US012391514B2

(12) **United States Patent**
Tanio

(10) **Patent No.: US 12,391,514 B2**
(45) **Date of Patent: Aug. 19, 2025**

(54) **PAPER TRANSPORT APPARATUS FOR TRANSPORTING PAPER AND IMAGE FORMING APPARATUS INCLUDING THE SAME**

(71) Applicant: **KYOCERA Document Solutions Inc.**, Osaka (JP)

(72) Inventor: **Koji Tanio**, Osaka (JP)

(73) Assignee: **KYOCERA Document Solutions Inc.**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 4 days.

(21) Appl. No.: **18/662,031**

(22) Filed: **May 13, 2024**

(65) **Prior Publication Data**

US 2024/0383707 A1 Nov. 21, 2024

(30) **Foreign Application Priority Data**

May 16, 2023 (JP) 2023-081112

(51) **Int. Cl.**
B65H 29/60 (2006.01)
B65H 5/06 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***B65H 85/00*** (2013.01); ***B65H 5/062*** (2013.01); ***B65H 5/26*** (2013.01); ***B65H 7/20*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC . B65H 7/02; B65H 7/20; B65H 29/60; B65H 85/00; B65H 2511/528; G03G 21/1638; G03G 2215/00586; G03G 2215/1675; G03G 2215/00548; G03G 2215/0043; G03G 2215/00438; G03G 2215/00675; G03G 15/23–235; G03G 15/6579; G03G 15/70; G03G 15/703
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,926,272 B2 * 8/2005 Carter B65H 7/02 271/301
8,167,304 B2 * 5/2012 Fukazawa B65H 29/58 271/225

(Continued)

FOREIGN PATENT DOCUMENTS

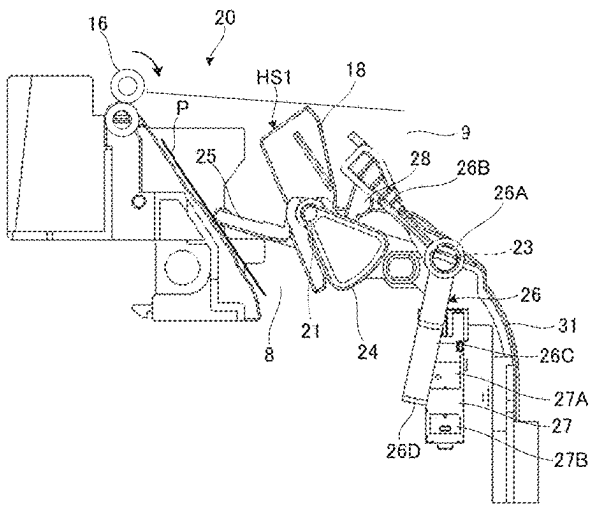
JP H04116061 A 4/1992

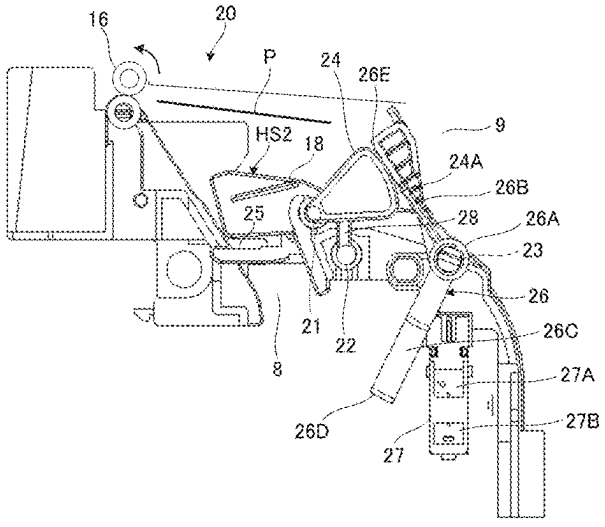
Primary Examiner — Ernesto A Suarez
(74) *Attorney, Agent, or Firm* — IP Business Solutions, LLC.

(57) **ABSTRACT**

In a paper transport apparatus, a controller determines recording paper of a first transport path when a solenoid is deactivated, a paper detection member retreats in contact with the recording paper of the first transport path in a state in which a switching guide is switched to a first transport position, a driven rotation member rotates twice according to this retreat, and a sensor does not detect a standby position of the driven rotation member. Moreover, the controller determines a second transport position of the switching guide when the solenoid is activated, the switching guide is switched to the second transport position, the driven rotation member rotates according to this switching, and the sensor does not detect the standby position of the driven rotation member.

5 Claims, 12 Drawing Sheets





(51) **Int. Cl.**

B65H 5/26	(2006.01)
B65H 7/20	(2006.01)
B65H 85/00	(2006.01)

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

CPC ***B65H 29/60*** (2013.01); *B65H 2511/528* (2013.01); *B65H 2513/10* (2013.01); *B65H 2513/50* (2013.01); *B65H 2801/06* (2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

8,442,421	B2 *	5/2013	Ichiki	G03G 15/6579 399/21
8,928,898	B2 *	1/2015	Onishi	G03G 15/70 358/3.32
9,836,000	B2 *	12/2017	Takemoto	G03G 21/1638
2024/0176273	A1 *	5/2024	Tanio	B65H 7/02

