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IMAGE FORMING APPARATUS FOR USE WITH DETACHABLE TONER CONTAINER

Abstract

An image forming apparatus includes an attaching portion including an operation member configured to be movable together with a container shutter, a toner storage portion configured to store toner received from a receiving port, an actuator configured to regulate a movement of the operation member, and a control unit configured to control the actuator. The operation member is configured to open and close the container shutter from an outside in a state in which the toner container is attached to the attaching portion. In a case where a predetermined condition is met, the control unit controls the actuator to release a regulation of the movement of the operation member.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a Continuation of International Patent Application No. PCT/JP2022/008884, filed Mar. 2, 2022, which claims the benefit of Japanese Patent Application No. 2021-035880, filed Mar. 5, 2021, both of which are hereby incorporated by reference herein in their entirety.

BACKGROUND OF THE INVENTION
Field of the Invention
[0002] This invention relates to an image forming apparatus forming an image on a sheet.
Description of the Related Art
[0003] In image forming apparatuses of an electrophotographic system, configurations in which developer is replenished to developer containers using replenishment containers that can be attached to and detached from the image forming apparatuses are known. In Japanese Patent Application Laid-Open No. 2020-154300, a configuration in which an opening/closing of a shutter member of a replenishment container is performed by rotating the replenishment container attached to an image forming apparatus is disclosed.
[0004] However, a shutter member described in Japanese Patent Application Laid-Open No. 2020-154300 is always openable and closable when the replenishment container is rotated, and cannot regulate toner replenishment in a case where performing a toner supply by the replenishment container is not desirable.
SUMMARY OF THE INVENTION
[0005] According to a first aspect of the present invention, an image forming apparatus to which a toner container including an opening portion for supplying toner and a container shutter configured to open and close the opening portion is detachably attached, the image forming apparatus includes an attaching portion to which the toner container is attached, the attaching portion including a receiving port configured to receive the toner supplied from the toner container, and an operation member configured to be movable together with the container shutter and configured to open and close the container shutter from an outside in a state in which the toner container is attached to the attaching portion, a toner storage portion configured to store the toner received from the receiving port, an actuator configured to regulate a movement of the operation member, and a control unit configured to control the actuator. The control unit controls the actuator to release a regulation of the movement of the operation member in a case where a predetermined condition is met.
[0006] According to a second aspect of the present invention, an image forming apparatus includes a receiving portion including a receiving port configured to receive toner supplied from an outside, an apparatus body shutter configured to open and close the receiving port, and an operation member configured to open and close the apparatus body shutter from an outside, a toner storage portion configured to store the toner received from the receiving port, an actuator configured to regulate a movement of the operation member, and a control unit configured to control the actuator. The control unit controls the actuator to release a regulation of the movement of the operation

member in a case where a predetermined condition is met.
[0007] Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0008] FIG. **1** is a perspective view illustrating an image forming apparatus of a first embodiment.
[0009] FIG. **2** is an overall schematic view illustrating the image forming apparatus.
[0010] FIG. **3**A is a perspective view illustrating the image forming apparatus with a back cover closed.
[0011] FIG. **3**B is a perspective view illustrating the image forming apparatus with the back cover opened.
[0012] FIG. **3**C is a perspective view illustrating an opening/closing detection sensor.
[0013] FIG. **4** is a perspective view illustrating a developer container.
[0014] FIG. **5** is a cross-sectional view illustrating a replenishment portion and the developer container.
[0015] FIG. **6**A is a perspective view illustrating the image forming apparatus with a sheet discharge tray closed.
[0016] FIG. **6**B is a perspective view illustrating the image forming apparatus with the sheet discharge tray opened.
[0017] FIG. **6**C is a perspective view illustrating the image forming apparatus with a replenishment pack attached to the replenishment portion.
[0018] FIG. **6**D is a plan view illustrating a state in which the replenishment pack is attached to the replenishment portion.
[0019] FIG. **7**A is a perspective view illustrating the replenishment portion.
[0020] FIG. **7**B is a perspective view illustrating the replenishment portion and part of the replenishment pack.
[0021] FIG. **7**C is a perspective view illustrating the replenishment portion at a time when an operation portion is positioned in a replenishing position.
[0022] FIG. **8**A is a perspective view illustrating the operation portion.
[0023] FIG. **8**B is a perspective view illustrating the operation portion and a top surface portion.
[0024] FIG. **8**C is a perspective view illustrating how the operation portion is attached to the top surface portion.
[0025] FIG. **9**A is a perspective view illustrating the replenishment pack at a time when a pack shutter portion is positioned in a closed position.
[0026] FIG. **9**B is a perspective view illustrating the replenishment pack at the time when the pack shutter portion is positioned in the closed position.
[0027] FIG. **10**A is a perspective view illustrating the replenishment pack at a time when the pack shutter portion is positioned in an opening position.
[0028] FIG. **10**B is a perspective view illustrating the replenishment pack at the time when the pack shutter portion is positioned in the opening position.
[0029] FIG. **11**A is an exploded perspective view illustrating the replenishment pack.
[0030] FIG. **11**B is the other exploded perspective view illustrating the replenishment pack.
[0031] FIG. **12**A is a bottom view illustrating a first lock mechanism that is in a lock state.
[0032] FIG. **12**B is a cross-sectional view illustrating the first lock mechanism that is in the lock state.
[0033] FIG. **13**A is a bottom view illustrating the first lock mechanism that is in an unlock state.
[0034] FIG. **13**B is a cross-sectional view illustrating the first lock mechanism that is in the unlock

