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Okazaki et al.

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(54) **SHEET CONVEYANCE APPARATUS, SHEET SUPPORT APPARATUS, AND IMAGE FORMING APPARATUS**

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B65H 1/08 (2006.01)

(52) **U.S. Cl.**
CPC ***B65H 1/08*** (2013.01); *B65H 2402/412* (2013.01); *B65H 2402/441* (2013.01); *B65H 2402/45* (2013.01); *B65H 2404/67* (2013.01); *B65H 2801/06* (2013.01)

(58) **Field of Classification Search**
CPC B65H 2404/67; B65H 2511/12; B65H 2405/324; B65H 2402/45; B65H 2402/412
See application file for complete search history.

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(57) **ABSTRACT**

A sheet conveyance apparatus includes an apparatus body including a conveyance assembly to convey a sheet, and a door pivotally supported around a pivot axis disposed in a lower portion of the apparatus body such that the door is opened and closed with respect to the apparatus body. The apparatus body includes a handle assembly including a first holder used to lift the apparatus body and is disposed inside a width of the door in an axis direction of the pivot axis. The handle assembly includes a first engaging section and a second engaging section disposed on the pivot axis, wherein the door includes a first engaged section to engage with the first engaging section and a second engaged section to engage with the second engaging section. The door is pivotably supported around the first engaging section and the second engaging section with respect to the handle assembly.

13 Claims, 17 Drawing Sheets

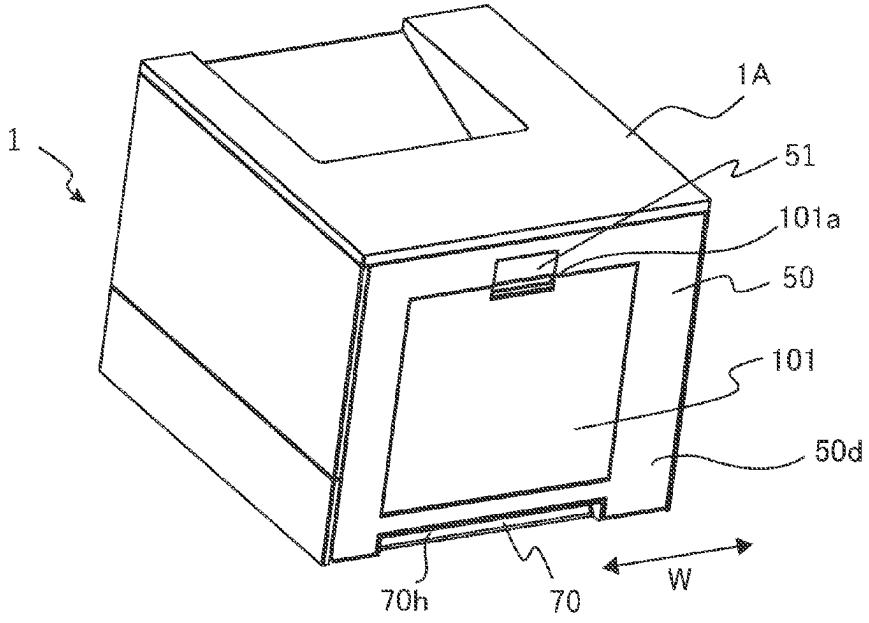


FIG. 1

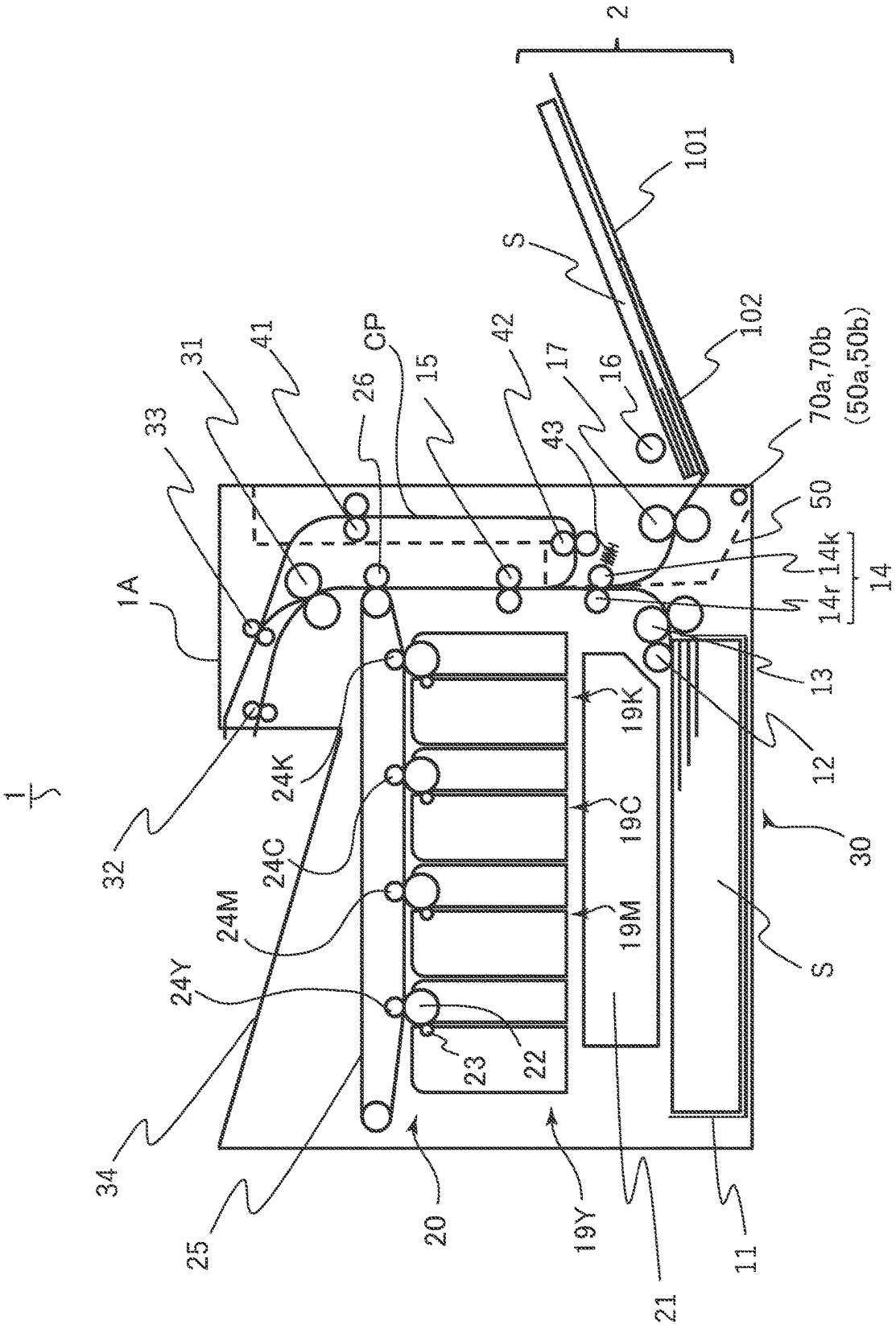

1
2
101
S
102
70a,70b
(50a,50b)
50
14k
14r
14
13
12
30
S
11
21
19Y
20
25
34
32
1A
33
31
41
26
CP
15
42
17
16
43
19K
19C
19M
24K
24C
24M
24Y
23
22