* cited by examiner

Fig.1

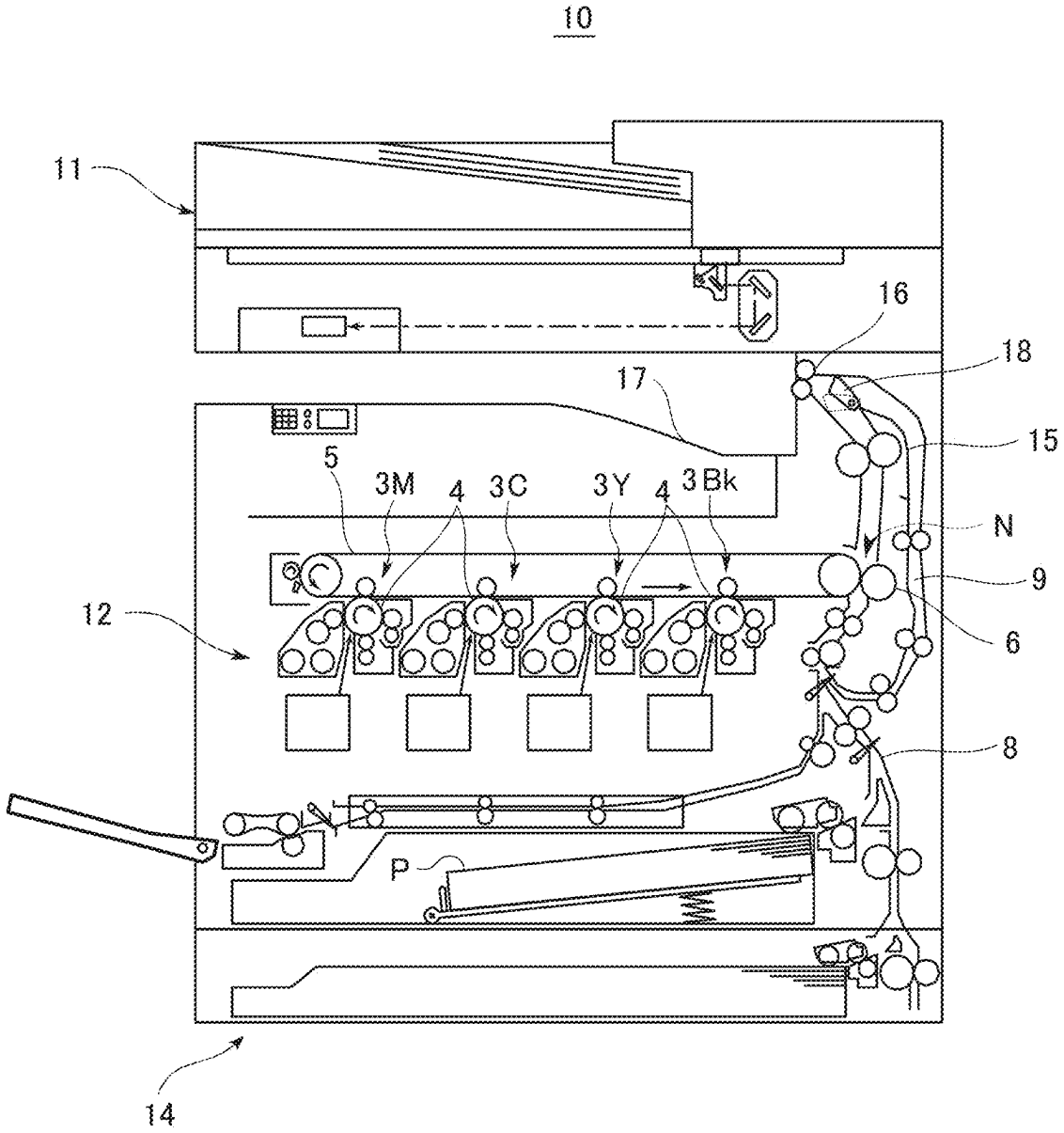


Fig.2A

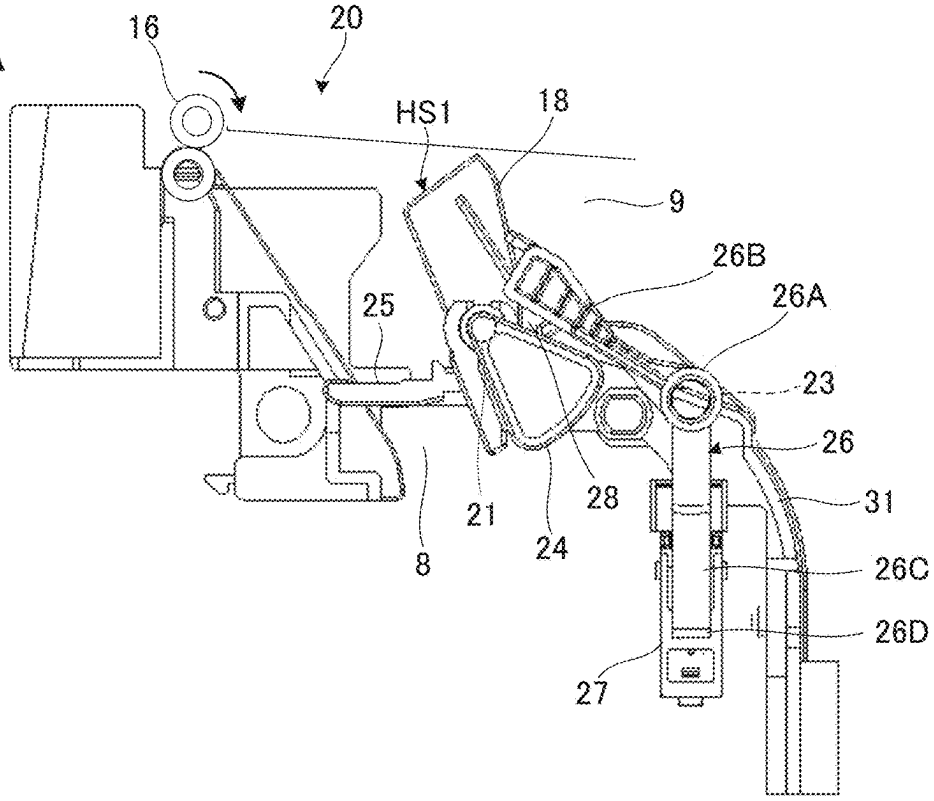

16
20
HS1
18
9
26B
26A
25
23
26
28
31
21
24
8
26C
26D
27

Fig.2B

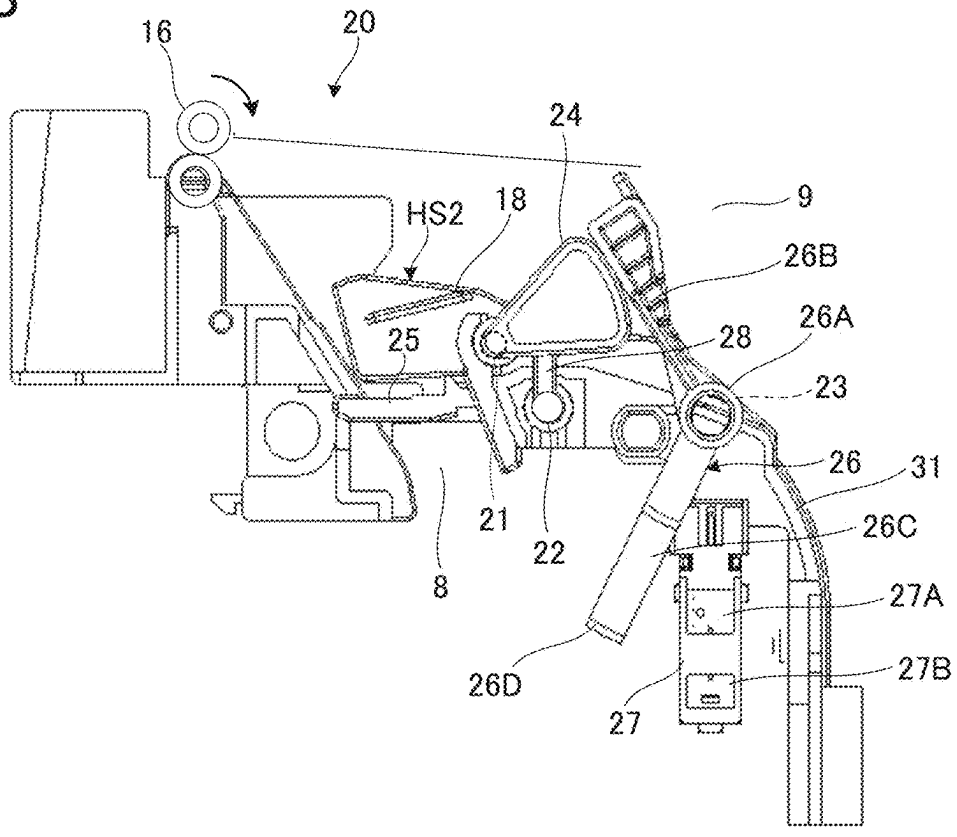

16
20
24
HS2
18
9
26B
26A
25
28
23
26
31
21
22
8
26C
27A
26D
27B
27

Fig.3

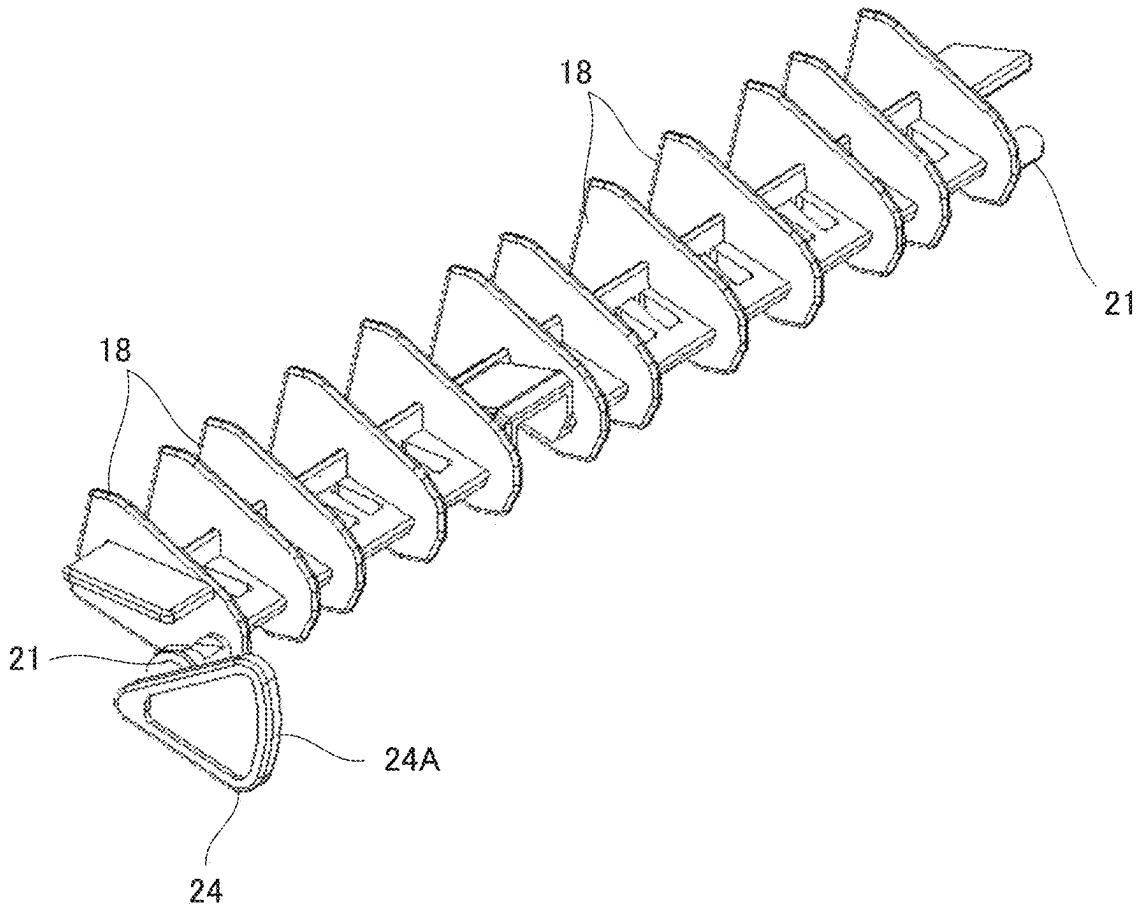


Fig.4A

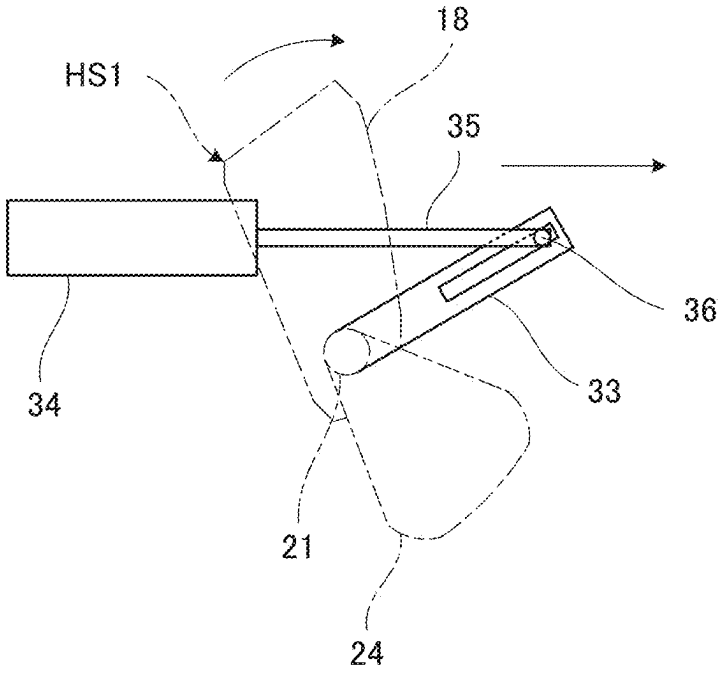