state.
[0035] FIG. **14** is a cross-sectional view illustrating a state in which the replenishment pack is attached to the replenishment portion.
[0036] FIG. **15** is a perspective view illustrating a second lock mechanism.
[0037] FIG. **16**A is an exploded perspective view illustrating the second lock mechanism.
[0038] FIG. **16**B is the other exploded perspective view illustrating the second lock mechanism.
[0039] FIG. **17**A is a perspective view illustrating the second lock mechanism that is in a lock state.
[0040] FIG. **17**B is a perspective view illustrating the second lock mechanism that is in an unlock state.
[0041] FIG. **18**A is a perspective view from a bottom surface side, illustrating the second lock mechanism that is in the lock state.
[0042] FIG. **18**B is a perspective view from a bottom surface side, illustrating the second lock mechanism that is in the unlocked state.
[0043] FIG. **19**A is a bottom view illustrating the second lock mechanism that is in the lock state.
[0044] FIG. **19**B is an expanded view of FIG. **19**A.
[0045] FIG. **19**C is a bottom view illustrating the second lock mechanism that is in the unlock state.
[0046] FIG. **20**A is a perspective view illustrating a window portion and a first display portion.
[0047] FIG. **20**B is a perspective view illustrating the window portion and a second display portion.
[0048] FIG. **21** is a block diagram for illustrating a function of a power supply board.
[0049] FIG. **22** is a flowchart illustrating the energization judgement processing of a solenoid.
[0050] FIG. **23**A is a plan view illustrating the second lock mechanism and the operation portion that are in the unlock state.
[0051] FIG. **23**B is a bottom view illustrating the second lock mechanism and the operation portion that are in the unlock state.
[0052] FIG. **24**A is a plan view illustrating the second lock mechanism and the operation portion that are in the lock state.
[0053] FIG. **24**B is a bottom view illustrating the second lock mechanism and the operation portion that are in the unlock state.
[0054] FIG. **25**A is a plan view illustrating a state in which the operation portion is operated at a time when the second lock mechanism is in the lock state.
[0055] FIG. **25**B is a bottom view illustrating the state in which the operation portion is operated at the time when the second lock mechanism is in the lock state.
[0056] FIG. **26** is a perspective view illustrating a display member of a second embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0057] Hereinafter, with reference to drawings, embodiments for implementing the present invention will be exemplarily described in detail based on examples. However, sizes, materials, shapes, relative arrangements, and the likes of components described in this embodiment are to be appropriately changed in accordance with configurations and various conditions of apparatuses to which this invention is applied. That is, it is to be understood that a scope of this invention is not limited to the embodiments described below.

First Embodiment

[0058] FIG. **1** is a perspective view illustrating an image forming apparatus **1** of a first embodiment. FIG. **2** is a schematic view illustrating a configuration of the image forming apparatus **1**. The image forming apparatus **1** is a monochrome printer forming an image on a recording material based on image information input from an external apparatus. The recording material includes various sheet materials different in a material including paper such as standard paper and cardboard, a plastic film such as a sheet for an overhead projector, a sheet of a special shape such as an envelope and index paper, cloth, and the like.
[0059] Further, in the following descriptions, in a case where the image forming apparatus **1** is installed on a horizontal surface, a height direction (direction opposite to the vertical direction) is

referred to as a Z direction. A direction intersecting with the Z direction and parallel to a rotational axis direction (main scanning direction) of a photosensitive drum **11**, described below, is referred to as an X direction. A direction intersecting with the X and Z directions is referred to as a Y direction. The X, Y, and Z directions preferably perpendicularly intersect with each other. Further, for convenience, a plus side and a minus side in the X direction are respectively referred to as a right side and a left side, a plus side and a minus side in the Y direction are respectively referred to as a front side or a fore side and a back side or a rear side, and a plus side and a minus side in the Z direction are respectively referred to as an upper side and a lower side.

Overall Configuration

[0060] As illustrated in FIGS. **1** and **2**, the image forming apparatus **1** includes an image forming unit **20** forming a toner image on the recording material, a sheet feed unit **30** feeding a recording material P, a fixing unit **9** fixing the toner image formed by the image forming unit **20** on the recording material P, and a sheet discharge roller pair **10**.