FIG.2A

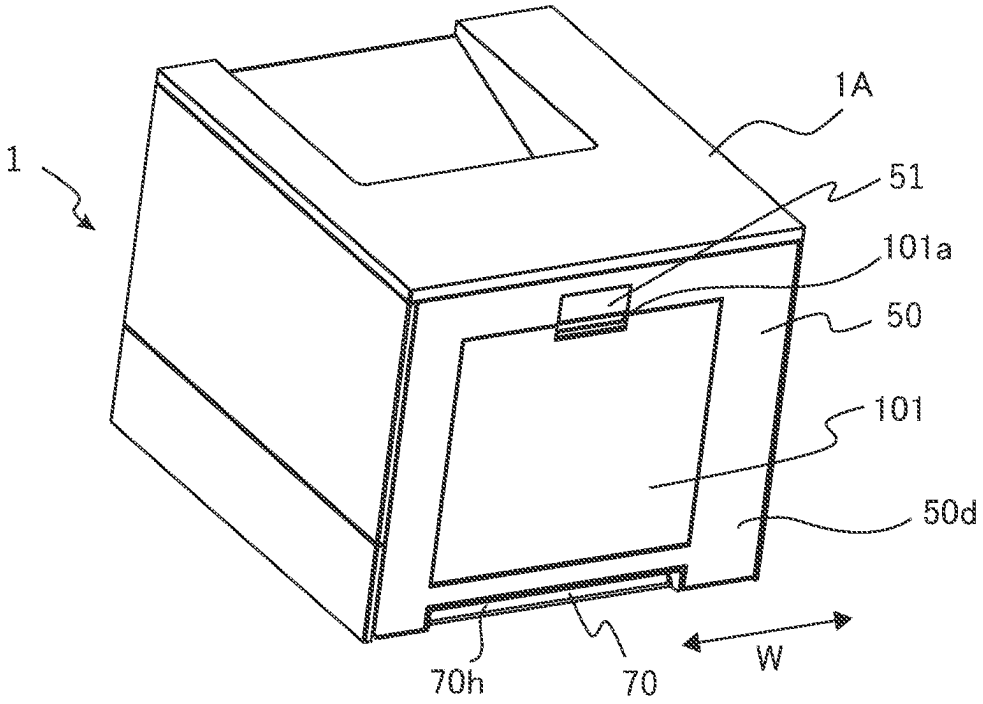


FIG.2B

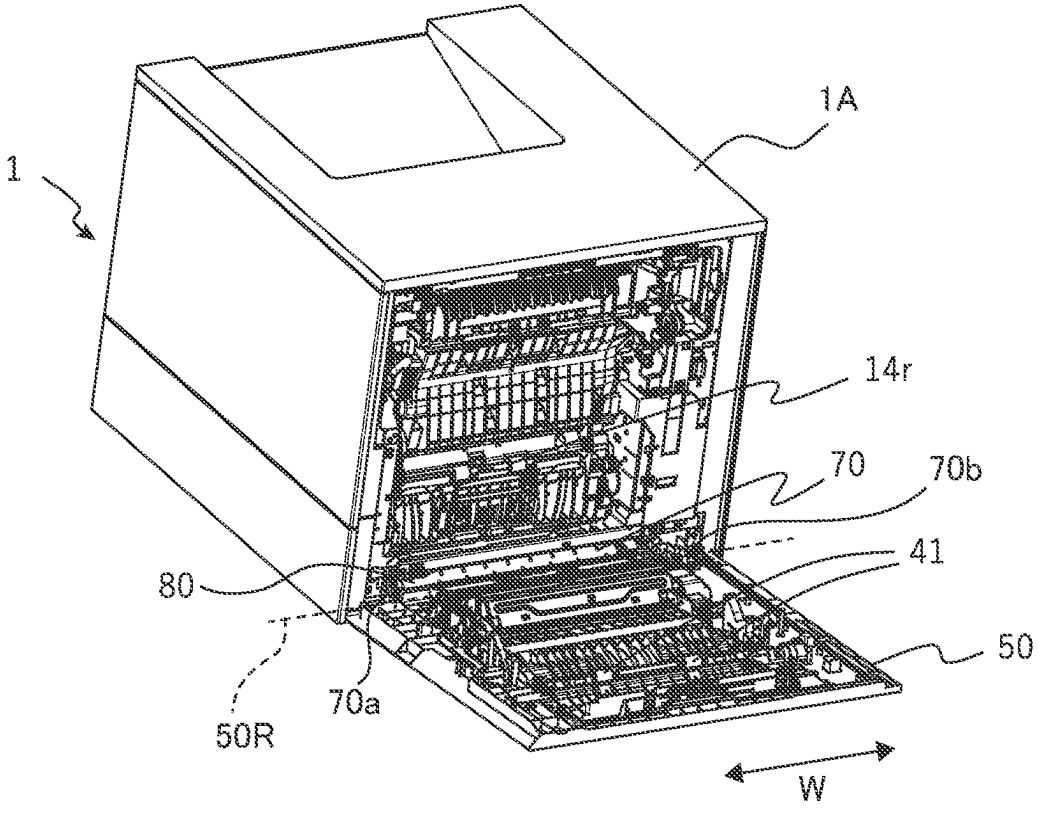


FIG.3

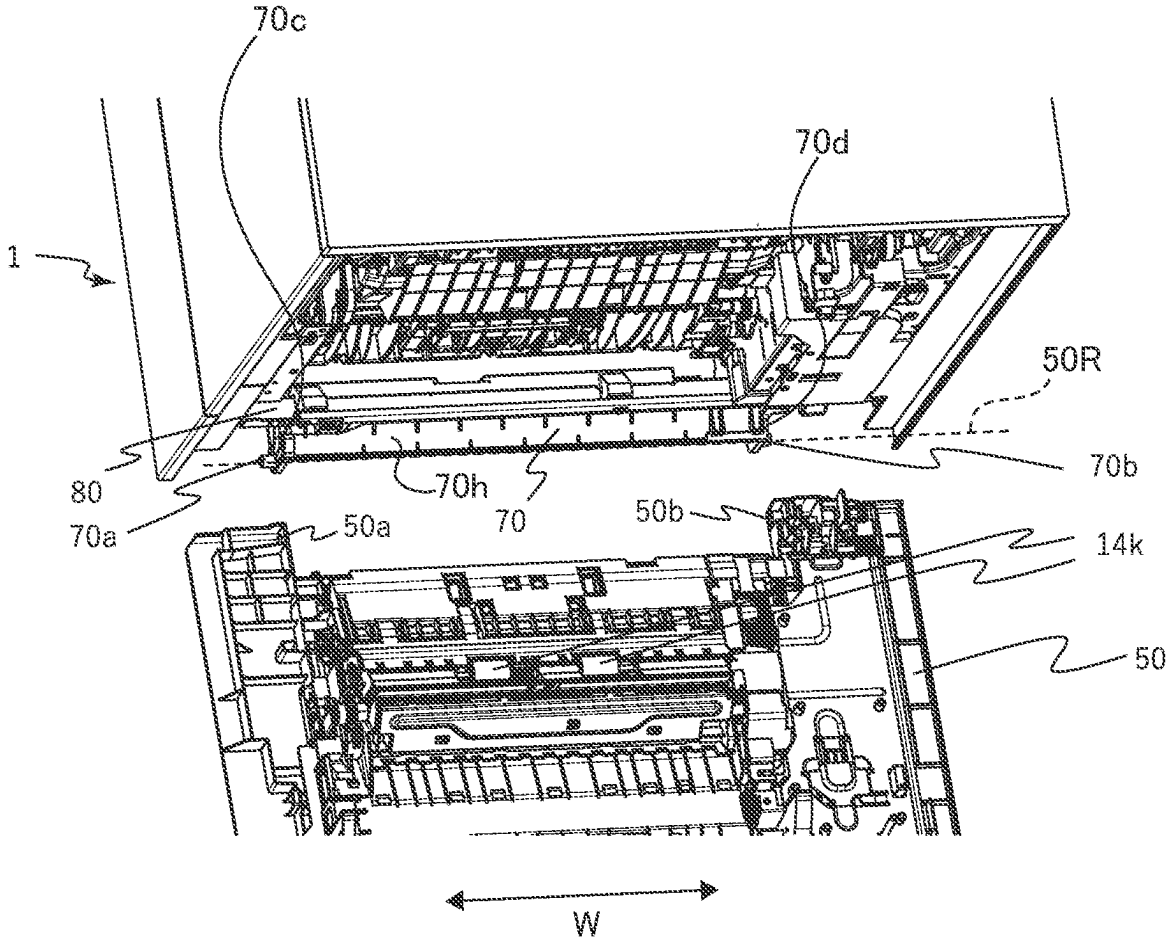


FIG.4A

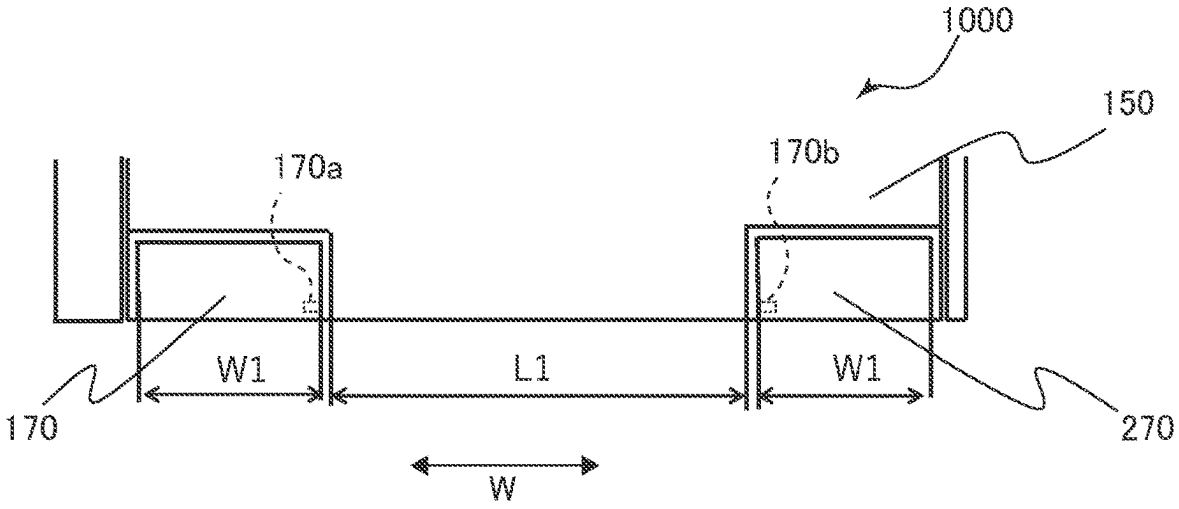

1000
150
170a
170b
W1
L1
W1
170
270
W

FIG.4B

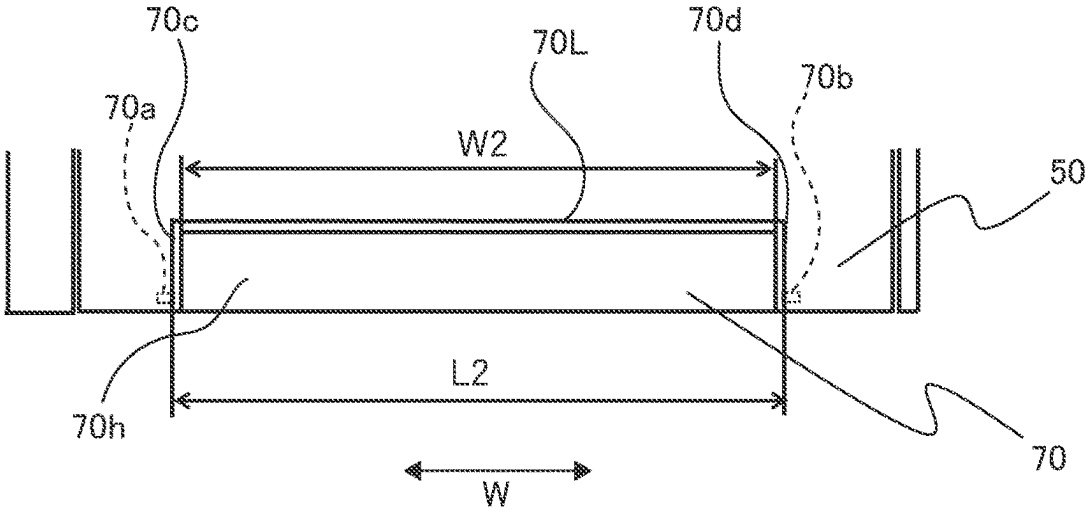

70c
70L
70d
70b
70a
W2
50
L2
70h
70
W

FIG.5

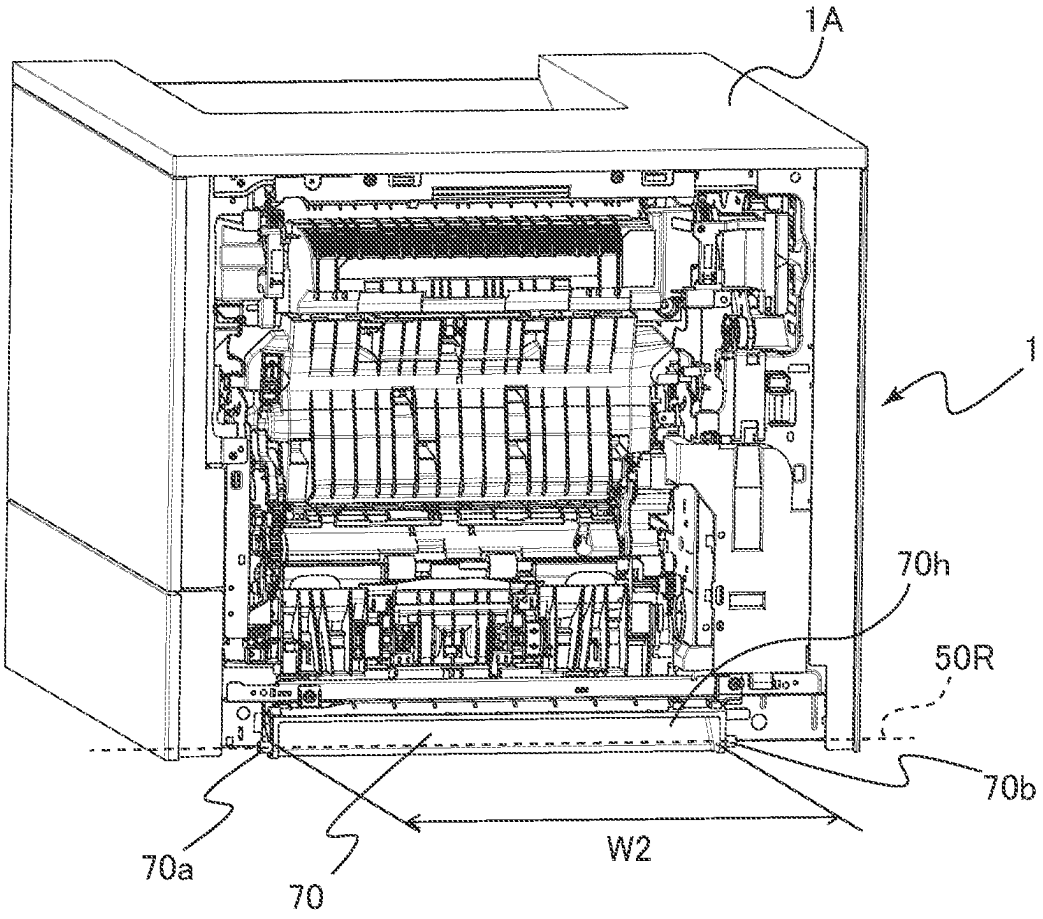


FIG.6

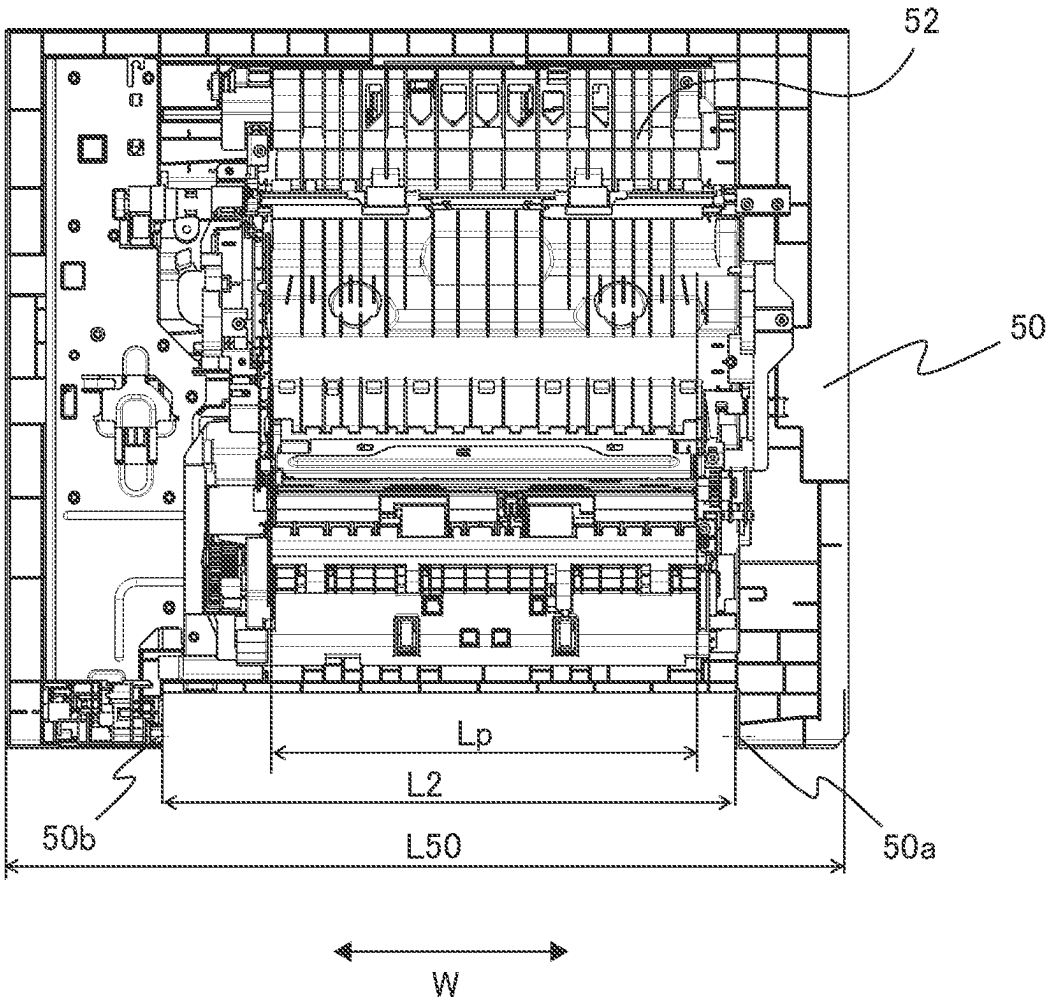


FIG.7

