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Kim et al.

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(54) **IMAGE FORMING APPARATUS AND IMAGE READING APPARATUS WITH LOCKING UNIT FOR LOCKING MOVABLE OBJECT**

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G03G 15/00 (2006.01)

(52) **U.S. Cl.** **399/107**; 399/110; 399/391; 399/393

(58) **Field of Classification Search** 399/107, 399/110–125, 391–393
See application file for complete search history.

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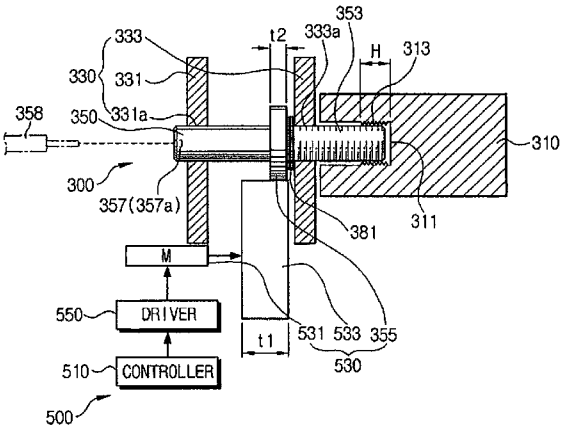
(57) **ABSTRACT**

An image forming apparatus includes an image forming body, a locking unit blocking movement of at least one movable object of the image forming body, and a control unit controlling a locking state of the locking unit and a releasing state of the locking unit. The locking unit includes a latching member provided on one of the at least one movable object and provided with a latching depression, a supporting member provided on the image forming body, and a locking member movably supported by the supporting member so as to be insertable into and removable from the latching depression of the latching member.

25 Claims, 6 Drawing Sheets



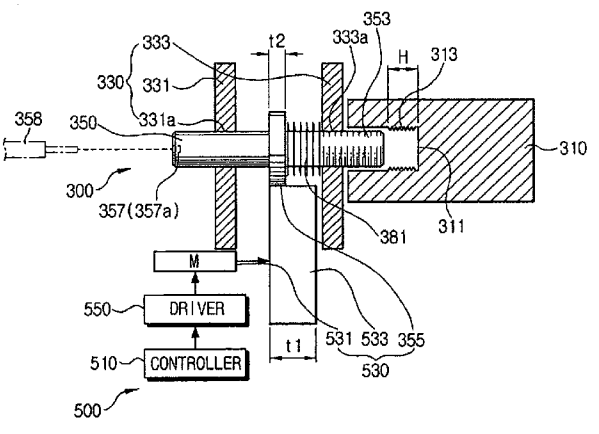


FIG. 1
(PRIOR ART)

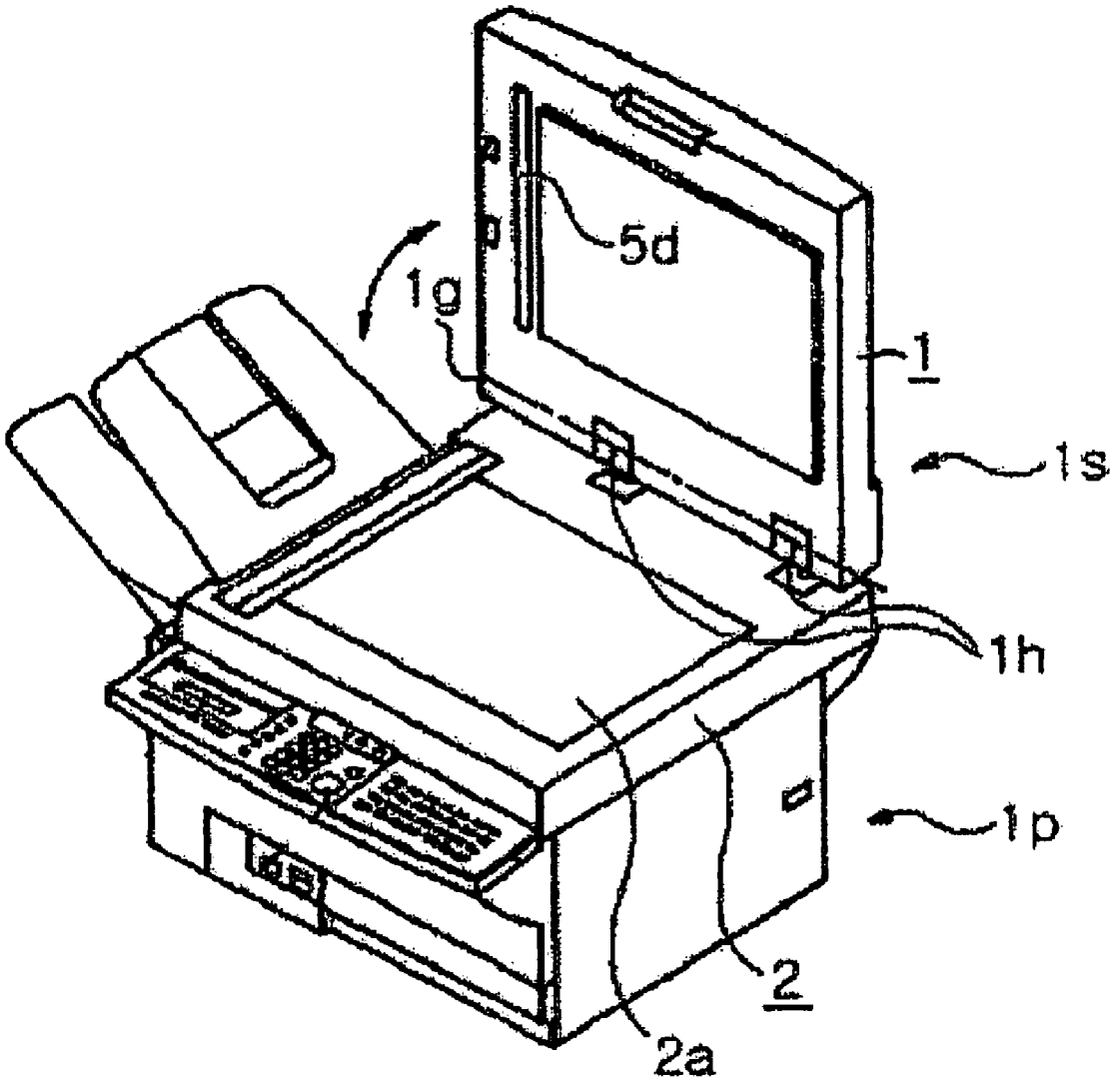


FIG. 2
(PRIOR ART)

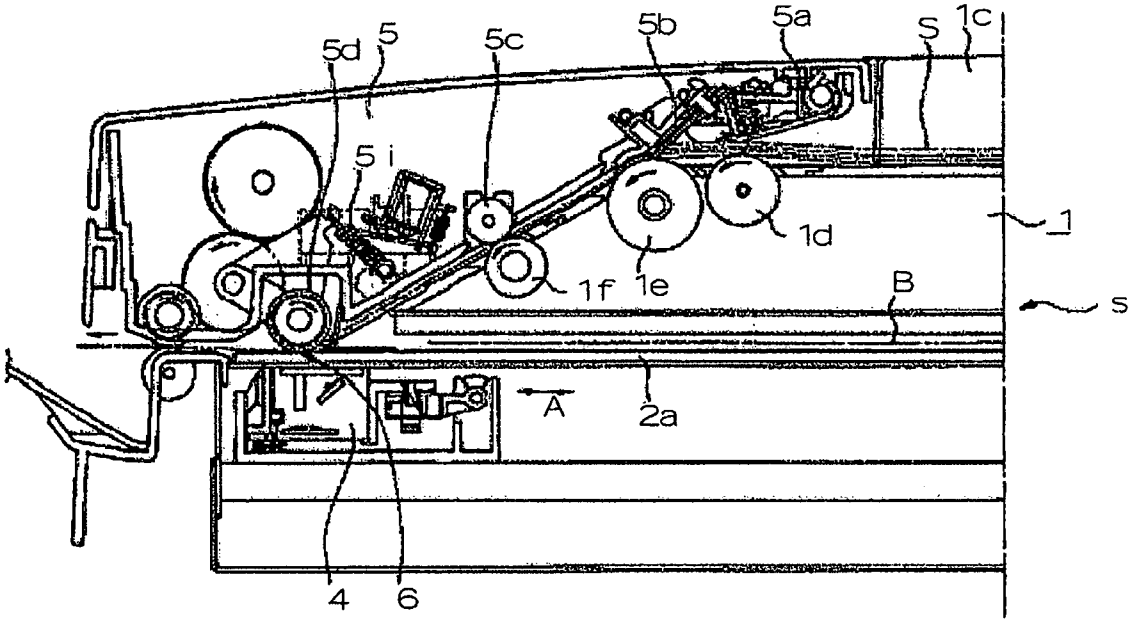


FIG. 3
(PRIOR ART)