[0061] The image forming unit **20** includes a scanner unit **50**, a process unit **40** of an electrophotographic system, and a transfer roller **7** transferring the toner image formed on the photosensitive drum **11** onto the recording material P. The process unit **40** includes the photosensitive drum **11**, a cleaning unit **13** arranged adjacently to the photosensitive drum **11**, a charge roller **17**, a developing roller **12**, and a storage portion **18** storing toner. To be noted, the process unit **40** may be secured to a casing **72** of the image forming apparatus **1** with a screw, and includes those that are detached by a service man.

[0062] The photosensitive drum **11**, serving as an image bearing member, is a photosensitive member formed in a cylindrical shape. The photosensitive drum **11** includes a photosensitive layer formed of a negatively chargeable organic photoreceptor on a drum-shaped base body formed of aluminum. Further, the photosensitive drum **11**, serving as the image bearing member, is rotatably driven in a predetermined direction (arrow R direction in FIG. **1**) at a predetermined process speed by a motor.

[0063] The charge roller **17** forms a charge portion by coming into contact with photosensitive drum **11** with predetermined pressure contact force. Further, since a desired charge voltage is applied by a high voltage charging power supply, a surface of the photosensitive drum **11** is uniformly charged to a predetermined potential. In the present embodiment, the photosensitive drum **11** is charged to a negative polarity by the charge roller **17**.

[0064] The scanner unit **50** scans and exposes the surface of the photosensitive drum **11** by irradiating the photosensitive drum **11** with a laser beam corresponding to the image information input from the external apparatus using a polygon mirror. By this exposure, an electrostatic latent image corresponding to the image information is formed on the surface of the photosensitive drum **11**. To be noted, the scanner unit **50** is not limited to a laser scanner apparatus, and, for example, it is acceptable to apply a light-emitting diode (LED) exposure apparatus with an LED array in which a plurality of LEDs are arranged in a row along a longitudinal direction of the photosensitive drum **11**.

[0065] The developing roller **12** is rotatably supported by the storage portion **18**, serving as a toner storage portion. Further, so as to face the photosensitive drum **11**, the developing roller **12** is arranged in an opening portion of a developer container **230** (refer to FIG. **4**) including the storage portion **18**. To be noted, in the storage portion **18**, it is acceptable to dispose a supply roller that applies the toner, serving as developer, to a surface of the developing roller **12**.

[0066] The process unit **40** of the present embodiment uses a contact developing system as a developing system. That is, a toner layer borne on the developing roller **12** comes into contact with the photosensitive drum **11** in a developing portion (developing region) in which the photosensitive drum **11** and the developing roller **12** face each other. A developing voltage is applied to the developing roller **12** by a high voltage developing power supply. By transferring the toner borne by the developing roller **12** from the developing roller **12** to the drum surface under the developing

voltage according to an electrical potential distribution on the surface of the photosensitive drum **11**, the electrostatic latent image is developed to the toner image.

[0067] Further, the toner of the present embodiment does not contain a magnetic component, and is a so-called non-magnetic one-component developer whose toner is borne by the developing roller **12** mainly by intermolecular force and by electrostatic force (image force). However, it is acceptable to use a one-component developer containing a magnetic component. Further, so as to adjust the fluidity and the charging performance of the toner, an additive (for example, wax and silica fine particles) other than a toner particle is sometimes contained in the one-component developer. Further, it is acceptable to use a two-component developer constituted by the non-magnetic toner and a carrier having magnetism. In a case of using the carrier having the magnetism, as a developer bearing member, a cylindrically shaped developing sleeve in which a magnet is arranged inside is used.

[0068] The fixing unit **9** is of a heat-fixing method which performs a fixing process of the image by heating and melting the toner on the recording material. The fixing unit **9** includes a heating roller **9***a* incorporating a fixing heater **9***c* and a press roller **9***b* coming into pressure contact with the heating roller **9***a*.

[0069] The sheet feed unit **30** includes a cassette **4** in which the recording material P is stacked, a pickup roller **3**, serving as a conveyance unit, a feed roller **5***a*, and a separation roller **5***b*. A front cover **70** is disposed in part of an end surface on the front side of the image forming apparatus **1**, and covers a circuit board **100**. The casing **72** includes the front cover **70**, a sheet discharge tray **14**, a back cover **73** (refer to FIG. **3**A), and an exterior cover **71** that constitutes an exterior of the image forming apparatus **1** apart from the front cover **70**, the sheet discharge tray **14**, and the back cover **73**. In the casing **72**, a sheet discharge port **15** through which the sheet discharged to the sheet discharge tray **14** passes is formed.

[0070] As illustrated in FIG. **2**, the image forming apparatus **1** includes the circuit board **100**. The circuit board **100** is constituted by a wiring board **101** made of an insulator, and electronic components **111** and **121** soldered to the wiring board **101**. Since a conductor is wired on a surface and in an interior of a board of the wiring board **101**, the electronic components **111** and **121** are electrically connected to each other. The circuit board **100** has functions such as converting an alternating current supplied from the outside of the image forming apparatus **1** into a direct current and converting an input voltage so as to obtain a predetermined voltage value required for an image forming process.