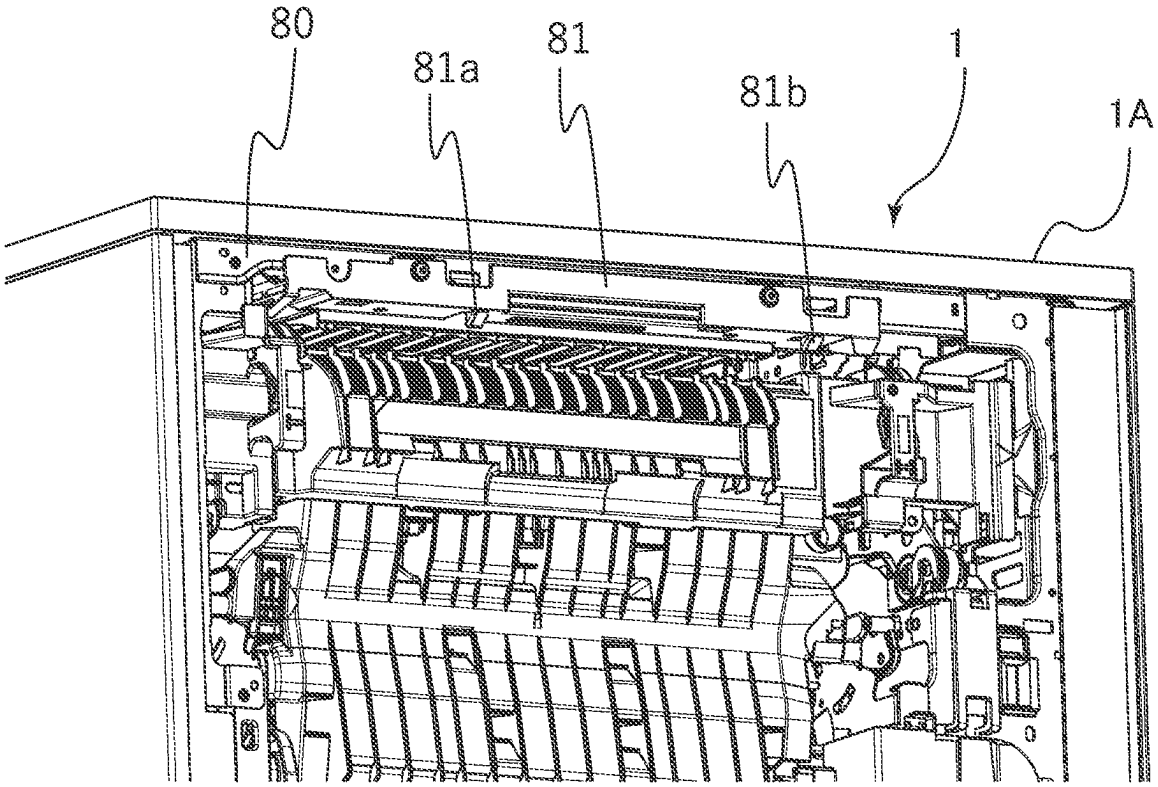


FIG.8

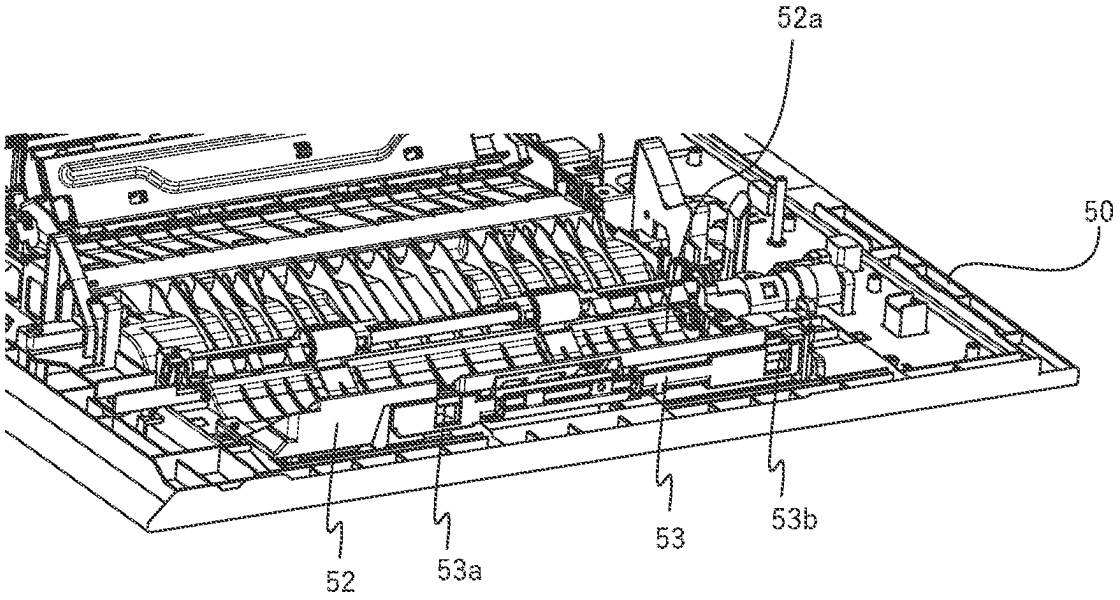


FIG.9A

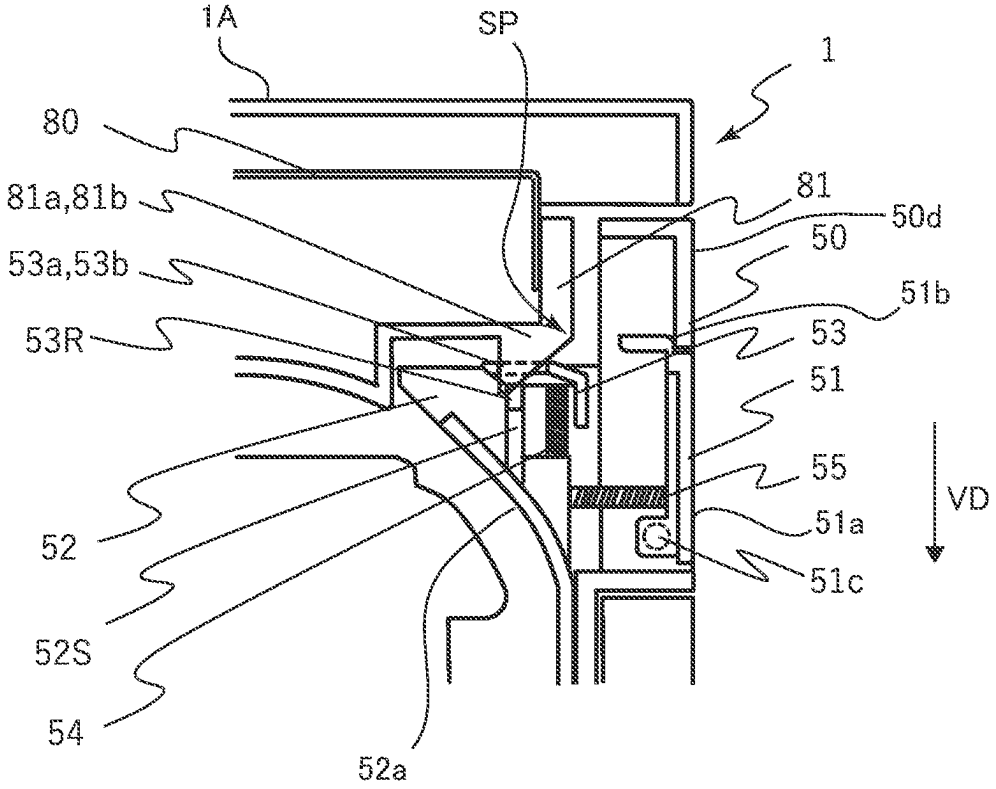
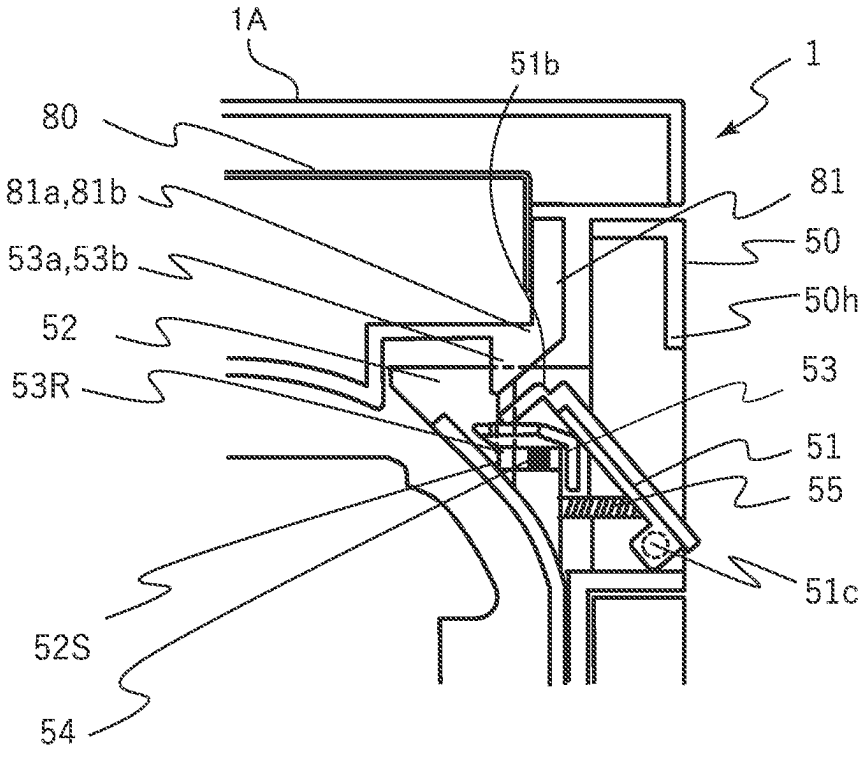

1A
SP
1
80
81a,81b
81
50d
50
53a,53b
51b
53R
53
51
55
VD
51a
52
51c
52S
54
52a

FIG.9B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51b
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53R
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51
55
51c
52S
54

