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Ito

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(54) **IMAGE FORMING DEVICE**

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G03G 15/00 (2006.01)

(52) **U.S. Cl.** **358/1.13**; 399/408

(58) **Field of Classification Search** 358/1.13
See application file for complete search history.

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(57) **ABSTRACT**

An image forming device includes a scanner swingable between a closed position to close an upper side of a catch tray of a printer and an opened position to open the upper side of the catch tray, a positioning mechanism having a protruding section formed at one of the printer and the scanner and a recessed section formed at the other such that the protruding section is fitted thereinto in the closed position, and a lock mechanism configured with an engagement hole formed at one of the protruding section and the recessed section and an engagement portion formed at the other so as to hold the closed position by engagement therebetween. When the scanner is swung to the closed position, a contact portion of the protruding section contacts a contact portion of the recessed section before the engagement portion contacts the engagement hole or a region around the engagement hole.

11 Claims, 10 Drawing Sheets

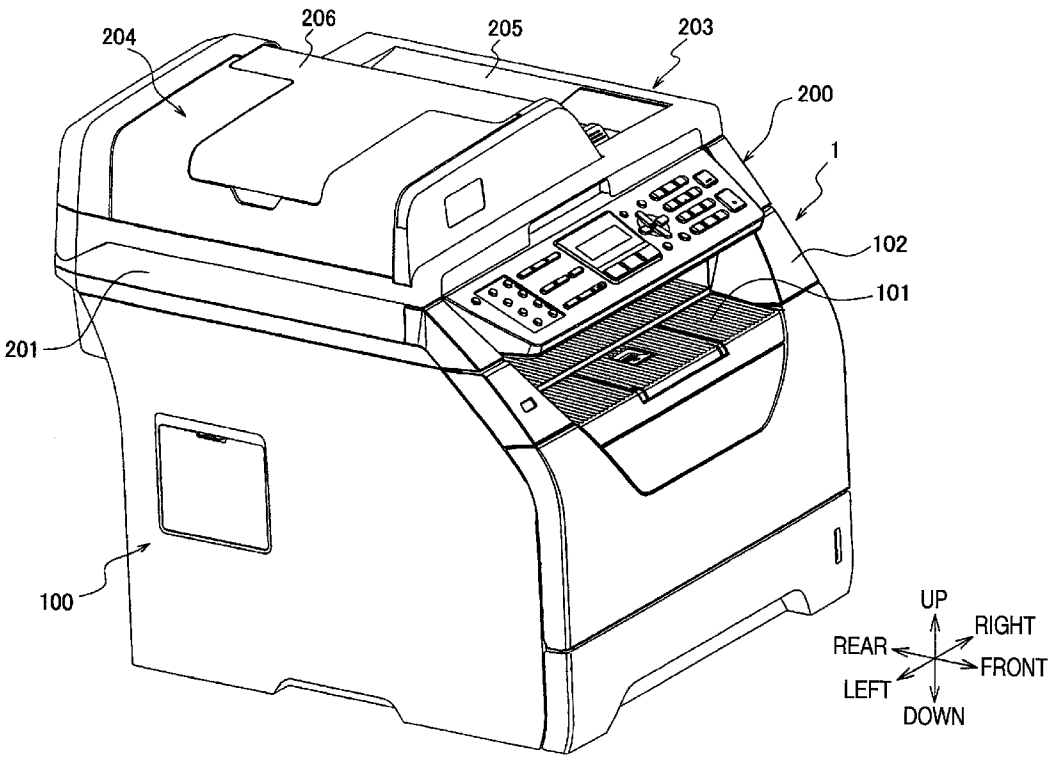
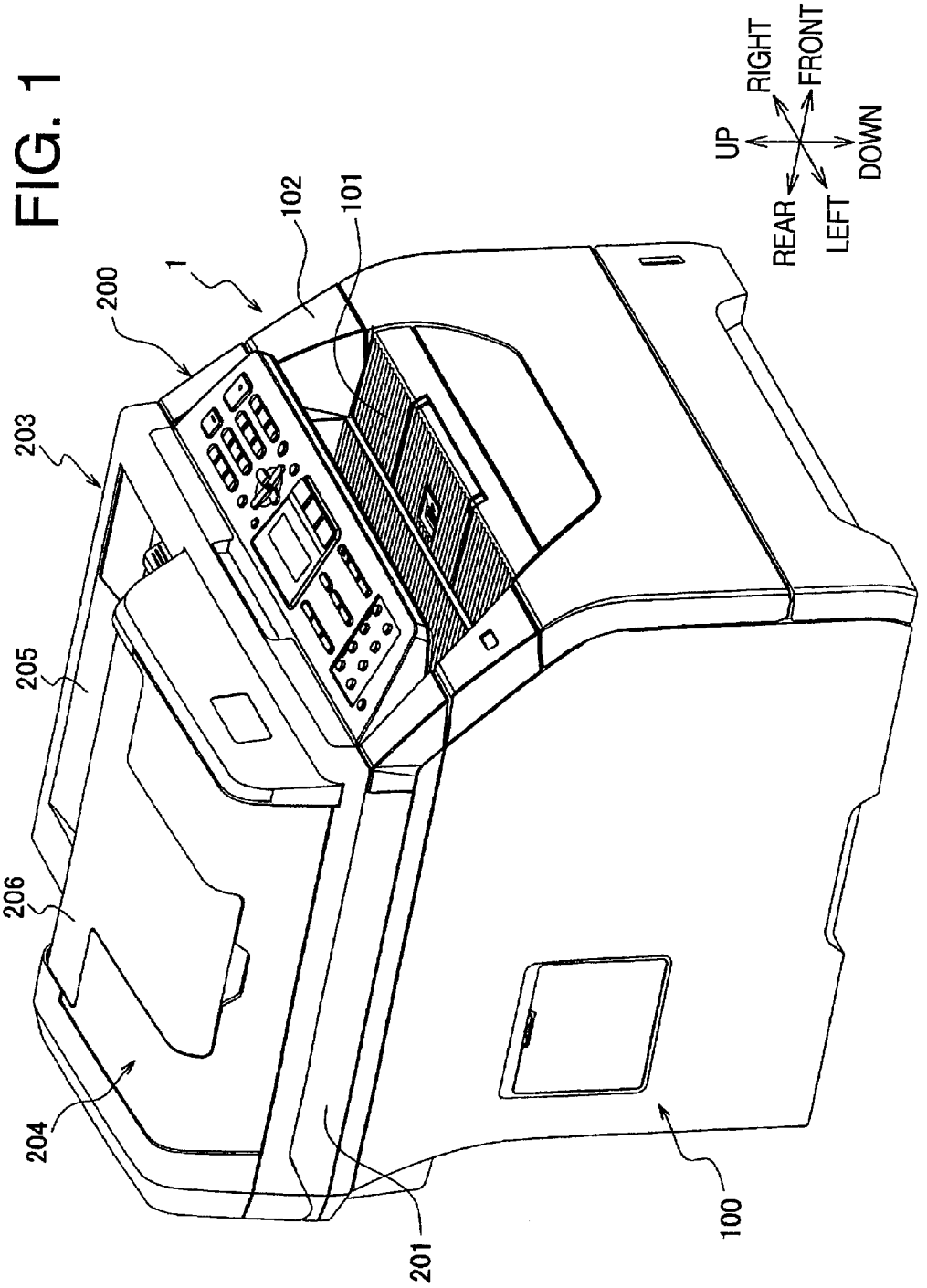


FIG. 1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DOWN
1
200
102
101
203
205
206
204
201
100