[0071] The circuit board **100** is arranged in an orientation in which a surface of the wiring board **101**, on which the electronic components **111** and **121** are attached, intersects with a sheet discharge direction. Further, the wiring board **101** is disposed between the front cover **70** and the scanner unit **50** in the sheet discharge direction. On the wiring board **101**, the electronic components **111** and **121** are disposed on a side of a surface that faces the scanner unit **50**.

[0072] Next, an image forming operation of the image forming apparatus **1** will be described. When an image formation instruction is input to the image forming apparatus **1**, the image forming process by the image forming unit **20** is started based on the image information input from an external computer connected to the image forming apparatus **1**. The scanner unit **50** irradiates the laser beam toward the photosensitive drum **11** based on the input image information. At this time, the photosensitive drum **11** has been charged by the charge roller **17** beforehand, and, by irradiating the laser beam, the electrostatic latent image is formed on the photosensitive drum **11**. Thereafter, this electrostatic latent image is developed by the developing roller **12**, and the toner image is formed on the photosensitive drum **11**.

[0073] In parallel with the image forming process described above, the pickup roller **3** of the sheet feed unit **30** sends out the recording material P supported on the cassette **4**. The recording P is separated into one sheet at a time by the feed roller **5***a* and the separation roller **5***b*, and conveyed to a conveyance roller pair **5***c*. Then, by the conveyance roller pair **5***c*, serving as a conveyance unit,

the recording material P is conveyed toward a transfer nip N**1**, serving as an image forming portion formed by the transfer roller **7** and the photosensitive drum **11**.
[0074] A transfer voltage is applied from a high voltage transferring power supply to the transfer roller **7**, and the toner image borne on the photosensitive drum **11** is transferred onto the recording material P conveyed by the conveyance roller pair **5***c*. The recording material P onto which the toner image has been transferred is conveyed to the fixing unit **9**, and, at a time of passing through a nip portion between the heating roller **9***a* and the press roller **9***b* of the fixing unit **9**, the toner image is heated and pressed. Thereby, the toner particle is melted, and, by being adhered thereafter, the toner image is fixed on the recording material P. The recording material P having passed through the fixing unit **9** is discharged from the sheet discharge port **15** to the outside of the image forming apparatus **1** (external to the apparatus) by the sheet discharge roller pair **10**, and loaded on the sheet discharge tray **14**. After the toner image has been transferred onto the recording material P, the toner remained on the photosensitive drum **11** is cleaned by the cleaning unit **13**.
[0075] To be noted, while the image forming apparatus **1** of the present embodiment is configured to be capable of forming the image only on one side of the recording material P, it is not limited to this. For example, it is acceptable to configure such that, by disposing a duplex conveyance path for inverting the recording material P on whose first surface the image has been formed, the image forming apparatus **1** is capable of forming the image on both surfaces of the recording material P.
[0076] As illustrated in FIGS. **3**A and **3**B, in the back surface of the image forming apparatus **1**, the back cover **73** that is supported in an openable and closable manner is disposed. The back cover **73**, serving as an opening/closing member, covers the process unit **40** in a closed state, and, by being opened, exposes the process unit **40**.
[0077] Further, by opening the back cover **73**, a conveyance path **19** (refer to FIG. **2**) through which the sheet conveyed by the conveyance roller pair **5***c* passes is opened. That is, the back cover **73** is movable between a closed position H**1** covering the conveyance path **19** and an opening position H**2** exposing the conveyance path **19** to the outside. Thereby, it is possible to detach a jam that has occurred in the conveyance path **19**.
[0078] On an outer surface **73***b* of the back cover **73**, that is, a surface constituting an exterior surface of the casing **72**, a gripping portion **73***c* which a user can grip at a time of opening and closing the back cover **73** is disposed. On an inner surface **73***d* on a side opposite to the outer surface **73***b* of the back cover **73**, a rib **74** and a support portion **75** rotatably supporting the transfer roller **7** are disposed. The rib **74** extends from the inner surface **73***d* toward a direction in which the back cover **73** is closed.
[0079] In the image forming apparatus **1**, an opening portion **76** arranged in a position corresponding to the rib **74** in a state in which the back cover **73** is closed is disposed, and an opening/closing detection sensor **80** is disposed inside of the opening portion **76**. To be noted, it is acceptable to dispose the opening portion **76** either in the process unit **40** or in a component of the image forming apparatus **1** other than the process unit **40**.
[0080] As illustrated in FIG. **3**C, the opening/closing detection sensor **80** includes a flag portion **81** and a sensor portion **82**, and, when the flag portion **81** is pressed by the rib **74** of the back cover **73**, the sensor portion **82** makes transition, for example, from an off state to an on state. Further, when the back cover **73** is opened, the rib **74** of the back cover **73** is separated from the flag portion **81**, and the sensor portion **82** makes transition, for example, from the on state to the off state. As described above, the opening/closing detection sensor **80** can detect the opening/closing of the back cover **73**.
Developer Container
[0081] Next, using FIGS. **4** and **5**, the developer container **230** and configurations adjacent to the developer container **230** will be described. As illustrated in FIG. **4**, the developer container **230** is constituted from the storage portion **18** and a replenishment portion **200**, serving as an attaching portion and a receiving portion. The replenishment portion **200** includes an operation portion **201**, a

cylindrically shaped toner receiving portion **202**, a replenishment path portion **203** connecting the toner receiving portion **202** and the storage portion **18**, and an apparatus body shutter portion **206**, serving as an apparatus body shutter. In an inner wall of the toner receiving portion **202**, a side opening **205** leading to the replenishment path portion **203** is formed.