FIG.10A

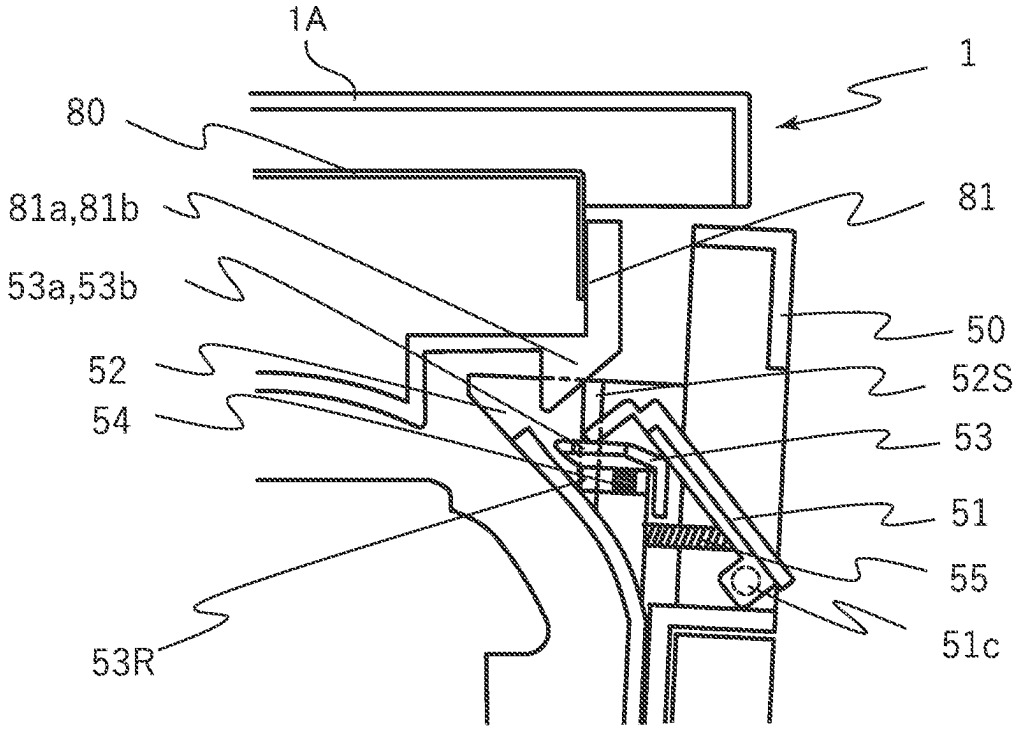


FIG.10B

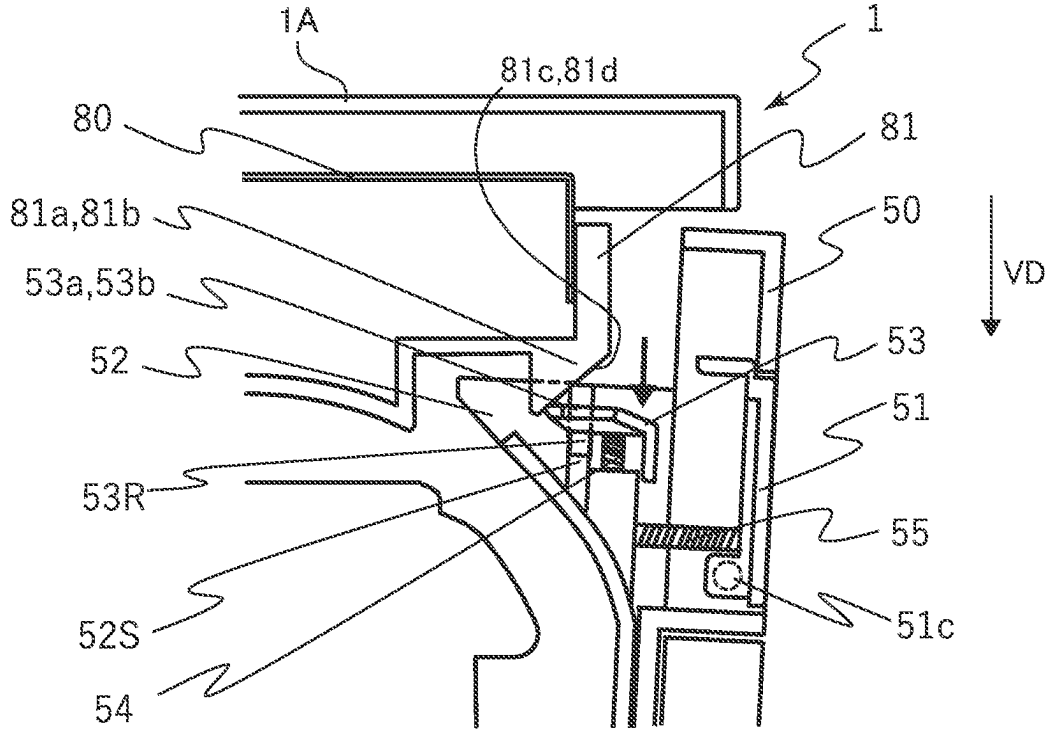


FIG.11

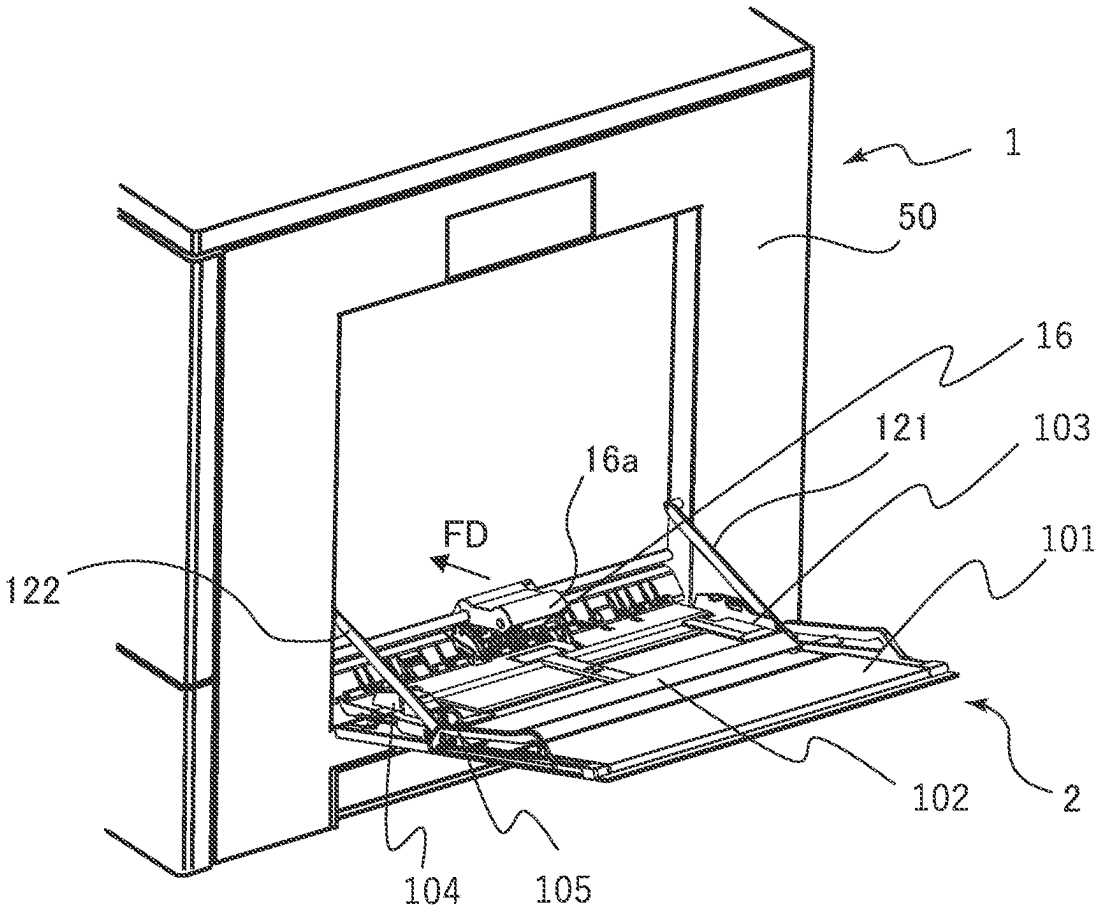


FIG. 12

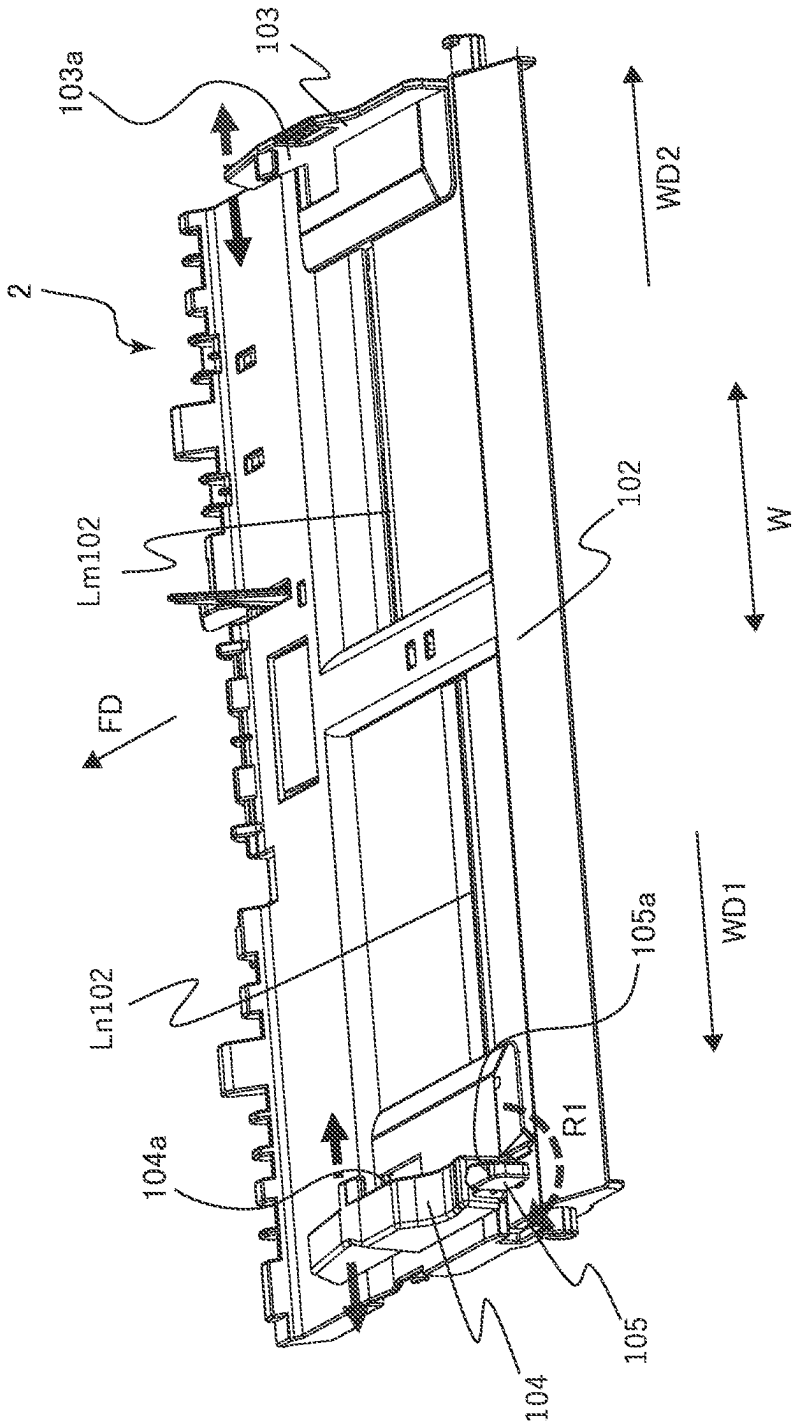


FIG.13

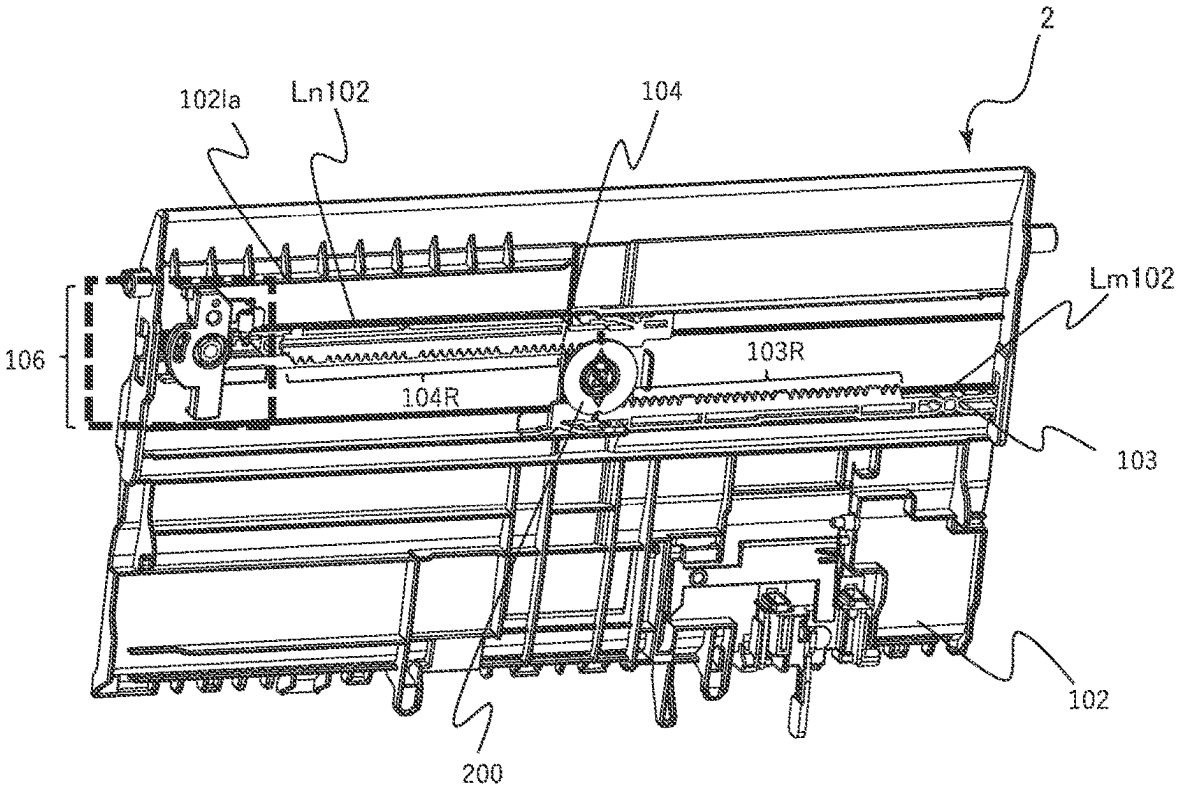


FIG.14

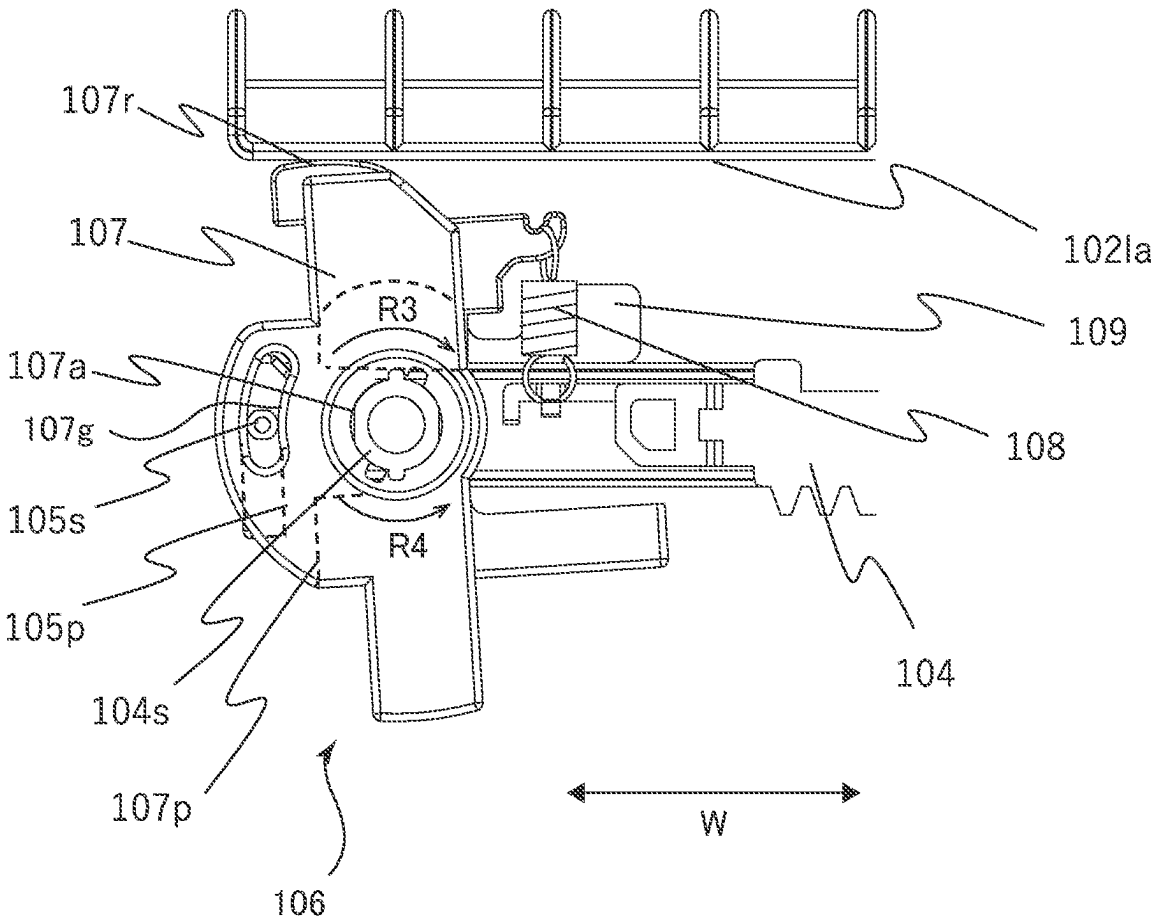

107r
107
102la
R3
109
107a
107g
108
105s
R4
105p
104
104s
107p
W
106

FIG.15

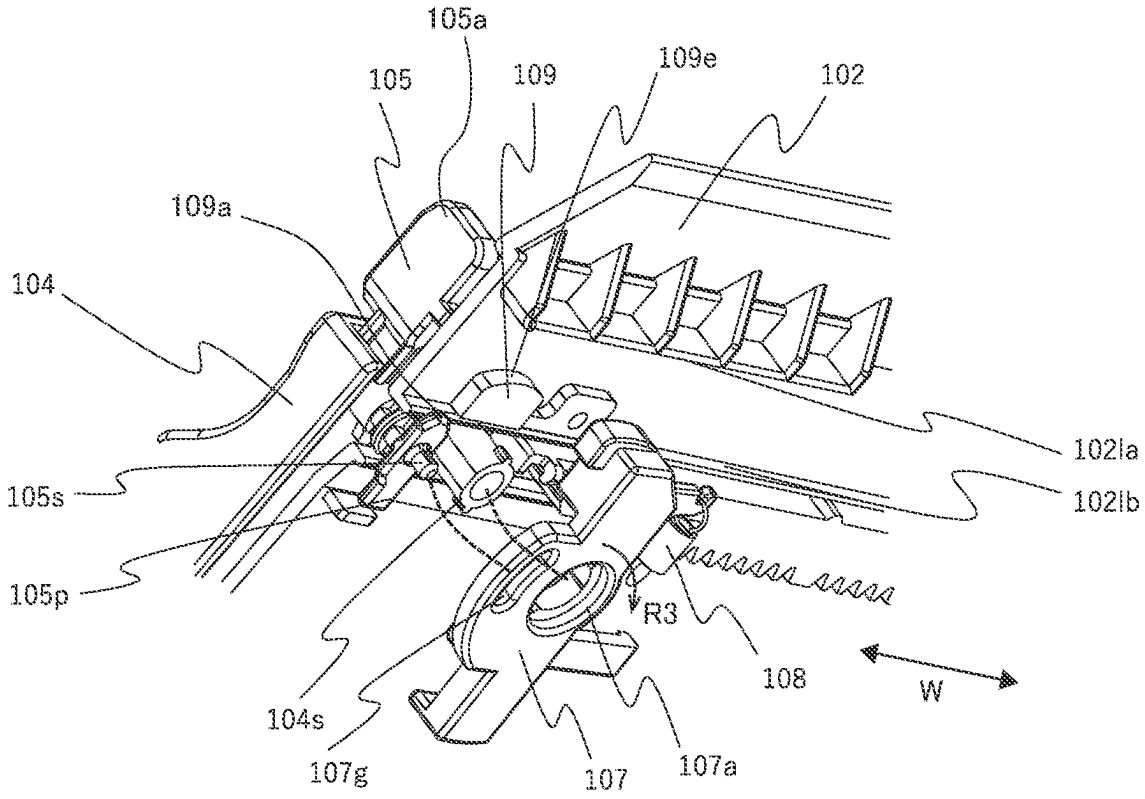

105a
105
109
109e
102
109a
104
102la
102lb
105s
105p
R3
108
W
104s
107g
107
107a

FIG.16

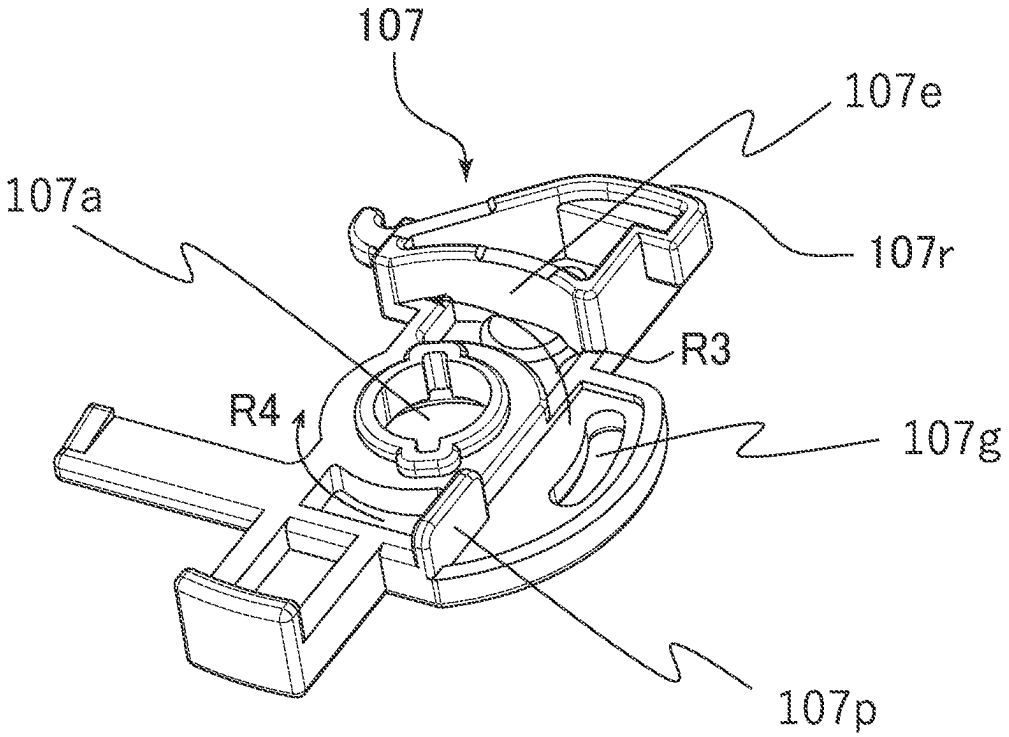


FIG.17A

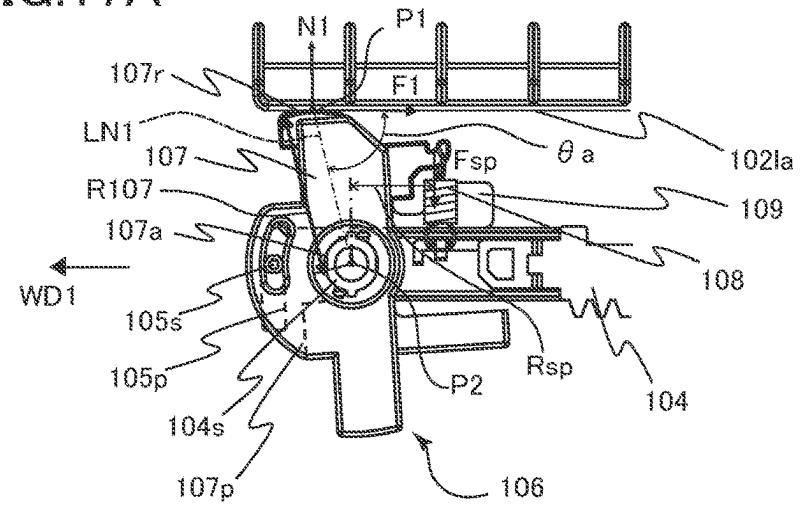


FIG.17B

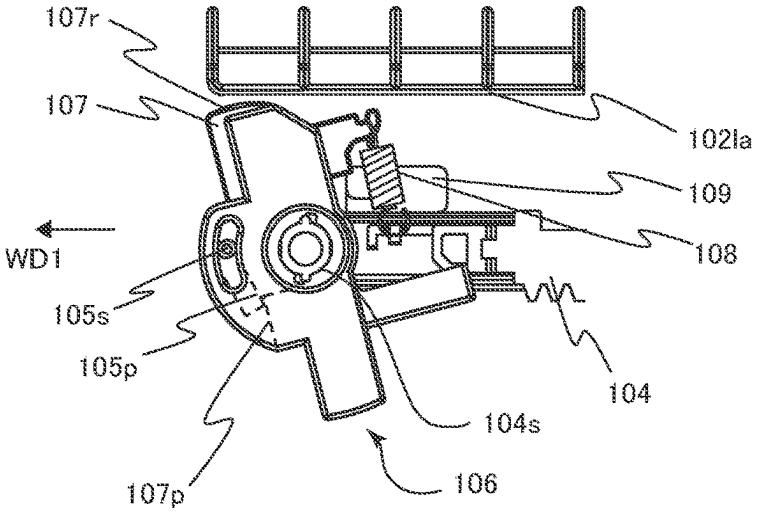
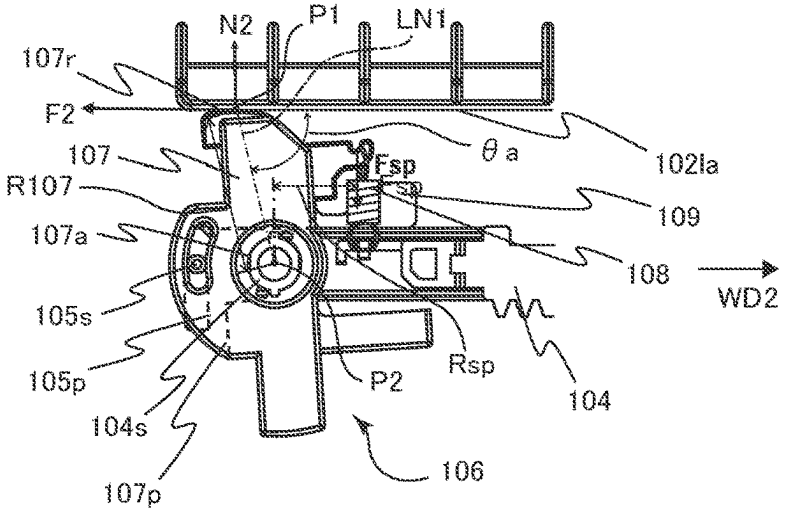


FIG.17C



SHEET CONVEYANCE APPARATUS, SHEET SUPPORT APPARATUS, AND IMAGE FORMING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a sheet conveyance apparatus that conveys a sheet, a sheet support apparatus that supports a sheet and an image forming apparatus.

Description of the Related Art

Japanese Patent Application Publication No. 2014-170058 proposes a copying machine that includes a housing and a double-sided cover. The double-sided cover is supported by the housing so as to be able to be opened and closed with respect to the housing by a user pivoting the double-sided cover on a cover pivot shaft. The copying machine is provided with a right-front handle portion and a right-back handle portion, which are used as handles when the copying machine is carried. The right-front handle portion and the right-back handle portion are disposed below the double-sided cover, and fixed to the housing.

However, since the right-front handle portion and the right-back handle portion are disposed below the double-sided cover, the cover pivot shaft of the double-sided cover described in Japanese Patent Application Publication No. 2014-170058 is positioned above the right-front handle portion and the right-back handle portion. Thus, the opening portion formed when the double-sided cover is opened becomes smaller, which causes insufficient maintainability.

In addition, the right-front handle portion and the right-back handle portion described in Japanese Patent Application Publication No. 2014-170058 are separate members, and disposed separated from each other. Thus, in the right side surface of the copying machine, more boundary lines between components are formed, which causes poor external appearance.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, a sheet conveyance apparatus includes an apparatus body including a conveyance portion configured to convey a sheet, and a door portion pivotally supported around a pivot axis disposed in a lower portion of the apparatus body such that the door portion is opened and closed with respect to the apparatus body. The apparatus body includes a holding member including a first holding portion used to lift the apparatus body, and the holding member is disposed inside a width of the door portion in an axis direction of the pivot axis. The holding member includes a first engaging portion and a second engaging portion disposed on the pivot axis. The door portion includes a first engaged portion configured to engage with the first engaging portion, and a second engaged portion configured to engage with the second engaging portion. The door portion is pivotably supported around the first engaging portion and the second engaging portion with respect to the holding member.

According to a second aspect of the present invention, a sheet support apparatus includes a sheet support portion configured to support a sheet, a regulation portion supported by the sheet support portion such that the regulation portion is configured to move in a first direction and a second direction opposite to the first direction, the regulation portion being configured to regulate a position of a downstream edge, in the first direction, of the sheet supported by the sheet support portion, and a brake unit configured to produce a first frictional force between the sheet support portion and the regulation portion in a case where the regulation portion moves toward the second direction, and produce a second frictional force larger than the first frictional force between the sheet support portion and the regulation portion in a case where the regulation portion moves toward the first direction.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an overall schematic diagram illustrating a printer of an embodiment.

FIG. **2**A is a perspective view illustrating an image forming apparatus that is in a state where a conveyance cover is closed.

FIG. **2**B is a perspective view illustrating the image forming apparatus that is in a state where the conveyance cover is opened.

FIG. **3** is an exploded perspective view illustrating the image forming apparatus that is in a state where the conveyance cover is detached.

FIG. **4**A is a diagram illustrating a shaft-to-shaft distance of a comparative example.