FIG. 2

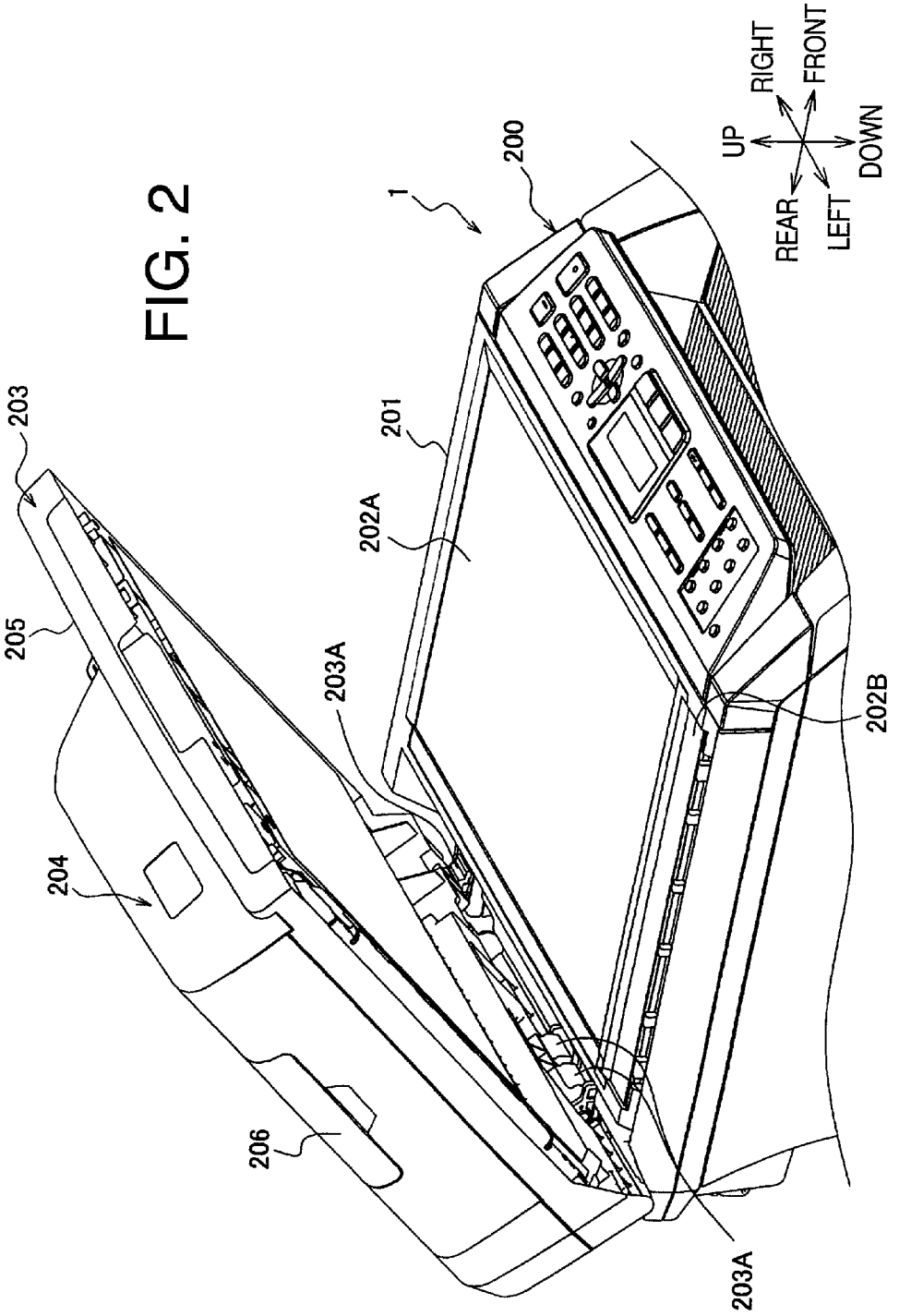
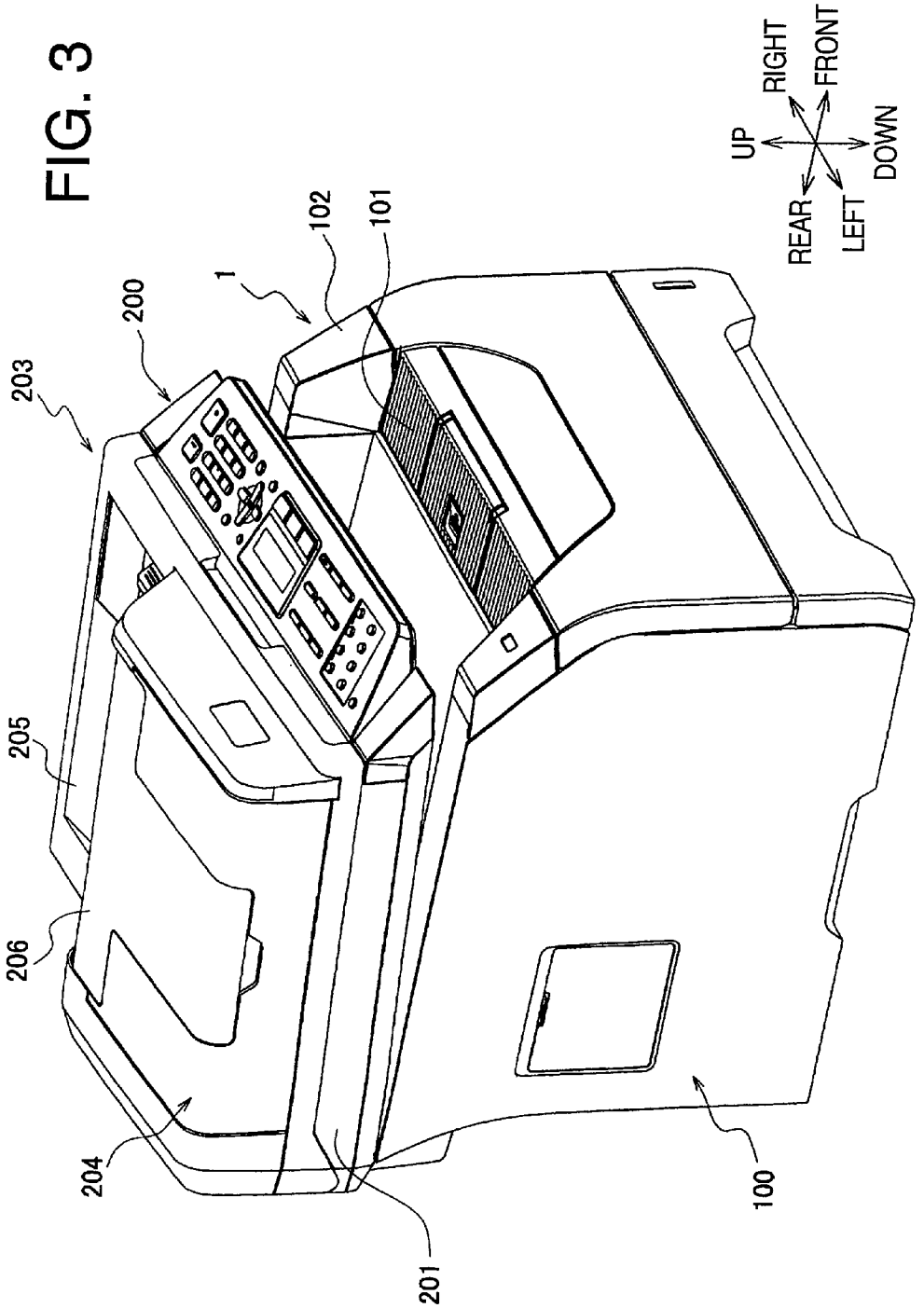

1
200
201
202A
202B
203
203A
203A
204
205
206
UP
RIGHT
FRONT
REAR
LEFT
DOWN

FIG. 3


UP
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DOWN
1
101
102
200
203
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206
204
201
100

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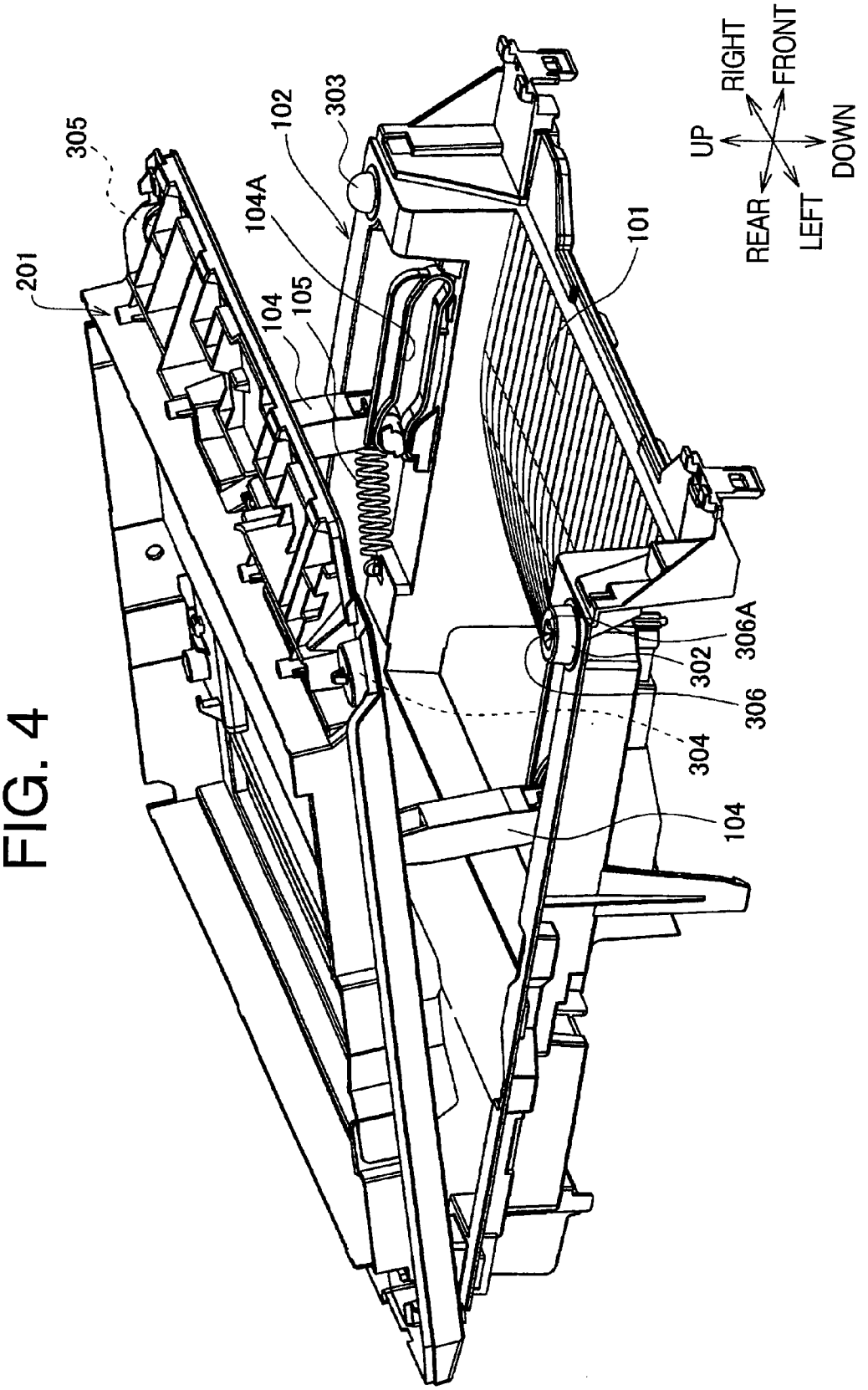