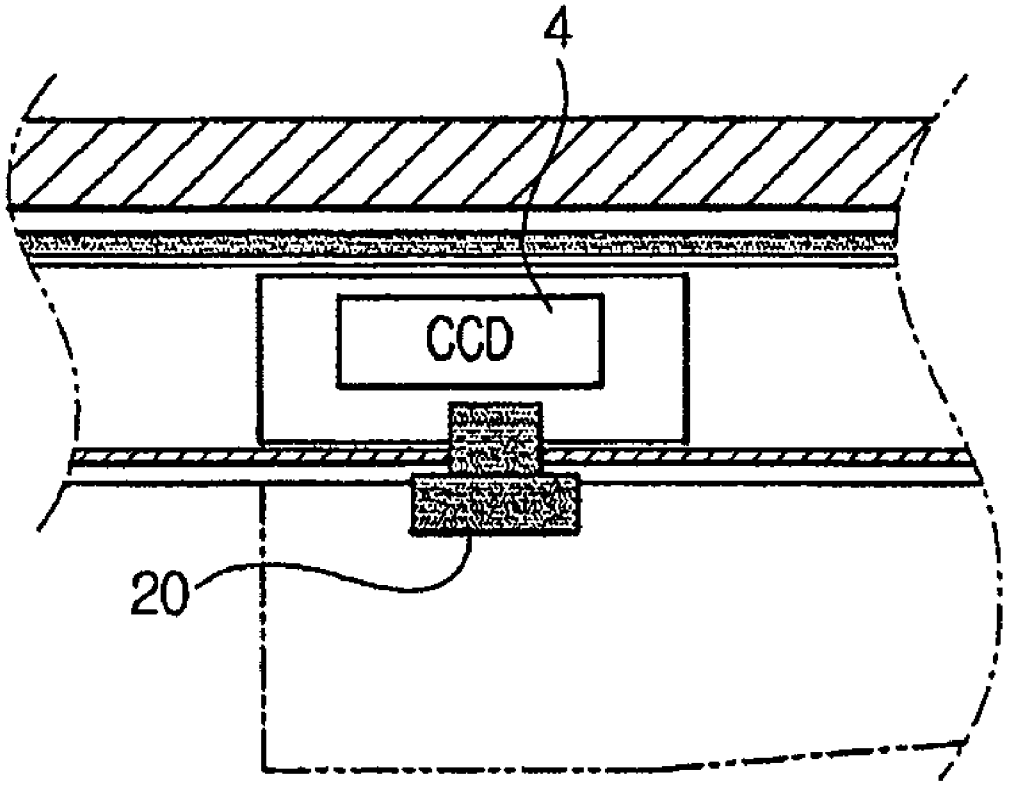
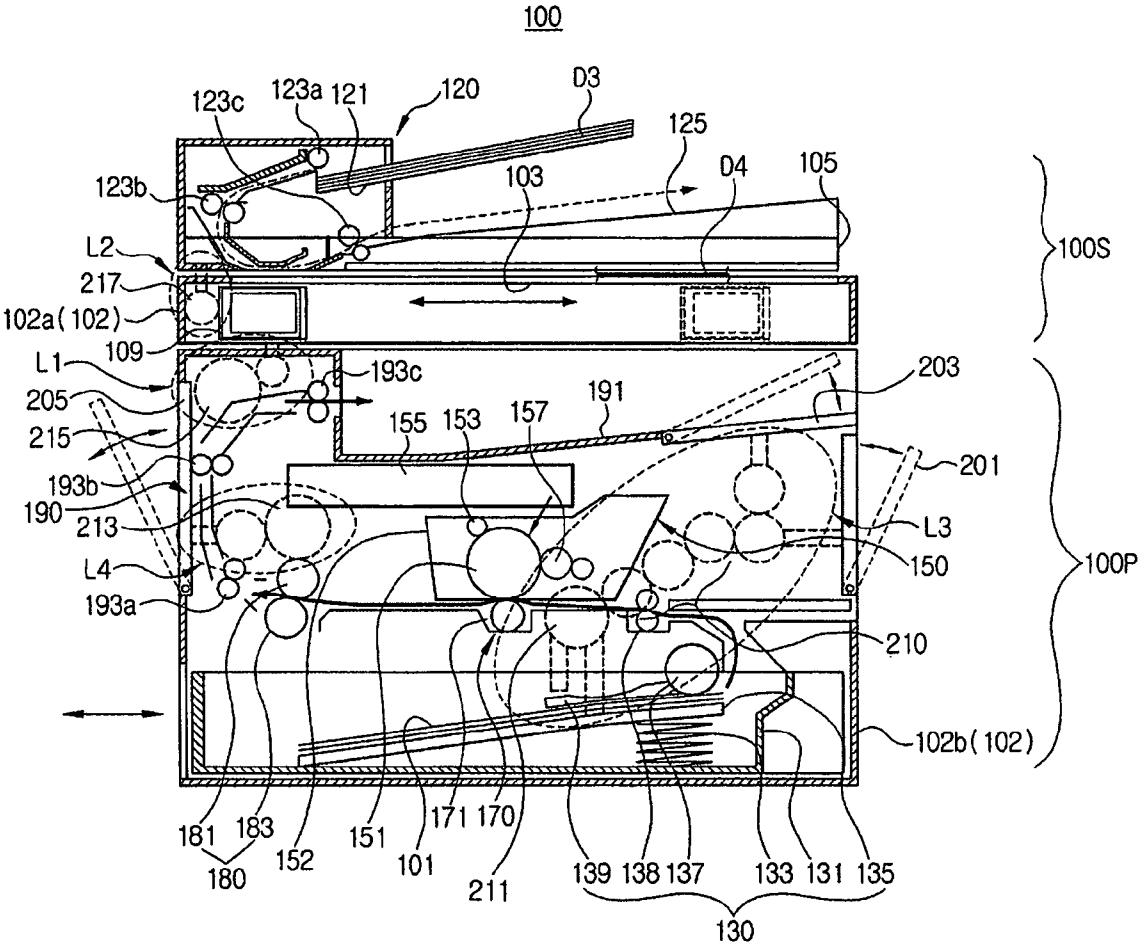


FIG. 4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123c
123a
121
120
D3
125
123b
103
D4
105
100S
L2
217
102a(102)
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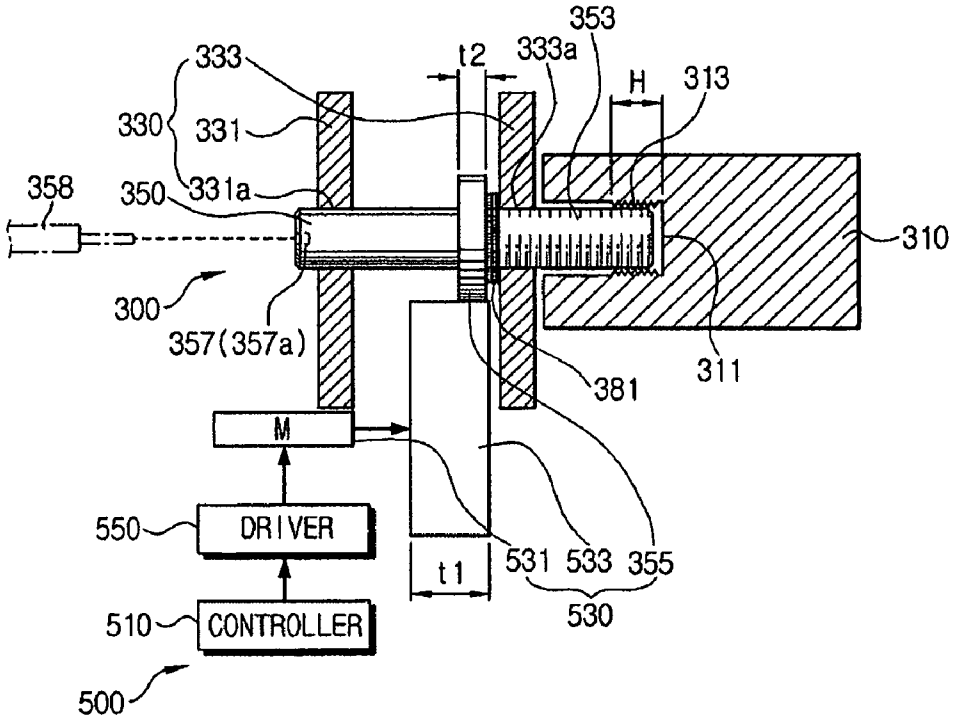
L1
193c
203
205
155
153
157
191
215
201
193b
190
213
L3
150
L4
100P
193a
210
102b(102)
181
183
180
152
151
101
171
170
211
139
138
137
133
131
135
130