FIG. **4**B is a diagram illustrating a shaft-to-shaft distance of the present embodiment.

FIG. **5** is a perspective view illustrating an apparatus body that is in a state where the conveyance cover is detached.

FIG. **6** is a diagram of the conveyance cover viewed from the apparatus body side.

FIG. **7** is a perspective view illustrating a conveyance guide of the apparatus body.

FIG. **8** is a perspective view illustrating a locking member disposed on the conveyance cover.

FIG. **9**A is a cross-sectional view illustrating a state where a handle is located at a first position and the locking member is located at a locking position.

FIG. **9**B is a cross-sectional view illustrating a state where the handle is located at a second position and the locking member is located at an unlocking position.

FIG. **10**A is a cross-sectional view illustrating a state where the conveyance cover is being opened while receiving an urging force of a spring.

FIG. **10**B is a cross-sectional view illustrating a state where the locking member is being pushed downward by a hook portion.

FIG. **11** is a perspective view illustrating a manual-feed conveyance portion.

FIG. **12** is a perspective view illustrating side regulation plates.

FIG. **13** is a bottom perspective view illustrating the side regulation plates and a brake mechanism.

FIG. **14** is a front view illustrating the brake mechanism.

FIG. **15** is an exploded perspective view illustrating the brake mechanism.

FIG. **16** is a perspective view illustrating a brake member.

FIG. **17**A is a diagram illustrating an operation of the brake mechanism performed when a side regulation plate is moved toward a first direction.

FIG. **17**B is a diagram illustrating an operation of the brake mechanism that is in a state where a brake release lever is being operated.

FIG. **17**C is a diagram illustrating an operation of the brake mechanism performed when the side regulation plate is moved toward a second direction.

DESCRIPTION OF THE EMBODIMENTS

Overall Configuration

An image forming apparatus **1** of the present embodiment is an electrophotographic full-color laser-beam printer. As illustrated in FIG. **1**, the image forming apparatus **1** includes an image forming portion **20** that forms an image on a sheet S, a sheet feeding portion **30**, a fixing apparatus **31**, and a manual-feed conveyance portion **2**. The image forming portion **20** includes four process cartridges **19**Y, **19**M, **19**C, and **19**K, and a scanner unit **21**. The four process cartridges **19**Y, **19**M, **19**C, and **19**K are used for forming four-color toner images of yellow (Y), magenta (M), cyan (C), and black (K), respectively.

Note that the four process cartridges **19**Y, **19**M, **19**C, and **19**K are the same in configuration as each other, except that they produce different colors of images. For this reason, the configuration and the image forming process of only the process cartridge **19**Y will be described, and the description for the process cartridges **19**M, **19**C, and **19**K will be omitted.

The process cartridge **19**Y includes a photosensitive drum **22**, a charging roller (not illustrated), and a developing roller **23**. The photosensitive drum **22** has an organic photoconductive layer coated on the outer surface of an aluminum cylinder, and is rotated by a driving motor (not illustrated). In addition, the image forming portion **20** includes an intermediate transfer belt **25**, and primary transfer rollers **24**Y, **24**M. **24**C, and **24**K disposed inside the intermediate transfer belt **25**.

The fixing apparatus **31** includes a fixing film that is heated by a heater (not illustrated), and a pressing roller that is in pressure contact with the fixing film. The sheet feeding portion **30** is disposed in a lower portion of the image forming apparatus **1**; and includes a cassette **11** that stores sheets, a pickup roller **12** that feeds a sheet, and a separation roller pair **13**.

Next, an image forming operation of the image forming apparatus **1** configured in this manner will be described. When the scanner unit **21** receives an image signal from an apparatus, such as a personal computer (not illustrated), the scanner unit **21** emits a laser beam, produced in accordance with the image signal, to the photosensitive drum **22** of the process cartridge **19**Y.

Since the surface of the photosensitive drum **22** is uniformly charged in advance by the charging roller (not illustrated) so as to have a predetermined polarity and potential, an electrostatic latent image is formed on the surface of the photosensitive drum **22** when the surface of the photosensitive drum **22** is irradiated with the laser beam from the scanner unit **21**. The electrostatic latent image formed on the photosensitive drum **22** is developed by the developing roller **23**, and a yellow (Y) toner image is formed on the photosensitive drum **22**.