Fig.4B

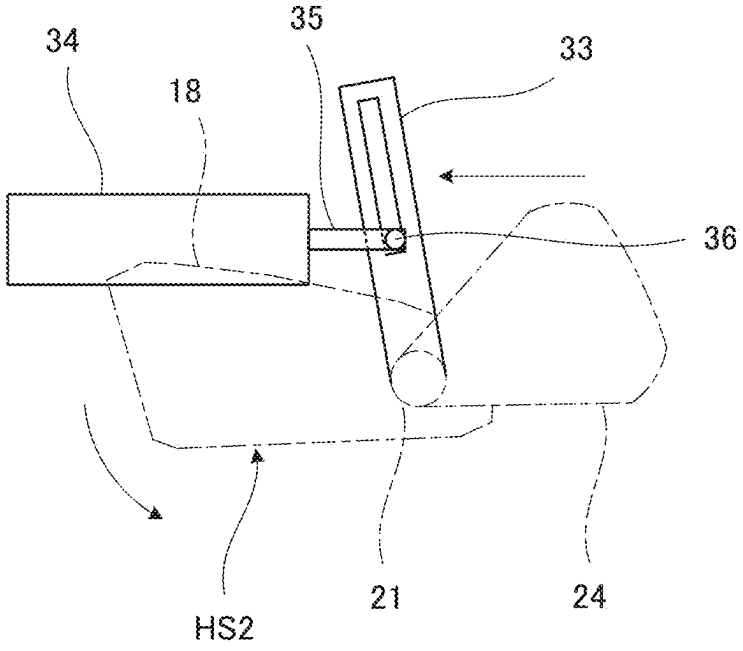


Fig.5

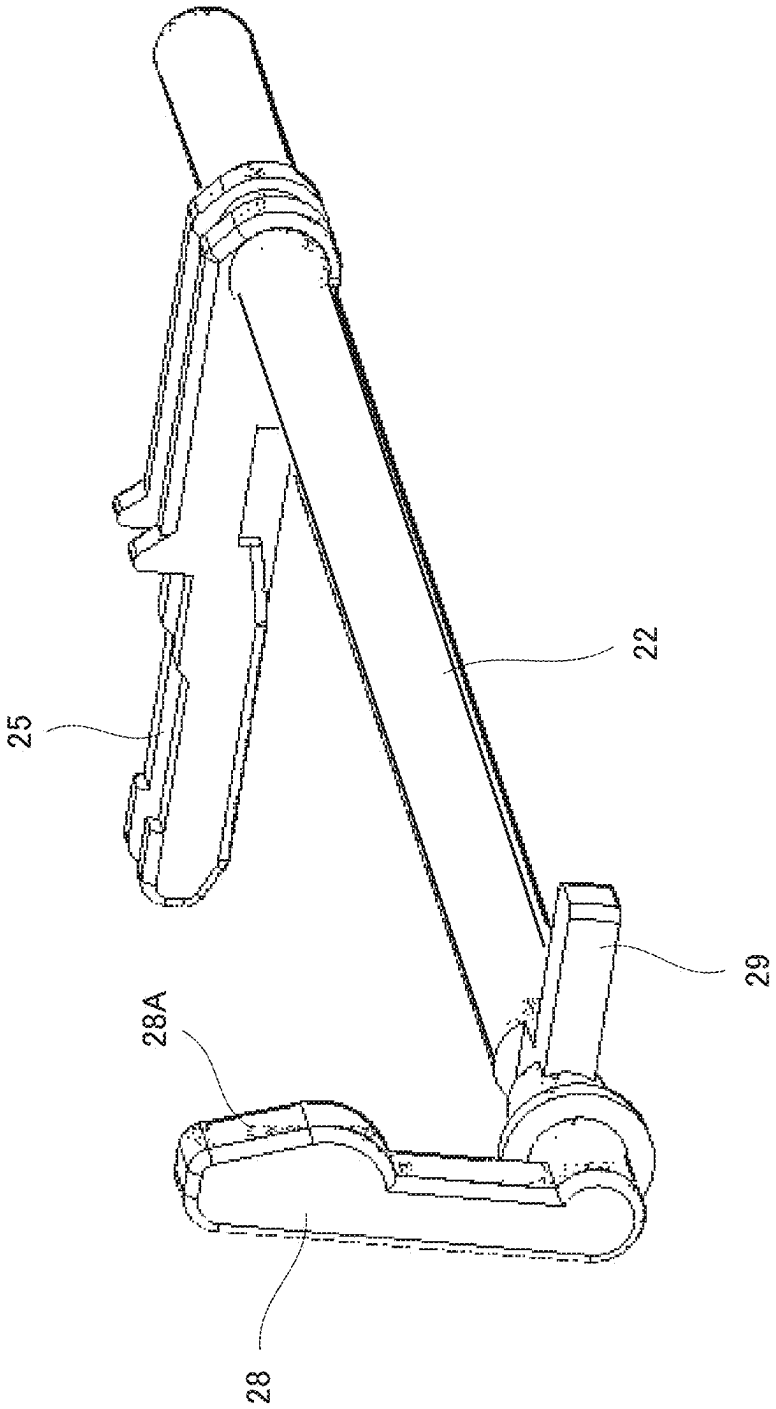


Fig.6A

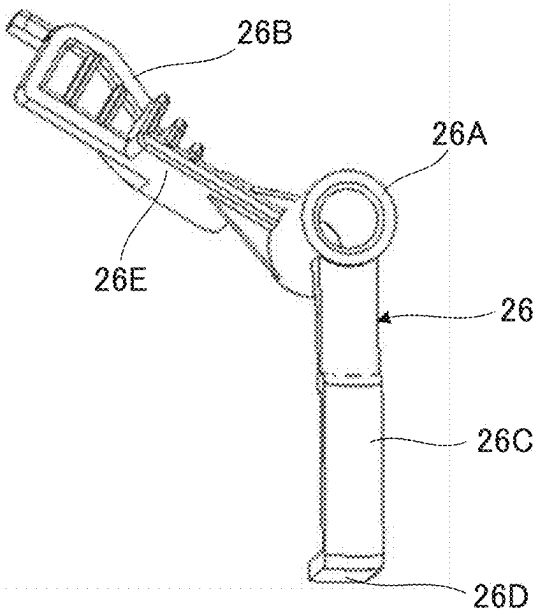


Fig.6B

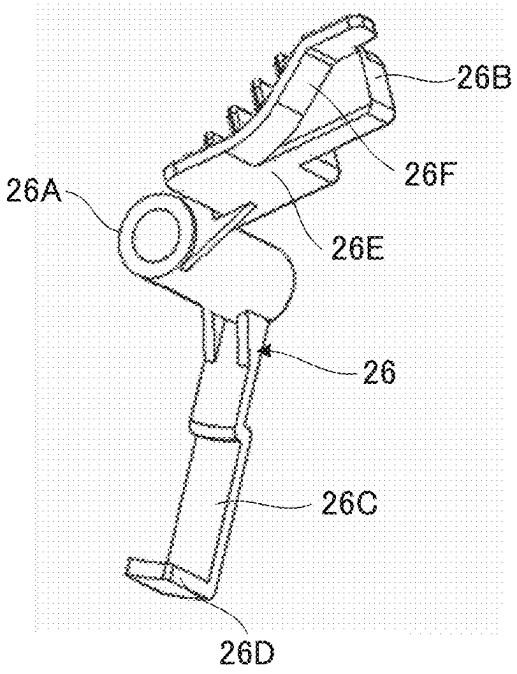


Fig.7A

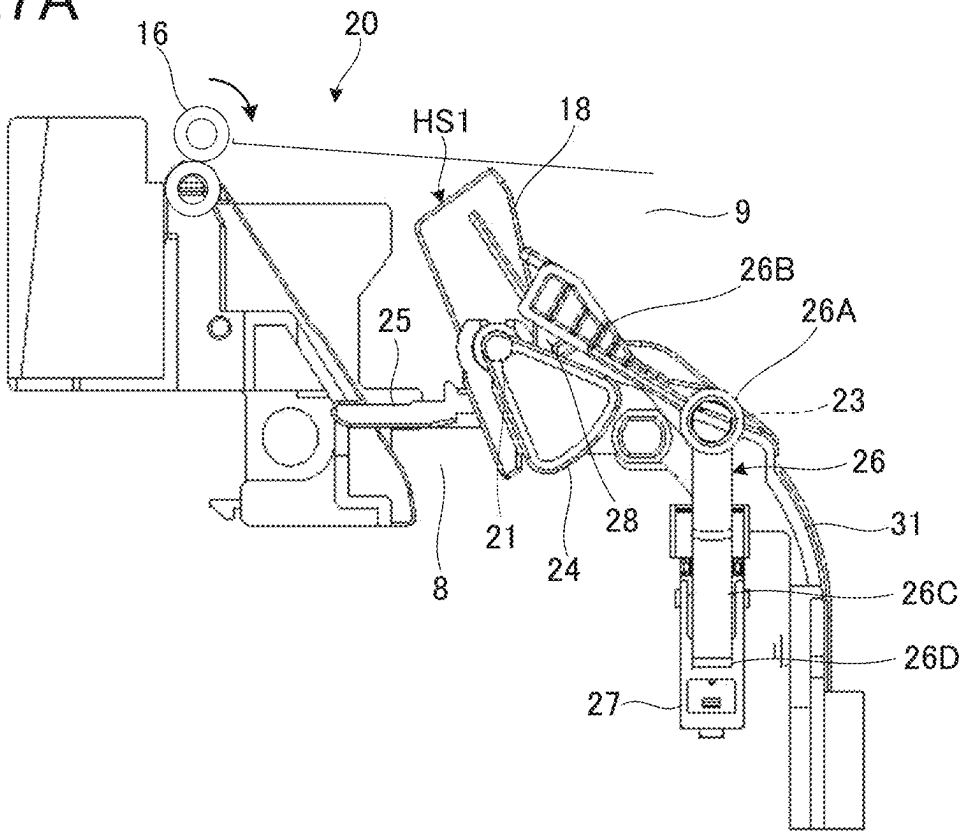

16
20
HS1
18
9
26B
26A
25
23
26
31
28
21
24
8
26C
26D
27

Fig.7B

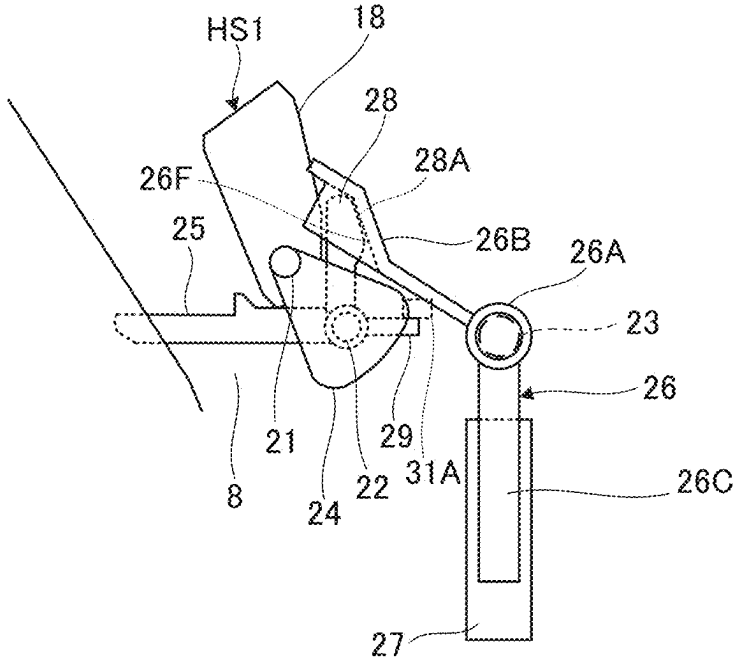

HS1
18
28
28A
26F
25
26B
26A
23