FIG. 5A


353
333
t2
333a
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331a
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311
381
M
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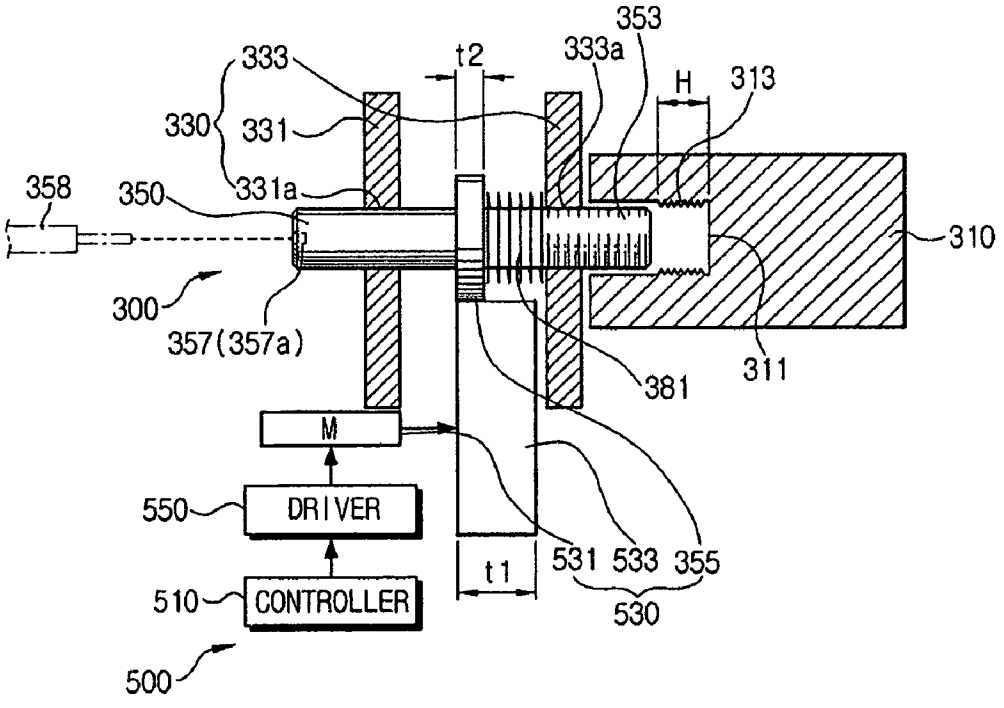
531 533 355
t1
530
510
CONTROLLER
500

FIG. 5B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CONTROLLER
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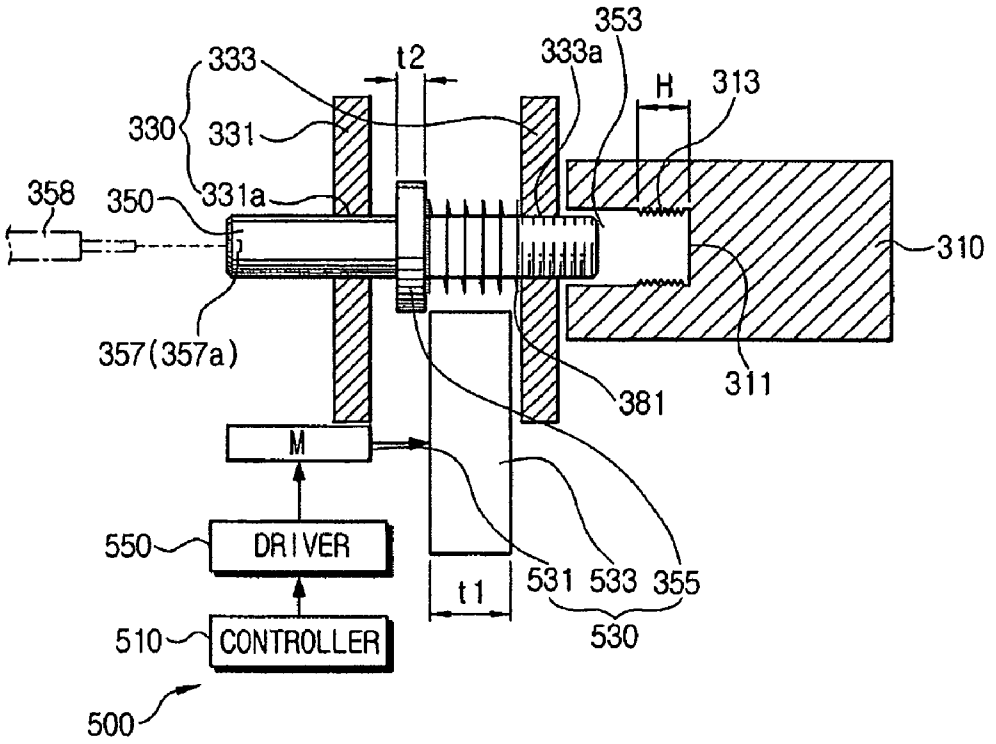
FIG. 5C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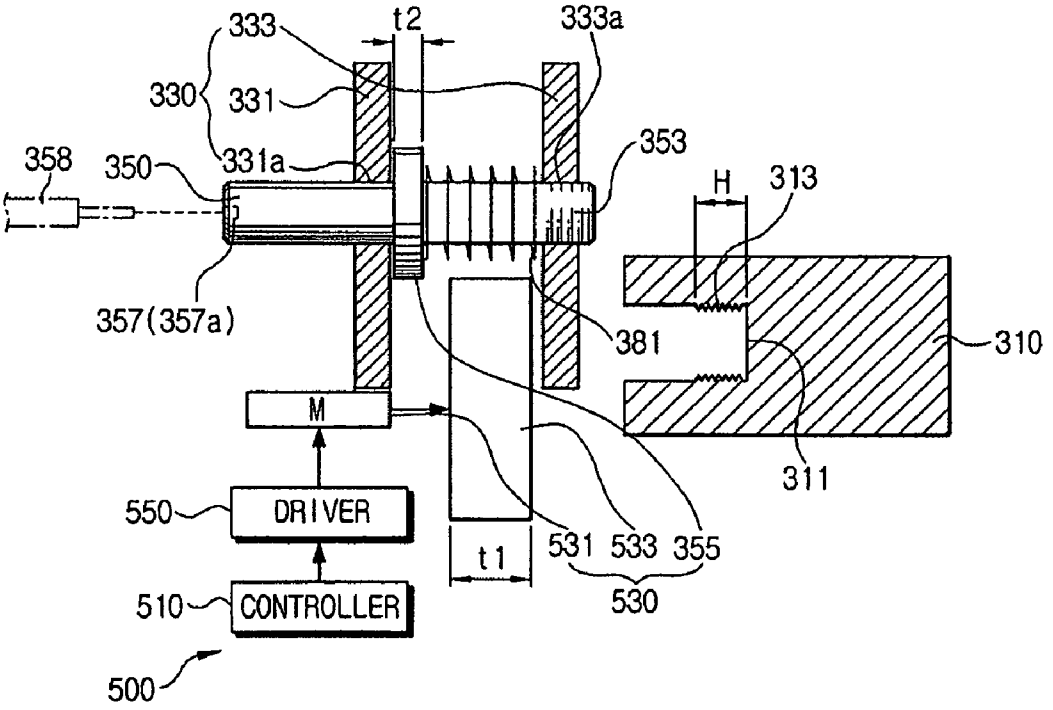
t1
530
510
CONTROLLER
500

FIG. 5D


333
t2
333a
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358
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331a
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311
550
DRIVER
531 533 355
t1
530
510
CONTROLLER
500

IMAGE FORMING APPARATUS AND IMAGE READING APPARATUS WITH LOCKING UNIT FOR LOCKING MOVABLE OBJECT

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of Korean Patent Application No. 2005-11147 filed on Feb. 7, 2005, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

An aspect of the present invention relates to an image forming apparatus and an image reading apparatus. More specifically, an aspect of the present invention relates to an image forming apparatus and an image reading apparatus in which movable objects (for example, an image reading unit, an opening/closing member, a recording material cassette, and the like) are locked so as not to move when a product is shipped, and a locking structure is automatically released when the product is unpacked and used for the first time by a user.