Similarly, photosensitive drums of the process cartridges **19**M, **19**C, and **19**K are also irradiated with laser beams from the scanner unit **21**; and magenta (M), cyan (C), and black (K) toner images are formed on the photosensitive drums. The toner images formed on the photosensitive drums and having respective colors are transferred onto the intermediate transfer belt **25** by the primary transfer rollers **24**Y, **24**M, **24**C, and **24**K; and are conveyed to the secondary transfer roller **26** by the intermediate transfer belt **25** that rotates. Note that an image forming process for one color is performed at a timing at which a corresponding toner image is superposed on an upstream toner image which has been primary-transferred onto the intermediate transfer belt **25**.

In parallel with the image forming process, a sheet S is fed from the sheet feeding portion **30** or the manual-feed conveyance portion **2**. For example, a sheet S stored in the cassette **11** of the sheet feeding portion **30** is fed by the pickup roller **12**. The sheet S fed by the pickup roller **12** is separated from others, one by one, by the separation roller pair **13**; and is conveyed to a registration roller pair **15**.

The manual-feed conveyance portion **2** includes a manual feed cover **101**, a manual feed tray **102**, a pickup roller **16**, and a separation roller pair **17**. The manual feed cover **101** is supported by the conveyance cover **50** so as to be able to be opened and closed, and the manual feed tray **102** is held by the manual feed cover **101**. The sheet S stacked on the manual feed tray **102** is fed by the pickup roller **16**; then separated from others, one by one, by the separation roller pair **17**; and then conveyed to the registration roller pair **15**.

The registration roller pair **15** corrects the skew of the sheet S, and conveys the sheet S at a predetermined conveyance timing. Then, a full-color toner image on the intermediate transfer belt **25** is transferred onto the sheet S by a secondary transfer bias applied to the secondary transfer roller **26**.

The sheet S onto which the toner image has been transferred is then applied with predetermined heat and pressure by the fixing film and the pressing roller of the fixing apparatus **31**, so that the toner is melted and solidifies (fixed). Then, the sheet S having passed through the fixing apparatus **31** is discharged to a discharging tray **34** by a discharge roller pair **32**.

In a case where images are to be formed on both sides of the sheet S, after an image is fixed to a first side of the sheet S by the fixing apparatus **31**, the sheet S is conveyed toward a reversing roller pair **33**. Then the sheet S is switch-backed by the reversing roller pair **33**, and is conveyed and guided to a duplex conveyance path CP. The sheet S having been guided to the duplex conveyance path CP is conveyed again to the secondary transfer roller **26** by conveyance roller pairs **41** and **42** and the registration roller pair **15**. Then an image is formed on a second side of the sheet S by the secondary transfer roller **26**, and the image is fixed to the second side of the sheet S by the fixing apparatus **31**. After that, the sheet S is discharged to the discharging tray **34**.

The image forming apparatus **1** includes an apparatus body **1**A and the conveyance cover **50**. The apparatus body **1**A includes the image forming portion **20** and the sheet feeding portion **30**. The conveyance cover **50** serves as a door portion, and is supported so as to be able to be opened and closed with respect to the apparatus body **1**A. As described in detail below, the conveyance cover **50**, which is indicated by a dotted-line area of FIG. **1**, is disposed on the right side surface of the image forming apparatus **1**; and the conveyance cover **50** supports a driven roller **14***k* of the conveyance roller pair **14**, a driven roller of the conveyance roller pair **41**, a driven roller of the conveyance roller pair **42**, and the manual-feed conveyance portion **2**. The conveyance roller pair **14** includes a driving roller **14***r* that serves as a first roller driven by a driving motor (not illustrated), and the driven roller **14***k* that serves as a second roller rotated by the rotation of the driving roller **14***r*. The driven roller **14***k* is urged by a spring **43**, which serves as an urging member, so that the driven roller **14***k* is in pressure contact with the driving roller **14***r*. Note that the driven roller **14***k*

may serve as a driving roller and the driving roller **14***r* may serve as a driven roller. In another case, another elastic member, such as a rubber member or a sponge member, may be used in place of the spring **43**.

Peripheral Configuration of Conveyance Cover

Next, a peripheral configuration of the conveyance cover **50** will be described with reference to FIGS. **2**A to **3**. As illustrated in FIG. **2**A, the conveyance cover **50** is disposed on the right side surface of the image forming apparatus **1**, and the manual feed cover **101** is supported by the conveyance cover **50** so as to be able to be opened and closed. The conveyance cover **50** can be opened by a user operating a handle **51**. The manual feed cover **101** includes a recess portion **101***a*, which is disposed below the handle **51**; and can be opened and closed with respect to the conveyance cover **50**, by a user operating the recess portion **101***a*.

As illustrated in FIGS. **2**A and **2**B, the apparatus body **1**A includes a frame **80** and a handle **70**. The handle **70** serves as a holding member fixed to the frame **80**. Since the handle **70** is fixed to the frame **80** as illustrated in FIG. **2**B, the position and posture of the handle **70** do not change even when the conveyance cover **50** is opened and closed. As illustrated in FIG. **2**A, the handle **70** includes a holding portion **70***h*, which serves as a first holding portion used to lift the apparatus body **1**A by a user. The holding portion **70***h* is recessed with respect to an exterior surface **50***d* of the conveyance cover **50** in a state where the conveyance cover **50** is closed with respect to the apparatus body **1**A.

In addition, the handle **70** is disposed in a lower portion of the apparatus body **1**A and inside the width of the conveyance cover **50** in a width direction W. In other words, the front edge of the handle **70** is positioned behind the front edge of the conveyance cover **50**, and the back edge of the handle **70** is positioned in front of the back edge of the conveyance cover **50**.

As illustrated in FIG. **3**, the handle **70** includes a first shaft portion **70***a* and a second shaft portion **70***b*. The first shaft portion **70***a* serves as a first engaging portion that is disposed on a lower edge portion of a first end surface **70***c*. The first end surface **70***c* is the surface of one end portion of the handle **70** in the width direction W. The second shaft portion **70***b* serves as a second engaging portion that is disposed on a lower edge portion of a second end surface **70***d*. The second end surface **70***d* is the surface of the other end portion of the handle **70** in the width direction W. That is, the holding portion **70***h* is disposed between the first shaft portion **70***a* and the second shaft portion **70***b* in the width direction W. The first shaft portion **70***a* and the second shaft portion **70***b* are shaft portions that extend in directions, one of which extends away from the other in the width direction W.

In addition, the conveyance cover **50** includes a first hole portion **50***a* and a second hole portion **50***b*. The first hole portion **50***a* serves as a first engaged portion that engages with the first shaft portion **70***a*. The second hole portion **50***b* serves as a second engaged portion that engages with the second shaft portion **70***b*. The conveyance cover **50** is pivotably supported around the first shaft portion **70***a* and the second shaft portion **70***b* with respect to the handle **70**. In other words, the first shaft portion **70***a*, the second shaft portion **70***b*, the first hole portion **50***a*, and the second hole portion **50***b* are disposed on a pivot axis **50**R that is a center of pivot of the conveyance cover **50**. The axis direction of the pivot axis **50**R is parallel with the width direction W. That is, the conveyance cover **50** is pivotably supported by the apparatus body **1**A around the pivot axis **50**R disposed in a lower portion of the apparatus body **1**A.

Next, an image forming apparatus **1000** will be described as a comparative example with reference to FIG. **4**A. As illustrated in FIG. **4**A, the image forming apparatus **1000** has two handles **170** and **270**. The handle **170** is disposed in a front edge portion of the image forming apparatus **1000**, and the handle **270** is disposed in a back edge portion of the image forming apparatus **1000**. A conveyance cover **150** of the image forming apparatus **1000** is pivotally supported by a first shaft portion **170***a* disposed on the handle **170**, and by a second shaft portion **170***b* disposed on the handle **270**.

Each of the handles **170** and **270** has a width W**1**, which is necessary for a user to hold the handle for carrying the image forming apparatus **1000**. Thus, a shaft-to-shaft distance L**1** between the first shaft portion **170***a* and the second shaft portion **170***b* in the width direction W is shortened by double the width W**1** of each of the two handles **170** and **270**.

If the shaft-to-shaft distance L**1** is shortened, the misalignment of the conveyance cover **150** produced in the attachment of the conveyance cover **150** will have more affect on the inclination of the conveyance cover **150** with respect to the pivot center axis. In addition, when the conveyance cover **150** is closed, the position of the conveyance cover **150** may deviate from a nominal position. Since the conveyance cover **150** supports the driven rollers of the conveyance roller pairs **14**, **41**, and **42**, the stability of conveyance of sheets will deteriorate if the position of the conveyance cover **150** deviates from the nominal position.

In contrast, in the present embodiment, only one handle **70** is disposed in the substantially central portion of the conveyance cover **50** in the width direction W, as illustrated in FIGS. **4**B and **5**. FIG. **5** is a perspective view illustrating the apparatus body **1**A that is in a state where the conveyance cover **50** is detached from the apparatus body **1**A. As can be seen, the holding portion **70***h* of the handle **70** has a width W**2** that is sufficient for a user to hold the holding portion **70***h* for carrying the apparatus body **1**A of the image forming apparatus **1**.

As described above, the first shaft portion **70***a* and the second shaft portion **70***b*, which pivotally support the conveyance cover **50**, are respectively disposed on the first end surface **70***c* and the second end surface **70***d* of the handle **70**. Thus, even in a state where the handle **70** has the width W**2**, it is possible to secure a shaft-to-shaft distance L**2** between the first shaft portion **70***a* and the second shaft portion **70***b* in the width direction W. The shaft-to-shaft distance L**2** is larger than the shaft-to-shaft distance L**1**.

FIG. **6** is a front view of the conveyance cover **50** closed with respect to the apparatus body **1** and viewed from the apparatus body **1**A side. As illustrated in FIG. **6**, the conveyance cover **50** has a width L**50** in the width direction W. In addition, the conveyance cover **50** has a conveyance guide **52**, which constitutes a part of the duplex conveyance path CP (see FIG. **1**). The duplex conveyance path CP is a conveyance path through which the sheet S, conveyed by the reversing roller pair **33** that serves as a conveyance portion, passes. The conveyance guide **52** has a width Lp, which is the length of the conveyance guide **52** in the width direction W. Note that the conveyance guide **52** may be formed integrated with the conveyance cover **50**, or may be a separate member different from the conveyance cover **50**.

The above-described shaft-to-shaft distance L**2** of the present embodiment is set equal to or larger than two thirds of the width L**50** of the conveyance cover **50**. In addition, the shaft-to-shaft distance L**2** is larger than the width Lp of the conveyance guide **52**. Since the shaft-to-shaft distance L**2** is set longer as much as possible, the misalignment of the

conveyance cover **50** produced in the attachment of the conveyance cover **50** have less affect on the inclination of the conveyance cover **50** with respect to the pivot axis **50**R. As a result, it becomes possible to improve the operational feeling that a user feels when opening and closing the conveyance cover **50**. In addition, it becomes possible to suppress the deviation of the position of the conveyance cover **50** from a nominal position, and improve the stability of conveyance of sheets.

In addition, in the present embodiment, the first shaft portion **70***a* is disposed on a lower edge portion of the first end surface **70***c* of the handle **70**, and the second shaft portion **70***b* is disposed on a lower edge portion of the second end surface **70***d*. With this arrangement, it is possible to dispose the pivot axis **50**R of the conveyance cover **50** in a lower edge portion of the handle **70** and in a lower edge portion of the image forming apparatus **1**. Thus, the opening formed when the conveyance cover **50** is opened can be made larger. As a result, it becomes possible to improve the maintainability, which is necessary for a user to perform the jam handling, the replacement of a process cartridge, the maintenance of the interior of the apparatus body **1**A, and the like.

Furthermore, in the present embodiment, since the handle **70** is not divided into two members and is a single member, boundary lines between components can be made simple in the right side surface of the image forming apparatus **1**. More specifically, as illustrated in FIG. **4**B, since a boundary line **70**L between the handle **70** and the conveyance cover **50** is a single continuous line, the external appearance of the image forming apparatus **1** can be improved. In addition, since the number of components is made smaller than that in the configuration in which two handles are disposed, the cost can be reduced.

Lock Mechanism

Next, a lock mechanism will be described. The lock mechanism causes the apparatus body **1**A to hold the conveyance cover **50** in a state where the conveyance cover **50** is closed. As illustrated in FIG. **7**, a conveyance guide **81** is fixed to the frame **80** of the apparatus body **1**A. The conveyance guide **81** constitutes a part of the duplex conveyance path CP (see FIG. **1**), and guides the sheet S. The conveyance guide **81** serves as a locked member, and includes hook portions **81***a* and **81***b*.

In addition, as illustrated in FIG. **8**, the conveyance guide **52** is fixed to the conveyance cover **50**. The conveyance guide **52** constitutes a part of the duplex conveyance path CP (see FIG. **1**), and supports a locking member **53** such that the locking member **53** can move. The conveyance guide **52** includes a guide surface **52***a* that guides the sheet S. The locking member **53** includes locking hole portions **53***a* and **53***b* that can respectively engage with the hook portions **81***a* and **81***b* disposed in the conveyance guide **81** of the apparatus body **1**A.

More specifically, the locking member **53** can move between a locking position (see FIG. **9**A) and an unlocking position (see FIG. **9**B), with respect to the conveyance guide **52**. When the locking member **53** is located at the locking position, the locking hole portions **53***a* and **53***b* engage with the hook portions **81***a* and **81***b*, and the locking member **53** locks the conveyance cover **50** on the apparatus body **1**A. When the locking member **53** is located at the unlocking position, the locking hole portions **53***a* and **53***b* are separated from the hook portions **81***a* and **81***b*, and the locking member **53** allows the conveyance cover **50** to be opened and closed with respect to the apparatus body **1**A.

Next, with reference to FIG. **2** and FIGS. **9**A and **9**B, a more detailed configuration of the lock mechanism will be described. As illustrated in FIGS. **2**A and **9**A, the conveyance cover **50** supports the handle **51**, which serves as a cover member, such that the handle **51** can pivot on an opening-and-closing axis **51***c* and can be opened and closed. More specifically, the handle **51** has an exterior surface **51***a* that constitutes a part of the exterior of the image forming apparatus **1**. The handle **51** can move between a first position illustrated in FIG. **9**A, and a second position illustrated in FIG. **9**B. When the handle **51** is located at the first position, the exterior surface **51***a* is flush with the exterior surface **50***d* of the conveyance cover **50**. If a user presses the exterior surface **51***a*, the handle **51** is pushed inward, and moved from the first position to the second position. At the first position, the handle **51** covers a below-described holding portion **50***h*.

