according to claim **2**, wherein
- in the continuous transport mode, the control unit monitors the displacement of the feeding-side movable roller using the plurality of first sensors during transport of the print medium.

7. The printing apparatus according to claim **2**, wherein
- the feeding-side buffer region includes a feeding-side movable plate rotatably supporting the feeding-side movable roller,
- a detection object is attached to the feeding-side movable plate, and
- the plurality of first sensors are disposed at a feeding-side sensor mounting bar.

8. The printing apparatus according to claim **7**, wherein
- a first range including a proper position of the feeding-side movable roller and a second range outside the first range are set in the feeding-side buffer region and
- more of the plurality of first sensors are disposed in the first range than in the second range.

9. The printing apparatus according to claim **1**, further comprising:
- a winding roller configured to collect the print medium;
- a winding-side buffer region positioned between the winding roller and the printing unit; and
- a winding-side movable roller in the winding-side buffer region, the winding-side movable roller being configured to apply tension to the print medium, wherein
- the control amounts controlled by the control unit include a winding amount and a winding speed in winding by the winding roller and
- the control unit controls the winding amount when the print mode is executed and controls the winding speed when the continuous transport mode is executed.

10. The printing apparatus according to claim **9**, wherein
- a plurality of second sensors configured to detect displacement of the winding-side movable roller are disposed in the winding-side buffer region and
- the control unit changes, of the control amounts, a control amount of the winding roller based on a detection result of the plurality of second sensors.

11. A control method for controlling a printing apparatus, the print apparatus including:
- a printing unit configured to form an image on a print medium,
- a feeding roller configured to feed the print medium toward the printing unit,
- a feeding-side movable roller in a feeding-side buffer region positioned between the feeding roller and the printing unit, the feeding-side movable roller being configured to apply tension to the print medium, and
- a front drive roller that is positioned between the feeding-side buffer region and the printing unit and with which

the print medium is intermittently transported, the control method comprising:

executing and switching between a print mode and a continuous transport mode;

controlling a feeding amount in feeding by the feeding roller when the print mode is executed; and

controlling a feeding speed in the feeding by the feeding roller when the continuous transport mode is executed.

* * * * *