2. Description of the Related Art

Conventionally, apparatuses such as a digital photocopier, a facsimile machine, a printer, and a multifunction device having an image reading section, an image forming section, and an automatic document conveyer are known.

The image reading section is a device for reading image information of supplied documents, and the image forming section is a device for printing images on recording materials based on the image information read by the image reading section. The automatic document conveyer is a device for supplying documents one sheet at a time to a reading position of the image reading section, and ejecting documents to a document ejection tray after the documents have been read.

FIG. **1** shows a configuration of a conventional image forming apparatus disclosed in Japanese Unexamined Patent Application Publication No. 10-293431 published on Nov. 4, 1998, and FIG. **2** is a perspective view showing a configuration of an image reading section of the image forming apparatus in FIG. **1**.

Referring to FIG. **1**, an image forming apparatus includes an image reading section **1***s* for reading images of documents S and B, and an image forming section **1***p* for forming images on recording materials based on the image information read by the image reading section **1***s*.

A pressing panel **1** is installed on a frame **2** with hinges **1***h* to rotate through a certain angular range about a hinge axis **1***g*.

Referring to FIG. **2**, a document stacking tray **1***c* is provided on the top of the pressing panel **1** in order to stack documents S. A document ejecting conveyer **5** is provided at the upper portion of the pressing panel **1**. The document ejecting conveyer **5** includes a preliminary conveyance roller **1***d* and a preliminary conveyance pressing panel **5***a* for conveying the documents S from the document stacking tray **1***c*, and a separating pad **5***b* and a separating roller **1***e* for separating the documents S that are conveyed by the preliminary conveyance roller **1***d* and the preliminary conveyance pressing panel **5***a* into individual sheets. In addition, the document ejecting conveyer **5** includes a document feed roller if and a paper feed roller **5***c* for feeding the documents S to a reading unit **6**, with the paper feed roller **5***c* being pressed against the document feed roller if by a pressing panel spring (not shown).

A contact image sensor **4** is installed at a curved portion of a conveyance path, and a document pressing roller **5***d* for pressing and conveying the documents on the conveyance path is installed opposite the contact image sensor **4**. The document pressing roller **5***d* is elastically pressed by a press spring **5***i* in the direction of the conveyance path, and if a document S enters the reading unit **6**, the document S is pressed by the document pressing roller **5***d* and conveyed while being in contact with a document base glass **2***a*.

The image reading section **1***s* described above can operate in either a flat-bed mode in which a stationary document is read, or a sheet-through mode in which a moving document is read.

In the flat-bed reading mode, a document B is placed on the document base glass **2***a*, and when the pressing plate **1** is rotated about the hinge axis **1***g*, the document B is pressed against the document base glass **2***a*. Then, the contact image sensor **4** moves in the direction of the arrow A, and reads an image of the document B placed on the document base glass **2***a*.

In the sheet-through reading mode, the contact image sensor **4** stands still at the position of the reading unit **6** and reads an image of a moving document S. The documents S placed on the document stacking tray **1***c* are first conveyed by the preliminary conveyance roller **1***d* and the preliminary conveyance pressing panel **5***a*, and are then separated into individual sheets by the separating roller **1***e* that is in contact with the separating pad **5***b*. Thereafter, the documents S are conveyed to the reading unit **6** by the paper feed roller **5***c* against which the document feed roller If is pressed by the pressing panel spring.

At the reading unit **6**, the documents S are conveyed while being in contact with a surface of the document pressing roller **5***d*, and images of the documents S are read by the contact image sensor **4**. The document pressing roller **5***d* is elastically pressed in the direction of the conveyance path by the press spring **5***i*, and prevents the documents S from floating on the document base glass **2***a*.

FIG. **3** shows an example of an image forming apparatus with a locking device **20** that holds an image reading sensor, such as the contact image sensor **4** described above, so that it does not move.

The image forming apparatus in FIGS. **1-2** described above uses a locking device **20** as shown in FIG. **3** to hold the contact image sensor **4** so that it does not move when the image forming apparatus is shipped.

Accordingly, a user can use the image reading section **1***s* only after the locking device **20** is released. If the locking device **20** is not released due to a user's mistake, the image reading section **1***s* cannot be used properly, and if serious problems occur as a result, service must be called for.

Conventionally, only a locking device **20** for locking an image reading sensor is provided. However, an image forming apparatus includes several easily movable parts, such as the pressing panel **1** and an opening/closing member for opening/closing the image forming section **1***p* described above, a recording material cassette for supplying recording materials on which images are printed based on the image information read by the contact image sensor **4**, and the like. Therefore, in order to prevent the easily movable parts described above from moving when the image forming apparatus is shipped, packing materials must be carefully selected, and special fixing materials must be additionally attached to fix the easily movable parts in place to prevent them from moving.

SUMMARY OF THE INVENTION

The present invention addresses the above drawbacks and/or other problems in the related art. An aspect of the invention is to provide an image forming apparatus in which a locking unit which locks an image reading unit is automatically released when the image forming apparatus is used.

Another aspect of the invention is to provide an image forming apparatus in which locking units for locking movable objects other than the image reading unit are provided and are automatically released when the image forming apparatus is used.

Another aspect of the invention is to provide an image forming apparatus in which the amount of packing materials required to ship the image forming apparatus is reduced by using locking units for locking movable structures including an image reading unit.

According to one aspect of the invention, an image forming apparatus includes an image forming body, a locking unit blocking movement of at least one movable object of the image forming body, and a control unit controlling a locking state of the locking unit and a releasing state of the locking unit.

The at least one movable object may be any one or any combination of an image reading unit reading images of documents, a cover installed on the image forming body so as to be openable away from and closable against a top surface of a document base glass on which a document is to be placed, a recording material cassette supplying recording materials on which images are to be formed based on the images read by the image reading unit, the recording material cassette being attachable to and removable from the image forming body, a knock-up plate installed inside the recording material cassette on which recording materials are to be stacked, a covering member opening and closing the image forming body, a multipurpose paper feed device feeding recording materials one sheet at a time or performing other functions, and a recording material guide lining up recording materials stacked on the knock-up plate in a width direction and/or a length direction.

The covering member may be a rear cover installed on a rear surface of the image forming body to replace a fixing unit installed inside the image forming body and/or to remove jammed recording materials from inside the image forming body, and/or a top cover installed on a top surface of the image forming body to replace a developing unit installed inside the image forming body and/or to remove jammed recording materials from inside the image forming body.

The locking unit may include a latching member provided on one of the at least one movable object and provided with a latching depression, a supporting member provided on the image forming body, and a locking member movably supported by the supporting member so as to be insertable into and removable from the latching depression of the latching member.

The latching depression may have nut threads formed therein, and an end portion of the locking member may have bolt threads corresponding to the nut threads formed thereon. The nut threads may be formed in the latching depression only up to a point that is a certain distance away from an end of the latching depression.

The supporting member may be provided on the image forming body facing the latching member across a certain gap and may include a supporting frame provided with a supporting hole through which the locking member passes so as to be supported by the supporting frame of the supporting member, and an elastic member may be provided between a portion of the latching member and the supporting frame.

A manual operating unit may be provided at an end portion of the locking member to enable the locking member to be operated manually, and the manual operating unit may be a tool socket corresponding to a manual tool.

The control unit may include a controller judging if a state of the image forming apparatus is a state in which the locking unit is to be locked or a state in which the locking unit is to be released, a driving unit driving the locking unit, and a driver operating the driving unit according to an output signal of the controller if the controller judges the state of the image forming apparatus to be a state in which the locking unit is to be locked or a state in which the locking unit is to be released.

The driving unit may include a motor generating a driving force, a driving gear directly or indirectly connected to the motor and rotatable in a locking direction to lock the locking unit and a releasing direction to release the locking unit, and a gear provided on the locking member and engaging the driving gear.

The motor may be any one of motors that drive operating units in the image forming body, and the driving gear may be directly connected to the any one of the motors that drive the operating units or may be connected to the any one of the motors that drive the operating units through at least one relay gear.

The driving gear may rotate at a fixed position in a linear direction, and a thickness of the driving gear may be greater than a thickness of the gear provided on the locking member.

The state of the image forming apparatus in which the locking unit is to be released may be a state in which power to the image forming apparatus is turned on or a state in which operating units in the image forming body are ready to start operating, and the state of the image forming apparatus in which the locking unit is to be locked may be a state in which a locking command is set by a user.