[0082] As illustrated in FIG. **5**, a replenishment pack **210**, described below, is attached to the replenishment portion **200**, and the toner discharged from the replenishment pack **210** is replenished to the storage portion **18** through an opening **207** of the apparatus body shutter portion **206**, the side opening **205** of the toner receiving portion **202**, and the replenishment path portion **203**.

[0083] As illustrated in FIG. **4**, the replenishment path portion **203** is connected to a side of a first end of the storage portion **18** in a longitudinal direction of the developer container **230**, that is, in the X direction. In an interior of the storage portion **18**, as illustrated in FIG. **5**, an agitation member **60** rotating around a rotation shaft **60***a* extending in the X direction as a center is disposed. The agitation member **60** includes a blade portion **60***b* secured to the rotation shaft **60***a*, and, by being rotatably driven by a drive motor **311**, conveys the toner toward the developing roller **12**, in conjunction with agitating the toner in the interior of the storage portion **18**. To be noted, while, in the present embodiment, the agitation member **60** is constituted by the rotation shaft **60***a* and the blade portion **60***b*, it is acceptable to use a helical shape agitation member as a configuration that distributes the toner over the whole length of the storage portion **18**.

[0084] Further, the agitation member **60** has a role of uniformizing the toner in the interior of the storage portion **18** by circulating the toner that has not been used for developing but has been stripped from the developing roller **12**. To be noted, the agitation member **60** is not limited to a rotating form. For example, it is acceptable to apply an agitation member in a swinging form. Further, it is acceptable to dispose yet another agitation member besides the agitation member **60**.

[0085] Further, a remaining amount detection sensor **312**, serving as a sensor for detecting a toner amount in the interior of the storage portion **18**, is disposed in the storage portion **18**, and the remaining amount detection sensor **312** includes a light emitting portion **312***a* and a light receiving portion **312***b*. Light emitted from the light emitting portion **312***a* passes through the interior of the storage portion **18**, and is received by the light receiving portion **312***b*. That is, the light emitting portion **312***a* and the light receiving portion **312***b* form a light path Q**1** in the interior of the storage portion **18**. To be noted, the light emitting portion **312***a* and the light receiving portion **312***b* may be disposed by arranging each of a light emitting element and a light receiving element in the interior of the storage portion **18**, or it is acceptable to guide the light to the inside and outside of the storage portion **18** using light guiding portions by arranging each of the light emitting element and the light receiving element in the outside of the storage portion **18**.

[0086] Further, the light emitting portion **312***a* and the light receiving portion **312***b* are disposed in a center section of the storage portion **18** in the X direction. By arranging the light emitting portion **312***a* and the light receiving portion **312***b* in the center section of the storage portion **18**, it is possible to satisfactorily detect a remaining amount of the toner in the storage portion **18**. That is, the developer (toner) is sometimes unevenly distributed in end portions of the storage portion **18** in the X direction, but, since an uneven distribution of the developer is less in the center section, it is possible to detect a realistic remaining amount of the toner.

[0087] To be noted, in the present embodiment, the LED is used for the light emitting portion **312***a*, and a photoresistor that is turned into an on state by the light from the LED is used for the light receiving portion **312***b*, however, it is not limited to this. For example, it is acceptable to apply a halogen lamp and a fluorescent lamp to the light emitting portion **312***a*, and acceptable to apply a photodiode and an avalanche photodiode to the light receiving portion **312***b*.

[0088] The light receiving portion **312***b* that is the photoresistor receives the light emitted from the light emitting portion **312***a*, and outputs a signal (electrical current) corresponding to a light amount of received light. This signal is converted into voltage, and input to an engine controller

130 (refer to FIG. **21**). That is, the light receiving portion **312***b* changes an output value based on the amount of the toner (developer) stored in the storage portion **18**.

[0089] Based on a voltage level that has been input, the engine controller **130** judges whether or not the light receiving portion **312***b* receives the light from the light emitting portion **312***a*. Based on a duration of time during which the light receiving portion **312***b* has detected each light at a time of agitating the toner in the interior of the storage portion **18** for a certain time, the engine controller **130** calculates the amount of the toner (amount of developer) in the interior of the storage portion **18**. That is, a read-only memory (ROM) of the engine controller **130** has stored beforehand a table capable of outputting the remaining amount of the toner from a light reception time when the agitation member **60** has conveyed the toner, and, based on this table, the engine controller **130** estimates/calculates the remaining amount of the toner.

