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Naito et al.

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(54) **PAPER TRANSPORT DEVICE**

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B65H 29/24	(2006.01)
G03G 15/00	(2006.01)

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(58) **Field of Classification Search**

CPC B65H 5/224; B65H 29/125; B65H 29/242; B65H 29/70; B65H 2301/5121; B65H 2406/32; B65H 2406/322; B65H 2406/3222; B65H 2406/362; B65H 2406/363; B65H 2406/3632; B65H 2511/12; B65H 2511/528; B65H 2601/255; G03G 15/657

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,815,303	B1 *	11/2017	Herrmann	B41J 11/0085
2010/0025918	A1 *	2/2010	Miyazawa	G03G 15/657 271/98
2010/0061741	A1 *	3/2010	Minbu	G03G 15/657 399/21

(Continued)

FOREIGN PATENT DOCUMENTS

JP	2001316011	11/2001

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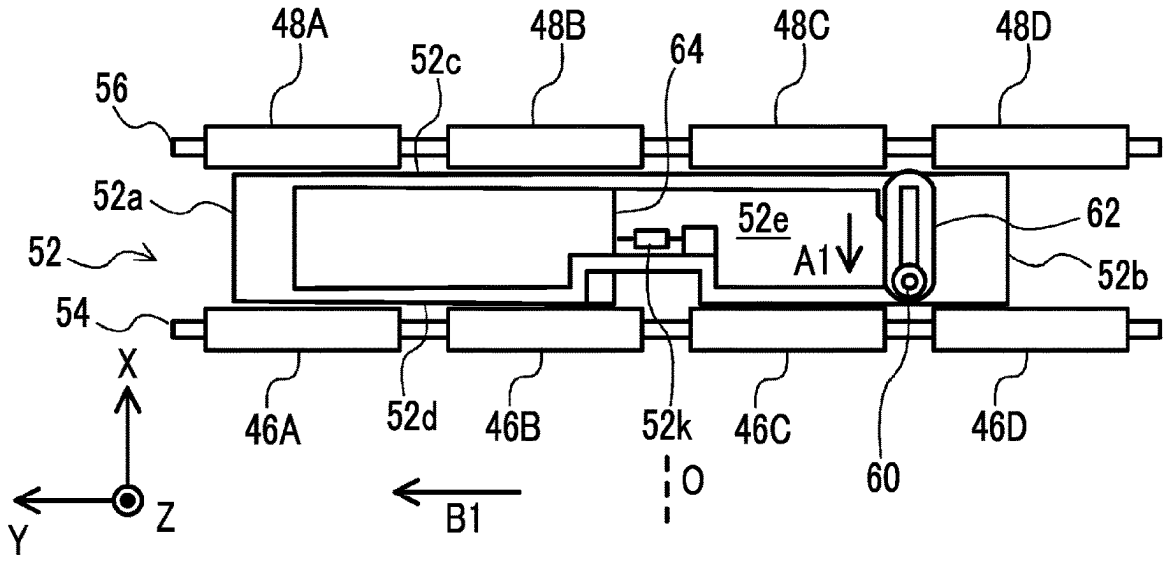
(57) **ABSTRACT**

A paper transport device includes a transport mechanism that transports paper to which an image is transferred to a fixing device while sucking the paper and a switching mechanism that switches between suction regions in a width direction of the transport mechanism, which corresponds to a width direction of the paper, according to a size of the paper.

11 Claims, 7 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

2010/0276879	A1*	11/2010	Bober	B65H 5/224 271/276
2010/0314828	A1*	12/2010	Hoover	B65H 5/224 271/264
2013/0164065	A1*	6/2013	Kosuga	G03G 15/657 399/400
2015/0259144	A1*	9/2015	Hershfeld	B41F 17/24 198/689.1