26
21
29
31A
22
8
24
26C
27

Fig.8A

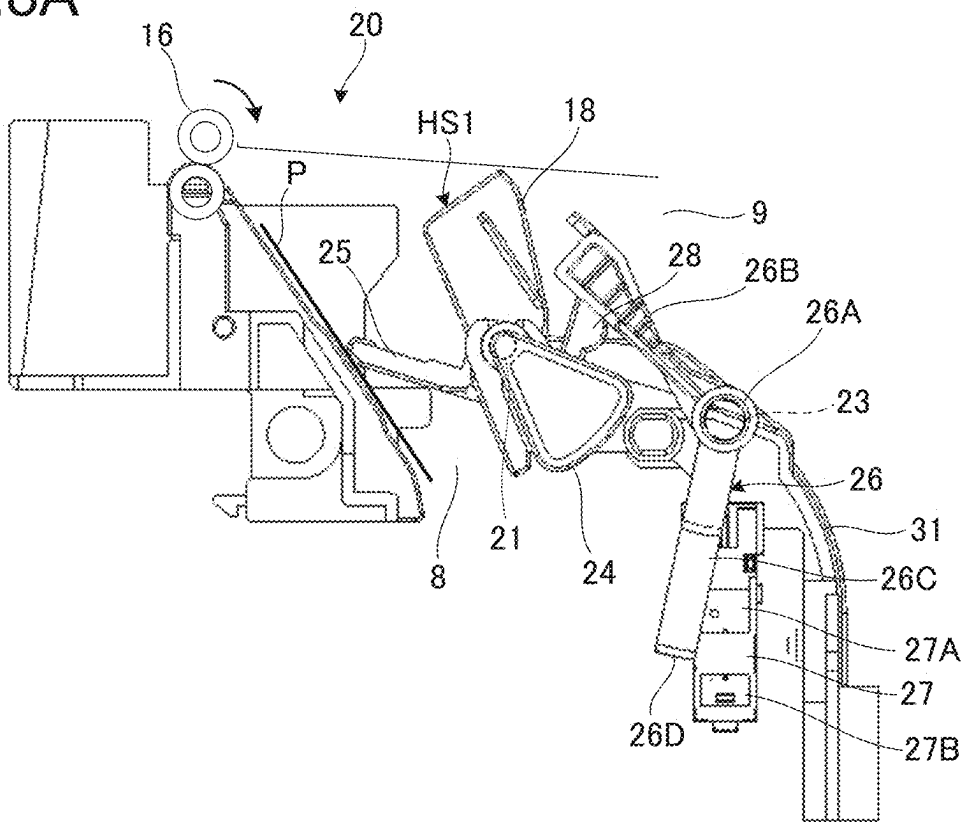

16
20
HS1
18
P
9
25
28
26B
26A
23
26
31
21
24
8
26C
27A
27
26D
27B

Fig.8B

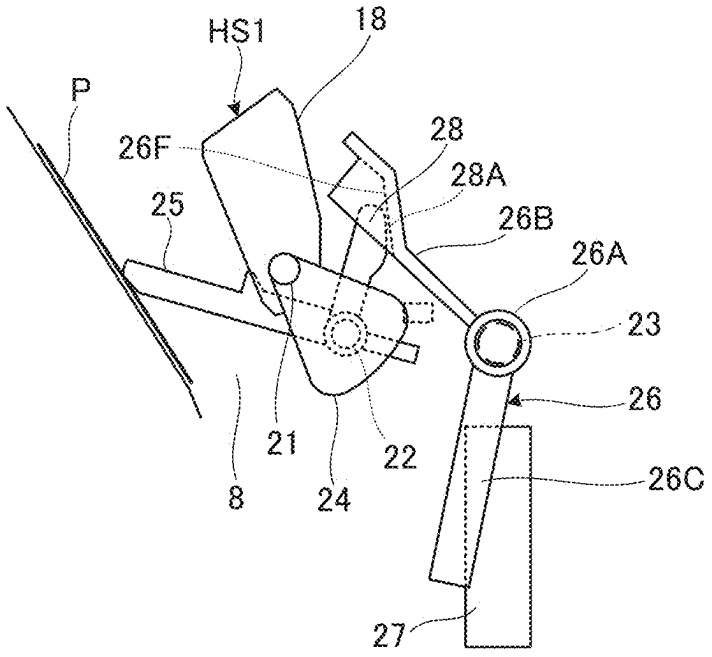

HS1
18
P
26F
28
28A
25
26B
26A
23
26
21
22
26C
8
24
27

Fig.9

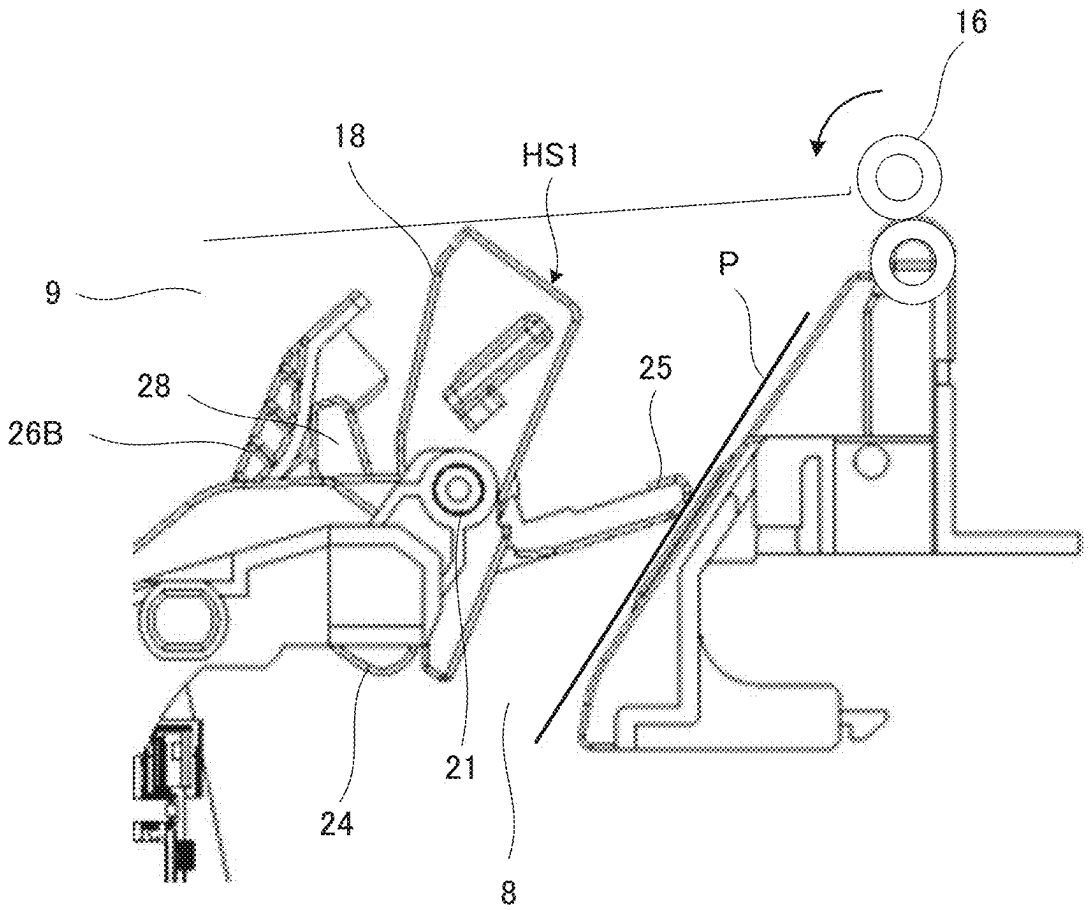


Fig.10A

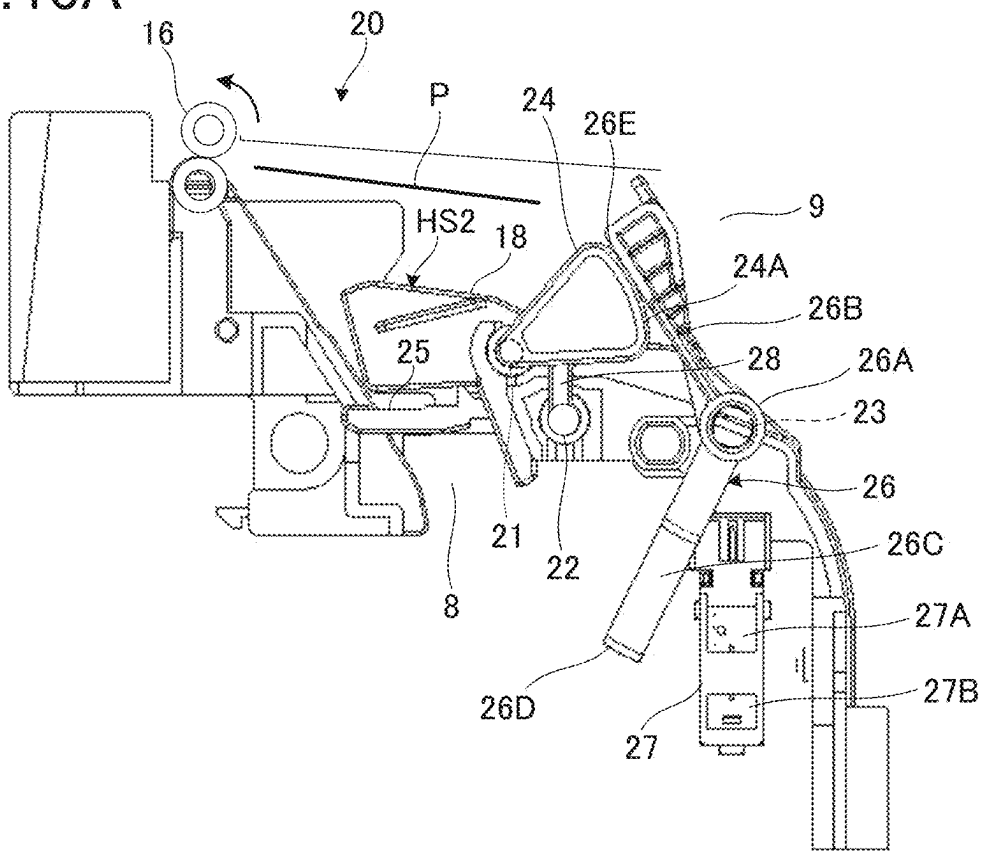
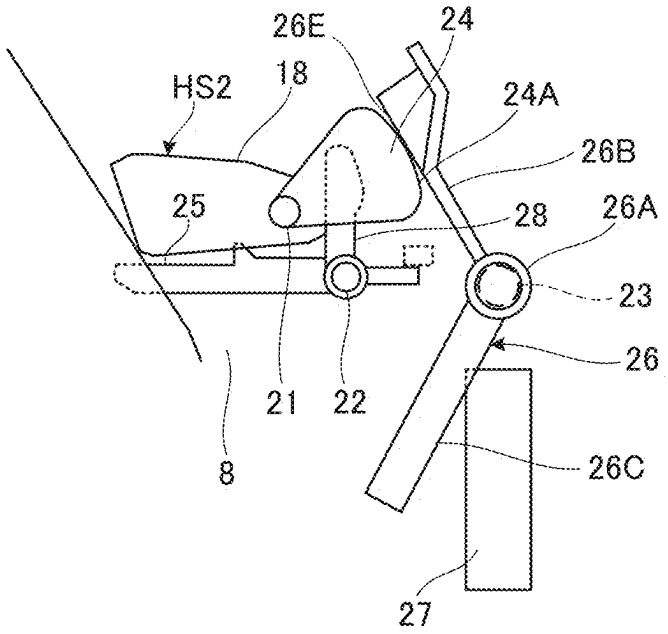