According to another aspect of the invention, an image reading apparatus includes an image reading main body, a document base glass installed on a top surface of the image reading main body and having a top surface on which documents are to be placed in a stationary state and/or a moving state, an image reading unit installed facing the document base glass reading images of the documents placed on the document glass, a cover installed on the image reading main body so as to be openable away from and closable against the top surface of the document base glass, a locking unit blocking movement of the image reading unit or the cover, and a control unit controlling a locking state of the locking unit and a releasing state of the locking unit.

According to another aspect of the invention, an image forming apparatus includes an image forming body, a movable object disposed in the image forming body, a controllable locking unit to selectively lock the movable object to prevent the movable object from moving and release the movable object to allow the movable object to move, and a control unit to control the controllable locking unit to selectively lock and release the movable object.

According to another aspect of the invention, an image reading apparatus includes an image reading main body, a document base glass disposed on the main body on which a document is to be placed, an image reading unit disposed in the image reading main body facing the document base glass and being movable relative to the document base glass to read an image of a document placed on the document base glass, a cover disposed on the image forming body and being openable away from and closable against the document base glass, a controllable locking unit to selectively lock the image reading unit or the cover to prevent the image reading unit or the cover from moving and release the image reading unit or the

cover to allow the image reading unit or the cover to move, and a control unit to control the controllable locking unit to selectively lock and release the image reading unit or the cover.

In an image forming apparatus according to an aspect of the invention described above, the locking units used to prevent movable objects from moving during shipping of the image forming apparatus need not be manually released by a user, thereby making the image forming apparatus convenient for the user to use.

In addition, the amount of packing materials required to prevent movement of movable objects in the image forming apparatus is reduced, thereby decreasing the consumption of packing materials which will be thrown away and reducing the space required to pack the image forming apparatus for shipping.

In addition, a user cannot use the image forming apparatus without releasing the locking units, thereby eliminating service calls resulting from the user trying to use the image forming apparatus without first releasing the locking units.

In addition, relocking of the locking units can be performed as needed, thereby allowing reuse of the locking units when moving the image forming apparatus to a different place where it is to be used.

Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

FIG. **1** shows a configuration of a conventional image forming apparatus;

FIG. **2** shows a configuration of an image reading section shown in FIG. **1**;

FIG. **3** shows an example of an image forming apparatus with a locking device that holds an image reading sensor so that it does not move;

FIG. **4** shows a configuration of an image forming apparatus according to one embodiment of the invention; and

FIGS. **5**A to **5**D are views for explaining the operation of movable object locking units of an image forming apparatus according to an aspect of the invention which may be used in the image forming apparatus shown in FIG. **4**.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Reference will now be made in detail to the present embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

FIG. **4** shows a configuration of an image forming apparatus according to one embodiment of the invention.

Referring to FIG. **4**, an image forming apparatus **100** includes an image reading section **100**S, and an image forming section **100**P for forming images on recording materials **101** using an electrophotographic method based on image information read by the image reading section **100**S.

The image reading section **100**S includes an image reading frame **102***a*, a document base glass **103**, a cover **105**, an automatic document feeding unit **120**, and an image reading unit **109**.

More specifically, the image reading section **100**S includes the image reading frame **102***a* as a portion of an image forming body **102**. The document base glass **103** is installed on top of the image reading frame **102***a*, and the image reading unit **109** is installed so as to read an image of a document D**3** supplied through the automatic document feeding unit **120** after being moved to a predetermined position inside the image reading frame **102***a*, or to read an image of a document D**4** resting on the upper surface of the document base glass **103** by moving rectilinearly and reciprocally in parallel with the document base glass **103**, or to rest at a home position inside the image reading frame **102***a* when the image reading unit **109** is not reading an image.

The cover **105** is installed so as to be openable away from and closable against the top surface of the document base glass **103**, and presses the upper surface of the document D**4** resting on the upper surface of the document base glass **103**.

The automatic document feeding unit **120** includes a document stacking tray **121** for stacking documents D**3**, rollers **123***a*, **123***b*, **123***c* for picking up, conveying, and ejecting documents D**3** from the document stacking tray **121**, and a document ejection tray **125** for stacking documents D**3** after they have been ejected. The roller **123***a* is a pickup roller for picking up the documents D**3** stacked in the document stacking tray **121**, the roller **123***b* is a conveyance roller for conveying the picked up documents D**3** to the document base glass **103**, and the roller **123***c* is an ejection roller for ejecting the conveyed documents D**3** to the document ejection tray **125**.

The automatic document feeding unit **120** is provided at one side of the upper portion of the cover **105**, and is mounted so as to move together with the cover **105** as the cover **105** is opened and closed.

The image forming section **100**P includes an image forming frame **102***b*, a paper feeding unit **130**, an image forming unit **150**, a transferring unit **170**, a fixing unit **180**, and a paper ejecting unit **190**.

The image forming frame **102***b* forms the image forming body **102** together with the image reading frame **102***a* described above.

The paper feeding unit **130** is for supplying the recording materials **101** to the image forming unit **150** and includes a recording material cassette **131** that is attachable to and removable from the image forming frame **102***b*, and a knock-up plate **135** that is provided in the recording material cassette **131** where it can move up and down and is elastically supported upwardly by an elastic member **133**, and has the recording materials **101** stacked on its top surface. In addition, the paper feeding unit **130** includes a pickup roller **137** for picking up the recording materials **101** stacked on the knock-up plate **135**, and a feed roller **138** for feeding the recording materials **101** picked up by the pickup roller **137** to the image forming unit **150**. The recording material cassette **131** is additionally provided with a recording material guide **139** for lining up the side edges of the recording materials **101** stacked on the knock-up plate **135** in the width direction. The recording material guide **139** may also be formed so as to line up the end edges of the recording materials **101** in the length direction.

The image forming unit **150** forms a toner image on a photoconductor **151** through charging, exposing, and developing.

The image forming unit **150** includes a cartridge **152**, a charging roller **153** for charging the surface of the photoconductor **151**, a laser beam scanning unit **155** for scanning a laser beam across the charged surface of the photoconductor **151** to form an electrostatic latent image on the photoconductor **151**, and a developing roller **157** for developing the electrostatic latent image formed on the photoconductor **151** using toner to form a toner image on the photoconductor **151**. The developing roller is in contact with the surface of the photoconductor **151** and rotates so as to apply the toner to the surface of the photoconductor **151**.

The transferring unit **170** includes a transferring roller **171** that rotates while contacting the photoconductor **151** to transfer the toner image formed on the photoconductor **151** onto the recording materials **101**.

The fixing unit **180** is for fixing the toner image transferred by the transferring roller **171** of the transferring unit **170** on the recording materials **101**, and includes a heating roller **181** that is heated to a high temperature, and a pressing roller **183** that rotates while contacting the heating roller **181**. The recording materials **101** are conveyed between the heating roller **181** and the pressing roller **183** to fix the toner image on the recording materials **101**.

The paper ejecting unit **190** ejects the recording materials **101** on which the toner image has been fixed by the fixing unit **180** onto a paper ejecting plate **191** that is provided outside the image forming frame **102***b*, and includes paper ejecting rollers **193***a*, **193***b*, **193***c*.

A multipurpose paper feed device **201** for supplying recording materials one sheet at a time or for performing other functions is installed at one side of the image forming frame **102***b* in an opening and closing manner. A top cover **203** for replacing the image forming unit **150** or removing jammed recording materials is installed at one side of the image forming frame **102***b* adjacent to the paper ejecting plate **191** in an opening and closing manner. A rear cover **205** is installed at the other side of the image forming frame **102***b* in an opening and closing manner, that is, at the opposite side of the image forming frame **102***b* from the multipurpose paper feed device **201**. The rear cover **205** is used for replacing the fixing unit **180** or removing jammed recording materials.

Various ones of the rollers described above are directly connected to a motor, or are connected to a motor through relay gears, in order to receive power from the motor. A main motor **211**, a fixing motor **213**, a paper ejecting motor **215**, and a scanning motor **217** are shown in FIG. **4**.

The main motor **211** primarily supplies power for driving the pickup roller **137**, the feed roller **138**, the photoconductor **151**, the developing roller **157**, the charging roller **153**, and the transferring roller **171**.

The fixing motor **213** supplies power for driving the heating roller **181** and the pressing roller **183** of the fixing unit **180**.