* cited by examiner

FIG. 1

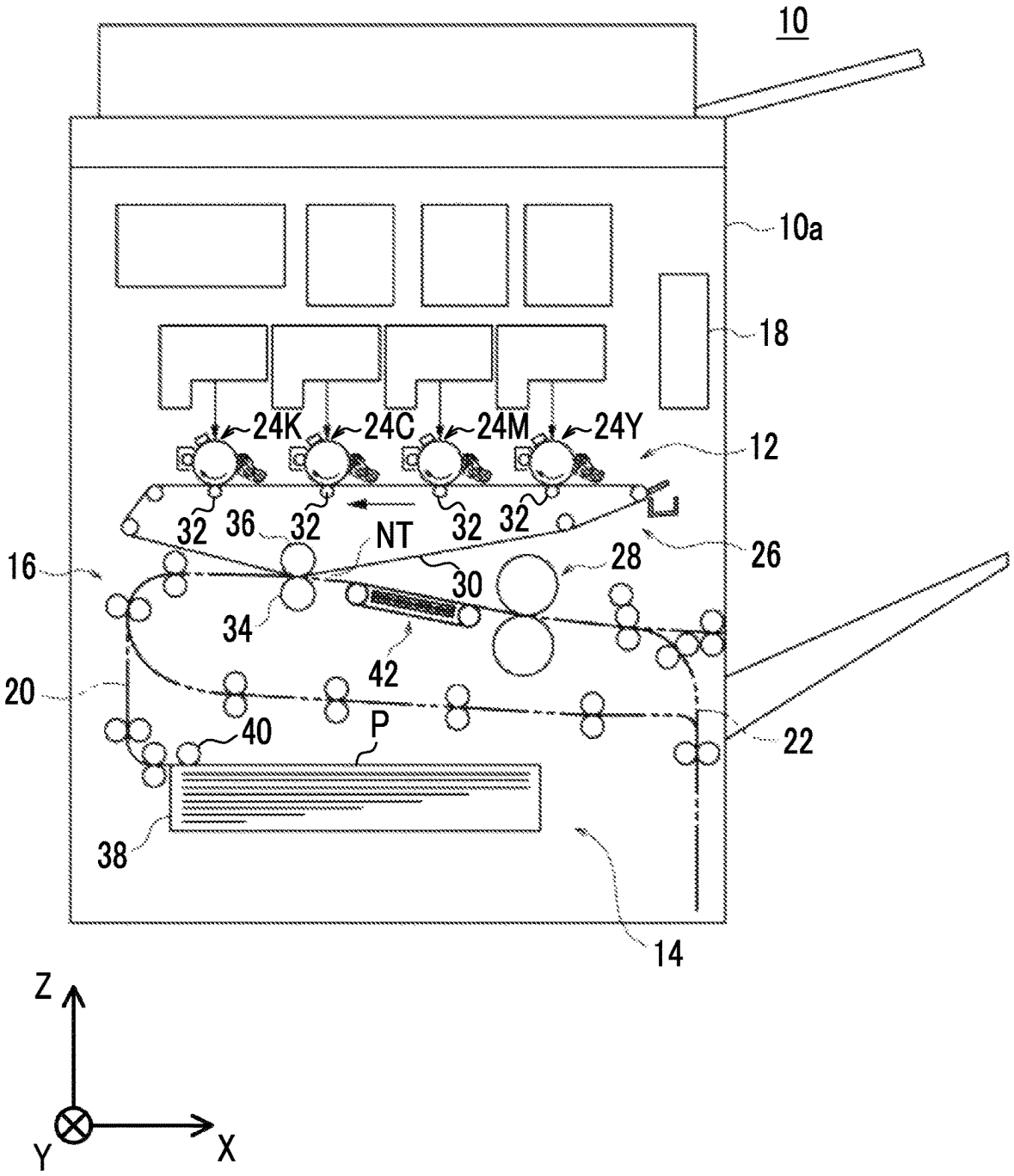

10
10a
18
24K
24C
24M
24Y
12
32
36
32
NT
32
32
26
16
28
30
34
42
20
40
P
22
38
14
Z
Y
X

FIG. 2

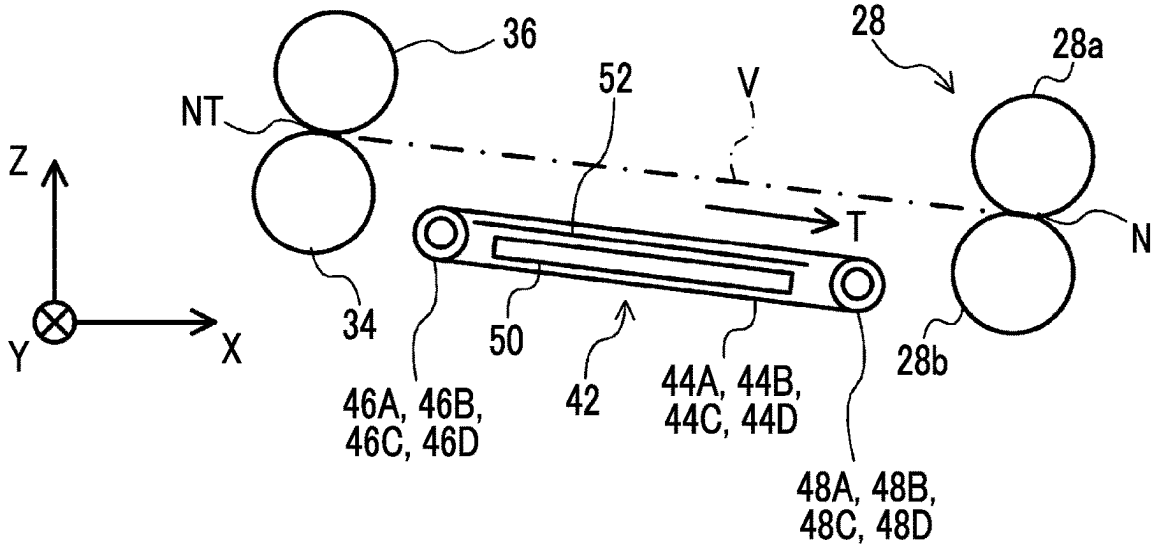

36
28
28a
52
V
NT
Z
T
N
Y
X
34
50
28b
46A, 46B,
46C, 46D
42
44A, 44B,
44C, 44D
48A, 48B,
48C, 48D

FIG. 3

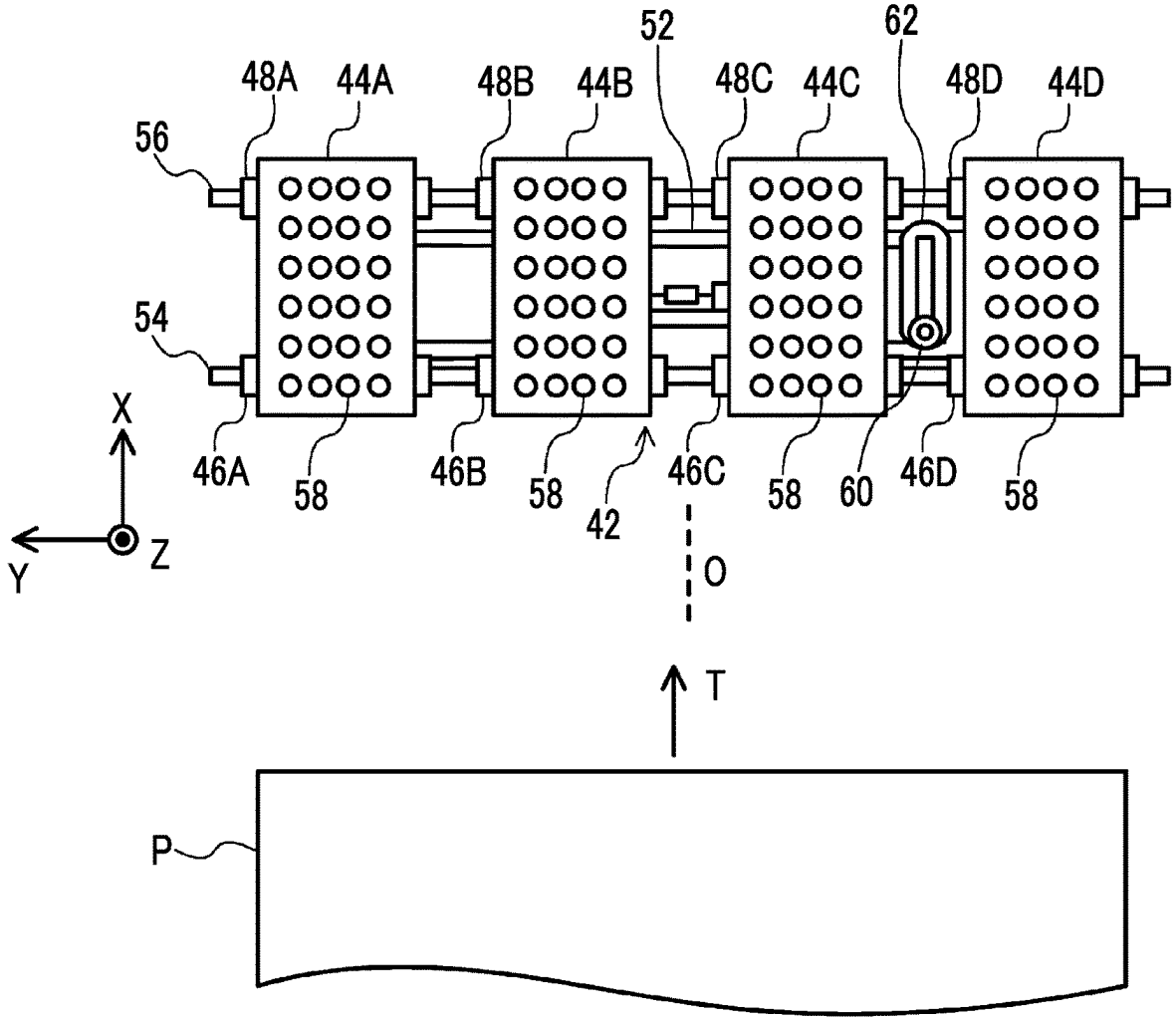

52
62
48A
44A
48B
44B
48C
44C
48D
44D
56
54
X
46A
58
46B
58
42
46C
58
60
46D
58
Y
Z
O
T
P

FIG. 4

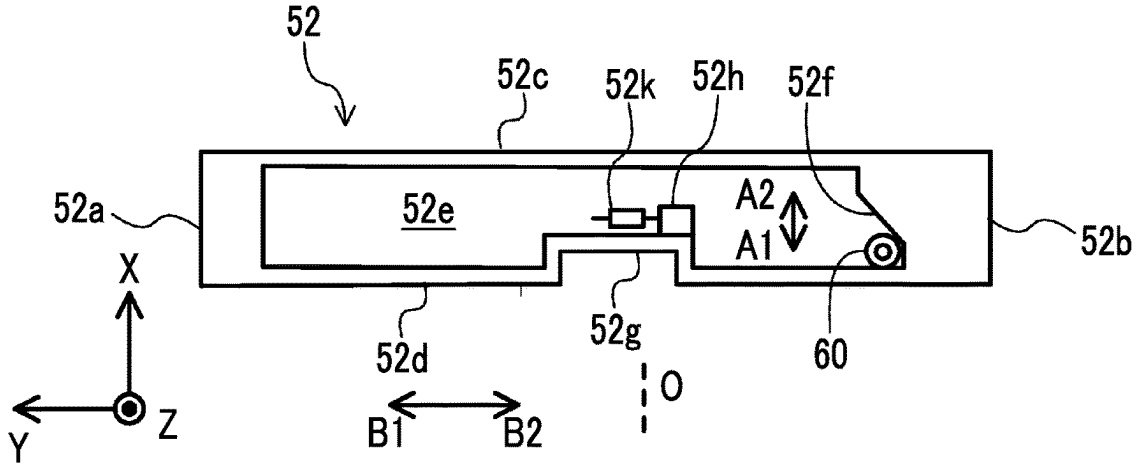
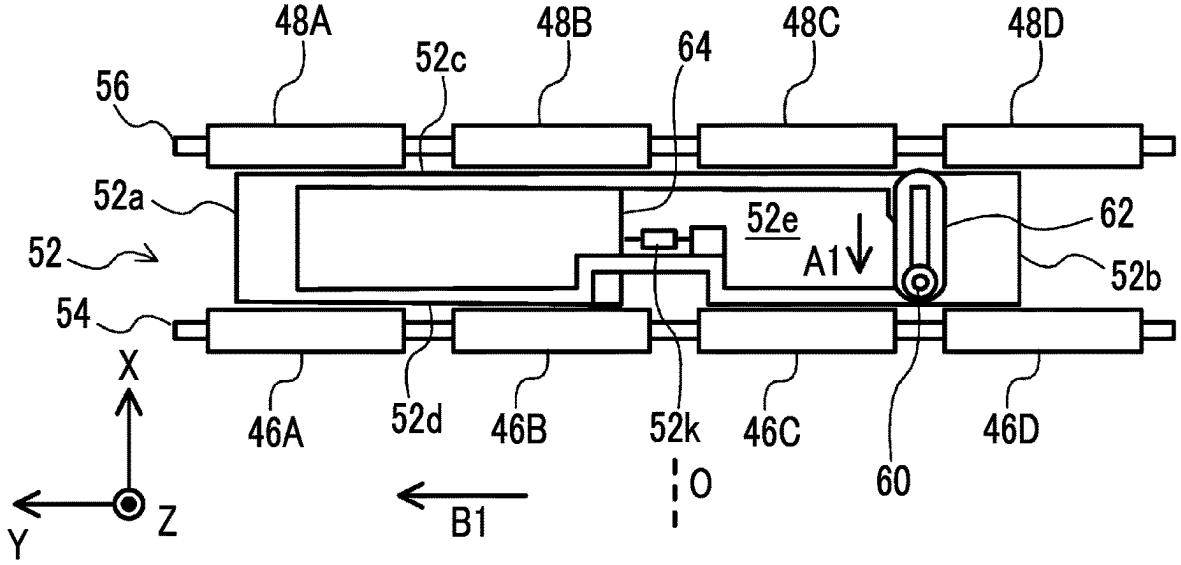

52
52c
52k
52h
52f
52a
52e
A2
A1
52b
X
52d
52g
60
O
Z
Y
B1
B2

FIG. 5


48A
52c
48B
64
48C
48D
56
52a
52e
62
52
A1
52b
54
X
46A
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46C
46D
60
O
Z
Y
B1