Fig.10B



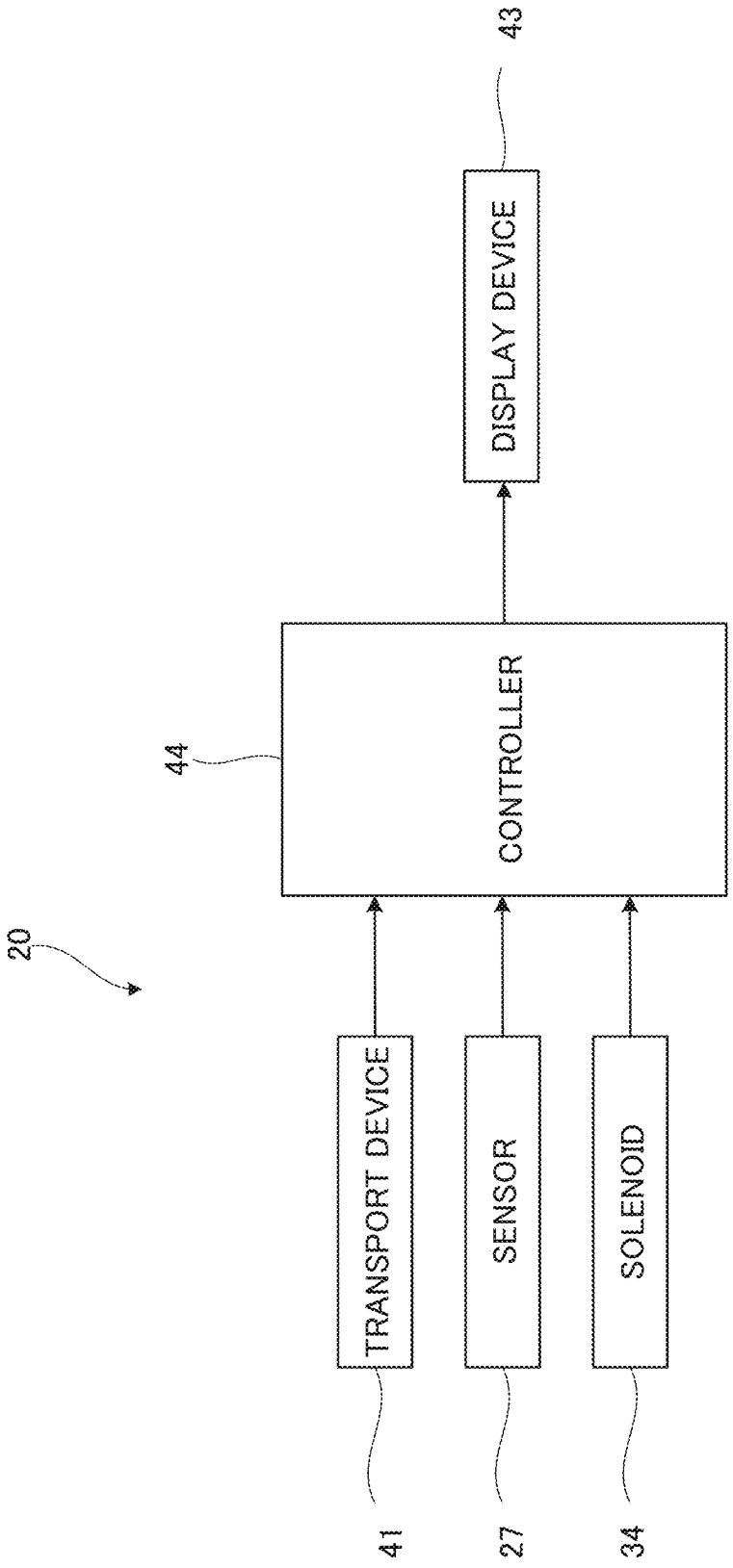
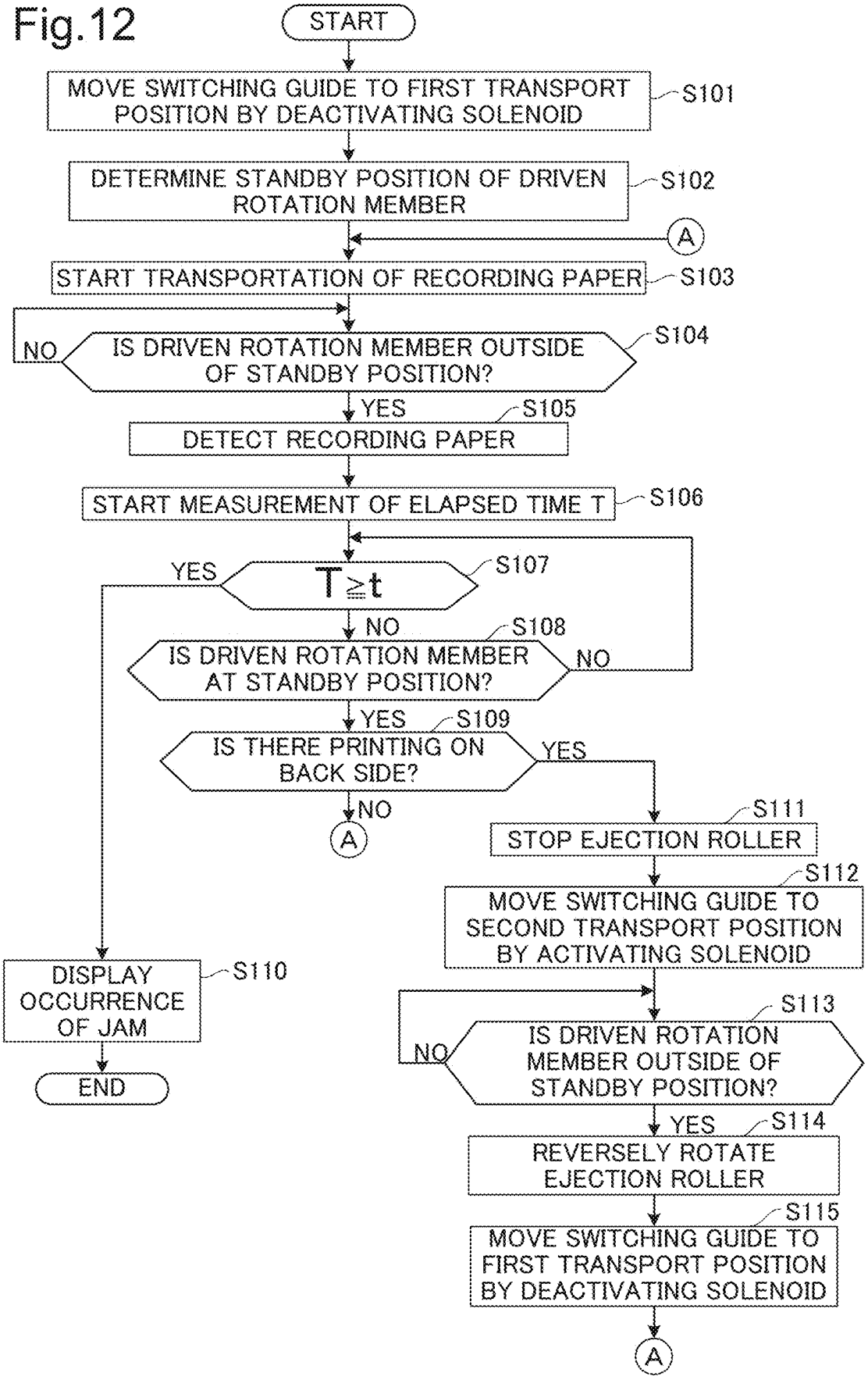

20
44
CONTROLLER
DISPLAY DEVICE
43
TRANSPORT DEVICE
SENSOR
SOLENOID
41
27
34

Fig.11

Fig.12


START
MOVE SWITCHING GUIDE TO FIRST TRANSPORT POSITION BY DEACTIVATING SOLENOID
S101
DETERMINE STANDBY POSITION OF DRIVEN ROTATION MEMBER
S102
A
START TRANSPORTATION OF RECORDING PAPER
S103
NO
IS DRIVEN ROTATION MEMBER OUTSIDE OF STANDBY POSITION?
S104
YES
S105
DETECT RECORDING PAPER
START MEASUREMENT OF ELAPSED TIME T
S106
YES
T≧t
S107
NO
S108
IS DRIVEN ROTATION MEMBER AT STANDBY POSITION?
NO
YES
S109
IS THERE PRINTING ON BACK SIDE?
YES
NO
A
S111
STOP EJECTION ROLLER
S112
MOVE SWITCHING GUIDE TO SECOND TRANSPORT POSITION BY ACTIVATING SOLENOID
DISPLAY OCCURRENCE OF JAM
S110
END
S113
NO
IS DRIVEN ROTATION MEMBER OUTSIDE OF STANDBY POSITION?
YES
S114
REVERSELY ROTATE EJECTION ROLLER
S115
MOVE SWITCHING GUIDE TO FIRST TRANSPORT POSITION BY DEACTIVATING SOLENOID
A

PAPER TRANSPORT APPARATUS FOR TRANSPORTING PAPER AND IMAGE FORMING APPARATUS INCLUDING THE SAME

INCORPORATION BY REFERENCE

This application claims priority to Japanese Patent Application No. 2023-081112 filed on May 16, 2023, the entire contents of which are incorporated by reference herein.

BACKGROUND

The present disclosure relates to a paper transport apparatus for transporting paper and an image forming apparatus including the same. In particular, the present disclosure relates to technology for switching a paper transport direction.

In an image forming apparatus, recording paper (an example of paper) is transported to an image forming device through a first transport path and the recording paper is ejected into a paper ejection tray through an ejection roller after an image of a manuscript is formed on a front side of the recording paper by the image forming device. Moreover, when an image of the manuscript is formed on a back side of the recording paper, the recording paper is transported to the ejection roller, switchback transport in which the ejection roller is temporarily stopped and reversely rotated is performed, the recording paper is transported in a direction opposite to a previous transport direction, the recording paper returns to the first transport path through a second transport path, the front and back sides of the recording paper are reversed, an image of the manuscript is formed on the back side of the recording paper by the image forming device, and the recording paper is ejected into the paper ejection tray through the ejection roller.

Moreover, there is a paper transport apparatus that transports recording paper from a carrying-in transport path to a reverse transport path, switches a paper transport direction to a reverse direction on the reverse transport path, and transports the recording paper from the reverse transport path to a paper ejection transport path. In order to switch the recording paper transport direction, a first branch pawl and a second branch pawl for switching the paper transport direction to a branch of the carrying-in transport path, the reverse transport path, and the paper ejection transport path are provided and a roller for transporting the paper to the reverse transport path in the reverse direction is provided.