305
102
303
104A
201
104
105
101
UP
RIGHT
FRONT
DOWN
REAR
LEFT
306A
302
306
304
104

FIG. 5

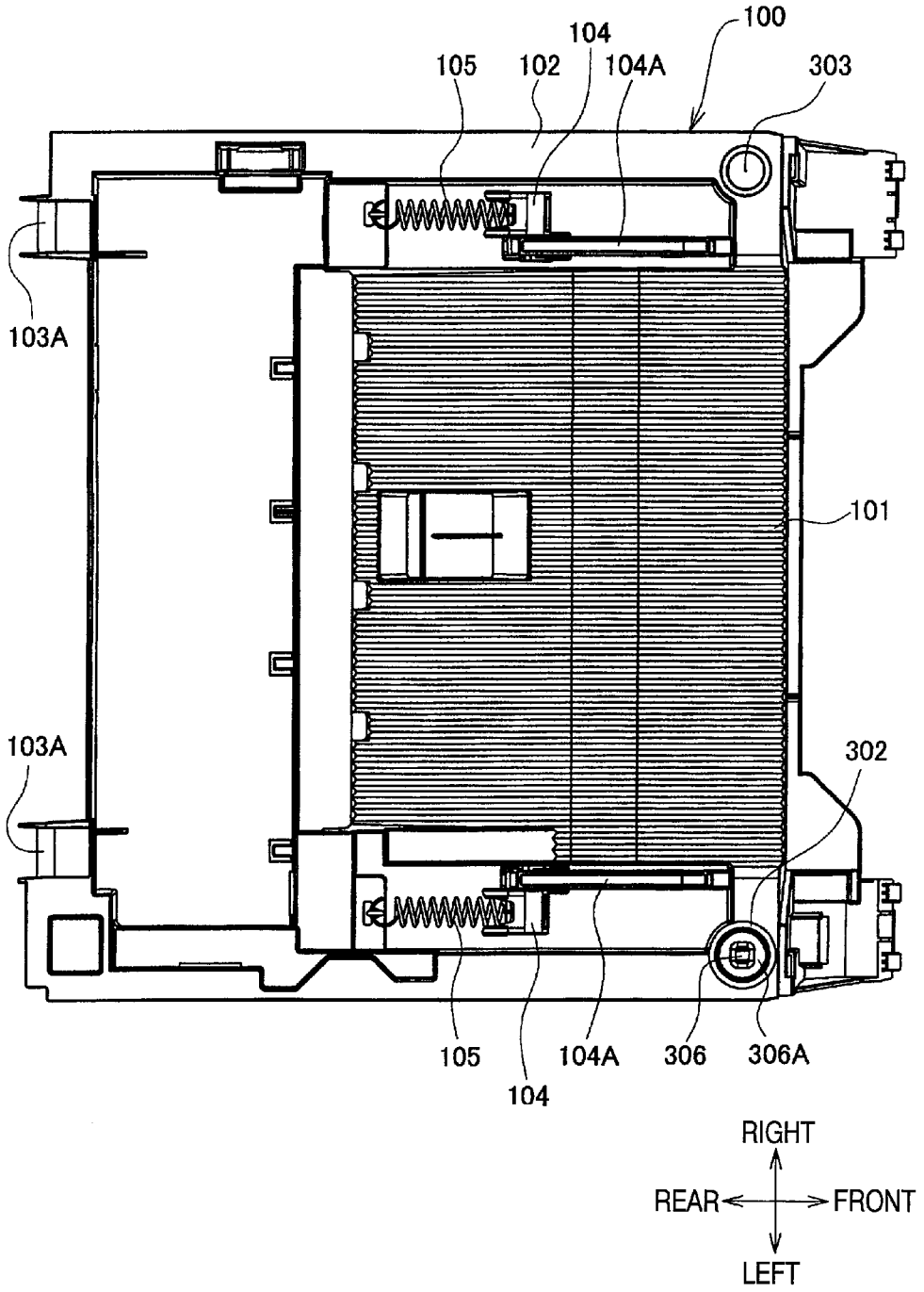
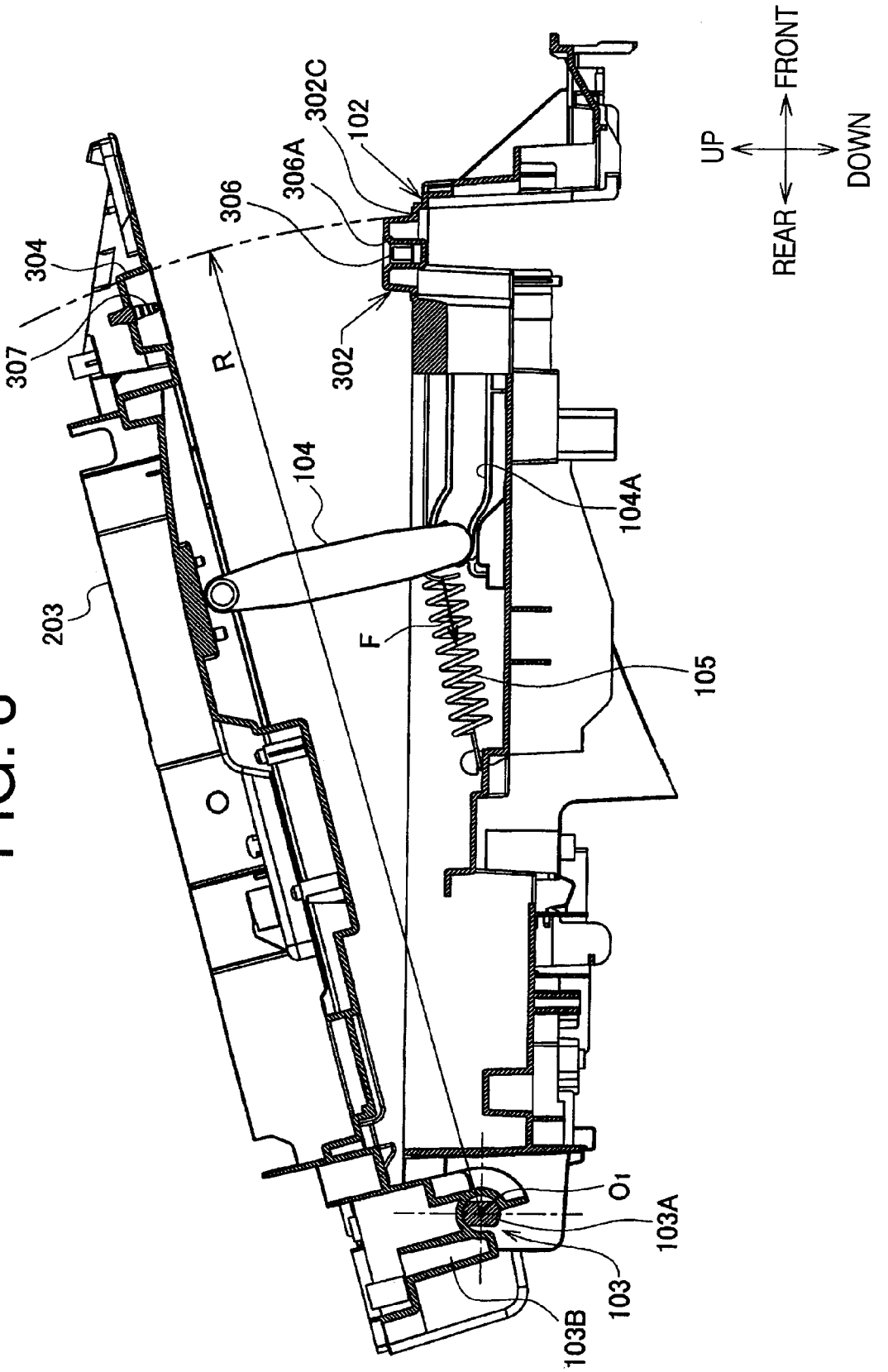
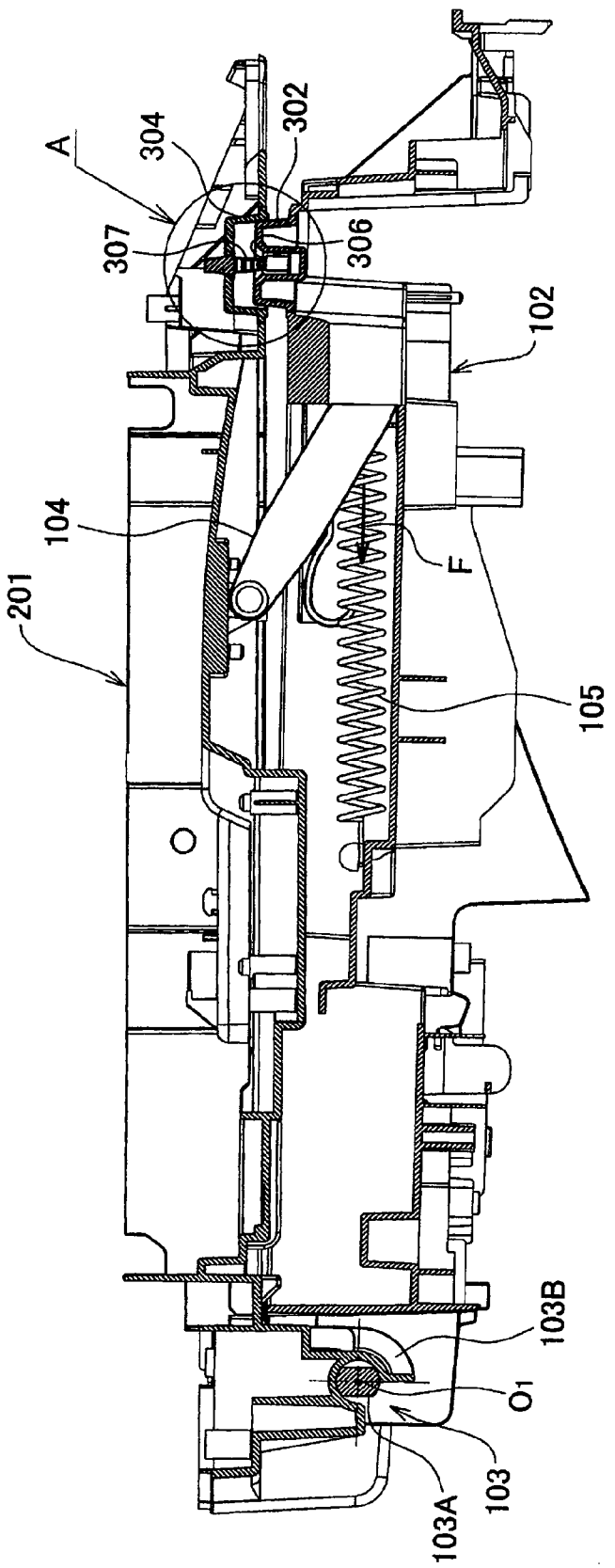