The handle **51** is urged, clockwise in FIG. **9**A, by a spring **55** toward the first position. An abutment surface **51***b* formed on the handle **51** abuts against the conveyance cover **50**, so that the handle **51** is positioned at the first position.

The conveyance guide **52** of the conveyance cover **50** is provided with a slide guide **52**S that extends in a vertical direction VD. The locking member **53** includes a slide rib **53**R that can engage with the slide guide **52**S. The locking member **53** is supported such that the engagement between the slide guide **52**S and the slide rib **53**R allows the locking member **53** to slide with respect to the conveyance guide **52** in the vertical direction VD. The locking member **53** is urged by a spring **54**, which serves as an urging member, toward the above-described locking position, and is positioned at the locking position by a stopper (not illustrated).

Next, with reference to FIGS. **9**A to **10**B, the operation of the handle **51**, the locking member **53**, and the conveyance cover **50** will be described. As illustrated in FIG. **9**A, in a state where the conveyance cover **50** is closed with respect to the apparatus body **1**A, the handle **51** is positioned at the first position, and the locking member **53** is positioned at the locking position.

As illustrated in FIGS. **9**A and **9**B, when a user opens the conveyance cover **50** with respect to the apparatus body **1**A, the user presses the exterior surface **51***a* of the handle **51** with a finger. With this operation, the handle **51** pivots counterclockwise on the opening-and-closing axis **51***c* against the urging force of the spring **55**, and moves from the first position to the second position. After that, the user can access the holding portion **50***h* disposed above the handle **51** and inside the conveyance cover **50**. Thus, the user can hook a finger to the holding portion **50***h*, which serves as a second holding portion, and hold the holding portion **50***h*.

While the handle **51** moves from the first position to the second position, the handle **51** presses the locking member **53** downward against the urging force of the spring **54**. With this operation, the locking member **53** slides to the unlocking position, as illustrated in FIG. **9**B. Since the locking member **53** is pushed downward from the locking position to the unlocking position, the hook portions, **81***a* and **81***b*, and the locking hole portions, **53***a* and **53***b*, are disengaged from each other, and the conveyance cover **50** is allowed to be opened and closed with respect to the apparatus body **1**A.

As described with reference to FIG. **1**, the conveyance cover **50** rotatably supports the driven roller **14***k*, and in a state where the conveyance cover **50** is closed, the driven roller **14***k* is urged by the spring **43** so as to be in pressure contact with the driving roller **14***r*. In addition, the driven roller **14***k* receives a reaction force, due to an urging force of

the spring **43**, from the driving roller **14***r* in a direction in which the conveyance cover **50** is opened.

As illustrated in FIG. **9**B, when the locking member **53** moves to the unlocking position, the conveyance cover **50** is moved with respect to the apparatus body **1**A and opened, by the above-described reaction force. With this operation, the conveyance cover **50** is moved to the open position and opened, as illustrated in FIG. **2**B. Note that a user may move the conveyance cover **50** to the open position for opening the conveyance cover **50**, while holding the holding portion **50***h*, after pressing and moving the handle **51** from the first position to the second position.

When a user closes the conveyance cover **50** with respect to the apparatus body **1**A, the user holds one portion of the conveyance cover **50** and pivots the conveyance cover **50** toward the closing direction, on the pivot axis **50**R (see FIG. **2**B), as illustrated in FIG. **10**B. As a result, the locking member **53** abuts against sloped surfaces **81***c* and **81***d* of the hook portions **81***a* and **81***b*. The sloped surfaces **81***c* and **81***d* are sloped such that as the sloped surfaces **81***c* and **81***d* extend closer to the photosensitive drum **22** (see FIG. **1**) in the horizontal direction, the sloped surfaces **81***c* and **81***d* extend more downward in the vertical direction VD.

If the conveyance cover **50** is further closed in this state, the locking member **53** is pressed downward by the sloped surfaces **81***c* and **81***d* against the urging force of the spring **54**. If the edge portion of the locking member **53** climbs over the sloped surfaces **81***c* and **81***d*, and the hook portions, **81***a* and **81***b*, and the locking hole portions, **53***a* and **53***b*, engage with each other, the locking member **53** is pushed upward to the locking position by the urging force of the spring **54**. With this operation, the conveyance cover **50** is locked in a state where the conveyance cover **50** is closed with respect to the apparatus body **1**A.

Since the lock mechanism is configured in this manner, the handle **51** is flush with the exterior surface **50***d* of the conveyance cover **50** when located at the first position and applied with no external force. Thus, the right side surface of the image forming apparatus **1** has no projecting and recess portions to open the conveyance cover **50**, so that the external appearance can be improved.

In addition, as illustrated in FIG. **9**A, the locking member **53** is disposed in a space SP formed between the guide surface **52***a* of the conveyance guide **52** and the exterior surface **50***d* of the conveyance cover **50** in the horizontal direction. Since the image forming apparatus **1** is required to be downsized, the space SP needs to be made smaller. For this reason, in the present embodiment, the locking member **53** is configured to slide and move in the vertical direction VD. Thus, the locking member **53** can be disposed in the small space SP, and the amount of engagement between the locking hole portions, **53***a* and **53***b*, and the hook portions, **81***a* and **81***b*, in the vertical direction VD can be maximized. That is, the downsizing of the lock mechanism and the image forming apparatus **1**, and the reliable lock of the conveyance cover **50** to the apparatus body **1**A can be both achieved.

Furthermore, in the present embodiment, when a user moves the handle **51** from the first position to the second position, the locking member **53** moves to the unlocking position in accordance with the movement of the handle **51**, and the conveyance cover **50** is automatically opened by the urging force of the spring **43**. Thus, the need for troublesome operation for opening the conveyance cover **50** can be eliminated, so that the usability can be improved. In addition, since a user can intuitively hold the holding portion **50***h* that appears simultaneously when the user pushes and opens the handle **51**, the user can open the conveyance cover **50** while holding the holding portion **50***h*. As a result, the shock caused when a user opens the conveyance cover **50** can be reduced.

Manual-Feed Conveyance Portion

Next, a lock configuration of side regulation plates **103** and **104** of the manual-feed conveyance portion **2** will be described. As illustrated in FIGS. **1** and **11**, the manual-feed conveyance portion **2**, which serves as a sheet support apparatus, includes a pickup arm **16***a* and a pickup roller **16**. The pickup roller **16** is supported by the pickup arm **16***a* so as to be able to move up and down. In addition, the manual-feed conveyance portion **2** includes a manual feed cover **101**, a manual feed tray **102**, tray links **121** and **122**, and the side regulation plates **103** and **104**. The manual feed tray **102** serves as a sheet support portion. The pickup roller **16** feeds the sheet S stacked on the manual feed tray **102**, in a feeding direction FD.

The manual feed cover **101** is supported so as to be opened and closed with respect to the conveyance cover **50**, and constitutes a part of the exterior surface of the apparatus. On the top of the manual feed cover **101**, the manual feed tray **102** is held. The manual feed cover **101** can be positioned at a predetermined degree of opening by the tray links **121** and **122**. One end portion of each of the tray links **121** and **122** is linked to the manual feed tray **102**, and the manual feed tray **102** can move in accordance with the opening/closing operation of the manual feed cover **101** along the manual feed cover **101**. In this configuration, when the manual feed cover **101** is closed, the manual feed tray **102** is retracted from the pickup arm **16***a* and the pickup roller **16**. Thus, the manual-feed conveyance portion **2** can be downsized.

As illustrated in FIG. **12**, in the manual feed tray **102**, guide grooves Lm**102** and Ln**102** that extend in the width direction W are formed. The side regulation plate **103** is held by the manual feed tray **102** so as to be able to move in the width direction W, along the guide groove Lm**102**. Similarly, the side regulation plate **104**, which serves as a regulation portion, is held by the manual feed tray **102** so as to be able to move in the width direction W, along the guide groove Ln**102**.

As illustrated in FIG. **13**, the side regulation plates **103** and **104** are respectively provided with rack-and-gear portions **103**R and **104**R, which extend in the width direction W. In addition, a pinion gear **200** that meshes with the rack-and-gear portions **103**R and **104**R is rotatably supported by the bottom portion of the manual feed tray **102**. Thus, the side regulation plates **103** and **104** are linked with each other via the rack-and-gear portions **103**R and **104**R and the pinion gear **200**, and move together so as to move in directions opposite to each other in the width direction W.

One direction in the width direction W is defined as a first direction WD**1**, and a direction opposite to the first direction WD**1** is defined as a second direction WD**2**. That is, the first direction WD**1** and the second direction WD**2** are orthogonal to the feeding direction FD. For example, the side regulation plates **103** and **104** move together such that if the side regulation plate **103** is moved by a user toward the first direction WD**1**, the side regulation plate **104** moves toward the second direction WD**2**. The side regulation plate **103** includes a regulation surface **103***a* that regulates the position of a downstream edge of the sheet S stacked on the manual feed tray **102**. The downstream edge is an edge of the sheet S, located downstream in the second direction WD**2**. The side regulation plate **104** includes a regulation surface **104***a* that regulates the position of a downstream edge of the sheet

S stacked on the manual feed tray **102**. The downstream edge is an edge of the sheet S, located downstream in the first direction WD**1**.

For example, by a user operating the side regulation plate **104**, both edge portions of the sheet S (stacked on the manual feed tray **102**), located in the width direction W, are nipped by the regulation surfaces **103***a* and **104***a*, so that the position of the sheet S in the width direction W is regulated. The manual-feed conveyance portion **2** is provided with a brake mechanism **106**, which serves as a brake unit that generates frictional force (brake force) for preventing the movement of the side regulation plate **104**.

Brake Mechanism

Next, a configuration of the brake mechanism **106** will be described with reference to FIGS. **14** to **16**. As illustrated in FIGS. **14** to **16**, the brake mechanism **106** includes a brake member **107**, a spring **108**, a brake wall **102***la*, a rail wall **102***lb*, a brake piece **109**, and a brake release lever **105**.

The side regulation plate **104** includes a shaft portion **104***s* that engages with a hole portion **107***a* of the brake member **107**. Thus, the brake member **107** is supported so as to be able to pivot on the shaft portion **104***s* of the side regulation plate **104**. The brake wall **102***la* and the rail wall **102***lb* are disposed on the manual feed tray **102**, and extend in the width direction W. Note that the brake wall **102***la* and the rail wall **102***lb* are disposed, shifted from each other in the sheet conveyance direction.

The brake member **107** includes a brake surface **107***r* that can abut against the brake wall **102***la*, a circumferential surface **107***e* that is formed around the hole portion **107***a*, a long hole **107***g* that is formed around the hole portion **107***a* and extending like an arc, and a release surface **107***p*. The brake member **107** is urged by an urging force of the spring **108**, which serves as a brake urging portion, toward a direction indicated by an arrow R**3** around the shaft portion **104***s*; and the brake surface **107***r* is pressed against the brake wall **102***la*.

As illustrated in FIG. **15**, the brake piece **109** is sandwiched between the manual feed tray **102** and the brake member **107** in the thickness direction of the brake piece **109**. The brake piece **109** includes a circumferential surface **109***e* that engages with the circumferential surface **107***e* of the brake member **107**, and a slide surface **109***a* that can slide on the rail wall **102***lb*.

The spring **108** produces the contact force applied between the brake surface **107***r* and the brake wall **102***la*, and the reaction force of the contact force produces the nipping force that causes the circumferential surface **107***e* of the brake member **107** and the rail wall **102***lb* to nip the brake piece **109**. In other words, the brake member **107** and the brake piece **109** are nipped between the brake wall **102***la* and the rail wall **102***lb*.

The brake member **107**, the spring **108**, the brake piece **109**, and the brake release lever **105** are arranged so as to move together with the side regulation plate **104**, in the width direction W. However, if the brake piece **109** is nipped by the circumferential surface **107***e* of the brake member **107** and the rail wall **102***lb*, the brake piece **109** applies brake force so that the side regulation plate **104** does not move in the width direction W.

Note that since the brake wall **102***la* and the rail wall **102***lb* extend in the width direction W, the brake mechanism **106** can apply the brake force to the side regulation plate **104**, regardless of the position of the side regulation plate **104** in the width direction W.

As illustrated in FIGS. **14** to **16**, the brake release lever **105**, which serves as a brake release member, is pivotally supported by the side regulation plate **104**. The brake release lever **105** includes a shaft **105***s*, a holding portion **105***a*, and a release portion **105***p*. The shaft **105***s* is disposed on the pivot axis of the brake release lever **105**, and loosely fits in the long hole **107***g* of the brake member **107**.

For releasing the brake of the side regulation plate **104**, a user pivots the brake release lever **105** on the shaft **105***s*, toward a direction indicated by an arrow R**1** (see FIG. **12**), by operating the holding portion **105***a*. As a result, the release portion **105***p* abuts against the release surface **107***p* of the brake member **107**. If the brake release lever **105** is further pivoted, in this state, toward the direction indicated by the arrow R**1**, the brake member **107** pivots on the shaft portion **104***s*, toward a below-described brake release position (see FIG. **17**B). When the brake release lever **105** is positioned at the brake release position, the brake of the side regulation plate **104** applied by the brake mechanism **106** is released.

Operation of Brake Mechanism

Next, an operation of the brake mechanism **106** will be described more specifically with reference to FIGS. **17**A to **17**C. As described above, the brake mechanism **106** of the present embodiment can release the brake force applied to the side regulation plate **104**, by a user operating the brake release lever **105**. In addition, in a state where the brake release lever **105** is not operated by a user, the operation of the brake mechanism **106** performed when the external force is applied to the side regulation plate **104** in the first direction WD**1** is different from the operation of the brake mechanism **106** performed when the external force is applied to the side regulation plate **104** in the second direction WD**2**. Hereinafter, the operation of the brake mechanism **106** performed when the external force is applied to the side regulation plate **104** in the first direction WD**1**, and the operation of the brake mechanism **106** performed when the external force is applied to the side regulation plate **104** in the second direction WD**2** will be described sequentially.