[0090] When the remaining amount of the toner is large, since the light path Q**1** is easily blocked by the toner, the duration of the time during which the light receiving portion **312***b* receives the light is shortened. On the other hand, when the remaining amount of the toner is small, the duration of the time during which the light receiving portion **312***b* receives the light is lengthened. Therefore, as described above, the engine controller **130** can judge a level of the remaining amount of the toner in the interior of the storage portion **18** based on the light reception time of the light receiving portion **312***b*.

[0091] To be noted, a detection/estimation method of the remaining amount of the toner is not limited to the method described above, and it is possible to apply various well-known methods as the detection/estimation method of the remaining amount of the toner. For example, by arranging equal to or more than two plates or sheets of a metal plate or a conductive resin sheet extending in a longitudinal direction of the developing roller **12** on an inner wall of the storage portion **18**, it is acceptable to estimate/calculate the remaining amount of the toner by measuring an electrostatic capacity between two metal plates or two conductive resin sheets. Alternatively, by disposing a load cell in a form that supports the developer container **230** from below, it is acceptable to calculate the remaining amount of the toner based on weight measured by the load cell.

Replenishment Portion

[0092] Next, using FIGS. **6**A to **8**C, the replenishment portion **200** will be described. The sheet discharge tray **14** is supported in an openable and closable manner between a closed position, capable of loading the recording material P, as illustrated in FIG. **6**A, and an opening position, opened with respect to an apparatus body of the image forming apparatus **1**, as illustrated in FIG. **6**B. The sheet discharge tray **14** covers the replenishment portion **200** in the closed position. When the sheet discharge tray **14** is opened to the opening position, a top surface portion **240** and the replenishment portion **200** arranged on the top surface portion **240** is exposed. The replenishment portion **200** is configured such that it is possible to attach and detach a replenishment pack **210** as illustrated in FIG. **6**C, and configured such that the user and the service man can replenish the toner from the outside without detaching the developer container **230** from the casing **72**.

[0093] As illustrated in FIGS. **6**B to **6**D, the operation portion **201**, serving as an operation member, is arranged on the top surface portion **240**, and forms a replenishment port **204** that is a receiving port for replenishing the toner. In the X direction, the width of the replenishment port **204** is narrower than the width of the storage portion **18**. Further, the operation portion **201** is disposed so as to enclose the replenishment port **204**, and includes a ring portion **201***a* rotatably supported by the top surface portion **240** or the toner receiving portion **202** and a lever portion **201***b* disposed integrally with the ring portion **201***a*. The operation portion **201** is a member for manipulating an opening/closing of the apparatus body shutter portion **206** and a pack shutter portion **214** from the outside.

[0094] As illustrated in FIG. **7**A, guide portions **247** and **248** disposed inside of the apparatus body shutter portion **206** and integrated with the toner receiving portion **202** are disposed in the toner receiving portion **202**. The apparatus body shutter portion **206** is a cylindrically shaped member

that is concentric with the toner receiving portion **202**, and is rotatably disposed inside of the toner receiving portion **202**. The apparatus body shutter portion **206** includes an opening **207** (refer to FIG. **7**C), and the opening **207** and the side opening **205** of the toner receiving portion **202** are misaligned in a closed position illustrated in FIG. **7**A. A seal member **243** is secured to the apparatus body shutter portion **206** so as to enclose a circumference edge portion of the opening **207**.

[0095] To be noted, since the side opening **205** is covered by the apparatus body shutter portion **206** positioned in the closed position, the side opening **205** is shown by dashed lines in FIG. **7**A. Therefore, the side opening **205** is shielded by the apparatus body shutter portion **206**, and the toner is not discharged to the replenishment path portion **203**. When the replenishment pack **210** is not attached, the operation portion **201** is regulated in a rotational direction by a first lock mechanism **250**, described below. By this first lock mechanism **250**, before attaching the replenishment pack **210**, it is possible to prevent inability to attach the replenishment pack **210** due to a phase misalignment between an operation portion drive transmission projection **201***d* and an apparatus body shutter portion drive transmission projection **206***a*.

[0096] Further, when the apparatus body shutter portion **206** is positioned in an opening position illustrated in FIG. **7**C, the opening **207** overlaps the side opening **205** of the toner receiving portion **202**. Therefore, it is possible to discharge the toner, replenished from the replenishment pack **210** (refer to FIG. **6**C) attached to the replenishment portion **200**, to the replenishment path portion **203** via the side opening **205** and the opening **207**.

[0097] The apparatus body shutter portion drive transmission projection **206***a* is disposed to the apparatus body shutter portion **206**, and, while details will be described below, the apparatus body shutter portion drive transmission projection **206***a* is used for receiving drive from the replenishment pack **210** so as to pivot the apparatus body shutter portion **206**. By rotationally manipulating the operation portion **201** with the replenishment pack **210** attached to the replenishment portion **200**, the apparatus body shutter portion **206** moves between the closed position and the opening position.