SUMMARY

As an aspect of the present disclosure, technology obtained by further improving the above-described technology is proposed.

According to an aspect of the present disclosure, a paper transport apparatus includes a first transport path, a roller, a second transport path, a switching guide, a first link member, a paper detection member, a second link member, a driven rotation member, a sensor, a drive device, and a controller. The first transport path is configured to guide paper. The roller transports the paper guided through the first transport path. The second transport path is configured to guide the paper transported in a direction opposite to a transport direction on the first transport path according to reverse rotation of the roller. The switching guide is rotationally supported according to a first shaft parallel to the roller and rotated back and forth around the first shaft to switch a transport direction of the paper by moving to either a first transport position for guiding the paper guided through the first transport path to the roller or a second transport position for guiding the paper transported in the opposite direction according to the reverse rotation of the roller to the second transport path. The first link member is rotatably supported by the first shaft, protrudes in a direction perpendicular to the first shaft, and rotates back and forth integrally with the switching guide around the first shaft. The paper detection member is rotatably supported by a second shaft parallel to the first shaft, protrudes toward the first transport path, rotates around the second shaft, and retreats from the first transport path when the paper detection member comes into contact with the paper transported through the first transport path. The second link member is rotatably supported by the second shaft and rotates integrally with the paper detection member around the second shaft when the paper detection member retreats from the first transport path. The driven rotation member is rotatably supported by a third shaft parallel to the first shaft, pressed and rotated by the first link member when the switching guide is switched to the second transport position and the first link member rotates, and pressed and rotated by the second link member when the paper detection member retreats from the first transport path and the second link member rotates. The sensor detects a standby position of the driven rotation member when the driven rotation member is not pressed by either the first link member or the second link member. The drive device rotates the switching guide back and forth around the first shaft and switches the switching guide to either the first transport position or the second transport position. The controller determines that the paper is being transported through the first transport path when the paper detection member retreats in contact with the paper transported through the first transport path in a state in which the switching guide is switched to the first transport position by controlling the drive device, the second link member rotates, the driven rotation member is pressed and rotated by the second link member, and the standby position of the driven rotation member is not detected by the sensor and determines that the switching guide has been switched from the first transport position to the second transport position when the first link member rotates with the switching guide after the switching guide is switched to the second transport position by controlling the drive device, the driven rotation member is pressed and rotated by the first link member, and the standby position of the driven rotation member is not detected by the sensor.

According to an aspect of the present disclosure, an image forming apparatus includes the paper transport apparatus according to the above-described aspect of the present disclosure and an image forming device configured to form an image on the paper transported by the paper transport apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a cross-sectional view showing an image forming apparatus to which a paper transport apparatus of an embodiment according to the present disclosure is applied.

FIGS. **2**A and **2**B are side views showing enlarged versions of an ejection roller and a switching guide in the paper transport apparatus of the present embodiment, wherein FIG. **2**A shows a first transport position of the switching guide when recording paper is guided to the ejection roller and FIG. **2**B shows a second transport position of the

switching guide when the recording paper transported in the opposite direction by the ejection roller is guided.

FIG. **3** is a perspective view showing each switching guide, the first link member, and a shaft for rotatably supporting each switching guide and the first link member.

FIGS. **4**A and **4**B schematically show an example of a mechanism for rotating each switching guide and the first link member back and forth, wherein FIG. **4**A shows a state in which each switching guide is moved to the first transport position and FIG. **4**B shows a state in which each switching guide is moved to the second transport position.

FIG. **5** is a perspective view showing a shaft that rotatably supports a paper detection member, a second link member, a paper detection member, and a second link member.

FIGS. **6**A and **6**B are a perspective view showing a driven rotation member seen from the front side and a perspective view showing the driven rotation member seen from the back side.

FIGS. **7**A and **7**B are a side view showing the first link member, the paper detection member, the driven rotation member, a sensor, and the second link member in a state in which each switching guide is moved to the first transport position and the recording paper is not being transported through the first transport path and a side view schematically showing the state.

FIGS. **8**A and **8**B are a side view showing the first link member, the paper detection member, the driven rotation member, the sensor, and the second link member in a state in which each switching guide is moved to the first transport position and the recording paper is being transported through the first transport path and a side view schematically showing the state.

FIG. **9** is a side view showing the first link member, the paper detection member, the driven rotation member, the sensor, and the second link member seen from the back side in the same state as FIGS. **8**A and **8**B.

FIGS. **10**A and **10**B are a side view showing the first link member, the paper detection member, the driven rotation member, the sensor, and the second link member in a state in which each switching guide has been moved from the first transport position to the second transport position and a side view schematically showing the state.

FIG. **11** is a block diagram schematically showing a configuration of a control system of the paper transport apparatus.

FIG. **12** is a flowchart showing a control procedure for determining the presence or absence of recording paper being transported through the first transport path and the second transport position of each switching guide.

DETAILED DESCRIPTION

Hereinafter, embodiments of the present disclosure will be described with reference to the drawings. Hereinafter, a rotational direction or left, right, up, and down directions may be shown, but these are the directions of the examples in each drawing unless otherwise stated. FIG. **1** is a cross-sectional view showing an image forming apparatus to which a paper transport apparatus of an embodiment according to the present disclosure is applied. As shown in FIG. **1**, an image forming apparatus **10** of the present embodiment includes an image reading device **11** and an image forming device **12**.

The image reading device **11** includes an image sensor (a CCD sensor or a contact image sensor) that optically reads an image of a manuscript and an output of the image sensor is converted into image data.

The image forming device **12** prints an image indicated in the above-described image data on recording paper and includes an image forming unit **3**M for magenta, an image forming unit **3**C for cyan, an image forming unit **3**Y for yellow, and an image forming unit **3**Bk for black. In any one of the image forming units **3**M, **3**C, **3**Y, and **3**Bk, a surface of a photoreceptor drum **4** is uniformly charged, the surface of the photoreceptor drum **4** is exposed, an electrostatic latent image is formed on the surface of the photoreceptor drum **4**, the electrostatic latent image on the surface of the photoreceptor drum **4** is developed into a toner image, and the toner image on the surface of the photoreceptor drum **4** is transferred to an intermediate transfer belt **5**. Thereby, a colored toner image is formed on the intermediate transfer belt **5**. This colored toner image is secondarily transferred to recording paper P transported from a paper feed device **14** through the first transport path **8** in a nip region N between the intermediate transfer belt **5** and a secondary transfer roller **6**.

Subsequently, the recording paper P is heated and pressurized by a fixing device **15** to fix the toner image on the recording paper P through thermocompression bonding, and the recording paper P is ejected into a paper ejection tray **17** through an ejection roller **16**.

Moreover, when the image of the manuscript is recorded on the back side of the recording paper P, switchback transport in which the recording paper P is transported to the ejection roller **16** in front of the paper ejection tray **17**, the ejection roller **16** is temporarily stopped and then reversely rotated, and the recording paper P is transported in the reverse direction is performed, the position of the switching guide **18** provided at a branch position of the first transport path **8** and the second transport path **9** is switched, the recording paper P is guided from the ejection roller **16** to a second transport path **9**, the recording paper P returns to the first transport path **8** through the second transport path **9**, the front and back sides of the recording paper P are reversed, the image forming device **12** forms the image of the manuscript on the back side of the recording paper P, and the recording paper P is ejected into the paper ejection tray **17** through the ejection roller **16**.

FIGS. **2**A and **2**B are side views showing enlarged versions of the periphery of the ejection roller **16** and the switching guide **18** in the paper transport apparatus **20** of the present embodiment. As shown in FIGS. **2**A and **2**B, the switching guide **18** is rotatably supported by a shaft **21** (a first shaft in the claims) parallel to the ejection roller **16** and is switched to a first transport position HS**1** or a second transport position HS**2** and positioned. In a state in which the switching guide **18** is positioned at the first transport position HS**1**, the recording paper is transported from the fixing device **15** (shown in FIG. **1**) to the ejection roller **16** through the first transport path **8** and ejected into the paper ejection tray **17** (shown in FIG. **1**) from the ejection roller **16**.

When the above-described switchback transport is performed, after the rear end of the recording paper passes through the switching guide **18** during the transportation of the recording paper by the ejection roller **16**, the ejection roller **16** is temporarily stopped when the ejection roller **16** is nipping the recording paper. The switching guide **18** is switched from the first transport position HS**1** to the second transport position HS**2** and the ejection roller **16** is reversely rotated. The recording paper is transported by the ejection roller **16** in a direction opposite to the previous transport direction and is guided to the second transport path **9** by the switching guide **18** at a branch position of the first transport path **8** and the second transport path **9**. Also, the recording

paper returns to the first transport path **8** through the second transport path **9**, and the front and back sides of the recording paper are reversed.

As shown in FIGS. **2**A and **2**B, a first link member **24**, a paper detection member **25**, a driven rotation member **26**, a sensor **27**, a second link member **28**, and the like are provided around the switching guide **18** and the shaft **21**. The paper detection member **25** is rotatably supported by a shaft **22** (a second shaft in the claims) parallel to the shaft **21** and is provided to detect recording paper transported through the first transport path **8**. The paper detection member **25** protrudes on the first transport path **8** side, and its tip enters a recess formed in the wall of the first transport path **8**.

The driven rotation member **26** is rotatably supported by a shaft **23** (a third shaft in the claims) parallel to the shaft **21**. The driven rotation member **26** includes a bearing device **26**A rotatably supported by the shaft **23**, a contact arm **26**B and a swing arm **26**C connected and fixed to the bearing device **26**A, and a detected piece **26**D bent inward and protruding at a lower end of the swing arm **26**C. The contact arm **26**B and the swing arm **26**C have a bent shape at a position of the bearing device **26**A.

The sensor **27** is an optical sensor in which a light emitting element **27**A and a light receiving element **27**B are arranged facing each other in the up/down direction and the detected piece **26**D at the lower end of the swing arm **26**C that penetrates between the light emitting element **27**A and the light receiving element **27**B is detected.

The shaft **21** for supporting the switching guide **18** is rotatably supported by a frame **31** inside the paper transport apparatus **20**. Likewise, the shaft **22** for supporting the paper detection member **25** is rotatably supported by the frame **31** inside the paper transport apparatus **20**. Moreover, the shaft **23** for supporting the driven rotation member **26** protrudes inward from an inner wall (not shown) of a housing of the paper transport apparatus **20** and is inserted into the bearing device **26**A of the driven rotation member **26**. The shaft **23** rotatably supports the driven rotation member **26** around the shaft **23**.