The paper ejecting motor **215** supplies power for driving the paper ejecting rollers **193***a*, **193***b*, **193***c*. The paper ejecting motor **215** may also drive a fan (not shown) for exhausting heat generated inside the image forming frame **102***b* by the fixing unit **180** which operates at a high temperature.

The scanning motor **217** supplies power for moving the image reading unit **109** rectilinearly and reciprocally in parallel with the document base glass **103**.

In the image forming apparatus **100** described above, the main motor **211**, the fixing motor **213**, the paper ejecting motor **215**, and the scanning motor **217** are provided. However, the invention is not limited to this example, but the number of motors may be decreased or increased by providing the motors in diverse forms. For example, the main motor **211** and the fixing motor **213** may be formed in one body, or the fixing motor **213** and the paper ejecting motor **215** may be formed in one body.

The image forming apparatus **100** described above is additionally provided with a locking unit for locking movable objects.

A movable object to be locked may be any one of the image reading unit **109** that moves rectilinearly and reciprocally inside the image reading frame **102***a* of the image forming body **102**, the cover **105** that is openable away from and closable against the document base glass **103**, and the opening/closing members for opening and closing the image forming body **102** such as the multipurpose paper feed device **201**, the top cover **203**, and the rear cover **205**. In addition, a movable object to be locked may be any one of the recording material cassette **131** that is attachable to and removable from the image forming frame **102***b* of the image forming body **102**, the knock-up plate **133** provided in the recording material cassette **131** that can move up and down and is elastically supported upwardly, or the recording material guide **139** for lining up the recording materials **101**. Movable objects to be locked are not limited to the structures described above, but diverse structures such as a double-sided paper feed device or a supplemental paper feed device may also be a movable object to be locked. Any combination of two or more of the structures described above may be movable objects to be locked.

Such movable objects are easily moved when image forming apparatus **100** is shipped or moved, and can be easily broken in such circumstances. Therefore, an aspect of the present invention is an image forming apparatus **100** in which movable objects are locked when the image forming apparatus **100** is shipped or moved, and are automatically unlocked when a user uses the image forming apparatus **100**.

L**1**-L**4** in FIG. **4** denotes the portions of the image forming apparatus **100** to which the locking unit referred to above is applied.

FIGS. **5**A to **5**D are views for explaining the operation of movable object locking units of an image forming apparatus according to an aspect of the invention.

Referring to FIGS. **5**A to **5**D, a locking unit **300** and a control unit **500** for controlling locking and releasing operations of the locking unit **300** are depicted.

A locking unit **300** includes a latching member **310** that is provided on the movable objects described above and has a latching depression **311**, a supporting member **330** that is provided on the image forming body **102** (i.e., on the image reading frame **102***a* or the image forming frame **102***b*), and a locking member **350** that is movably supported by the supporting member **330** so as to be insertable into or removable from the latching depression **311** of the latching member **310**.

The latching depression **311** has nut threads **313** formed therein, and the end portion of the locking member **350** has bolt threads **353** corresponding to the nut threads **313** formed thereon. The nut threads **313** are preferably formed in the latching depression **311** only up to a point that is a certain distance H away from the end of the latching depression **311** so that the locking member **350** can be easily removed from the latching depression **311**.

The supporting member **330** is provided on the image forming body (the image reading frame **102***a* or the image forming frame **102***b*) facing the latching member **310** across a certain gap, and includes supporting frames **331**, **333** provided with supporting holes **331***a*, **333***a* through which the locking member **350** passes so as to be supported by the supporting frames **331**, **333** of the supporting member **330**.

The control unit **500** includes a controller **510** for judging if a state of the image forming apparatus **100** is a state in which the locking unit **300** is to be locked or a state in which the locking unit **300** is to be released, a driving unit **530** for driving the locking member **350**, and a driver **550** for receiving a signal from the controller **510** and driving the driving unit **530**.

The driving unit **530** includes a motor **531** for generating a driving force, a driving gear **533** that rotates when it receives the driving force from the motor **531**, and a gear **355** that is formed on the outer surface of the locking member **350** so as to engage and be rotated by the driving gear **533**. The driving gear **533** may be directly connected to the motor **531** so as to directly receive the driving force from the motor **531**, or may receive the driving force indirectly from the motor **531** through a relay gear train. If a relay gear train is used, the motor **531** can be replaced by a motor for driving one or more of the operating units of the image forming apparatus **100**. The motor for driving one or more of the operating units may be the main motor **211**, the fixing motor **213**, the paper ejecting motor **215**, the scanning motor **217**, or any other motor provided for driving one or more of the operating units. FIG. **4** is an example showing the top cover **203** and the multipurpose paper feed device **201** being connected to the main motor **211** through a relay gear train **210**. Any combination of two or more of the motors described above may be used to replace the motors **531** in any combination of two or more of the locking units **300**.

The driving gear **533** rotates at a fixed position in a linear direction, and the thickness t1 of the driving gear **533** is preferably greater than the thickness t**2** of the gear **355**. The reason for this is to enable the driving gear **533** to guide the gear **355** so that the gear **355** moves a certain distance in the linear direction while engaging and being rotated by the driving gear **533**. The gear **355** moves away from the latching member **310** in the linear direction when the driving gear **533** rotates in a releasing direction as a result of the bolt threads **353** of the locking member **350** unscrewing from the nut threads **313** of the latching member **310**, and moves toward the latching member **310** in the linear direction when the driving gear **533** rotates in a locking direction opposite to the releasing direction as a result of the bolt threads **353** of the locking member **350** screwing into the nut threads **313** of the latching member **310**. As a matter of course, diverse gears such as a bevel gear, a helical gear, a rack-and-pinion gear, a spur gear, or any other suitable type of gear may be applied to both the gear **355** and the driving gear **533**, taking into consideration the direction of the driving axis and the engagement ratio of the gear **355** and the driving gear **533**.

In addition, an elastic member **381** is provided between the gear **355** and the supporting frame **333**. The elastic member **381** applies an elastic force between the gear **355** and the supporting frame **333**, which acts as a releasing force for releasing the locking member **350**.

A state of the image forming apparatus **100** which the controller **510** judges to be a state in which the locking unit **300** is to be released may be a certain standby state such as a standby state in which power to the image forming apparatus **100** is turned on, or a standby state in which each operating unit, e.g., the paper feeding unit **130**, the image reading unit **109**, the image forming unit **150**, the fixing unit **180**, the paper ejecting unit **190**, and the like, is ready to start operating. The standby state in which each operating unit is ready to start operating may be a standby state in which image reading is possible, a standby state in which printing is possible, or a standby state in which each operating unit is warmed up.

A state of the image forming apparatus **100** which the controller **510** judges to be a state in which the locking unit **300** is to be locked may be a state in which a user desires to move and reinstall the image forming apparatus **100**. In this state, if the user selects a locking function through an operation such as pressing a locking button provided in an operating unit for operating the image forming apparatus **100**, the locking unit **300** is relocked. In the example of the locking unit **300** described above, the relocking is accomplished by rotating the driving gear **533** described above in the locking direction opposite to the releasing direction to move the locking member **350** toward the latching member **310** in the linear direction so as to insert the locking member **350** into the latching member **310** and screw the bolt threads **353** on the locking member **350** into the nut threads **313** of the latching member **310**.

The locking member **350** described above may be formed so as to be operated manually after a user thoroughly learns how to release it by reading a user's manual. For this purpose, a manual operator **357** is provided at the end portion of the locking member **350**. The manual operator **357** is preferably formed by a tool socket **357***a* corresponding to a manual tool **358**. The manual operator **357** may be formed so as to be operated simply by hand without using the manual tool **358**.

The operation of the locking unit **300** described above will be explained below with an example of releasing the locking unit **300**.

First, as shown in FIG. **5**A, the locking member **350** has been inserted into the latching depression **311** of the latching member **310**, and the bolt threads **353** of the locking member **350** have been screwed into the nut threads **313** of the latching member **310** so that movable objects in the image forming apparatus **100** (the image reading unit **109**, the cover **105**, the multipurpose paper feed device **201**, the top cover **203**, the rear cover **205**, the recording material cassette **131**, the knock-up plate **133**, the recording material guide **139**, and the like) cannot move, thereby achieving the locking state. Accordingly, when the image forming apparatus **100** is shipped and moved, the movable objects do not move, thereby maintaining the image forming apparatus **100** in a stable state.