100
104
105
102
104A
303
103A
101
103A
302
105
104A
306
306A
104
RIGHT
REAR
FRONT
LEFT

FIG. 6


UP
FRONT
DOWN
REAR
302C
102
306A
306
304
307
R
302
104
104A
203
F
105
O
O1
103A
103
103B


A
304
302
307
306
102
104
F
201
105
103B
O1
103
103A

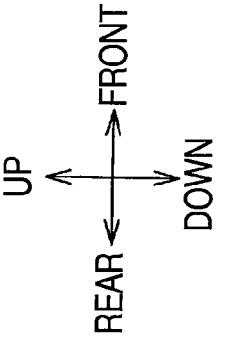
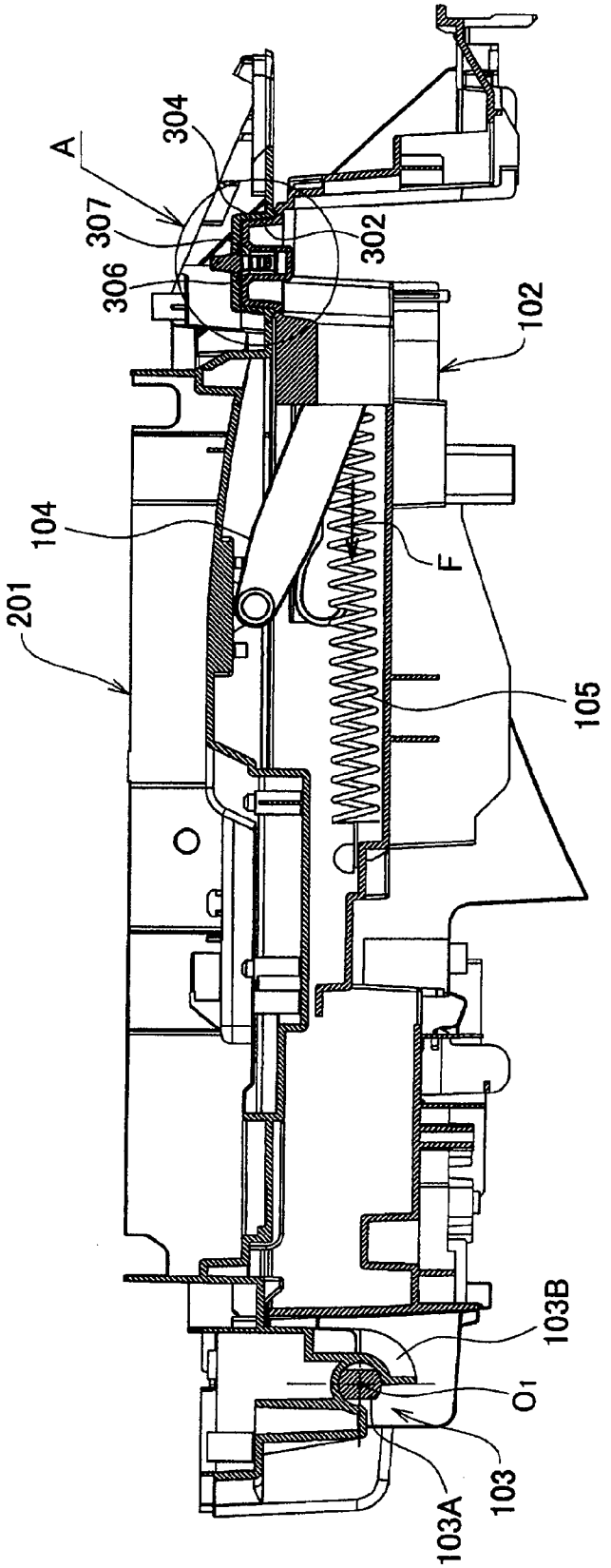