FIG. **3** is a perspective view showing the switching guide **18**, the shaft **21**, and the like. As shown in FIG. **3**, a plurality of switching guides **18** are provided at intervals in a width direction of the recording paper and each switching guide **18** is fixed to the shaft **21**. Moreover, the first link member **24** protruding in a direction perpendicular to the shaft **21** is fixed to one end of the shaft **21**. The first link member **24** is a fan shape extending from the shaft **21** and has a sliding contact surface **24**A that draws a smooth arc on the outer circumference of the fan shape. When the shaft **21** is rotated back and forth, each switching guide **18** and the first link member **24** are integrally rotated back and forth around the shaft **21** and each switching guide **18** is switched to the first transport position HS**1** or the second transport position HS**2**.

FIGS. **4**A and **4**B are views showing an example of a mechanism for rotating each switching guide **18** and the first link member **24** back and forth around the shaft **21**. As shown in FIGS. **4**A and **4**B, a guide member **33** is connected and fixed to one end of the shaft **21** in a direction perpendicular to the shaft **21** and a pin **36** provided at the tip of a plunger **35** of a solenoid **34** is inserted into a groove of the guide member **33**. Moreover, the guide member **33** is biased by a spring (not shown) in a clockwise direction centered on the shaft **21**. When the solenoid **34** is deactivated, the guide member **33** is biased by the spring in the clockwise direction and the plunger **35** follows the guide member **33** and protrudes from the solenoid **34**. Simultaneously, each switching guide **18** and the first link member **24** rotate in the clockwise direction and each switching guide **18** is positioned at the first transport position HS**1**.

Moreover, when the solenoid **34** is activated and driven, the solenoid **34** pulls the plunger **35** against a biasing force of the spring, and the guide member **33** follows the plunger **35** and rotates in a counterclockwise direction. Simultaneously, each switching guide **18** and the first link member **24** rotate in the counterclockwise direction and each switching guide **18** is positioned at the second transport position HS**2**.

FIG. **5** is a perspective view showing the paper detection member **25**, the shaft **22**, and the like. As shown in FIG. **5**, the paper detection member **25** is connected to a portion of the shaft **22** separated from one end of the shaft **22** and protrudes from a position between the switching guides **18** to the first transport path **8** side at approximately the center of the shaft **21** for supporting each switching guide **18** shown in FIG. **3**. The second link member **28** and a stopper **29** protruding in a direction orthogonal to the shaft **22** are fixed to one end of the shaft **22**, the second link member **28** protrudes upward, the stopper **29** protrudes in a direction opposite to the paper detection member **25**, and the second link member **28** and the stopper **29** are oriented in directions whose difference is approximately 90°. The second link member **28** is rod-shaped and has a sliding contact surface **28**A that draws a smooth arc on a rod-shaped side surface. When the paper detection member **25** is rotated back and forth around the shaft **22**, the paper detection member **25**, the second link member **28**, and the stopper **29** are integrally rotated back and forth.

FIGS. **6**A and **6**B are a perspective view showing the driven rotation member **26** seen from the front side and a perspective view showing the driven rotation member **26** seen from the back side. As shown in FIGS. **6**A and **6**B, the driven rotation member **26** includes the bearing device **26**A, the contact arm **26**B, the swing arm **26**C, and the detected piece **26**D protruding inward from the lower end of the swing arm **26**C. The contact arm **26**B has a smooth surface **26**E facing downward in contact with the sliding contact surface **24**A of the first link member **24** fixed to one end of the shaft **21**. Moreover, the contact arm **26**B has a bent inclined surface **26**F facing downward in contact with the sliding contact surface **28**A of the second link member **28** fixed to one end of the shaft **22**.

As shown in FIGS. **2**A and **2**B, the first link member **24** fixed to the one end of the shaft **21** and the second link member **28** fixed to the one end of the shaft **22** are located inside and outside, i.e., the smooth surface **26**E of the contact arm **26**B in contact with the sliding contact surface **24**A of the first link member **24** is located outside, the bent inclined surface **26**F of the contact arm **26**B in contact with the sliding contact surface **28**A of the second link member **28** is located inside, and the smooth surface **26**E and the sliding contact surface **28**A are adjacent to each other inside and outside.

FIGS. **7**A and **7**B are a side view showing the first link member **24**, the paper detection member **25**, the driven rotation member **26**, the sensor **27**, and the second link member **28** in a state in which each switching guide **18** is moved to the first transport position HS**1** and the recording paper is not being transported through the first transport path **8** and a side view schematically showing the first link member **24**, the paper detection member **25**, the driven rotation member **26**, the sensor **27**, and the second link member **28** in the state.

When the solenoid **34** is deactivated as shown in FIGS. **4**A, each switching guide **18** and the first link member **24**

rotate in a clockwise direction around the shaft **21** and each switching guide **18** is positioned at the first transport position HS**1** as shown in FIGS. **7**A and **7**B.

The paper detection member **25** is biased and rotated in the counterclockwise direction around the shaft **22** due to its weight and the tip of the paper detection member **25** enters the recess formed in the wall of the first transport path **8**. At this time, the stopper **29** rotates in the counterclockwise direction around the shaft **22** and stops in contact with a part **31**A of the frame **31** inside the paper transport apparatus **20**, the paper detection member **25** stops in a substantially horizontal direction, and the second link member **28** stops facing upward.

The driven rotation member **26** is biased and rotated in the counterclockwise direction around the shaft **23** due to its weight and the bent inclined surface **26**F of the contact arm **26**B of the driven rotation member **26** is in contact with the sliding contact surface **28**A of the second link member **28** and the driven rotation member **26** stops. At this time, the swing arm **26**C of the driven rotation member **26** stops facing downward and the sensor **27** detects the detected piece **26**D of the swing arm **26**C.

Therefore, when the swing arm **26**C of the driven rotation member **26** is facing downward and the driven rotation member **26** is at a preset standby position, the sensor **27** detects the detected piece **26**D at the lower end of the swing arm **26**C.

FIGS. **8**A and **8**B are a side view showing the first link member **24**, the paper detection member **25**, the driven rotation member **26**, the sensor **27**, and the second link member **28** in a state in which each switching guide **18** is moved to the first transport position HS**1** and the recording paper is being transported through the first transport path **8** and a side view schematically showing the first link member **24**, the paper detection member **25**, the driven rotation member **26**, the sensor **27**, and the second link member **28** in the state. Moreover, FIG. **9** is a side view showing the first link member **24**, the paper detection member **25**, the driven rotation member **26**, the sensor **27**, and the second link member **28** seen from the back side in the same state as FIGS. **8**A and **8**B.

A state in which the solenoid **34** is deactivated is maintained as shown in FIG. **4**A and each switching guide **18** is positioned at the first transport position HS**1** as shown in FIGS. **8**A, **8**B, and **9**.

When the recording paper P is transported through the first transport path **8**, the tip of the paper detection member **25** is pushed up in contact with the recording paper P, the paper detection member **25** rotates in the clockwise direction around the shaft **22**, and the second link member **28** also rotates in the clockwise direction. At this time, the sliding contact surface **28**A of the second link member **28** pushes away the bent inclined surface **26**F of the contact arm **26**B of the driven rotation member **26** in a right direction, the driven rotation member **26** rotates in the clockwise direction around the shaft **23**, and the detected piece **26**D of the swing arm **26**C of the driven rotation member **26** is removed from a detection position of the sensor **27**.

Therefore, in the state in which the recording paper P is transported through the first transport path **8**, the driven rotation member **26** is at a position outside the standby position and the sensor **27** does not detect the detected piece **26**D at the lower end of the swing arm **26**C.

FIGS. **10**A and **10**B are a side view showing the first link member **24**, the paper detection member **25**, the driven rotation member **26**, the sensor **27**, and the second link member **28** in a state in which each switching guide **18** is moved from the first transport position HS**1** to the second transport position HS**2** and a side view schematically showing the first link member **24**, the paper detection member **25**, the driven rotation member **26**, the sensor **27**, and the second link member **28** in the state.

When the solenoid **34** is activated as shown in FIG. **4**B, each switching guide **18** and the first link member **24** rotate in the counterclockwise direction around the shaft **21** and each switching guide **18** is positioned at the second transport position HS**2** as shown in FIGS. **10**A and **10**B.

When the first link member **24** rotates in the counterclockwise direction, the sliding contact surface **24**A of the first link member **24** pushes away the smooth surface **26**E of the contact arm **26**B of the driven rotation member **26** in the right direction, the driven rotation member **26** rotates in the clockwise direction around the shaft **23**, and the detected piece **26**D of the swing arm **26**C of the driven rotation member **26** is removed from a detection position of the sensor **27**.

Therefore, in a state in which each switching guide **18** is moved from the first transport position HS**1** to the second transport position HS**2**, the driven rotation member **26** is at a position outside the standby position and the sensor **27** does not detect the detected piece **26**D at the lower end of the swing arm **26**C.

That is, as shown in FIGS. **7**A and **7**B, in a state in which each switching guide **18** is moved to the first transport position HS**1** and the recording paper is not transported through the first transport path **8**, the driven rotation member **26** is at the standby position and the sensor **27** detects the detected piece **26**D at the lower end of the swing arm **26**C. Moreover, in a state in which each switching guide **18** is moved to the first transport position HS**1** and the recording paper is transported through the first transport path **8** as shown in FIGS. **8**A, **8**B, and **9** and a state in which each switching guide **18** is moved to the second transport position HS**2** as shown in FIGS. **10**A and **10**B, the driven rotation member **26** is at a position outside the standby position and the sensor **27** does not detect the detected piece **26**D at the lower end of the swing arm **26**C.

FIG. **11** is a block diagram schematically showing a configuration of a control system of the paper transport apparatus **20**. As shown in FIG. **11**, the paper transport apparatus **20** includes a transport device **41** configured to transport the recording paper P through the first transport path **8** or the second transport path **9**, the solenoid **34**, the sensor **27**, a display device **43**, and a controller **44**.

The transport device **41** includes a motor, a clutch, and the like for rotating each transport roller in the first transport path **8**, each transport roller in the second transport path **9**, the ejection roller **16**, and the like and transports the recording paper P through the first transport path **8** or the second transport path **9**. As shown in FIGS. **4**A and **4**B, the solenoid **34** rotates each switching guide **18** and the first link member **24** in the counterclockwise or clockwise direction around the shaft **21** and positions each switching guide **18** at the first transport position HS**1** or the second transport position HS**2**. The sensor **27** detects the detected piece **26**D at the lower end of the swing arm **26**C of the driven rotation member **26** and a detection output of the sensor **27** indicates that the driven rotation member **26** is at a standby position or a position outside the standby position.