FIG. 6

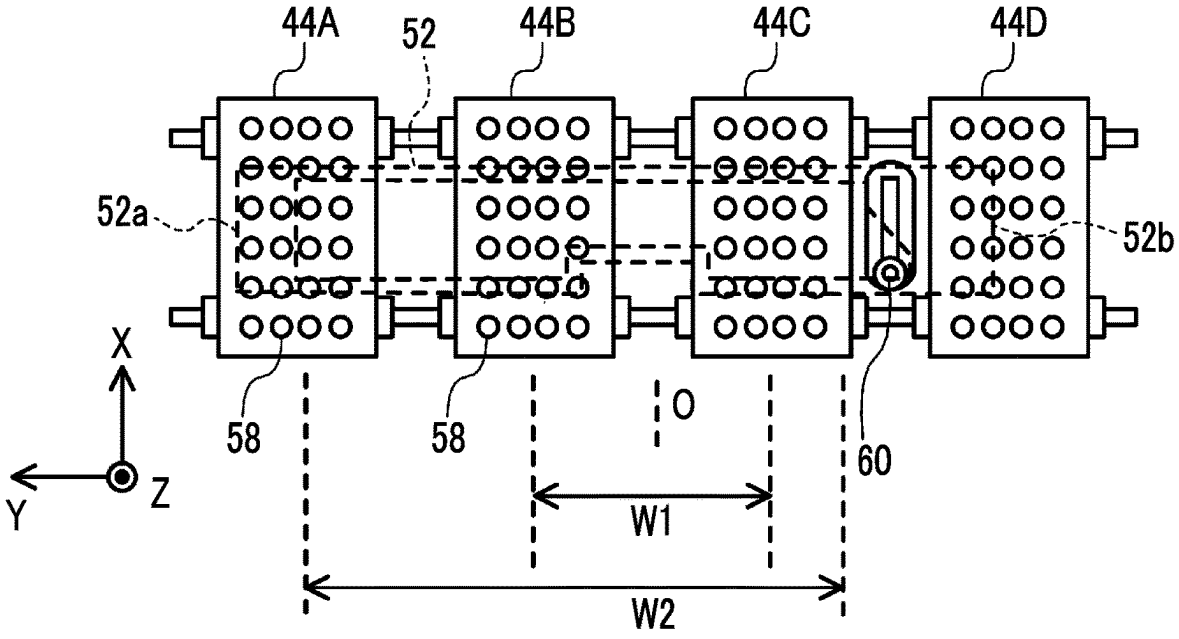

44A
52
44B
44C
44D
52a
52b
X
Y
Z
58
58
O
60
W1
W2

FIG. 7

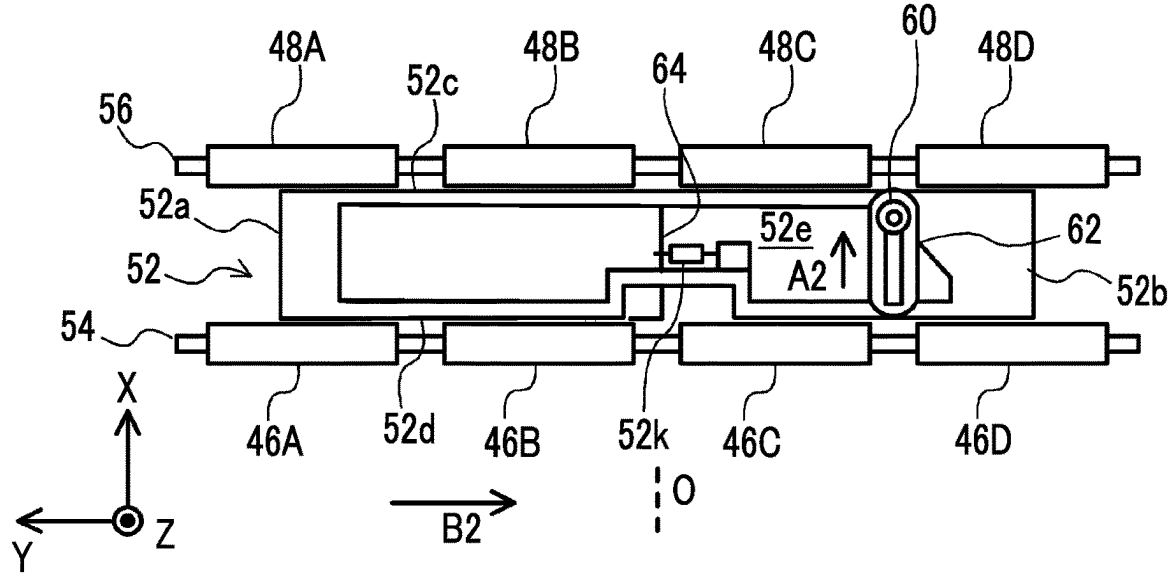

48A
52c
48B
64
48C
60
48D
56
52a
52e
A2
62
52
52b
54
X
Y
Z
46A
52d
46B
52k
46C
46D
O
B2