[0098] The operation portion drive transmission projection **201***d* that projects more inwardly in a radial direction than an inner circumferential surface of the toner receiving portion **202** is disposed to the operation portion **201**. The operation portion drive transmission projection **201***d* is engaged with the apparatus body shutter portion drive transmission projection **206***a* via a pair of drive transmission surfaces **214***b* (refer to FIG. **9**B) of the pack shatter portion **214** of the replenishment pack **210**. A lock release concave portion **201***f*, described below, is disposed to the apparatus body shutter portion drive transmission projection **206***a*. When the user rotates the lever portion **201***b* of the operation portion **201** by 90 degrees in a counter-clockwise direction, the apparatus body shutter portion drive transmission projection **206***a* moves from the closed position illustrated in FIG. **7**A to the open position illustrated in FIG. **7**C.

[0099] At a time of forming the image on the recording material P, it is necessary to block the side opening **205** by the apparatus body shutter portion **206** such that the toner does not leak from the side opening **205** because of the agitation of the toner in the interior of the storage portion **18** by the agitation member **60** (refer to FIG. **5**). Therefore, at the time of forming the image, the operation portion **201** is positioned in an operating position illustrated in FIG. **7**A so as to position the apparatus body shutter portion **206** in the closed position. On the other hand, at a time of replenishing the toner from the replenishment pack **210**, described below, it is necessary to open the side opening **205**. Therefore, at the time of replenishing the toner, the operation portion **201** is positioned in a replenishing position illustrated in FIG. **7**C so as to position the apparatus body shutter portion **206** in the opening position.

[0100] As illustrated in FIG. **8**B, the operation portion **201** is rotatably supported by a support portion **240***a* of the top surface portion **240**. As illustrated in FIG. **8**A, the operation portion **201** includes a retaining portion **201***j*, an engaged portion **201***k*, and an opening portion **201***e*. In the

rotational direction of the operation portion **201**, the retaining portion **201***j* is arranged substantially in the same position as the lever portion **201***b*, and the engaged portion **201***k* is arranged in a position different from the retaining portion **201***j*. It is possible to insert a lever lock press portion **227***a* of a lever lock member **227**, described below, into the opening portion **201***e*. By inserting the lever lock press portion **227***a* into the opening portion **201***e*, the operation portion **201** is regulated in the rotation in a state of being positioned in the operating position.

[0101] As illustrated in FIG. **8**C, the operation portion **201** is attached with respect to the support portion **240***a* by positioning the retaining portion **201***j* to a groove portion **240***d* disposed in the support portion **240***a*. To be noted, at a time when the operation portion **201** is positioned in the operating position or the replenishing position, the retaining portion **201***j* and the groove portion **240***d* are positioned in positions not overlapping each other when viewed in a rotational axis direction of the operation portion **201**. Further, in a range in which the operation portion **201** pivots between the operating position and the replenishing position, the retaining portion **201***j* and the groove portion **240***d* do not overlap each other when viewed in the rotational axis direction of the operation portion **201**. That is, at a time when the operation portion **201** is manipulated between the operating position and the replenishing position, the operation portion **201** is retained with respect to the support portion **240***a* of the top surface portion **240**.

Replenishment Pack

[0102] Next, using FIGS. **9**A to **11**B, a configuration of the replenishment pack **210** will be described. FIGS. **9**A and **9**B are perspective views illustrating the replenishment pack at a time when the pack shutter portion **214** is positioned in a closed position. FIGS. **10**A and **10**B are illustrating the replenishment pack at a time when the pack shatter portion **214** is positioned in an opening position. FIGS. **11**A and **11**B are exploded perspective views illustrating the replenishment pack.

[0103] The replenishment pack **210**, serving as a toner container, includes a pouch portion **211**, serving as a bag containing the toner for replenishment, a cylindrically shaped insertion portion **212** that is inserted into the replenishment port **204**, and the pack shutter portion **214**, serving as a container shutter. The insertion portion **212**, serving as a nozzle portion, communicates with the pouch portion **211**. An opening **213**, serving as an opening through which the toner in an interior of the pouch portion **211** is discharged outside, is formed in the insertion portion **212**. To be noted, while the pouch portion **211** is constituted from a plastic bag body that is easily deformed, it is not limited to this. For example, the pouch portion **211** may be constituted from a resin bottle container and from containers made of paper and vinyl.

[0104] Further, a holding portion **215** is disposed at a tip portion of the insertion portion **212**, and a pouch end portion **216** is formed at an end opposite to the insertion portion **212**. The pouch portion **211** has a flat shape toward the pouch end portion **216**, and the pouch end portion **216** extends in a radial direction perpendicular to a rotational axis direction of the pack shutter portion **214**.

[0105] The pack shutter portion **214** is a cylindrical member that is concentric with the insertion portion **212**, and disposed outside in a radial direction of the insertion portion **212**. The pack shutter portion **214** includes an opening **214***c*, and, by rotating with respect to the insertion portion **212**, can make transition between the closed position that shields the opening **213** of the insertion portion **212** and the opening position that opens the opening **213**. When the opening **214***c* of the pack shutter portion **214** overlaps the opening **213** of the insertion portion **212**, it is possible to replenish the toner from the replenishment pack **210** to the replenishment portion **200**.