UP
FRONT
REAR
DOWN

FIG. 7


A
304
307
306
302
102
104
201
F
105
O
103B
O1
103
103A

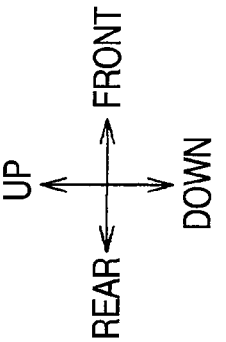

UP
FRONT
REAR
DOWN

FIG. 8

FIG.9B

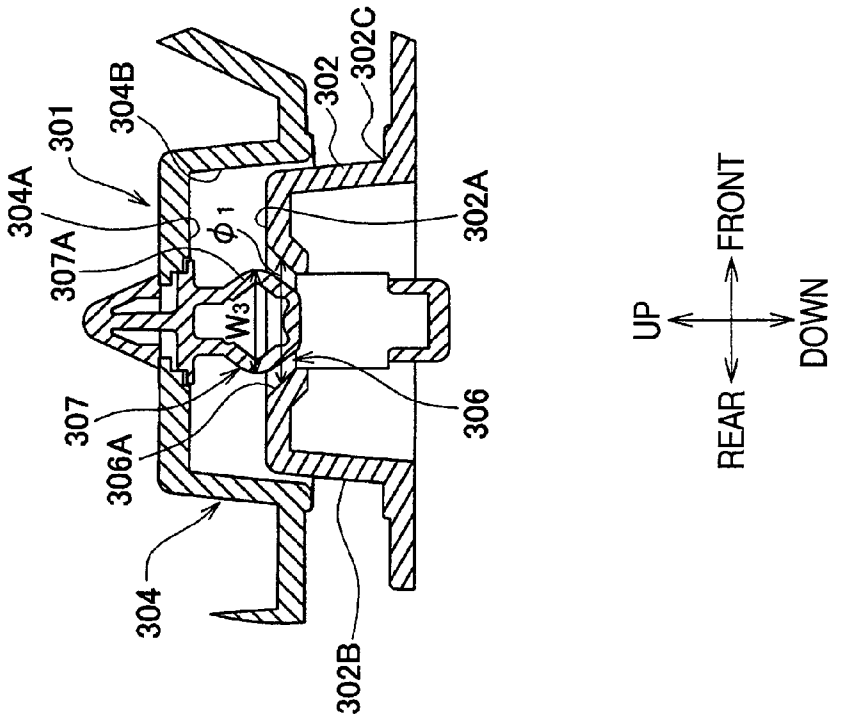

304
307
306A
307A
304A
301
304B
302
302C
302A
306
302B
W3
φ1
UP
FRONT
REAR
DOWN

FIG.9A

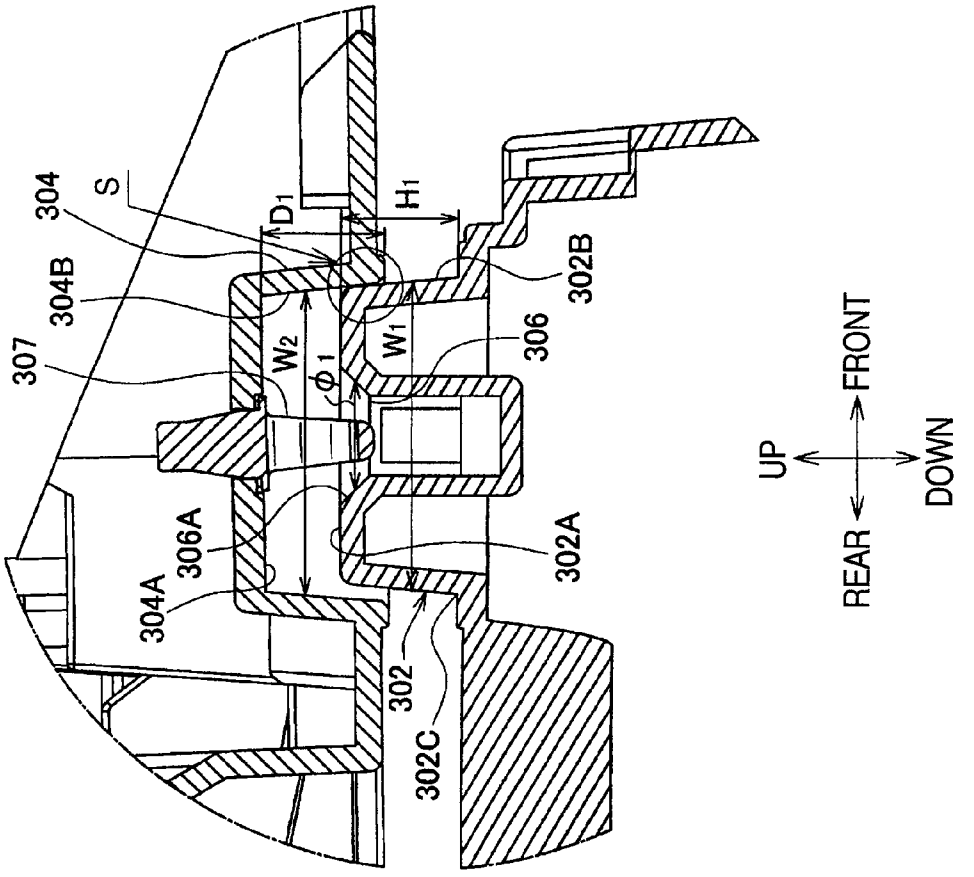

304
S
D1
H1
304B
307
W2
φ1
W1
306
302B
306A
304A
302A
302
302C
UP
FRONT
REAR
DOWN

FIG.10B

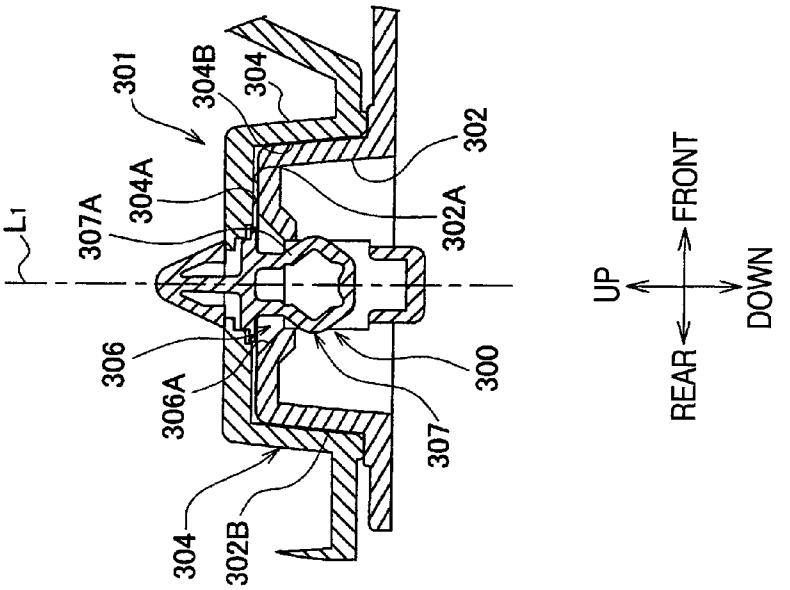


FIG.10A

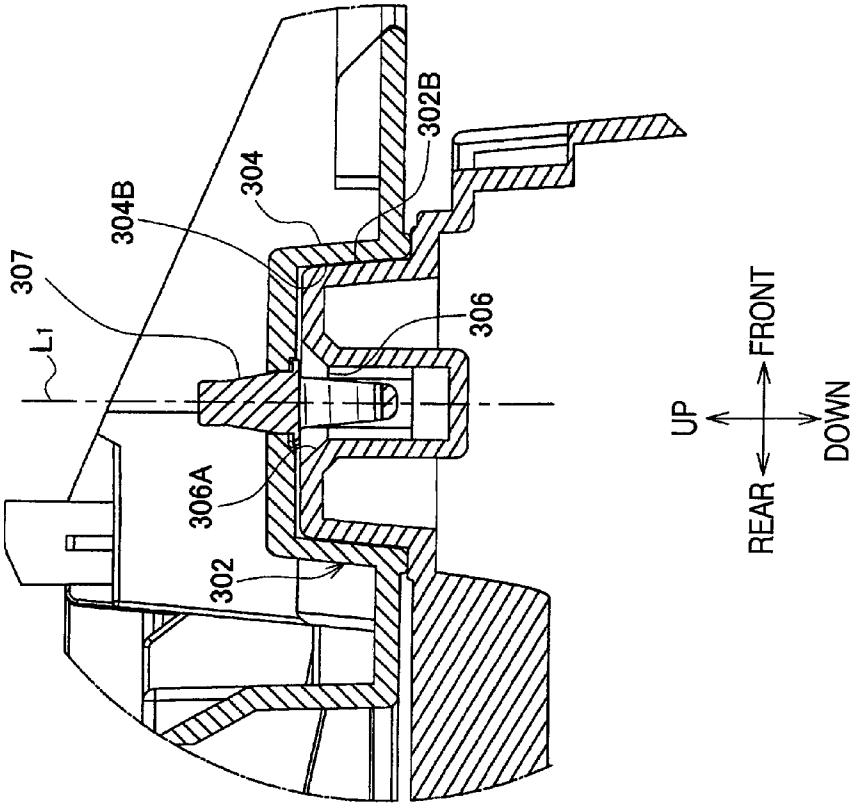


IMAGE FORMING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This application claims priority under 35 U.S.C. §119 from Japanese Patent Application No. 2009-127825 filed on May 27, 2009. The entire subject matter of the application is incorporated herein by reference.

BACKGROUND

1. Technical Field

The following description relates to one or more image forming devices having a scanning unit swingably attached thereto above a printing unit.

2. Related Art

As an example of image forming devices with a scanning unit swingably attached thereto above a printing unit, an image forming device has been known which has a dome-shaped positioning section for positioning the scanning unit relative to the printing unit and a lock member for preventing the scanning unit from being swung so as to be opened when a user operates the scanning unit (e.g., see Japanese Patent Provisional Publication No. 2006-119474).

SUMMARY

According to the aforementioned image forming device, however, when the scanning unit is closed, the lock member collides against the positioning section, and thus might be damaged due to a shock accompanying the collision.

Aspects of the present invention are advantageous to provide one or more improved techniques, for an image forming device with a scanning unit swingably attached thereto above a printing unit, which make it possible to prevent an engagement member such as the lock member from being damaged.

According to aspects of the present invention, an image forming device is provided, which includes a printer configured to form an image on a recording sheet and eject, onto a catch tray thereof, the recording sheet on which the image is formed, a scanner configured to read an image on a document sheet, the scanner being swingable around a swing central axis relative to the printer between a closed position to close and cover an upper side of the catch tray and an opened position to open the upper side of the catch tray, a positioning mechanism including a protruding section formed at one of the printer and the scanner so as to protrude in a protruding direction, and a recessed section formed at a different one of the printer and the scanner so as to be recessed in a recessed direction, the protruding section being configured to be fitted into the recessed section when the scanner is in the closed position, a lock mechanism including an engagement hole formed at one of a distal end of the protruding section and a bottom of the recessed section, and an engagement portion formed at a different one of the distal end of the protruding section and the bottom of the recessed section, the engagement hole and the engagement portion being configured to hold the closed position of the scanner by engagement therebetween, a first contact portion provided to the protruding section, and a second contact portion provided to the recessed section. The first contact portion is configured to, when the scanner is swung from the opened position to the closed position, come into contact with the second contact portion before the engagement portion contacts the engagement hole or a region around the engagement hole.