FIG. 8

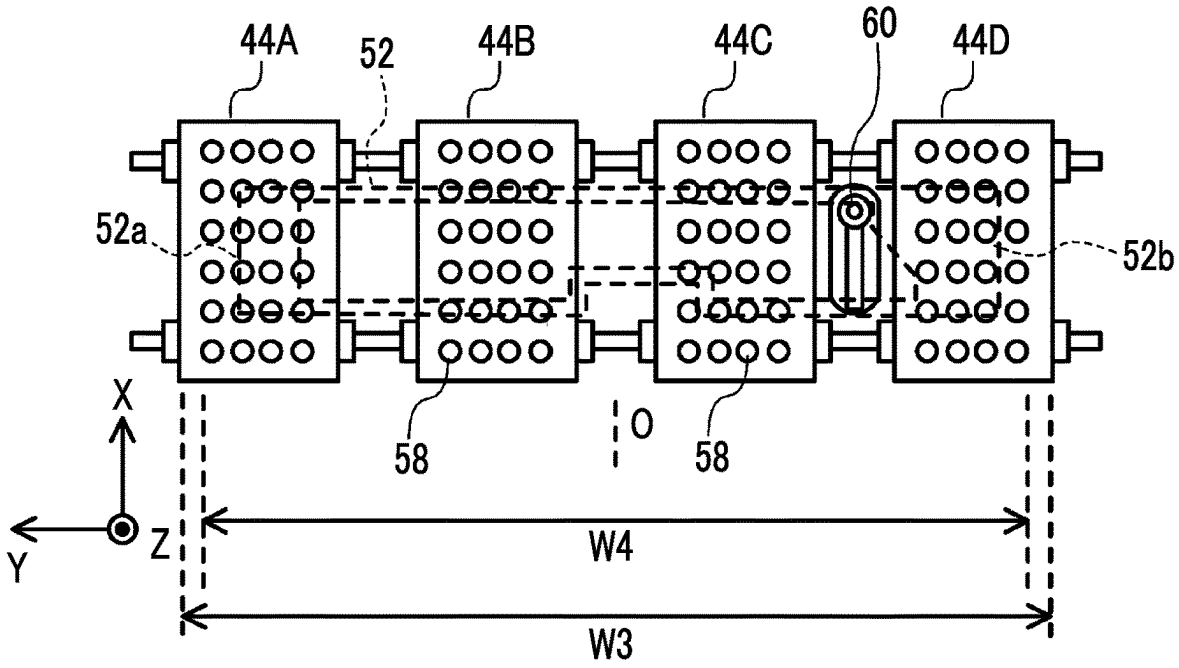


FIG. 9

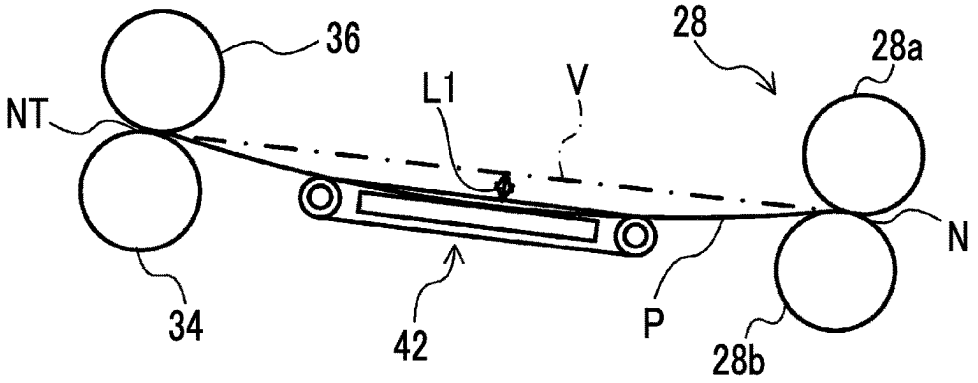


FIG. 10

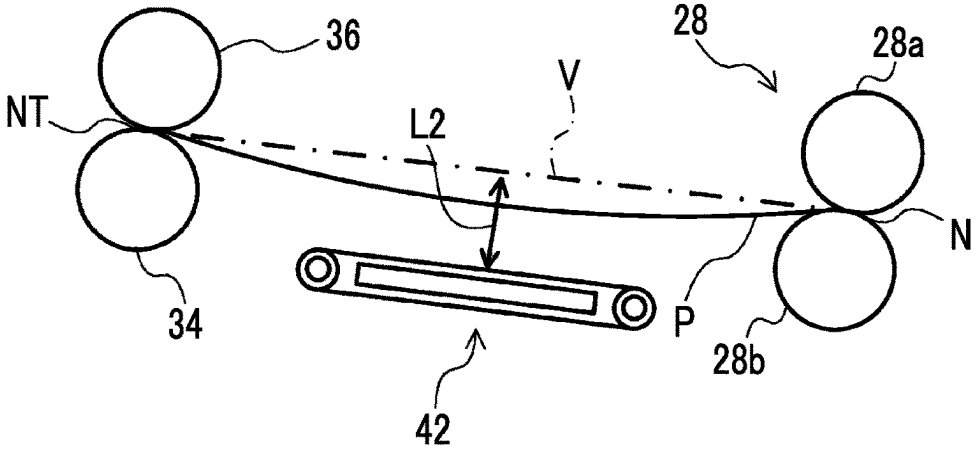


FIG. 11

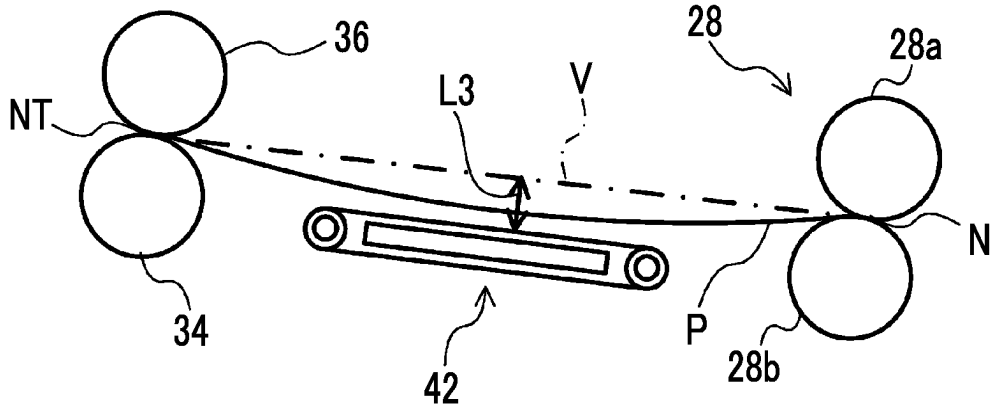


FIG. 12

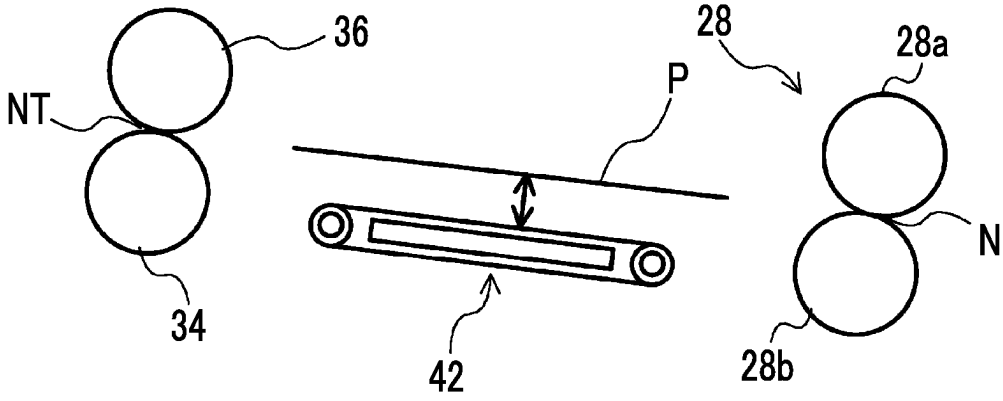
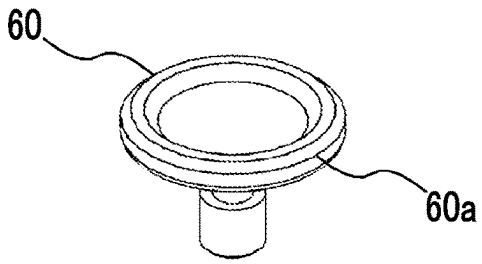


FIG. 13

DISTANCE L	BENDING REGION	SUCTION FORCE INCREASE	SUCTION AREA	RUNNABILITY	
				LONG PAPER	SHORT PAPER
4 mm OR LESS	× (INSUFFICIENT)	NOT NECESSARY (DEFAULT)	DEFAULT	×	○
4 TO 8 mm	△	NECESSARY (20 TO 50%)	70 TO 90%	△	○
8 TO 14 mm	○	NECESSARY (50 TO 90%)	50 TO 70%	○	○
14 mm OR MORE	○	– (TRANSPORT IMPOSSIBLE)	– (TRANSPORT IMPOSSIBLE)	○	×

FIG. 14



PAPER TRANSPORT DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2021-197046 filed Dec. 3, 2021.

BACKGROUND

(i) Technical Field

The present invention relates to a paper transport device.

(ii) Related Art

A device that transports paper in an image forming apparatus is known.

JP2001-316011A describes a mechanism that changes a region where a sticking force acts on the paper transported by a paper transport belt to have a width substantially the same as a paper width in a direction orthogonal to a transport direction of the paper.

SUMMARY

However, in a device that transports paper to which an image is transferred to a fixing device while sucking the paper, in a case where a suction region in a width direction of the paper is constant regardless of the size of the paper, a paper jam or a positional shift occurs during transport or a paper wrinkle occurs according to the size of the paper in some cases.

Aspects of non-limiting embodiments of the present disclosure relate to a paper transport device that suppresses the occurrence of a transport failure in a case where paper to which an image is transferred is transported to a fixing device while being sucked, compared to a case where a suction region is kept constant in a width direction of the paper regardless of the size of the paper.

Aspects of certain non-limiting embodiments of the present disclosure overcome the above disadvantages and/or other disadvantages not described above. However, aspects of the non-limiting embodiments are not required to overcome the disadvantages described above, and aspects of the non-limiting embodiments of the present disclosure may not overcome any of the disadvantages described above.

According to an aspect of the present disclosure, there is provided a paper transport device including a transport mechanism that transports paper to which an image is transferred to a fixing device while sucking the paper and a switching mechanism that switches between suction regions in a width direction of the transport mechanism, which corresponds to a width direction of the paper, according to a size of the paper.

BRIEF DESCRIPTION OF THE DRAWINGS

Exemplary embodiment(s) of the present invention will be described in detail based on the following figures, wherein:

FIG. **1** is a view showing an image forming apparatus according to an exemplary embodiment;

FIG. **2** is a view showing a secondary transfer portion, a fixing device, and a paper transport device;

FIG. **3** is a view showing the paper transport device;

FIG. **4** is a view showing a shutter;

FIG. **5** is a view showing a configuration of the paper transport device and a configuration excluding a transport belt;

FIG. **6** is a view showing the paper transport device;

FIG. **7** is a view showing a configuration of the paper transport device and a configuration excluding the transport belt;

FIG. **8** is a view showing the paper transport device;

FIG. **9** is a view showing the secondary transfer portion, the fixing device, and the paper transport device;

FIG. **10** is a view showing the secondary transfer portion, the fixing device, and the paper transport device;

FIG. **11** is a view showing the secondary transfer portion, the fixing device, and the paper transport device;

FIG. **12** is a view showing the secondary transfer portion, the fixing device, and the paper transport device;

FIG. **13** is a view showing a result of transport according to a distance between an imaginary line and the paper transport device; and

FIG. **14** is a perspective view showing a knob.

DETAILED DESCRIPTION

An image forming apparatus according to an exemplary embodiment will be described with reference to FIG. **1**. For convenience of description, an X-direction, a Y-direction, and a Z-direction, which are orthogonal to each other, are defined. The X-direction and the Y-direction are horizontal directions, and the Z-direction is a vertical direction. For example, the X-direction corresponds to a width direction of an image forming apparatus **10**, the Y-direction corresponds to a depth direction of the image forming apparatus **10**, and the Z-direction corresponds to a height direction of the image forming apparatus **10**. The name of each of the width direction, the depth direction, and the height direction of the image forming apparatus **10** is given for convenience of description, and does not limit the significance of each direction of the image forming apparatus **10**.

The image forming apparatus **10** includes an image forming unit **12**, an accommodating unit **14**, a transport unit **16**, and a control device **18**.

The image forming unit **12** forms a toner image, for example, through an electrophotographic method. The accommodating unit **14** accommodates paper P which is an example of a recording medium. The transport unit **16** transports the paper P accommodated in the accommodating unit **14** toward the image forming unit **12** along a transport path **20**. In addition, the transport unit **16** transports the paper P transported along the transport path **20** along an inversion path **22** to invert the front and back of the paper P and again transports the paper toward the image forming unit **12**.

The toner image formed by the image forming unit **12** is formed on the front surface of the paper P transported along the transport path **20**. The paper P on which the toner image is formed is discharged to the outside of a housing **10***a* of the image forming apparatus **10**.

In a case of forming a toner image on the back surface of the paper P, the paper P having the front surface on which the toner image is formed is transported along the inversion path **22**, and the toner image is again formed on the back surface of the paper P by the image forming unit **12**. After then, the paper P is discharged to the outside of the housing **10***a*. In the example shown in FIG. **1**, the image forming apparatus **10** has a function of forming toner images on both surfaces

of the paper P, but may have a function of forming a toner image only on one surface of the paper P.

The image forming unit **12** includes, for example, image forming units **24**Y, **24**M, **24**C, and **24**K, a transfer unit **26**, and a fixing device **28** and forms a toner image for each color. The image forming unit **24**Y forms a yellow (Y) toner image using a yellow (Y) toner. The image forming unit **24**M forms a magenta (M) toner image using a magenta (M) toner. The image forming unit **24**C forms a cyan (C) toner image using a cyan (C) toner. The image forming unit **24**K forms a black (K) toner image using a black (K) toner. The transfer unit **26** transfers the toner image formed by each of the image forming units **24**Y, **24**M, **24**C, and **24**K to the paper P. The fixing device **28** fixes the toner image transferred to the paper P by the transfer unit **26** to the paper P. Although four colors of toners are used in the example shown in FIG. **1**, this is merely an example, and five or more colors of toners may be used. For example, in addition to yellow, magenta, cyan, and black, other colors may be used. As another example, only a black toner may be used.