Thereafter, as shown in FIGS. **5**B and **5**C, if a user performs an operation such as pressing a power switch, the controller **510** judges that this state is a state in which the locking unit **300**, is to be released and outputs a driving signal to the driver **550**. Then, the driver **550** drives the driving unit **530** according to the signal received by the driver **550** from the controller **510**. Considering the driving operation in detail, when the motor **531** is driven, the drive driving gear **533** rotates in the releasing direction, and the gear **355** engaging the driving gear **533** is accordingly rotated by the driving gear **533**. At this point, the driving gear **533** rotates in the releasing direction at the fixed position in the linear direction, so that the locking member **350** moves away from the latching member **310** in the linear direction while the gear **355** is engaging and being rotated by the driving gear **533** as a result of the bolt threads **353** of the locking member **350** unscrewing from the nut threads **313** of the latching member **310**.

Then, as shown in FIG. **5**D, when the locking member **350** has moved away from the latching member **310** in the linear direction until it has reached a point where the gear **355** is separated from the driving gear **533**, the locking member **350** is removed from the latching depression **311** by the elastic force of the elastic member **381**, so that the locking unit **300** is released, thereby enabling the latching member **310** and the movable object on which the latching member **310** is provided to move.

FIGS. **5**A through **5**D explain the operation of the locking unit **300** as applied to the image reading unit **109** to lock the image reading unit **109** in place at the home position inside the image reading frame **102***a*. FIG. **5**D shows a state where the locking unit **300** has been released and the latching member **310** and the image reading unit **109** on which the latching member **310** is provided have moved away from the locking member **350** and the home position of the image reading unit **109** inside the image reading frame **102***a* as the image reading unit **109** begins an image reading operation.

After the image reading unit **109** has completed the image reading operation, the image reading unit **109** returns to the home position inside the image reading frame **102***a* where the latching depression **311** of the latching member **310** provided on the image reading unit **109** is aligned with the locking member **350**. In this state, if the user selects the locking function through an operation such as pressing the locking button provided in the operating unit for operating the image forming apparatus **100**, the locking unit **300** is relocked as described above, thereby locking the image reading unit **109** in place at the home position inside the image reading frame **102***a*.

When the locking unit **300** is an unlocked state, the locking member **350** is held away from the latching depression **311** of the latching member **310** by the elastic force of the elastic member **381**. Therefore, before the locking unit **300** can be relocked, the locking member **350** must be reinserted in the latching depression **311** of the latching member **310** so that the bolt threads **353** on the locking member **350** can engage the nut threads **313** of the latching member **310**. One way of accomplishing this is to use a pressing device (not shown) to press the locking member **350** into the latching depression **311** of the latching member **310**. One example of such a pressing device is a solenoid with a plunger that presses the locking member **350** into the latching depression **311** of the latching member **310** when the solenoid is energized. However, any suitable pressing device may be used. Alternatively, the user may manually press the locking member **350** into the latching depression **311** of the latching member **310** using, for example, either the manual tool **358** or one of the user's fingers.

When the locking unit **300** is applied to a movable object that can be opened and closed, such as the cover **105**, the multipurpose paper feed device **201**, the top cover **203**, and the rear cover **205**, the latching member **310** and the locking member **350** are disposed so that the latching depression **311** of the latching member **310** provided on the movable object is aligned with the locking member **350** when the movable object is closed to enable the locking unit **300** to be relocked.

When the locking unit **300** is applied to a movable object that can be attached to or detached from the image forming apparatus **100**, such as the recording material cassette **131**, the latching member **310** and the locking member **350** are disposed so that the latching depression **311** of the latching member **310** provided on the movable object is aligned with the locking member **350** when the movable object is attached to the image forming apparatus to enable the locking unit **300** to be relocked.

When the locking unit **300** is applied to a movable object that can be moved to different positions, such as the knock-up plate **133** provided in the recording material cassette **131** and the recording material guide **139**, the latching member **310** and the locking member **350** are disposed so that the latching depression **311** of the latching member **310** provided on the movable object is aligned with the locking member **350** when the movable object is at a predetermined position to enable the locking unit **300** to be relocked.

Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. An image forming apparatus comprising:
- an image forming body;
- a locking unit blocking movement of at least one movable object of the image forming body; and
- a control unit controlling a locking state of the locking unit and a releasing state of the locking unit;
- wherein:
- the control unit automatically releases the locking unit so that the locking unit is in a released state before the image forming body begins forming an image, and maintains the locking unit in the released state while the image forming body is forming the image;
- the control unit relocks the locking unit so that the locking unit is once again in a locked state in response to a locking command set by a user after the locking unit has been in the released state as a result of the control unit automatically releasing the locking unit; and
- the locking unit comprises two threaded members that are engaged with one another when the locking unit is in the locked state, and that are disengaged from one another when the locking unit is in the released state.

2. The apparatus as claimed in claim **1**, wherein the at least one movable object is any one or any combination of an image reading unit reading images of documents, a cover installed on the image forming body so as to be openable away from and closable against a top surface of a document base glass on which a document is to be placed, a recording material cassette supplying recording materials on which images are to be formed based on the images read by the image reading unit, the recording material cassette being attachable to and removable from the image forming body, a knock-up plate installed inside the recording material cassette on which recording materials are to be stacked, a covering member opening and closing the image forming body, a multipurpose paper feed device feeding recording materials one sheet at a time or performing other functions, and a recording material guide lining up recording materials stacked on the knock-up plate in a width direction and/or a length direction.

3. The apparatus as claimed in claim **2**, wherein the covering member is a rear cover installed on a rear surface of the image forming body to replace a fixing unit installed inside the image forming body and/or to remove jammed recording materials from inside the image forming body, and/or a top cover installed on a top surface of the image forming body to replace a developing unit installed inside the image forming body and/or to remove jammed recording materials from inside the image forming body.

4. The apparatus as claimed in claim **1**, wherein:
- the locking unit further comprises supporting member provided on the image forming body; and
- the two threaded members of the locking unit comprise:
  - a threaded latching member provided on one of the at least one movable object and provided with a threaded latching depression; and
  - a threaded locking member movably supported by the supporting member so as to be insertable into and removable from the threaded latching depression of the threaded latching member.

5. The apparatus as claimed in claim **1**, wherein the control unit comprises:

a controller judging if a state of the image forming apparatus is a state in which the locking unit is to be locked or a state in which the locking unit is to be released;

a driving unit driving the locking unit; and

a driver operating the driving unit according to an output signal of the controller if the controller judges the state of the image forming apparatus to be a state in which the locking unit is to be locked or a state in which the locking unit is to be released.

6. The apparatus as claimed in claim **5**, wherein a state of the image forming apparatus in which the locking unit is to be released is a state in which power to the image forming apparatus is turned on or a state in which operating units in the image forming body are ready to start operating.

7. The apparatus as claimed in claim **5**, wherein a state of the image forming apparatus in which the locking unit is to be locked is a state in which the locking command is set by the user.

8. An image forming apparatus comprising:

an image forming body;

a locking unit blocking movement of at least one movable object of the image forming body; and

a control unit controlling a locking state of the locking unit and a releasing state of the locking unit;

wherein:

the control unit automatically releases the locking unit so that the locking unit is in a released state before the image forming body begins forming an image, and maintains the locking unit in the released state while the image forming body is forming the image;

the control unit relocks the locking unit so that the locking unit is once again in a locked state in response to a locking command set by a user after the locking unit has been in the released state as a result of the control unit automatically releasing the locking unit;

the locking unit comprises:

a latching member provided on one of the at least one movable object and provided with a latching depression;

a supporting member provided on the image forming body; and

a locking member movably supported by the supporting member so as to be insertable into and removable from the latching depression of the latching member; and

the latching depression has nut threads formed therein, and an end portion of the locking member has bolt threads corresponding to the nut threads formed thereon.

9. The apparatus as claimed in claim **8**, wherein the nut threads are formed in the latching depression only up to a point that is a certain distance away from an end of the latching depression.

10. An image forming apparatus comprising:

an image forming body;

a locking unit blocking movement of at least one movable object of the image forming body; and

a control unit controlling a locking state of the locking unit and a releasing state of the locking unit;

wherein:

the control unit automatically releases the locking unit so that the locking unit is in a released state before the image forming body begins forming an image, and maintains the locking unit in the released state while the image forming body is forming the image;

the control unit relocks the locking unit so that the locking unit is once again in a locked state in response to a locking command set by a user after the locking unit has been in the released state as a result of the control unit automatically releasing the locking unit;

the locking unit comprises:

a latching member provided on one of the at least one movable object and provided with a latching depression;

a supporting member provided on the image forming body; and

a locking member movably supported by the supporting member so as to be insertable into and removable from the latching depression of the latching member; and the supporting member is provided on the image forming body facing the latching member across a certain gap and comprises a supporting frame provided with a supporting hole through which the locking member passes so as to be supported by the supporting frame of the supporting member, and an elastic member is provided between a portion of the latching member and the supporting frame.