The controller **44** controls the transport device **41** so that the recording paper P is transported through the first transport path **8** or the second transport path **9**, activates or deactivates the solenoid **34** to switch each switching guide **18** to the first transport position HS**1** or the second transport

position HS2, and further determines that the driven rotation member **26** is at a standby position or a position outside the standby position on the basis of the detection output of the sensor **27**.

Here, in order to appropriately control the recording paper transport operation of the paper transport apparatus **20**, it is necessary to detect the presence or absence of recording paper being transported through the first transport path **8** and to detect that each switching guide **18** has been moved from the first transport position HS1 to the second transport position HS2 according to the activation of the solenoid **34**. However, if a sensor for detecting the presence or absence of the recording paper and a sensor for detecting the second transport position HS2 of each switching guide **18** are provided separately, the cost increases.

Therefore, in the paper transport apparatus **20** of the present embodiment, while only the sensor **27** is provided, it is possible to determine both the presence or absence of recording paper and the second transport position HS2 of each switching guide **18**.

Next, a control procedure for determining the presence or absence of recording paper P being transported through the first transport path **8** and the second transport position HS2 of each switching guide **18** will be described with reference to the flowchart shown in FIG. **12**.

The controller **44** deactivates the solenoid **34** as shown in FIGS. **4**A, moves each switching guide **18** to the first transport position HS1 as shown in FIGS. **7**A and **7**B (S**101**), determines that the driven rotation member **26** is at the standby position on the basis of the detection output of the sensor **27** (S**102**), and controls the transport device **41** so that the transport device **41** starts the transportation of the recording paper P (S**103**).

As shown in FIGS. **8**A, **8**B, and **9**, when the recording paper P is transported through the first transport path **8**, the tip of the paper detection member **25** is pushed up in contact with the recording paper P, the second link member **28** rotates in the clockwise direction with the paper detection member **25**, the sliding contact surface **28**A of the second link member **28** pushes away the bent inclined surface **26**F of the contact arm **26**B of the driven rotation member **26** in the right direction, the driven rotation member **26** rotates in the clockwise direction, and the swing arm **26**C of the driven rotation member **26** is removed from a detection position of the sensor **27**.

The controller **44** determines that the driven rotation member **26** is not outside of the standby position on the basis of the detection output of the sensor **27** before the recording paper P reaches the tip of the paper detection member **25** ("No" in S**104**), determines that the recording paper P is being transported through the first transport path **8** (S**105**) if the recording paper P reaches the tip of the paper detection member **25** and the driven rotation member **26** moves to a position outside the standby position ("Yes" in S**104**), starts the measurement of the elapsed time T (S**106**), determines whether or not the elapsed time T is greater than or equal to a prescribed time t (S**107**), and determines whether or not the driven rotation member **26** has returned to the standby position on the basis of the detection output of the sensor **27** (S**108**).

The prescribed time t is a period from the time when the tip of the paper detection member **25** is pushed up in contact with the recording paper P to the time when it returns to an original position (the time when the recording paper P passes through the position of the tip of the paper detection member **25**) and is obtained in advance on the basis of the length of the recording paper P and the transport speed of the recording paper P.

For example, when the controller **44** determines that the driven rotation member **26** has returned to the standby position on the basis of the detection output of the sensor **27** ("Yes" in S**108**) before the elapsed time T is greater than or equal to the prescribed time t ("No" in S**107**), the recording paper P is normally transported, the rear end of the recording paper P passes through the position of the tip of the paper detection member **25**, and the tip of the paper detection member **25** returns to its original position as shown in FIGS. **7**A and **7**B, such that it is determined whether or not there is printing on the back side of the recording paper P (S**109**) and it returns to the process from S**103** when it is determined that there is no printing on the back side of the recording paper P ("No" in S**109**).

Moreover, when the controller **44** determines that the driven rotation member **26** has not returned to the standby position ("No" in S**108**) and the elapsed time T is greater than or equal to the prescribed time t ("Yes" in S**107**), because the recording paper P is not transported normally, the rear end of the recording paper P does not pass through the position of the tip of the paper detection member **25**, and there is a possibility that a jam will occur, the paper transport apparatus **20** is stopped and a message indicating the occurrence of the jam is displayed on the display device **43** (S**110**) and the control procedure shown in FIG. **12** ends.

Moreover, when it is determined that there is printing on the back side of the recording paper P ("Yes" in S**109**), the controller **44** controls the transport device **41** and stops the ejection roller **16** after a preset first time from a point in time when the driven rotation member **26** returns to the standby position on the basis of the detection output of the sensor **27**, i.e., a point in time when the rear end of the recording paper P passes through the position of the tip of the paper detection member **25** (S**111**). Also, as shown in FIGS. **4**B, the controller **44** activates the solenoid **34** to move each switching guide **18** to the second transport position HS2 as shown in FIGS. **10**A and **10**B (S**112**).

At this time, the first link member **24** rotates in the counterclockwise direction with each switching guide **18**, the sliding contact surface **24**A of the first link member **24** pushes away the smooth surface **26**E of the contact arm **26**B of the driven rotation member **26** in the right direction, the driven rotation member **26** rotates in the clockwise direction, and the detected piece **26**D of the swing arm **26**C of the driven rotation member **26** is removed from the detection position of the sensor **27**.

If the controller **44** waits for the driven rotation member **26** to move to a position outside the standby position on the basis of the detection output of the sensor **27** ("No" in S**113**) simultaneously with the time when the solenoid **34** is activated and the driven rotation member **26** moves to a position outside the standby position ("Yes" in S**113**), each switching guide **18** is moved from the first transport position HS1 to the second transport position HS2, such that it is determined that each switching guide **18** has been moved from the first transport position HS1 to the second transport position HS2, the transport device **41** is controlled to reversely rotate the ejection roller **16** (S**114**), and the recording paper P is guided from the ejection roller **16** to the second transport path **9**. Thereby, the recording paper P is transported in the switchback transport.

When a predetermined second time has elapsed after the reverse rotation of the ejection roller **16**, the controller **44** stops the ejection roller **16**, deactivates the solenoid **34**

again, and moves each switching guide **18** from the second transport position HS**2** to the first transport position HS**1** as shown in FIGS. **7**A and **7**B (S**115**), confirms that the driven rotation member **26** is at a standby position on the basis of the detection output of the sensor **27**, and returns to the process from S**103**.

As described above, in the present embodiment, the first link member **24**, the paper detection member **25**, the driven rotation member **26**, the sensor **27**, the second link member **28**, and the like are used to determine the presence or absence of recording paper being transported through the first transport path **8** and the second transport position HS**2** of each switching guide **18**, it is possible to implement cost reduction without increasing the number of sensors.

On the other hand, in the case of a general paper transport apparatus other than the present embodiment, in a configuration in which a plurality of transport paths are provided and the transport path along which the paper is transported is switched by the branch pawl, it is necessary to detect the recording paper being transported through the transport path, the position the branch pawl, and the like and a configuration necessary for this detection is complex. For example, the number of motors, the number of solenoids, and the number of sensors increase and hence the cost also increases.

According to the present embodiment, in a mechanism for switching the paper transport direction, a constituent element for detecting the recording paper being transported through the transport path, the position of the branch pawl, and the like can be implemented with a simpler configuration.

Furthermore, the configuration and process of the above-described embodiment described with reference to FIGS. **1** to **12** are only one embodiment of the present disclosure and the present disclosure is not limited to the configuration and process.

While the present disclosure has been described in detail with reference to the embodiments thereof, it would be apparent to those skilled in the art that the various changes and modifications may be made therein within the scope defined by the appended claims.

What is claimed is:

1. A paper transport apparatus comprising:

a first transport path configured to guide paper;

a roller configured to transport the paper guided through the first transport path;

a second transport path configured to guide the paper transported in a direction opposite to a transport direction on the first transport path according to reverse rotation of the roller;

a switching guide rotationally supported according to a first shaft parallel to the roller and rotated back and forth around the first shaft to switch a transport direction of the paper by moving to either a first transport position for guiding the paper guided through the first transport path to the roller or a second transport position for guiding the paper transported in the opposite direction according to the reverse rotation of the roller to the second transport path;

a first link member rotatably supported by the first shaft and configured to protrude in a direction perpendicular to the first shaft and rotate back and forth integrally with the switching guide around the first shaft;

a paper detection member rotatably supported by a second shaft parallel to the first shaft, protruding toward the first transport path, and configured to rotate around the second shaft and retreat from the first transport path when the paper detection member comes into contact with the paper transported through the first transport path;

a second link member rotatably supported by the second shaft and configured to rotate integrally with the paper detection member around the second shaft when the paper detection member retreats from the first transport path;

a driven rotation member rotatably supported by a third shaft parallel to the first shaft, pressed and rotated by the first link member when the switching guide is switched to the second transport position and the first link member rotates, and pressed and rotated by the second link member when the paper detection member retreats from the first transport path and the second link member rotates;

a sensor configured to detect a standby position of the driven rotation member when the driven rotation member is not pressed by either the first link member or the second link member;

a drive device configured to rotate the switching guide back and forth around the first shaft and switch the switching guide to either the first transport position or the second transport position; and

a controller configured to determine that the paper is being transported through the first transport path when the paper detection member retreats in contact with the paper transported through the first transport path in a state in which the switching guide is switched to the first transport position by controlling the drive device, the second link member rotates, the driven rotation member is pressed and rotated by the second link member, and the standby position of the driven rotation member is not detected by the sensor and determine that the switching guide has been switched from the first transport position to the second transport position when the first link member rotates with the switching guide after the switching guide is switched to the second transport position by controlling the drive device, the driven rotation member is pressed and rotated by the first link member, and the standby position of the driven rotation member is not detected by the sensor.

2. The paper transport apparatus according to claim **1**, wherein the controller switches the switching guide to the second transport position by controlling the drive device if it is determined that there is printing on a back side of the paper when the paper detection member retreats in contact with the paper transported through the first transport path in the state in which the switching guide is switched to the first transport position by controlling the drive device, the second link member rotates, the driven rotation member is pressed and rotated by the second link member, and a state in which the standby position of the driven rotation member is not detected by the sensor ends in less than a prescribed time.

3. The paper transport apparatus according to claim **1**, wherein the controller determines that a jam has occurred when the paper detection member retreats in contact with the paper transported through the first transport path in the state in which the switching guide is switched to the first transport position by controlling the drive device, the second link member rotates, the driven rotation member is pressed and rotated by the second link member, and a state in which the standby position of the driven rotation member is not detected by the sensor continues for a prescribed time or longer.

4. The paper transport apparatus according to claim 3, wherein the controller calculates the prescribed time on the basis of a length of the paper in a transport direction and a transport speed of the paper.

5. An image forming apparatus comprising:

the paper transport apparatus according to claim 1; and

an image forming device configured to form an image on the paper transported by the paper transport apparatus.

* * * * *