The image forming units **24**Y, **24**M, **24**C, and **24**K have basically the same configuration except for a toner to be used. For example, each of the image forming units **24**Y, **24**M, **24**C, and **24**K includes a rotating cylindrical image holding body, a charger that charges the image holding body, an exposure device, and a developing device. The exposure device irradiates the charged image holding body with light and forms an electrostatic latent image. The developing device develops the electrostatic latent image with a developer containing a toner as a toner image.

The transfer unit **26** includes a transfer belt **30**, a primary transfer roller **32**, a secondary transfer roller **34**, and a roller **36**. The transfer belt **30** is wound around a plurality of rollers including the roller **36** and moves around in a direction of an arrow in FIG. **1**. A secondary transfer portion NT (that is, a nip portion) where a toner image is transferred to the paper P is formed between the secondary transfer roller **34** and the transfer belt **30**.

The fixing device **28** is arranged on a downstream side of the secondary transfer portion NT in a transport direction of the paper P.

The accommodating unit **14** includes an accommodating member **38** and a feeding roller **40**. The accommodating member **38** accommodates the paper P. The feeding roller **40** feeds the paper P accommodated in the accommodating member **38** to the transport path **20**.

The transport unit **16** includes a plurality of transport rollers and a paper transport device **42**. The paper P fed from the accommodating unit **14** is transported along the transport path **20** by the plurality of transport rollers. The paper transport device **42** transports the paper P to which the toner image is transferred while sucking the paper and delivers the paper to the fixing device **28**.

The control device **18** controls each unit of the image forming apparatus **10**.

The image forming apparatus **10** forms an image on the paper P as described below.

First, in each of the image forming units **24**Y, **24**M, **24**C, and **24**K, an electrostatic latent image is formed as the surface of the image holding body is charged by the charger and the surface of the image holding body is exposed by the exposure device, and the electrostatic latent image is developed by the developing device. Accordingly, a toner image is formed on the surface of the image holding body. A toner image having each color is transferred to the transfer belt **30** by the primary transfer roller **32** in turn.

The paper P is fed from the accommodating member **38** to the transport path **20** by the feeding roller **40** and is fed to the secondary transfer portion NT along the transport path **20**. As the paper P is transported between the transfer belt **30** and the secondary transfer roller **34**, the toner image transferred to the transfer belt **30** is transferred to the front surface of the paper P at the secondary transfer portion NT.

The paper P to which the toner image is transferred is transported to the fixing device **28** by the paper transport device **42**. The toner image transferred to the front surface of the paper P is fixed to the paper P by the fixing device **28**. The paper P to which the toner image is fixed is discharged to the outside of the housing **10***a*.

In a case of forming a toner image also on the back surface of the paper P, the transport unit **16** inverts the front and back of the paper P by transporting the paper P, which has passed through the fixing device **28**, along the inversion path **22** and transports the paper P of which the front and back are inverted to the secondary transfer portion NT along the transport path **20**. The toner image is transferred to the back surface of the paper P at the secondary transfer portion NT and the toner image is fixed to the paper P by the fixing device **28**. The paper P to which the toner image is fixed is discharged to the outside from the housing **10***a*.

Hereinafter, the paper transport device **42** will be described with reference to FIGS. **2** and **3**. FIG. **2** shows the secondary transfer portion NT, the fixing device **28**, and the paper transport device **42**. FIG. **3** shows a configuration in a case where the paper transport device **42** is viewed from the Z-direction.

As shown in FIG. **2**, the paper transport device **42** is arranged on the downstream side of the secondary transfer portion NT and an upstream side of the fixing device **28** in the transport direction of the paper.

The fixing device **28** includes a fixing roller **28***a* and a pressurizing roller **28***b*. The fixing roller **28***a* and the pressurizing roller **28***b* are cylindrical rollers, are attached to rotating shafts having the Y-direction as an axial direction, and are rotatable. The fixing roller **28***a* is rotated by a motor (not shown). In addition, a heater such as a halogen lamp is built in the fixing roller **28***a* and heats the paper P. The pressurizing roller **28***b* is arranged at a position facing the fixing roller **28***a* with the transport path of the paper P placed therebetween. The pressurizing roller **28***b* is pressed against the fixing roller **28***a* by an elastic member such as a spring. Accordingly, the pressurizing roller **28***b* pressurizes the paper P toward the fixing roller **28***a*. A fixing portion N (that is, a nip portion) where a toner image is fixed to the paper P is formed between the fixing roller **28***a* and the pressurizing roller **28***b*. The paper P transported to the fixing portion N is heated by the fixing roller **28***a* and is pressurized toward the fixing roller **28***a* by the pressurizing roller **28***b*. Accordingly, the toner image is fixed to the paper P. A fixing belt wound around the fixing roller **28***a* may be used, the fixing portion N may be formed between the fixing belt and the pressurizing roller **28***b*, and the toner image may be fixed to the paper P. In addition, the fixing portion N may be formed between the fixing belt wound around a fixed-type fixing pad member and the pressurizing roller, and the toner image may be fixed to the paper P.

In the example shown in FIG. **2**, an imaginary line V is defined. The imaginary line V is a line connecting a position (that is, the secondary transfer portion NT) where a toner image is transferred to the paper P and a position (that is, the fixing portion N) where the toner image is fixed to the paper P by the fixing device **28** to each other.

The paper transport device **42** includes transport belts **44**A, **44**B, **44**C, and **44**D, support rollers **46**A, **46**B, **46**C, and **46**D, drive rollers **48**A, **48**B, **48**C, and **48**D, an intake unit **50**, and a shutter **52**.

The transport belts **44**A, **44**B, **44**C, and **44**D are belts for transporting the paper P. The transport belt **44**A is wound around the support roller **46**A and the drive roller **48**A. The transport belt **44**B is wound around the support roller **46**B and the drive roller **48**B. The transport belt **44**C is wound around the support roller **46**C and the drive roller **48**C. The transport belt **44**D is wound around the support roller **46**D and the drive roller **48**D.

The support rollers **46**A, **46**B, **46**C, and **46**D are cylindrical members having the Y-direction as an axial direction and are arranged on a secondary transfer portion NT side (that is, an upstream side) of the intake unit **50** with an interval in the Y-direction. In addition, the support rollers **46**A, **46**B, **46**C, and **46**D are attached to a rotating shaft **54** having the Y-direction as an axial direction. The rotating shaft **54** is supported by a bearing member (not shown) so as to be rotatable.

The drive rollers **48**A, **48**B, **48**C, and **48**D are cylindrical members having the Y-direction as an axial direction and are arranged on a fixing device **28** side (that is, the downstream side) of the intake unit **50** with an interval in the Y-direction. In addition, the drive rollers **48**A, **48**B, **48**C, and **48**D are attached to a rotating shaft **56** having the Y-direction as an axial direction. The rotating shaft **56** rotates as being supported by the bearing member (not shown) and being driven by the motor (not shown).

The support roller **46**A and the drive roller **48**A are arranged with the intake unit **50** placed therebetween in the transport direction of the paper P. The support roller **46**B and the drive roller **48**B are arranged with the intake unit **50** placed therebetween in the transport direction of the paper P. The support roller **46**C and the drive roller **48**C are arranged with the intake unit **50** placed therebetween in the transport direction of the paper P. The support roller **46**D and the drive roller **48**D are arranged with the intake unit **50** placed therebetween in the transport direction of the paper P.

The transport belts **44**A, **44**B, **44**C, and **44**D are, for example, endlessly formed belts (for example, belts made of silicone rubber). A plurality of holes **58** which have penetrated from an inner side to an outer side are formed in the transport belts **44**A, **44**B, **44**C, and **44**D.

The intake unit **50** takes in air on the inner side of the transport belts **44**A, **44**B, **44**C, and **44**D. For example, an intake fan is arranged inside the intake unit **50**. As the intake fan operates, the intake unit **50** takes in air above the transport belts **44**A, **44**B, **44**C, and **44**D. Accordingly, the paper P sticks to the transport belts **44**A, **44**B, **44**C, and **44**D.

In a case where the drive rollers **48**A, **48**B, **48**C, and **48**D are rotated as the rotating shaft **56** is rotated by the motor, the transport belts **44**A, **44**B, **44**C, and **44**D move around such that the paper P is transported from the secondary transfer portion NT to the fixing device **28**. In addition, as the intake unit **50** takes in air above the transport belts **44**A, **44**B, **44**C, and **44**D, the paper P is transported from the secondary transfer portion NT to the fixing device **28** while sticking to the transport belts **44**A, **44**B, **44**C, and **44**D. FIGS. **2** and **3** show a transport direction T of the paper P.

The transport belts **44**A, **44**B, **44**C, and **44**D and the intake unit **50** are examples of a transport mechanism.

The shutter **52** is arranged in a space between the support rollers **46**A, **46**B, **46**C, and **46**D and the drive rollers **48**A, **48**B, **48**C, and **48**D of a space between the transport belts **44**A, **44**B, **44**C, and **44**D and the intake unit **50**. The shutter **52** is a member that is movable in a width direction of the transport mechanism and is a member that switches between suction regions in the width direction of the transport mechanism by moving in the width direction, which is the transport direction. The shutter is an example of a switching mechanism.

The width direction of the transport mechanism is a width direction of the transport belts **44**A, **44**B, **44**C, and **44**D. The width direction of the transport mechanism matches, for example, axial directions (that is, a direction in which the support roller and the drive roller extend) of the rotating shafts **54** and **56** and matches a direction orthogonal to a direction in which the transport belts **44**A, **44**B, **44**C, and **44**D move around. In the example shown in FIG. **3**, the Y-direction is the width direction of the transport mechanism. The width direction of the transport mechanism corresponds to a width direction of the paper P. Herein, for example, the width direction of the paper P is defined as the width direction of the transport mechanism.