According to aspects of the present invention, further provided is an image forming device that includes a printer configured to form an image on a recording sheet and eject, onto a catch tray thereof, the recording sheet on which the image is formed, a scanner configured to read an image on a document sheet, the scanner being swingable relative to the printer around a swing central axis disposed lower than a lower end of the protruding section, between a closed position to close and cover an upper side of the catch tray and an opened position to open the upper side of the catch tray, a positioning mechanism that includes a protruding section formed at the printer so as to protrude in a protruding direction, and a recessed section formed at the scanner so as to be recessed in a recessed direction, the protruding section being configured to be fitted into the recessed section when the scanner is in the closed position, a lock mechanism that includes an engagement hole formed at a distal end of the protruding section, and an engagement portion formed at a bottom of the recessed section, the engagement hole and the engagement portion being configured to hold the closed position of the scanner by engagement therebetween, a first contact portion provided to an outer side wall of the protruding section, the outer side wall being formed in a rotational symmetry shape with respect to a central axis parallel to the protruding direction, and a second contact portion provided to an inner side wall of the recessed section, the inner side wall being formed in a rotational symmetry shape with respect to a central axis parallel to the recessed direction. Each of the first contact portion and the second contact portion is formed in an arc shape with a predetermined radius around the swing central axis of the scanner when viewed in a direction parallel to the swing central axis. The first contact portion is configured to, when the scanner is swung from the opened position to the closed position, come into contact with the second contact portion before the engagement portion contacts the engagement hole or a region around the engagement hole.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

FIG. **1** is a perspective view showing an external configuration of an image forming device in an embodiment according to one or more aspects of the present invention.

FIG. **2** is a perspective view showing a partial configuration of the image forming device in a state where a document cover thereof is opened in the embodiment according to one or more aspects of the present invention.

FIG. **3** is a perspective view showing an overall configuration of the image forming device in a state where a scanning unit thereof is opened in the embodiment according to one or more aspects of the present invention.

FIG. **4** is a perspective view showing a framework configuration of the image forming device in a state where a document table is set in an opened position relative to a top cover in the embodiment according to one or more aspects of the present invention.

FIG. **5** is a top of a printing unit of the image forming device in the embodiment according to one or more aspects of the present invention.

FIG. **6** is a side view showing a framework configuration of the image forming device in the state where the document table is set in the opened position relative to the top cover in the embodiment according to one or more aspects of the present invention.

FIG. **7** is a side view showing a framework configuration of the image forming device in a state where the document table

is swung into a closed position relative to the top cover in the embodiment according to one or more aspects of the present invention.

FIG. **8** is a side view showing a framework configuration of the image forming device in a state where the document table is set in the closed position relative to the top cover in the embodiment according to one or more aspects of the present invention.

FIG. **9**A is an enlarged side view of a portion A shown in FIG. **7** in the embodiment according to one or more aspects of the present invention.

FIG. **9**B is an enlarged front view of the portion A shown in FIG. **7** in the embodiment according to one or more aspects of the present invention.

FIG. **10**A is an enlarged side view of the portion A shown in FIG. **8** in the embodiment according to one or more aspects of the present invention.

FIG. **10**B is an enlarged front view of the portion A shown in FIG. **8** in the embodiment according to one or more aspects of the present invention.

DETAILED DESCRIPTION

It is noted that various connections are set forth between elements in the following description. It is noted that these connections in general and, unless specified otherwise, may be direct or indirect and that this specification is not intended to be limiting in this respect.

Hereinafter, an embodiment according to aspects of the present invention will be described with reference to the accompany drawings.

1. Configuration of Image Forming Device

As illustrated in FIG. **1**, an image forming device **1** of the embodiment includes a printing unit **100** configured to form an image on a printing sheet, and a scanning unit **200** that is provided above the printing unit and configured to read an image on a document sheet.

The printing unit **100** is an electrophotographic image forming device that forms an image on a sheet by transferring a developing agent onto the sheet. The printing unit **100** has a top cover **102** that covers the upper side of the printing unit **100** and a catch tray **101** onto which a sheet is ejected with an image formed thereon by the printing unit **100**.

In addition, the scanning unit **200** is provided with a static-document reading function (flat bed reading function) for reading a statically-placed document sheet and an automatically-fed-document reading function (ADF reading function) for reading an automatically-fed document sheet. Further, the scanning unit **200** includes a document table **201** which is provided with a first reading window **202**A for the static-document reading function and a second reading window **202**B for the automatically-fed-document reading function, as illustrated in FIG. **2**.

Further, the scanning unit **200** has a document cover **203** attached to the upper side of the document table **201** via hinges **203**A. The document cover **203** is swingable between a first position and a second position. In the first position, the document cover **203** covers the first reading window **202**A from the upper side of the first reading window **202**A (a state shown in FIG. **1**). In the second position, the upper side of the first reading window **202**A is opened (a state shown in FIG. **2**). In order to perform document reading using the static-document reading function, a user is required to manually open the document cover **203** up and place a document sheet on the first reading window **202**A.

Under the first reading window **202**A, there is an imaging device (not shown) disposed that receives light reflected by the document sheet and generates electrical signals based on the received light. The scanning unit **200** is configured to read an image while converting the image (e.g., characters) on the document sheet via the imaging device into the electrical signals.

The imaging device is attached to the document table **201** movably in a longitudinal direction of the document table **201** (in the left-to-right direction defined in the embodiment). When operated with the automatically-fed-document reading function, the imaging device reads an image of a document sheet which is passing over the second reading window **202**B for the automatically-fed-document reading function in a state where the imaging device stops beneath the second reading window **202**B. Meanwhile, when operated with the static-document reading function, the imaging device reads an image of a document sheet placed on the first reading window **202**A while moving beneath the first reading window **202**A.

To a portion, of the document cover **203**, which corresponds to the second reading window **202**B, a document feeding mechanism (an automatic document feeder) **204** for automatically feeding document sheets is provided as shown in FIG. **1**. The document feeding mechanism **204** automatically feeds document sheets, which are stacked on a document tray **205** disposed at the upper side of the document cover **203**, toward the second reading window **202**B on a sheet-by-sheet basis. Then, the document feeding mechanism **204** automatically ejects sheets completely read, onto an ejection tray **206** disposed above the document tray **205**.

The scanning unit **200** is attached to the top cover **102** of the printing unit **100** so as to be swingable between a closed position where the upper side of the printing unit **100** is closed as shown in FIG. **1** and an opened position where the upper side of the printing unit **100** is opened as shown in FIG. **3**.

Specifically, the document table **201** is attached to the top cover **102** to be swingable via hinge mechanisms **103** at the same sides (at the rear side in the embodiment) as the hinges **203**A for the document cover **203**, as shown in FIG. **6**. Each of the hinge mechanisms **103** includes a swing shaft **103**A provided to the top cover **102** and a substantially C-shaped engagement section **103**B which is attached rotatably relative to the swing shaft **103**A.

It is noted that in the embodiment, the hinge mechanisms **103** are provided in two respective positions of the top cover **102** along an axial direction (in the left-to-right direction in the embodiment) of the swing shaft **103**A. Further, as illustrated in FIG. **6**, arms **104** for holding the document table **201** are provided in respective positions, which are away from the hinge mechanisms **103** along a direction (frontward in the embodiment) perpendicular to the axial direction of the swing shafts **103**A. One end of each of the arms **104** is swingably attached to the document table **201**, while the other end is attached to the top cover **102** via a guide groove **104**A movably in the front-to-rear direction.

Further, the other end of each of the arms **104** is connected with a spring **105**, which applies to the other end of each of the arms **104** an elastic force F directed toward (a corresponding one of) the hinge mechanisms **103**. Therefore, in the closed position, the elastic forces F are applied to the arms **104** in such a direction as to restrain the scanning unit **200** from being displaced farther from a swing center O1 of the scanning unit **200**. Further, in the opened position, the elastic forces F are applied to the arms **104** so as to hold the arms **104** in predetermined positions.

Namely, since the elastic force F of each spring **105** is directed from the other end of the arm **104** toward the hinge mechanism **103**. Therefore, in the closed position, as shown

in FIG. **8**, a longitudinal direction of the arm **104** comes to be more parallel to the direction of the elastic force F, and the one end of the arm **104** (i.e., the joint with the document table) is located closer to the hinge mechanism **103** than the other end of the arm **104**. Thus, the document table **201** is urged by the elastic force F toward the hinge mechanism **103**.

Further, in the opened position, as illustrated in FIG. **6**, the other end of each arm **104** is pressed by the elastic force F against an end of the guide groove **104**A at the hinge mechanism **103** side. Thus, the other end of the arm **104** is regulated with respect to the position thereof, and held in a predetermined position so as to maintain the opened position.

When a sheet to be printed has a small size, the printed sheet is ejected at the hinge mechanism **103** side (the rear side in the embodiment) on the catch tray **101**. When the scanning unit **200** is in the closed position, the catch tray **101** has the upper side thereof covered with the scanning unit **200** as shown in FIG. **1**. Hence, it may be difficult to take out the printed sheet placed at the rear side on the catch tray **101**.

However, in the image forming device **1** of the embodiment, the scanning unit **200** is swingable relative to (the top cover **102** of) the printing unit **100**. Therefore, when the scanning unit **200** is set into the opened position, the upper side of the catch tray **101** is opened. Thus, even though the printed sheet is placed at the rear side on the catch tray **101**, it is possible to easily take out the printed sheet.