First, with reference to FIG. **17**A, the operation of the brake mechanism **106** performed when the external force is applied to the side regulation plate **104** in the first direction WD**1**, in a state where the brake release lever **105** is not operated by a user, will be described. As one example, the case where the external force is applied to the side regulation plate **104** in the first direction WD**1** is a case where the regulation surface **104***a* of the side regulation plate **104** receives force from the sheet S when the sheet S stacked on the manual feed tray **102** is fed by the pickup roller **16**. As another example, the case where the external force is applied to the side regulation plate **104** in the first direction WD**1** is a case where a user tries to manually move the side regulation plate **104** in the first direction WD**1**.

As illustrated in FIG. **17**A, if the external force tries to move the side regulation plate **104** toward the first direction WD**1**, a frictional force F**1** that serves as a second frictional force is produced. The frictional force F**1** is brake force produced between the brake surface **107***r* of the brake member **107** and the brake wall **102***la*. When the frictional force F**1** is produced, the brake surface **107***r* exerts a normal force N**1** on the brake wall **102***la*. The frictional force F**1** and the normal force N**1** are expressed by the following computational equation.

$$F1=\mu\times N1 \quad (1)$$

$$N1=F1\times\tan\theta a+(Fsp\times Rsp)/(R107\times\cos\theta a) \quad (2)$$

μ: a coefficient of friction between the brake surface **107***r* and the brake wall **102***la*

θa: an angle between a straight line LN**1** and the brake wall **102***la*, where the straight line LN**1** passes through a contact point P**1** between the brake surface **107***r* and the brake wall **102***la* and a center P**2** of the shaft portion **104***s*

R107: a distance between the contact point P**1** and the center P**2**

Fsp: a force produced by the spring **108**

Rsp: a radius in the rotation moment that the spring **108** gives the brake member **107**

From the above-described equations (1) and (2), the frictional force F**1** that is the brake force is expressed by the following equation (3).

$$F1=[\mu\times(Fsp\times Rsp)/(R107\times\cos\theta a)]/(1-\mu\times\tan\theta a) \quad (3)$$

From equation (3), it is understood that even when the coefficient of friction and the force Fsp produced by the spring **108** have small values, the frictional force F**1** has a relatively large value if the angle θa has a value near 90 degrees. For example, if is 0.3, R107 is 20 mm, Fsp is 150 gf, Rsp is 20 mm, and θa is 70 degrees, the frictional force F**1** is 748.5 gf. Thus, even if the external force is applied to the side regulation plate **104** in the first direction WD**1**, the frictional force F**1** can sufficiently hold the side regulation plate **104** so that the side regulation plate **104** does not move.

As is clear from the above-described equations (1) and (2), the frictional force F**1** includes a force, F**1**×tan θa, which is applied as the brake surface **107***r* bites into the brake wall **102***la*. For example, if a user tries to move the side regulation plate **104** toward the first direction WD**1** while the contact point P**1** hardly moves due to the frictional force F**1**, the angle θa increases. Note that the angle θa is larger than 0 degrees and smaller than 90 degrees. If a user tries to move the side regulation plate **104** toward the first direction WD**1**, the force, F**1**×tan θa, increases, increasing the frictional force F**1**. In other words, the frictional force F**1** increases as the side regulation plate **104** moves more downstream in the first direction WD**1** in a state where the brake surface **107***r* is in contact with the brake wall **102***la*.

Thus, even if the sheet S presses the regulation surface **104***a* of the side regulation plate **104** for example, the position of the side regulation plate **104** is kept by the brake mechanism **106**, so that the failure in conveyance of sheets, such as skew of sheets, can be reduced.

Next, with reference to FIG. **17**B, the operation of the brake mechanism **106** performed when a user tries to move the side regulation plate **104** toward the first direction WD**1** while pivoting the brake release lever **105** toward the direction indicated by the arrow R**1** will be described. If a user operates and pivots the brake release lever **105** toward the direction indicated by the arrow R**1** (see FIG. **12**), the brake member **107** pivots and moves to the brake release position, as illustrated in FIG. **17**B.

As a result, the brake surface **107***r* of the brake member **107** is separated from the brake wall **102***la* of the manual feed tray **102**, and the above-described frictional force F**1** disappears. Thus, the user can move the side regulation plate **104** toward the first direction WD**1**, with weak force in a state where the frictional force F**1** is not produced. In addition, even when the user tries to move the side regulation plate **104** toward the second direction WD**2** while pivoting the brake release lever **105** toward the direction indicated by the arrow R**1**, the frictional force F**1** is not produced.

Next, with reference to FIG. **17**C, the operation of the brake mechanism **106** performed when the external force is applied to the side regulation plate **104** in the second direction WD**2**, in a state where the brake release lever **105** is not operated by a user, will be described. For example, the case where the external force is applied to the side regulation plate **104** in the second direction WD**2** is a case where a user tries to manually move the side regulation plate **104** toward the second direction WD**2**.

As illustrated in FIG. **17**C, if the external force tries to move the side regulation plate **104** toward the second direction WD**2**, a frictional force F**2** that serves as a first frictional force is produced. The frictional force F**2** is brake force produced between the brake surface **107***r* and the brake wall **102***la*. When the frictional force F**2** is produced, the brake surface **107***r* exerts a normal force N**2** on the brake wall **102***la*. The frictional force F**2** and the normal force N**2** are expressed by the following computational equation.

$$F2=\mu\times N2 \quad (4)$$

$$N2=(Fsp\times Rsp)/(R107\times\cos\theta a) \quad (5)$$

From the above-described equations (4) and (5), the frictional force F**2** that is the brake force is expressed by the following equation (6).

$$F2=\mu\times(Fsp\times Rsp)/(R107\times\cos\theta a) \quad (6)$$

If a user tries to move the side regulation plate **104** toward the second direction WD**2**, the brake surface **107***r* behaves so as to separate from the brake wall **102***la*, due to the frictional force F**2**. Thus, as is clear from the above-described equation (6) and is different from the description made with reference to FIG. **17**A, the frictional force F**2** does not include the force, F**1**×tan θa, which is applied as the brake surface **107***r* bites into the brake wall **102***la*.

Similar to the parameters described with reference to FIG. **17**A, if is 0.3, R107 is 20 mm, Fsp is 150 gf, Rsp is 20 mm, and θa is 70 degrees, the frictional force F**2** is 131.5 gf. That is, the above-described frictional force F**1** is larger than the frictional force F**2**. In addition, since the frictional force F**2** does not include the above-described force, F**1**×tan θa, the brake surface **107***r* slides on the brake wall **102***la* and the angle θa is unchanged even if the side regulation plate **104** is moved toward the second direction WD**2**. In other words, even if the side regulation plate **104** is moved downstream in the second direction WD**2** in a state where the brake surface **107***r* is in contact with the brake wall **102***la*, the frictional force F**2** is constant.

Thus, a user can move the side regulation plate **104** toward the second direction WD**2** against the frictional force F**2** with relatively weak force, without moving the brake release lever **105** toward the direction indicated by the arrow R**1**. That is, a user can easily move the side regulation plates **103** and **104** toward a direction in which the side regulation plates **103** and **104** move closer to the sheet S stacked on the manual feed tray **102**. In this manner, a user can easily regulate the position of the sheet Sin the width direction W. Thus, the usability can be improved.

In addition, the brake mechanism **106** of the present embodiment can steplessly regulate the position of the side regulation plate **104** in the width direction W. Thus, the distance between an edge portion of the sheet S in the width direction W and the regulation surface **103***a* of the side regulation plate **103**, and the distance between an edge portion of the sheet S in the width direction and the regulation surface **104***a* of the side regulation plate **104** can be made smaller, so that the sheet S can be positioned with

high accuracy. For example, there is a case in which the size of the sheet S differs from the nominal size of the sheet S due to a tolerance produced in the cutting process of the sheet S. Even in such a case, since the distance between an edge portion of the sheet S in the width direction W and the regulation surface **103***a*, and the distance between an edge portion of the sheet S in the width direction and the regulation surface **104***a* can be minimized, the failure in conveyance of sheets, such as skew of sheets, can be reduced.

Other Embodiments

In the present embodiment, the first shaft portion **70***a* and the second shaft portion **70***b* are disposed in the handle **70**, and the first hole portion **50***a* and the second hole portion **50***b* are disposed in the conveyance cover **50**. However, the present disclosure is not limited to this. For example, the first hole portion and the second hole portion may be disposed in the handle **70**, and the first shaft portion and the second shaft portion, which engage with the first hole portion and the second hole portion, may be disposed in the conveyance cover **50**.

In addition, although the description has been made for the image forming apparatus **1** in the present embodiment, the present invention is not limited to this. For example, the present invention may be applied to a large-capacity feeding deck that can be connected to the image forming apparatus **1**, or to another sheet conveyance apparatus, such as a post-process apparatus, that does not include the image forming portion **20**.

In addition, although the locking member **53** is disposed, in the present embodiment, so as to be able to slide in the vertical direction VD, the present disclosure is not limited to this. For example, the locking member **53** may be pivotally supported by the conveyance guide **52** or another member.

In addition, although the brake mechanism **106** is disposed in the side regulation plate **104** in the present embodiment, the present disclosure is not limited to this. For example, the brake mechanism **106** may be disposed in the side regulation plate **103** or a trailing-edge regulation plate that regulates the position of the trailing edge of the sheet.

In addition, although the brake mechanism **106** produces a predetermined frictional force, in the present embodiment, when the brake mechanism **106** moves toward the second direction WD**2** in a state where the brake release lever **105** is not operated, the present disclosure is not limited to this. That is, the brake mechanism **106** may produce no frictional force when the brake mechanism **106** moves toward the second direction WD**2**, even in a state where the brake release lever **105** is not operated.

In addition, although the brake mechanism **106** is disposed, in the present embodiment, in the side regulation plate **104** of the manual-feed conveyance portion **2**, the present disclosure is not limited to this. For example, the brake mechanism **106** may be disposed in a side regulation plate disposed in the cassette **11**, or may be disposed in a side regulation plate disposed in an auto document feeder (ADF).

In addition, although the description has been made for the electrophotographic image forming apparatus **1** in the present embodiment, the present invention is not limited to this. For example, the present invention may also be applied to an ink-jet image forming apparatus that forms images on sheets by injecting ink from a nozzle.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2022-091005, filed Jun. 3, 2022, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A sheet conveyance apparatus comprising:
- an apparatus body including a conveyance assembly configured to convey a sheet; and
- a door pivotally supported around a pivot axis disposed in a lower portion of the apparatus body such that the door is opened and closed with respect to the apparatus body,
- wherein the apparatus body includes a handle assembly including a first holder used to lift the apparatus body and is disposed inside a width of the door in an axis direction of the pivot axis,
- wherein the handle assembly includes a first engaging section and a second engaging section disposed on the pivot axis,
- wherein the door includes:
  - a first engaged section configured to engage with the first engaging section; and
  - a second engaged section configured to engage with the second engaging section, and
- wherein the door is pivotably supported around the first engaging section and the second engaging section with respect to the handle assembly.

2. The sheet conveyance apparatus according to claim **1**, wherein the first holder is disposed between the first engaging section and the second engaging section in the axis direction.

3. The sheet conveyance apparatus according to claim **1**, wherein the first engaging section is disposed on a first end surface of the handle assembly in the axis direction, and
- wherein the second engaging section is disposed on a second end surface of the handle assembly in the axis direction.

4. The sheet conveyance apparatus according to claim **3**, wherein the first engaging section is disposed on a lower edge portion of the first end surface, and
- wherein the second engaging section is disposed on a lower edge portion of the second end surface.

5. The sheet conveyance apparatus according to claim **1**, wherein the first engaging section and the second engaging section are shaft portions extending in directions that extend away from each other in the axis direction, and
- wherein the first engaged section and the second engaged section are hole portions configured to respectively engage with the first engaging section and the second engaging section.

6. The sheet conveyance apparatus according to claim **1**, wherein a distance between the first engaging section and the second engaging section in the axis direction is equal to or larger than two thirds of a width of the door in the axis direction.

7. The sheet conveyance apparatus according to claim **1**, wherein the door includes a conveyance guide configured to constitute a part of a conveyance path through which a sheet conveyed by the conveyance assembly passes, and
- wherein a distance between the first engaging section and the second engaging section in the axis direction is larger than a length of the conveyance assembly in the axis direction.

8. The sheet conveyance apparatus according to claim **1**, wherein the first holder is recessed with respect to an

exterior surface of the door in a state where the door is closed with respect to the apparatus body.

9. The sheet conveyance apparatus according to claim **1**, wherein the apparatus body includes a lockable assembly,

wherein the door includes:

a second holder configured to be held by a user;

a conveyance assembly configured to constitute a part of a conveyance path through which a sheet conveyed by the conveyance assembly passes;

a cover movably supported by the door between a first position and a second position, the first position being a position at which the cover covers the second holder and is flush with an exterior surface of the door, the second position being a position that allows the user to access the second holder;

a lock configured to move with respect to the conveyance assembly between a locking position and an unlocking position, the locking position being a position at which the lock engages with the lockable assembly so as to lock the door on the apparatus body, the unlocking position being a position at which the lock is separated from the lockable assembly so as to allow the door to be opened and closed with respect to the apparatus body; and

a biasing element configured to urge the door toward a direction in which the door is opened with respect to the apparatus body,

wherein the lock moves from the locking position to the unlocking position in accordance with a movement of the cover from the first position toward the second position, and

wherein the door is opened with respect to the apparatus body by an urging force of the biasing element in a case where the lock moves from the locking position to the unlocking position.

10. The sheet conveyance apparatus according to claim **9**, wherein the lock moves from the locking position to the unlocking position by being pressed by the cover in a case where the cover moves from the first position toward the second position.

11. The sheet conveyance apparatus according to claim **9**, wherein the lock is supported such that the lock is configured to slide with respect to the conveyance assembly between the locking position and the unlocking position.

12. The sheet conveyance apparatus according to claim **9**, wherein the apparatus body includes a first roller,

wherein the sheet conveyance apparatus further includes a second roller that is configured to be rotatably supported by the door, and that is in contact with the first roller in a state where the door is closed with respect to the apparatus body, and

wherein the biasing element is configured to urge the second roller toward the first roller in a state where the door is closed with respect to the apparatus body.

13. An image forming apparatus comprising:

the sheet conveyance apparatus according to claim **1**; and

an image forming portion disposed in the apparatus body and configured to form an image on a sheet conveyed by the sheet conveyance apparatus.

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