As shown in FIG. **3**, the paper transport device **42** further includes a knob **60** and a guide member **62**. The knob **60** is a member for operating the movement of the shutter **52** in the width direction of the transport mechanism. The knob **60** is a member that is movable between the rotating shaft **54** and the rotating shaft **56**. The guide member **62** is a member that is arranged between the rotating shaft **54** and the rotating shaft **56** and that guides the movement of the knob **60**. A groove is formed in the guide member **62** along a direction from the rotating shaft **54** toward the rotating shaft **56**, and the knob **60** is moved along the groove. The knob **60** is operated by an operator such as a user.

For example, the knob **60** and the guide member **62** are provided between the transport belt **44**C and the transport belt **44**D. That is, the knob **60** and the guide member **62** are provided on a transport mechanism end portion side with respect to a center O of the transport mechanism in the width direction. A top portion of the knob **60** is provided at a position lower than surfaces of the transport belts **44**A, **44**B, **44**C, and **44**D through which the paper P passes (that is, surfaces to which the paper P sticks). Accordingly, the knob **60** does not interfere with the transport of the paper P.

The center O of the transport mechanism in the width direction corresponds to a center in the width direction in a case where the transport belts **44**A, **44**B, **44**C, and **44**D are arranged in this order and specifically, corresponds to a center between the transport belt **44**B and the transport belt **44**C.

Since the knob **60** is arranged on the end portion side with respect to the center O, it is easy to operate the knob **60** from the end portion side (for example, a transport belt **44**D side) compared to a case where the knob **60** is arranged at the center O. For example, in a case where the transport belt **44**D is arranged on a front side of the image forming apparatus **10**, it is easy to operate the knob **60** from the front side compared to a case where the knob **60** is arranged at the center O. That is, as the knob **60** is arranged on the front side with respect to the center O, the knob **60** can be operated without extending a hand to a back side of the image forming apparatus **10** since a distance from the front side to the knob **60** is short compared to a case where the knob **60** is arranged at the center O.

Hereinafter, the shutter **52** will be described in detail with reference to FIGS. **4** and **5**. FIG. **4** shows the shutter **52**. FIG. **5** shows a configuration of the paper transport device **42** and a configuration excluding the transport belts **44**A, **44**B, **44**C, and **44**D.

The shutter **52** has a rectangular frame shape as a whole. Specifically, the shutter **52** includes short side members **52***a* and **52***b* and long side members **52***c* and **52***d*.

The short side members **52***a* and **52***b* are members facing each other. The short side members **52***a* and **52***b* are arranged along the direction from the rotating shaft **54** toward the rotating shaft **56** in the space between the support rollers **46**A, **46**B, **46**C, and **46**D and the drive rollers **48**A, **48**B, **48**C, and **48**D. The short side member **52***a* is arranged on a position side where the support roller **46**A and the drive roller **48**A are arranged with respect to the center O of the transport mechanism in the width direction, and the short side member **52***b* is arranged on a position side where the support roller **46**D and the drive roller **48**D are arranged with respect to the center O of the transport mechanism in the width direction.

The long side members **52***c* and **52***d* are members facing each other. The long side members **52***c* and **52***d* are arranged along the rotating shafts **54** and **56** in the space between the support rollers **46**A, **46**B, **46**C, and **46**D and the drive rollers **48**A, **48**B, **48**C, and **48**D. The long side member **52***c* is arranged on a rotating shaft **56** side, and the long side member **52***d* is arranged on a rotating shaft **54** side.

The short side members **52***a* and **52***b* are connected to each other by the long side members **52***c* and **52***d*. That is, an end portion of the short side member **52***a* on the rotating shaft **56** side is connected to one end of the long side member **52***c*, and an end portion of the short side member **52***b* on the rotating shaft **56** side is connected to the other end of the long side member **52***c*. In addition, an end portion of the short side member **52***a* on the rotating shaft **54** side is connected to one end of the long side member **52***d*, and an end portion of the short side member **52***b* on the rotating shaft **54** side is connected to the other end of the long side member **52***d*.

The shutter **52** may be one member obtained by integrating the short side members **52***a* and **52***b* and the long side members **52***c* and **52***d* with each other, and the shutter **52** may be formed by making the short side members **52***a* and **52***b* and the long side members **52***c* and **52***d* members separate from each other and assembling the short side members **52***a* and **52***b* and the long side members **52***c* and **52***d*.

A space **52***e* is a space surrounded by the short side members **52***a* and **52***b* and the long side members **52***c* and **52***d*. The intake unit **50** takes in air above the transport belts **44**A, **44**B, **44**C, and **44**D via the space **52***e*.

The short side members **52***a* and **52***b* function as members blocking intake by the intake unit **50**. That is, the intake unit **50** takes in air via the space **52***e*. However, at a place where the short side members **52***a* and **52***b* are arranged, the short side members **52***a* and **52***b* block intake by the intake unit **50**, and the intake unit **50** does not take in air above the transport belts **44**A, **44**B, **44**C, and **44**D. Thus, the paper P sticks to the transport belts **44**A, **44**B, **44**C, and **44**D due to the intake unit **50** at a place corresponding to the space **52***e*, but does not stick to the transport belts at the place where the short side members **52***a* and **52***b* are arranged.

A side **52***f* of the short side member **52***b* in contact with the space **52***e* is formed obliquely with respect to the direction from the rotating shaft **54** toward the rotating shaft **56**. For example, the side **52***f* is formed obliquely such that the width (that is, a length in a direction corresponding to the width direction of the transport mechanism) of the short side member **52***b* gradually increases from the rotating shaft **54** side to the rotating shaft **56** side. That is, from the long side member **52***d* to the long side member **52***c*, the side **52***f* is formed obliquely from a short side member **52***b* side to a short side member **52***a* side.

A portion of the side **52***f* on the rotating shaft **54** side and a portion of the side **52***f* on the rotating shaft **56** side are formed along the direction from the rotating shaft **54** toward the rotating shaft **56** such that the knob **60** is arranged. In the example shown in FIG. **4**, the knob **60** is arranged at the portion of the side **52***f* on the rotating shaft **54** side.

A portion **52***g* of the long side member **52***d*, which corresponds to the center O of the transport mechanism in the width direction, protrudes to a space **52***e* side. On the space **52***e* side of the protruding portion **52***g*, a support member **52***h* is provided. One end of a spring **52***k* is attached to the support member **52***h*. The spring **52***k* is provided along the width direction of the transport mechanism. As shown in FIG. **5**, the other end of the spring **52***k* is attached to a member **64**. The member **64** is arranged on the short side member **52***a* side of the spring **52***k*. The spring **52***k* applies a force acting in the width direction of the transport mechanism to the shutter **52**. The spring **52***k* is an example of the elastic member. Rubber may be used as an elastic member other than the spring **52***k*.

As described with reference to FIG. **3**, the knob **60** is a member movable along the guide member **62** between the rotating shaft **54** and the rotating shaft **56**. More specifically, the knob **60** is movable in an A1 direction or an A2 direction between the long side member **52***c* and the long side member **52***d* in the space **52***e*. The A1 direction is a direction toward the long side member **52***d*. The A2 direction is a direction toward the long side member **52***c*.

In response to the movement of the knob **60** in the A1 direction or the A2 direction, the shutter **52** is moved in the width direction of the transport mechanism.

Specifically, in a case where the knob **60** is moved in the A1 direction, the shutter **52** is moved to a transport belt **44**A side in the width direction of the transport mechanism. In the example shown in FIG. **4**, the shutter **52** is moved in a B1 direction. The spring **52***k* extends with the movement of the shutter **52**, and accordingly, an elastic force in a direction toward the transport belt **44**D (a B2 direction in FIG. **4**) is generated.

In addition, in a case where the knob **60** is moved in the A2 direction, the shutter **52** is moved to the transport belt **44**D side in the width direction of the transport mechanism. In the example shown in FIG. **4**, the shutter **52** is moved in the B2 direction. The spring **52***k* contracts with the movement of the shutter **52**, and accordingly, an elastic force in a direction toward the transport belt **44**A (the B1 direction in FIG. **4**) is generated.

Hereinafter, an operation of the shutter **52** will be described with reference to FIGS. **5** to **8**. FIGS. **6** and **8** are views showing the paper transport device **42**. FIG. **7** shows a configuration of the paper transport device **42** and a configuration excluding the transport belts **44**A, **44**B, **44**C, and **44**D. In FIGS. **6** and **8**, the shutter **52** is shown by a broken line.

In a case where the knob **60** is moved in the A1 direction, the shutter **52** is moved to the transport belt **44**A side, that is, in the B1 direction as shown in FIGS. **5** and **6**. Accordingly, at least the center O and a periphery thereof are defined as a region where intake is performed by the intake unit **50**. The suction region in a case where the shutter **52** is moved in the B1 direction is an example of a second suction region. As shown in FIG. **6**, a region having a width W2 in the width direction of the transport mechanism is the second suction region. In a region on the outer side of the second

suction region in the width direction, intake from the holes **58** is blocked by the short side members **52***a* and **52***b*. For example, intake from the holes **58** formed in the transport belt **44**A is blocked by the short side member **52***a*, and intake from the holes **58** formed in the transport belt **44**D is blocked by the short side member **52***b*. As a result of blocking the intake in the region on the outer side of the second suction region as described above, a suction force in the second suction region increases.