When document reading is performed with the static-document reading function, as described above, the user is required to open the document cover **203** up and place a document sheet on the first reading window **202**A. However, the document table **201** may be swung as well toward the opened position by an operation force applied for opening the document cover **203**.

In consideration of the above situation, the image forming device **1** of the embodiment has a lock mechanism **300** (see FIG. **10**B) and a positioning mechanism **301** (see FIG. **10**B). The lock mechanism **300** is configured to prevent the scanning unit **200** from swinging to open when the user operates the scanning unit **200**. Further, the positioning mechanism **301** is configured to position the scanning unit **200** relative to the printing unit **100**.

2. Configurations of Lock Mechanism and Positioning Mechanism

As illustrated in FIG. **4**, the positioning mechanism **301** includes protruding sections **302** and **303** provided to (the top cover **102** of) the printing unit **100** and recessed sections **304** and **305** provided to (the document table **201** of) the scanning unit **200**.

The protruding sections **302** and **303** protrude from the upper surface of the top cover **102** toward (the document table **201** of) the scanning unit **200**. The recessed sections **304** and **305** are recessed from the lower surface of the document table **201** (a surface facing the top cover **102**), in a direction in which the protruding sections **302** and **303** protrude (upward in the embodiment). With respective engagements between the protruding sections **302** and **303** and the recessed sections **304** and **305** in the closed position, the scanning unit **200** is positioned relative to the printing unit **100**.

In the positioning mechanism **301** of the embodiment, a first engagement pair of the protruding section **302** and the recessed section **304** and a second engagement pair of the protruding section **303** and the recessed section **305** are disposed at the left and right sides, respectively, at the front side relative to the swing shafts **103**A via the catch tray **101**, so as to face each other across the catch tray **101**.

The first engagement pair of the protruding section **302** and the recessed section **304** is provided with the lock mechanism **300**. Meanwhile, the second engagement pair of the protruding section **303** and the recessed section **305** is not provided with any lock mechanism. In the second engagement pair, the protruding section **303** and the recessed section **305** are formed in dome shapes, respectively.

Further, as shown in FIG. **6**, a side wall **302**B of the protruding section **302** is formed in an arc shape defined with a curvature radius R around the swing center O**1**, when viewed in the axial direction of the swing shaft **103**A (the left-to-right direction in the embodiment). It is noted that the curvature radius R is a distance between the swing center O**1** and a front-end root of the protruding section **302**. Additionally, as illustrated in FIGS. **4** and **5**, the side wall **302**B of the protruding section **302** is formed in a rotational symmetry shape with respect to a central axis L**1** (see FIG. **10**A) parallel to the protruding direction thereof.

Further, as shown in FIG. **6**, the swing center O**1** of the scanning unit **200** is disposed to be lower than a lower end **302**C of the protruding section **302**. Therefore, the protruding section **302** is formed substantially in such a tapered conical shape that an outer shape dimension W**1** (see FIG. **9**A) thereof in a direction perpendicular to the central axis L**1** is reduced from the lower end **302**C (the root side) thereof toward a distal end **302**A thereof.

On the other hand, an inner wall **304**B of the recessed section **304** is formed in an analogous shape to the side wall **302**B of the protruding section **302**, i.e., with substantially the same dimensions as those of the side wall **302**B of the protruding section **302**. In other words, as shown in FIG. **6**, the inner wall **304**B of the recessed section **304** is as well formed in an arc shape defined with the curvature radius R around the swing center O**1**, when viewed in the axial direction of the swing shaft **103**A (the left-to-right direction in the embodiment). Additionally, the inner wall **304**B of the recessed section **304** is formed in a rotational symmetry shape with respect to the central axis L**1** (see FIG. **10**A) parallel to the recessed direction thereof.

Therefore, the recessed section **304** is formed substantially in such a tapered conical shape that an outer shape dimension W**2** (see FIG. **9**A) thereof in a direction perpendicular to the central axis L**1** increases from a bottom **304**A thereof toward the open side thereof.

In addition, as shown in FIGS. **9**A and **9**B, the lock mechanism **300** includes an engagement hole **306** provided to the distal end **302**A of the protruding section **302** and an elastically deformable engagement portion **307** provided to the bottom **304**A of the recessed section **304**.

The engagement hole **306** has a tapered portion **306**A formed therearound in such a cone shape that a hole diameter ϕ**1** is reduced from the distal end **302**A toward the lower end **302**C of the protruding section **302**. Meanwhile, as illustrated in FIGS. **9**B and **10**B, the engagement portion **307** is formed substantially in a pantograph shape with an elastically-deformable lozenge-shaped portion **307**A.

The lozenge-shaped portion **307**A is configured to elastically deform so as to open and close in a direction (the left-to-right direction in the embodiment) parallel to the axial direction of the swing shaft **103**A. When the lozenge-shaped portion **307**A is engaged with the engagement hole **306** as shown in FIG. **10**B, engagement between the engagement portion **307** and the engagement hole **306** is established.

Therefore, when the scanning unit **200** is swung from the opened position to the closed position, i.e, when the scanning unit **200** is being closed, as shown in FIG. **9**B, the lozenge-shaped portion **307**A is elastically narrowed down while being guided by the tapered portion **306**A. Consequently, a

dimension W3 of the lozenge-shaped portion **307**A in the left-to-right direction is reduced.

Then, when the scanning unit **200** is set in the closed position, the lozenge-shaped portion **307**A passes through the engagement hole **306**, and the dimension W3 of the lozenge-shaped portion **307**A in the left-to-right direction is restored to the original dimension in an elastically expanded manner. Thereby, as illustrated in FIG. **10**B, the engagement portion is adequately engaged with the engagement hole **306**, so as to maintain the closed position of the scanning unit **200**.

Further, the inner wall **304**B of the recessed section **304** is formed in an analogous shape to the side wall **302**B of the protruding section **302**, with substantially the same dimensions as those of the side wall **302**B of the protruding section **302**. Therefore, when the protruding section **302** is fitted into the recessed section **304**, and the side wall **302**B of the protruding section **302** contacts the inner wall **304**B of the recessed section **304**, the scanning unit **200** is positioned relative to the printing unit **100** without so greatly jouncing, as illustrated in FIG. **8**.

Further, in the embodiment, when the scanning unit **200** is swung from the opened position to the closed position, the side wall **302**B of the protruding section **302** comes into contact with the inner wall **304**B of the recessed section **304** before the engagement portion **307** contacts the engagement hole **306** or surrounding portions (e.g., the tapered portion **306**A).

Specifically, a height H1 of the side wall **302**B and a depth D1 of the inner wall **304**B are set such that when the scanning unit **200** is swung from the opened position to the closed position, as shown in FIG. **9**A, a side wall portion S of the side wall **302**B comes into first contact with a portion of the inner wall **304**B that faces the side wall portion S. It is noted that the side wall portion S of the side wall **302**B is located at the side of the distal end of the protruding section **302**, opposite the hinge mechanism **103**.

When the side wall **302**B contacts the inner wall **304**B, the scanning unit **200** is positioned relative to the printing unit **100** without so greatly jouncing. Then, while maintaining the state where the scanning unit **200** is positioned relative to the printing unit **100**, the scanning unit **200** is swung. Thereafter, lozenge-shaped portion **307**A is elastically deformed while being guided in contact with the tapered portion **306**A, and thus the engagement between the engagement portion **307** and the engagement hole **306** is completely established (see FIGS. **10**A and **10**B).

It is noted that since the scanning unit **200** is configured to swing around the swing center O1, contact between the side wall **302**B and the inner wall **304**B is not generally established in the direction parallel to the axial direction of the swing shaft **103**A, as shown in FIG. **9**B. However, the contact between the side wall **302**B and the inner wall **304**B may be established in the direction parallel to the axial direction of the swing shaft **103**A, depending on dimensional variations therebetween.

3. Features of Image Forming Device

In the embodiment, as described above, when the scanning unit **200** is swung from the opened position to the closed position, the side wall **302**B of the protruding section **302** comes into contact with the inner wall **304**B of the recessed section **304** before the engagement portion **307** contacts the engagement hole **306** or surrounding portions. Therefore, an impulsive force is received by a contact portion between the side wall **302**B and the inner wall **304**B when the scanning unit **200** is swung from the opened position to the closed position. Accordingly, an impulsive force applied to the engagement portion **307** can be reduced, and thus it is possible to restrain the engagement portion **307** from being damaged.

Further, in the embodiment, at least the following two portions are formed in an arc shape defined with the curvature radius R around the swing center O1 of the scanning unit **200**, as shown in FIGS. **6** and **7**. One of the two portions is a portion, of the inner wall **304**B of the recessed section **304**, which contacts the side wall **302**B of the protruding section **302** when the scanning unit **200** is swung from the opened position to the closed position. The other is a portion, of the side wall **302**B, which comes into first contact with the inner wall **304**B when the scanning unit **200** is swung from the opened position to the closed position. Therefore, it is possible to displace the recessed section **304** relative to the protruding section **302** smoothly while letting the side wall **302**B contact the inner wall **304**B.