11. An image forming apparatus comprising:

an image forming body;

a locking unit blocking movement of at least one movable object of the image forming body; and

a control unit controlling a locking state of the locking unit and a releasing state of the locking unit;

wherein:

the control unit automatically releases the locking unit so that the locking unit is in a released state before the image forming body begins forming an image, and maintains the locking unit in the released state while the image forming body is forming the image;

the control unit relocks the locking unit so that the locking unit is once again in a locked state in response to a locking command set by a user after the locking unit has been in the released state as a result of the control unit automatically releasing the locking unit;

the locking unit comprises:

a latching member provided on one of the at least one movable object and provided with a latching depression;

a supporting member provided on the image forming body; and

a locking member movably supported by the supporting member so as to be insertable into and removable from the latching depression of the latching member; and

a manual operating unit is provided at an end portion of the locking member to enable the locking member to be operated manually.

12. The apparatus as claimed in claim **11**, wherein the manual operating unit is a tool socket corresponding to a manual tool.

13. An image forming apparatus comprising:

an image forming body;

a locking unit blocking movement of at least one movable object of the image forming body; and

a control unit controlling a locking state of the locking unit and a releasing state of the locking unit;

wherein the control unit comprises:

a controller judging if a state of the image forming apparatus is a state in which the locking unit is to be locked or a state in which the locking unit is to be released;

a driving unit driving the locking unit; and

a driver operating the driving unit according to an output signal of the controller if the controller judges the state of the image forming apparatus to be a state in

which the locking unit is to be locked or a state in which the locking unit is to be released;

wherein the driving unit comprises:

a motor generating a driving force;

a driving gear directly or indirectly connected to the motor and rotatable in a locking direction to lock the locking unit and a releasing direction to release the locking unit; and

a gear provided on the locking unit and engaging the driving gear; and

wherein the driving gear rotates at a fixed position in a linear direction, and a thickness of the driving gear is greater than a thickness of the gear provided on the locking unit.

14. The apparatus as claimed in claim **13**, wherein the motor is any one of motors that drive operating units in the image forming body, and the driving gear is directly connected to the any one of the motors that drive the operating units or is connected to the any one of the motors that drive the operating units through at least one relay gear.

15. An image reading apparatus comprising:

an image reading main body;

a document base glass installed on a top surface of the image reading main body and having a top surface on which documents are to be placed in a stationary state and/or a moving state;

an image reading unit installed facing the document base glass reading images of the documents placed on the document glass;

a cover installed on the image reading main body so as to be openable away from and closable against the top surface of the document base glass;

a locking unit blocking movement of the image reading unit or the cover; and

a control unit controlling a locking state of the locking unit and a releasing state of the locking unit;

wherein:

the control unit automatically releases the locking unit so that the locking unit is in a released state before the image reading unit begins reading an image, and maintains the locking unit in the released state while the image reading unit is reading the image;

the control unit relocks the locking unit so that the locking unit is once again in a locked state in response to a locking command set by a user after the locking unit has been in the released state as a result of the control unit automatically releasing the locking unit; and

the locking unit comprises two threaded members that are engaged with one another when the locking unit is in the locked state, and that are disengaged from one another when the locking unit is in the released state.

16. An image forming apparatus comprising:

an image forming body;

a movable object disposed in the image forming body;

a controllable locking unit to selectively lock the movable object to prevent the movable object from moving and release the movable object to allow the movable object to move; and

a control unit to control the controllable locking unit to selectively lock and release the movable object;

wherein:

the control unit automatically controls the controllable locking unit to release the movable object so that the controllable locking unit is in a released state before the image forming body begins forming an image, and to maintain the controllable locking unit in the released state while the image forming body is forming the image;

the control unit controls the controllable locking unit to relock the movable object so that the controllable locking unit is once again in a locked state in response to a locking command set by a user after the controllable locking unit has been in the released state as a result of the control unit automatically controlling the controllable locking unit to release the movable object; and

the controllable locking unit comprises two threaded members that are engaged with one another when the locking unit is in the locked state, and that are disengaged from one another when the locking unit is in the released state.

17. The apparatus as claimed in claim **16**, further comprising:

a plurality of operating units disposed in the image forming body that cooperate to form an image on a recording material;

at least one recording material supply unit to supply the recording material, the recording material supply unit being attachable to and removable from the image forming body; and

at least one covering member to open and close an opening in the image forming body;

wherein the movable object is one of the operating units, or one of the at least one recording material supply unit, or one of the at least one covering member.

18. The apparatus as claimed in claim **16**, wherein:

the two threaded members of the controllable locking unit comprise:

a threaded latching member disposed on the movable object; and

a threaded locking member movably disposed in the image forming body to be selectively lockable to and releasable from the threaded latching member; and

the controllable locking unit further comprises a driving unit to drive the threaded locking member to selectively lock to and release from the threaded latching member, thereby causing the controllable locking unit to selectively lock and release the movable object.

19. The apparatus as claimed in claim **18**, wherein the driving unit comprises a motor coupled to the locking member; and

wherein the control unit controls the motor to operate in a locking direction to drive the locking member to lock to the latching member, thereby controlling the controllable locking unit to lock the movable object, and controls the motor to operate in a releasing direction opposite to the locking direction to drive the locking member to release from the latching member, thereby controlling the controllable locking unit to release the movable object.

20. The apparatus as claimed in claim **19**, wherein the driving unit further comprises:

a driving gear coupled to the motor; and

a gear disposed on the locking member and engaging the driving gear during at least a portion of a locking operation of the controllable locking unit and a portion of a releasing operation of the controllable locking unit.

21. The apparatus as claimed in claim **19**, further comprising a plurality of operating units disposed in the image forming body that cooperate to form an image on a recording material;

wherein the motor is coupled to the locking member and at least one of the operating units to drive the locking member and the at least one of the operating units.

22. The apparatus as claimed in claim 16, wherein the control unit monitors a state of the image forming apparatus, controls the controllable locking unit to lock the movable object if the control unit judges that the state of the image forming apparatus is a state in which the movable object is to be locked, and controls the controllable locking unit to release the movable object if the control unit judges that the state of the image forming apparatus is a state in which the movable object is to be released.

23. The apparatus as claimed in claim 22, wherein the state in which the movable object is to be locked is a state in which the image forming apparatus is to be shipped, or a state in which the image forming apparatus is to be moved, or a state in which the user has set the locking command, thereby indicating that the movable object is to be locked.

24. The apparatus as claimed in claim 22, wherein the state in which the movable object is to be released is a state in which power to the image forming apparatus is turned on, or a state in which the image forming apparatus is ready to start operating.

25. An image reading apparatus comprising:

an image reading main body;

a document base glass disposed on the main body on which a document is to be placed;

an image reading unit disposed in the image reading main body facing the document base glass and being movable relative to the document base glass to read an image of a document placed on the document base glass;

a cover disposed on the image forming body and being openable away from and closable against the document base glass;

a controllable locking unit to selectively lock the image reading unit or the cover to prevent the image reading unit or the cover from moving and release the image reading unit or the cover to allow the image reading unit or the cover to move; and

a control unit to control the controllable locking unit to selectively lock and release the image reading unit or the cover;

wherein:

the control unit automatically controls the controllable locking unit to release the image reading unit or the cover so that the controllable locking unit is in a released state before the image reading unit begins reading an image, and to maintain the controllable locking unit in the released state while the image reading unit is reading the image;and

the control unit controls the controllable locking unit to relock the image reading unit or the cover so that the controllable locking unit is once again in a locked state in response to a locking command set by a user after the controllable locking unit has been in the released state as a result of the control unit automatically controlling the controllable locking unit to release the image reading unit or the and

the controllable locking unit comprises two threaded members that are engaged with one another when the locking unit is in the locked state, and that are disengaged from one another when the locking unit is in the released state.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 7,409,175 B2
APPLICATION NO. : 11/340792
DATED : August 5, 2008
INVENTOR(S) : Young-min Kim et al.

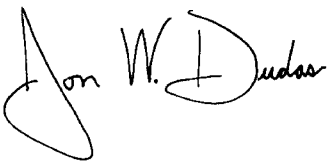
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 18, line 16 claim 25, delete “and”.

Column 18, line 24 claim 25, insert --cover;-- after “the”.

Signed and Sealed this

Seventh Day of October, 2008



JON W. DUDAS
Director of the United States Patent and Trademark Office