In a case where the knob **60** is moved in the A2 direction, the shutter **52** is moved to the transport belt **44**D side, that is, in the B2 direction as shown in FIGS. **7** and **8**. Accordingly, the center O, the periphery thereof, a region of the transport belt **44**A on the end portion side in the width direction and a region of the transport belt **44**D on the end portion side in the width direction are defined as a region where intake is performed by the intake unit **50**. That is, via not only the holes **58** formed in the center O and the periphery thereof but also the holes **58** formed on the outermost side of the transport belt **44**A in the width direction and the holes **58** formed on the outermost side of the transport belt **44**D in the width direction, air is taken in by the intake unit **50**. The suction region in a case where the shutter **52** is moved in the B2 direction is an example of a first suction region. As shown in FIG. **8**, a region having a width W4 in the width direction of the transport mechanism is the first suction region. That is, the first suction region is formed from the positions of the holes **58** formed on the outermost side of the transport belt **44**A in the width direction to the positions of the holes **58** formed on the outermost side of the transport belt **44**D in the width direction.

As described above, the shutter **52** has a function of switching regions where air is taken in by the intake unit **50** in the width direction of the transport mechanism. That is, the shutter **52** has a function of switching the regions where the paper P is sucked in the width direction of the transport mechanism.

For example, as the knob **60** is moved in the A1 direction or the A2 direction according to the size of the paper P, the first suction region and the second suction region are switched. The knob **60** functions as an operation unit for operating the shutter **52** and switching the suction regions.

For example, in a case where the paper P having a width W1 in the width direction of the transport mechanism is used as shown in FIG. **6**, the knob **60** is moved in the A1 direction as shown in FIG. **5**. Accordingly, as shown in FIGS. **5** and **6**, the shutter **52** is moved in the B1 direction, and as a result, the center O and the periphery thereof are defined as a region where air is taken in by the intake unit **50** (that is, the second suction region having the width W2).

The paper P having the width W1 passes through a region of the paper transport device **42** including the center O. For example, the paper P is transported by the transport belts **44**B and **44**C while being sucked via some of the plurality of holes **58** formed in the transport belts **44**B and **44**C.

As described above, a suction force in the second suction region increases since intake from the holes **58** is blocked by the short side members **52***a* and **52***b* in the region on the outer side of the second suction region in the width direction. Accordingly, the suction force with respect to the paper P increases, and a transport failure such as a paper jam attributable to a decrease in the suction force is prevented.

In addition, as shown in FIG. **6**, the width W2 of the second suction region is longer than the width W1 of the paper P, and the second suction region in the width direction of the transport mechanism is a region wider than the paper P. For this reason, the paper P is sucked including a region on the outer side of the end portion of the paper P in the width direction. That is, since the suction region having the width W2 larger than the width W1 of the paper P is formed, the entire paper P in the width direction is sucked, and a region on the outer side of the paper P in the width direction is also further sucked. In a case where the paper P having a small size is used like the paper P having the width W2, the temperature of the atmosphere rises in some cases. By sucking the region on the outer side of the end portion of the paper P in the width direction, a rise in the temperature of the atmosphere is suppressed.

For example, in a case where the postcard-sized paper P (for example, paper having a width of 100 mm and a length of 148 mm) is used, it is assumed that the knob **60** is moved in the A1 direction and the second suction region is set. Accordingly, in a case where the paper P having a relatively small size is used, a suction force with respect to the paper P is increased, and a transport failure is prevented. In a case where paper that has a narrow width, has a length in the transport direction T shorter than a distance between the secondary transfer portion NT and the fixing portion N, and is longer than the length of the paper transport device **42** in the transport direction T, like the postcard-sized paper P, a suction force with respect to the paper P weakens, and a transport failure such as a paper jam occurs in some cases when the first suction region is formed and the paper P is sucked. In addition, in a case where an image is formed on both surfaces of the paper P, the positions of the front surface and the back surface are shifted from each other in some cases. On the contrary, as the second suction region is formed and a suction force is increased, the occurrence of a transport failure such as a paper jam is prevented, and a positional shift in a case of forming an image on both surfaces is prevented.

In addition, for example, in a case where the paper P having a width W3 in the width direction of the transport mechanism is used as shown in FIG. **8**, the knob **60** is moved in the A2 direction as shown in FIG. **7**. Accordingly, as shown in FIGS. **7** and **8**, the shutter **52** is moved in the B2 direction. As a result, the center O, the periphery thereof, the region of the transport belt **44**A on the end portion side in the width direction, and the region of the transport belt **44**D on the end portion side in the width direction are defined as a region where intake is performed by the intake unit **50** (that is, the first suction region). That is, the first suction region is formed from the positions of the holes **58** formed on the outermost side of the transport belt **44**A in the width direction to the positions of the holes **58** formed on the outermost side of the transport belt **44**D in the width direction.

The paper P having the width W3 passes through the region of the paper transport device **42** including the center O. For example, the paper P is transported by all of the transport belts (that is, the transport belts **44**A, **44**B, **44**C, and **44**D) while being sucked via the plurality of holes **58** formed in all of the transport belts.

As shown in FIG. **8**, the width W4 of the first suction region is shorter than the width W3 of the paper P, and the first suction region in the width direction of the transport mechanism is a region narrower than the paper P. For this reason, both end portions of the paper P in the width direction are not sucked by the intake unit **50**. As described above, since the end portion of the paper P in the width direction is not sucked, the end portion of the paper P is prevented from being sucked and caught on the transport

belts **44**A and **44**D, and as a result, paper wrinkles and the like are prevented from being generated.

For example, in a case where the A4 paper P (for example, paper having a width of 210 mm and a length of 297 mm) or the wider paper P (for example, paper having a width of approximately 330 mm) is used, it is assumed that the knob **60** is moved in the A2 direction and the first suction region is set. In addition, in a case where the thin paper P (for example, paper having approximately 52 gsm) is used, it is assumed that the first suction region is set. In a case where such paper P is used, a transport failure, such as twisting and fluttering of the paper P, occurs between the secondary transfer portion NT and the fixing portion N in some cases when the second suction region is formed and the paper P is sucked. On the contrary, as the first suction region wider than the second suction region is formed and the paper P is sucked, the occurrence of a transport failure, such as twisting and fluttering, is prevented. For example, if the second suction region is formed in a case where the thin paper P is used, behavior of both end portions of the paper P in the width direction is unstable, and damage to the paper P occurs or paper wrinkles are generated in some cases when the paper P is transported to the fixing portion N. As the first suction region is formed and the paper P is sucked in the region wider than the second suction region, behavior of both end portions of the paper P in the width direction becomes stable, and damage to the paper P and paper wrinkles are prevented from being generated.

Hereinafter, a positional relationship between the imaginary line V and the paper transport device **42** will be described with reference to FIGS. **9** to **12**. FIGS. **9** to **12** show the secondary transfer portion NT, the fixing device **28**, and the paper transport device **42**.

There are various transport modes according to the length of the paper P in the transport direction T. For example, the following modes (1) and (2) are assumed. Hereinafter, the length of the paper P in the transport direction T will be referred to as "the length of the paper P".

Mode (1) In a case where the length of the paper P is larger than the distance between the secondary transfer portion NT and the fixing portion N, a portion of the paper P on a leading end side is located at the fixing portion N, and a portion of the paper P on a trailing end side is located at the secondary transfer portion NT.

Mode (2) In a case where the length of the paper P is smaller than the distance between the secondary transfer portion NT and the fixing portion N, the portion of the paper P on the leading end side is located at the fixing portion N, and the portion of the paper P on the trailing end side is not located at the secondary transfer portion NT. Alternatively, in a state where the portion of the paper P on the leading end side has not reached the fixing portion N, the portion of the paper P on the trailing end side is located at the secondary transfer portion NT in some cases. In such cases, a leading end of the paper P is not located at the fixing portion N, and a trailing end of the paper P is not located at the secondary transfer portion NT in some cases.

FIGS. **9** to **11** show mode (1), and FIG. **12** shows mode (2).

For example, in a case where the size of the paper P is the A4 size (for example, paper having a width of 210 mm and a length of 297 mm), mode (1) occurs. In a case where the size of the paper P is the postcard size (for example, paper having a width of 100 mm and a length of 148 mm), mode (2) occurs.

Hereinafter, for convenience of description, the paper P having a length larger than the distance between the secondary transfer portion NT and the fixing portion N will be referred to as "the long paper P", and the paper P having a length smaller than the distance between the secondary transfer portion NT and the fixing portion N will be referred to as "the short paper P".

The paper transport device **42** is provided at a position farther from the imaginary line V than a first position is. The first position is a position where a region for bending the paper P is not secured between the imaginary line V and the paper transport device **42**. In addition, the paper transport device **42** is provided at a position closer to the imaginary line V than a second position is. The second position is a position farther from the imaginary line than the first position is and is a position where a transport failure of the paper P can occur. That is, the paper transport device **42** is provided at the position farther from the imaginary line V than the first position is and the position closer to the imaginary line V than the second position is. Accordingly, the long paper P can be transported from the secondary transfer portion NT to the fixing portion N while being bent, and the short paper P can be transported from the secondary transfer portion NT to the fixing portion N while suppressing a decrease in a suction force with respect to the short paper P. Hereinafter, this point will be described in detail.