Accordingly, it is possible to make the side wall **302**B of the protruding section **302** and the inner wall **304**B of the recessed section **304** serve as guiders for establishing the engagement between the protruding section **302** and the recessed section **304**. Hence, in the embodiment, it is not required to prepare separate guiders, and thus it is possible to prevent a protruding dimension of the protruding section **302** and a recessed dimension of the recessed section **304** from increasing.

Further, in the embodiment, the side wall **302**B of the protruding section **302** and the inner wall **304**B of the recessed section **304** are formed in a rotational symmetry shape with respect to the central axis L1. Therefore, it is possible to easily perform resin forming for the protruding section **302** and the recessed section **304**.

Additionally, in the embodiment, owing to the springs **105**, it is possible to prevent the scanning unit **200** from being displaced to be farther from the swing center O1. Therefore, when the scanning unit **200** is swung from the opened position to the closed position, it is possible to certainly make the side wall portion S, which is the farthest portion of the side wall **302**B from the swing center O1, contact the farthest portion of the inner wall **304**B from the swing center O1. Accordingly, it is possible to fit the protruding section **302** smoothly into the recessed section **304**, and thus to position the scanning unit **200** in an easy and certain manner.

Moreover, in the embodiment, the swing center O1 of the scanning unit **200** is disposed to be lower than the lower end **302**C of the protruding section **302**. Therefore, it is possible to form each overall outer shape of the protruding section **302** and the recessed section **304** substantially in such a tapered shape that the outer shape dimension thereof is increased from the opened position toward the closed position, as shown in FIGS. **7** and **8**. Accordingly, it is possible to guide the protruding section **302** into the recessed portion **304** such that the protruding section **302** is certainly fitted into the recessed section **304**.

Further, in the embodiment, the engagement portion **307** has the lozenge-shaped portion **307**A configured to be elastically deformed so as to open and close in the left-to-right direction parallel to the axial direction of the swing shaft **103**A of the scanning unit **200**. Therefore, as illustrated in FIG. **10**B, the engagement portion **307** is configured to engage with the engagement hole **306** in two positions in the left-to-right direction parallel to the axial direction of the swing shaft **103**A.

Therefore, when the scanning unit **200** is swung from the opened position to the closed position, it is possible to cause two L-shaped engagement segments provided at both the left and right sides of the lozenge-shaped portion **307**A to contact

the engagement hole **306** substantially at the same time. Accordingly, it is possible to prevent a great impulsive force from being applied to only one of the two engagement segments, and thus to prevent the engagement portion **307** from being damaged early.

Hereinabove, the embodiment according to aspects of the present invention has been described. The present invention can be practiced by employing conventional materials, methodology and equipment. Accordingly, the details of such materials, equipment and methodology are not set forth herein in detail. In the previous descriptions, numerous specific details are set forth, such as specific materials, structures, chemicals, processes, etc., in order to provide a thorough understanding of the present invention. However, it should be recognized that the present invention can be practiced without reapportioning to the details specifically set forth. In other instances, well known processing structures have not been described in detail, in order not to unnecessarily obscure the present invention.

Only an exemplary embodiment of the present invention and but a few examples of their versatility are shown and described in the present disclosure. It is to be understood that the present invention is capable of use in various other combinations and environments and is capable of changes or modifications within the scope of the inventive concept as expressed herein. For example, the following modifications are possible.

In the aforementioned embodiment, the protruding section **302** and the recessed section **304** are formed in a rotational symmetry shape. However, the protruding section **302** and the recessed section **304** may be formed in any other shape.

Further, in the aforementioned embodiment, the protruding sections **302** and **303** are provided to the top cover **102**, and the recessed sections **304** and **305** are provided to the document table **201**. However, the protruding sections **302** and **303** may be provided to the document table **201**, and the recessed sections **304** and **305** may be provided to the top cover **102**.

Further, in the aforementioned embodiment, the engagement portion **307** is provided to the recessed section **304**, and the engagement hole **306** is provided to the protruding section **302**. However, the engagement portion **307** may be provided to the protruding section **302**, and the engagement hole **306** is provided to the recessed section **304**.

Further, in the aforementioned embodiment, the positioning mechanism **301** includes the first engagement pair of the protruding section **302** and the recessed section **304** and the second engagement pair of the protruding section **303** and the recessed section **305**, which pairs are disposed at the left and right sides, respectively, so as to face each other across the catch tray **101**. However, the second engagement pair of the protruding section **303** and the recessed section **305** may be omitted.

Further, in the aforementioned embodiment, the engagement portion **307** is formed substantially in a pantograph shape with the elastically-deformable lozenge-shaped portion **307**A. However, the engagement portion **307** may be formed in any other shape.

What is claimed is:

1. An image forming device comprising:

a printer configured to form an image on a recording sheet and eject, onto a catch tray thereof, the recording sheet on which the image is formed;

a scanner configured to read an image on a document sheet, the scanner being swingable around a swing central axis relative to the printer between:

a closed position to close and cover an upper side of the catch tray; and

an opened position to open the upper side of the catch tray;

a positioning mechanism comprising:

a protruding section formed at one of the printer and the scanner so as to protrude in a protruding direction; and

a recessed section formed at a different one of the printer and the scanner so as to be recessed in a recessed direction,

wherein the protruding section is configured to be fitted into the recessed section when the scanner is in the closed position;

a lock mechanism comprising:

an engagement hole formed at one of a distal end of the protruding section and a bottom of the recessed section; and

an engagement portion formed at a different one of the distal end of the protruding section and the bottom of the recessed section,

wherein the engagement hole and the engagement portion are configured to hold the closed position of the scanner by engagement therebetween;

a first contact portion provided to the protruding section; and

a second contact portion provided to the recessed section,

wherein the first contact portion is configured to, when the scanner is swung from the opened position to the closed position, come into contact with the second contact portion before the engagement portion contacts the engagement hole or a region around the engagement hole.

2. The image forming device according to claim **1**,

wherein the first contact portion is provided to an outer side wall of the protruding section,

wherein the second contact portion is provided to an inner side wall of the recessed section, and

wherein each of the first contact portion and the second contact portion is formed in an arc shape with a predetermined radius around the swing central axis of the scanner when viewed in a direction parallel to the swing central axis.

3. The image forming device according to claim **2**,

wherein the protruding section is configured with the outer side wall formed in a rotational symmetry shape with respect to a central axis parallel to the protruding direction, and

wherein the recessed section is configured with the inner side wall formed in a rotational symmetry shape with respect to a central axis parallel to the recessed direction.

4. The image forming device according to claim **3**, further comprising an elastic member configured to apply, to the scanner, an elastic force that restrains the scanner from being displaced so as to be farther from the swing central axis of the scanner.

5. The image forming device according to claim **4**,

wherein the swing central axis of the scanner is disposed lower than a lower end of the protruding section.

6. The image forming device according to claim **1**,

wherein the protruding section is configured with an outer side wall formed in a rotational symmetry shape with respect to a central axis parallel to the protruding direction, and

wherein the recessed section is configured with an inner side wall formed in a rotational symmetry shape with respect to a central axis parallel to the recessed direction.

7. The image forming device according to claim 1, further comprising an elastic member configured to apply, to the scanner, an elastic force that restrains the scanner from being displaced so as to be farther from the swing central axis of the scanner.

8. The image forming device according to claim 1,

wherein the swing central axis of the scanner is disposed lower than a lower end of the protruding section.

9. The image forming device according to claim 1,

wherein the engagement portion is configured to be elastically deformed so as to open and close in a direction parallel to the swing central axis of the scanner.

10. The image forming device according to claim 9,

wherein the engagement portion is formed in a pantograph shape.

11. An image forming device comprising:

a printer configured to form an image on a recording sheet and eject, onto a catch tray thereof, the recording sheet on which the image is formed;

a scanner configured to read an image on a document sheet, the scanner being swingable relative to the printer around a swing central axis disposed lower than a lower end of the protruding section, between:

a closed position to close and cover an upper side of the catch tray; and

an opened position to open the upper side of the catch tray;

a positioning mechanism comprising:

a protruding section formed at the printer so as to protrude in a protruding direction; and

a recessed section formed at the scanner so as to be recessed in a recessed direction,

wherein the protruding section is configured to be fitted into the recessed section when the scanner is in the closed position;

a lock mechanism comprising:

an engagement hole formed at a distal end of the protruding section; and

an engagement portion formed at a bottom of the recessed section,

wherein the engagement hole and the engagement portion are configured to hold the closed position of the scanner by engagement therebetween;

a first contact portion provided to an outer side wall of the protruding section, the outer side wall being formed in a rotational symmetry shape with respect to a central axis parallel to the protruding direction; and

a second contact portion provided to an inner side wall of the recessed section, the inner side wall being formed in a rotational symmetry shape with respect to a central axis parallel to the recessed direction,

wherein each of the first contact portion and the second contact portion is formed in an arc shape with a predetermined radius around the swing central axis of the scanner when viewed in a direction parallel to the swing central axis, and

wherein the first contact portion is configured to, when the scanner is swung from the opened position to the closed position, come into contact with the second contact portion before the engagement portion contacts the engagement hole or a region around the engagement hole.

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