In a case where the long paper P is used, paper wrinkles are generated in some cases when the portion of the paper P on the leading end side is located at the fixing portion N and an end portion of the paper P on the trailing end side is located at the secondary transfer portion NT. For example, in a case where a speed at which the paper P is transported at the fixing portion N is slower than a speed at which the paper P is transported at the secondary transfer portion NT, paper wrinkles are generated in some case since a trailing end is transported later than the leading end of the paper P. In order to prevent the paper wrinkles, the paper P is bent between the imaginary line V and the paper transport device **42** in a space between the secondary transfer portion NT and the fixing portion N. The paper transport device **42** is provided at a position where the region for bending the paper P can be secured between the imaginary line V and the paper transport device **42**. The position where the region for bending the paper can be secured is a position farther from the imaginary line V than the first position is. By providing the paper transport device **42** at the position farther from the imaginary line V than the first position is, the paper P is bent between the imaginary line V and the paper transport device **42**, and paper wrinkles are prevented.

As a distance between the imaginary line V and the paper transport device **42** increases (that is, as the paper transport device **42** becomes farther from the imaginary line V), a region where the paper P is bent becomes wider, and a result, the frequency of occurrence of paper wrinkles decreases. On the other hand, as the paper transport device **42** becomes farther from the imaginary line V, intake by the intake unit **50** with respect to the position of the imaginary line V weakens, and as a result, a suction force with respect to the paper P weakens. In a case where the paper transport device **42** is provided at the position farther from the imaginary line V than the second position is, a failure in transport with suction occurs. That is, a suction force sufficient for allowing transport by suction becomes unable to be obtained, and as a result, a transport failure occurs. For example, in a case where the short paper P is used, the paper P stands between the secondary transfer portion NT and the fixing portion N, and a transport failure such as a paper jam occurs in some cases. In order to prevent the transport failure, the paper

transport device **42** is provided at the position closer to the imaginary line V than the second position is.

In the example shown in FIG. **9**, the paper transport device **42** is arranged at a position where a linear distance between the imaginary line V and the paper transport device **42** is a distance L1. The position of the distance L1 corresponds to the first position. In a case where the paper transport device **42** is provided at the position, the region where the paper P is bent is not secured between the imaginary line V and the paper transport device **42** as shown in FIG. **9**.

In the example shown in FIG. **10**, the paper transport device **42** is provided at a position where the linear distance between the imaginary line V and the paper transport device **42** is a distance L2. The distance L2 is a distance longer than the distance L1, and the position of the distance L2 corresponds to the second position. In a case where the paper transport device **42** is provided at the position, the region where the paper P is bent is secured between the imaginary line V and the paper transport device **42** as shown in FIG. **10**. However, in a case where the short paper P is used, a suction force with respect to the paper P decreases, and as a result, a transport failure occurs in some cases.

In the example shown in FIG. **11**, the paper transport device **42** is provided at a position where the linear distance between the imaginary line V and the paper transport device **42** is a distance L3. The distance L3 is a distance between the distance L1 and the distance L2, and the position of the distance L3 is a position farther from the imaginary line V than the first position is and is a position closer to the imaginary line V than the second position is. By providing the paper transport device **42** at a third position, the long paper P is transported between the imaginary line V and the paper transport device **42** while being bent in the space between the secondary transfer portion NT and the fixing portion N, and a decrease in a suction force with respect to the short paper P is suppressed. Accordingly, the occurrence of paper wrinkles of the long paper P is prevented, and the occurrence of a transport failure of the short paper P is prevented.

FIG. **13** shows a result of transport according to a distance L between the imaginary line V and the paper transport device **42**.

In a case where the distance L is 4 mm or less, the region where the long paper P is bent is not secured between the imaginary line V and the paper transport device **42** (a bending region "×" in FIG. **13**), and a transport failure (for example, paper wrinkles) occurs (runnability "×" in FIG. **13**) in the long paper P (for example, A4 paper).

In a case where the distance L is longer than 4 mm and is equal to or less than 8 mm (in a case of 4 to 8 mm), the region where the long paper P is bent is sufficient (the bending region "Δ" in FIG. **13**), and a transport failure such as a paper wrinkle occurs in the long paper P in some cases (the runnability "Δ" in FIG. **13**). In a case where the short paper P (for example, the postcard-sized paper) is used, a suction force by the intake unit **50** is increased (for example, the suction force is increased by approximately 20 to 50%), and the area of the suction region in the paper transport device **42** is decreased (for example, the area of 70 to 90%).

In a case where the distance L is longer than 8 mm and is equal to or less than 14 mm (in a case of 8 to 14 mm), the region where the long paper P is bent is secured (the bending region "○" in FIG. **13**), and the occurrence of a paper wrinkle is prevented (the runnability "○" in FIG. **13**).

In a case where the distance L is 14 mm or more, the region where the long paper P is bent is secured (the bending region "○" in FIG. **13**), but a suction force for transporting the short paper P while sucking is not obtained, and a transport failure occurs in the short paper P (the runnability "×" in FIG. **13**).

In the example shown in FIG. **13**, a distance of 4 to 8 mm corresponds to an example of the distance L3. That is, by arranging the paper transport device **42** at a position in a range where the distance L from the imaginary line V is 4 to 8 mm, a transport failure does not occur in both of the long paper P and the short paper P, and the paper P is transported.

Numerical values shown in FIG. **13** are merely examples, the distance between the secondary transfer portion NT and the fixing portion N can change according to the size of the inside of the image forming apparatus **10**, the magnitude of a suction force by the intake unit **50**, and the size of the paper transport device **42**. For example, the distance L3 is assumed to be obtained through experiments or simulations for each image forming apparatus **10** or for each type of device.

Hereinafter, the shape of the knob **60** will be described with reference to FIG. **14**. FIG. **14** is a perspective view of the knob **60**. The knob **60** has a disk shape. In a side surface of the knob **60**, a recess **60***a* is formed in a circumferential direction along the side surface. For example, the operator, such as a user, is assumed to operate the knob **60** by hooking the finger to the recess **60***a*.

The foregoing description of the exemplary embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various embodiments and with the various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

What is claimed is:

1. A paper transport device comprising:

a transport mechanism that transports paper to which an image is transferred to a fixing device while sucking the paper, wherein the transport mechanism comprises a transport belt; and

a switching mechanism that switches between suction regions in a width direction of the transport mechanism, which corresponds to a width direction of the paper, according to a size of the paper, wherein the switching mechanism is a shutter having an open space, and the transport mechanism is configured to suck the paper via the open space,

wherein the switching mechanism is configured to move in the width direction of the transport mechanism, and the suction regions have different widths,

wherein an imaginary line connects a position where the image is transferred to the paper and a position where the image is fixed to the paper by the fixing device to each other, and

the transport mechanism is provided at a position farther from the imaginary line than a first position is, wherein the first position is a position at which paper wrinkles occur in a case where a speed at which the paper is transported at the position where the image is fixed to the paper is slower than a speed at which the paper is transported at the position where the image is transferred to the paper.

2. The paper transport device according to claim 1,

wherein the transport mechanism is provided at a position closer to the imaginary line than a second position that is farther from the imaginary line than the first position is, wherein the second position is a position at which a transport failure of the paper occurs.

3. The paper transport device according to claim 2,

wherein the switching mechanism switches, according to the size of the paper, between a first suction region in the width direction of the transport mechanism and a second suction region different from the first suction region,

an end portion of the paper in the width direction is not sucked by the transport mechanism in the first suction region in a case where a width of the paper is larger than a width of the first suction region, and

a region on an outer side of the end portion of the paper in the width direction is sucked in the second suction region in a case where the width of the paper is smaller than a width of the second suction region.

4. The paper transport device according to claim 3, further comprising:

a knob that is provided on an end portion side with respect to a center of the transport mechanism and is used for operating the switching mechanism to switch between the suction regions in the width direction of the transport mechanism.

5. The paper transport device according to claim 2, further comprising:

a knob that is provided on an end portion side with respect to a center of the transport mechanism and is used for operating the switching mechanism to switch between the suction regions in the width direction of the transport mechanism.

6. The paper transport device according to claim 1,

wherein the switching mechanism switches, according to the size of the paper, between a first suction region in the width direction of the transport mechanism and a second suction region different from the first suction region,

an end portion of the paper in the width direction is not sucked by the transport mechanism in the first suction region in a case where a width of the paper is larger than a width of the first suction region, and

a region on an outer side of the end portion of the paper in the width direction is sucked in the second suction region in a case where the width of the paper is smaller than a width of the second suction region.

7. The paper transport device according to claim 6, further comprising:

a knob that is provided on an end portion side with respect to a center of the transport mechanism and is used for operating the switching mechanism to switch between the suction regions in the width direction of the transport mechanism.

8. The paper transport device according to claim 1, further comprising:

a knob that is provided on an end portion side with respect to a center of the transport mechanism and is used for operating the switching mechanism to switch between the suction regions in the width direction of the transport mechanism.

9. The paper transport device according to claim 1,

wherein the switching mechanism switches, according to the size of the paper, between a first suction region in the width direction of the transport mechanism and a second suction region different from the first suction region,

an end portion of the paper in the width direction is not sucked by the transport mechanism in the first suction region in a case where a width of the paper is larger than a width of the first suction region, and

a region on an outer side of the end portion of the paper in the width direction is sucked in the second suction region in a case where the width of the paper is smaller than a width of the second suction region.

10. The paper transport device according to claim 9, further comprising:

a knob that is provided on an end portion side with respect to a center of the transport mechanism and is used for operating the switching mechanism to switch between the suction regions in the width direction of the transport mechanism.

11. The paper transport device according to claim 1, further comprising:

a knob that is provided on an end portion side with respect to a center of the transport mechanism and is used for operating the switching mechanism to switch between the suction regions in the width direction of the transport mechanism.

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