[0106] Further, a seal member **231** capable of sliding and rubbing an outer circumferential surface of the insertion portion **212** is secured to an inner circumferential surface of the pack shutter portion **214**, and the seal member **231** shields the opening **213** of the insertion portion **212** at a time when the pack shutter portion **241** is positioned in the closed position.

[0107] As illustrated in FIG. **11**A, a guided portion **232** that is recessed from the outer circumferential surface of the insertion portion **212** is formed in the insertion portion **212**, and the

guided portion **232** includes one pair each of first guided portions **232***a* and second guided portions **232***b*. When the replenishment pack **210** is attached to the replenishment portion **200**, guide portions **247** and **248** integrated with the toner receiving portion **202** are inserted into the guided portion **232**. Thereby, a relative movement between the insertion portion **212** and the toner receiving portion **202** in a circumferential direction around the rotational axis of the pack shutter **214** as a center is regulated by each other.

[0108] Further, as illustrated in FIG. **11**B, an outer circumferential surface of the pack shutter portion **214** includes a positioning portion **217** engaging with the operation portion **201** and the drive transmission surfaces **214***b* facing across the positioning portion **217**. That is, on the outer circumferential surface of the pack shatter portion **214**, a groove shape (concave portion that is recessed inwardly in the radial direction of the pack shatter portion **214**) in which the positioning portion **217** serves as a groove bottom surface and the drive transmission surfaces **214***b* serve as groove side surfaces are formed. This groove portion is open at an end portion of the outer circumferential surface of the pack shutter portion **214** in an insertion direction of the insertion portion **212**. When the drive transmission surfaces **214***b* receive force from the operation portion drive transmission projection **201***d* of the operation portion **201** in the circumferential direction, the pack shutter portion **214** rotates with respect to the insertion portion **212**. A lever lock release rib **214***a* that releases the first lock mechanism **250**, described below, of the operation portion **201** is disposed between the drive transmission surfaces **214***b*. By disposing the lever lock release rib **214***a* between the drive transmission surfaces **214***b*, at a time of attaching the replenishment pack **210**, it is possible to accurately release the first lock mechanism **250** of the operation portion **201**.

[0109] Further, as illustrated in FIGS. **11**A and **11**B, a memory tag **219**, serving as a memory, is held at the holding portion **215** disposed at the tip of the insertion portion **212**. The memory tag **219** stores predetermined authentication information.

[0110] At a time when the pack shutter portion **214** is positioned in the closed position, the insertion portion **212** is brought into a state in which the opening **214***c* disposed in the pack shutter portion **214** and the guided portion **232** disposed in a manner of being recessed from the outer circumferential surface of the insertion portion **212** overlap each other in a rotational phase in the circumferential direction.

[0111] In this state, the guide portions **247** and **248** of the replenishment portion **200** are inserted into the guided portion **232** of the replenishment pack **210**, and the opening **214***c* is brought into a state of engaging with a circumference edge of the seal member **243** disposed on the inner circumferential surface of the apparatus body shutter member **206**. In the state where the replenishment pack **210** is attached to the replenishment portion **200**, in the guided portions **232**, the first guided portions **232***a* on an upstream side in an insertion direction are brought into a state of engaging with the guide portion **247**, and the second guided portions **232***b* on a downstream side are brought into a state of facing the guide portion **248**. A surface, which is a step portion between the first and second guided portions **232***a* and **232***b* and extends in the circumferential direction engages with respect to a surface, which is a step portion between the guide portions **247** and **248** and extends in the circumferential direction, in the insertion direction, and determines a position between the insertion portion **212** and the operation portion **212** in the insertion direction. The opening **214***c* has a shape of widening toward the tip side of the insertion portion **212** and opening in a notched shape. A pair of facing portions that form the opening **214***c* and face each other in the circumferential direction are brought into a state of sandwiching the seal member **243** in the circumferential direction.

[0112] In conjunction with engaging with the operation portion drive transmission projection **201***d* of the operation portion **201**, the drive transmission surfaces **214***b* of the pack shutter portion **214** engage with the apparatus body shutter portion drive transmission projection **206***a* of the apparatus body shutter portion **206**. In conjunction with being moved (rotated) by the operation (motion) force of the operation portion **201**, the pack shutter portion **214** moves the apparatus body shutter

portion **206** by transmitting the operation force. That is, as a force receiving region, the drive transmission surface **214***b* includes a region for engaging with and coming into contact with the operation portion drive transmission projection **201***d*. The operation portion drive transmission projection **201***d* has a shape of a projecting portion extending inwardly from the inner circumferential surface of the operation portion **201** in the radial direction, and, as a force applying region, the drive transmission surface **214***b* has a region for engaging with and coming into contact with the apparatus body shutter portion drive transmission projection **206***a*.

Description of First Lock Mechanism

[0113] With reference to FIGS. **7**A to **7**C and FIGS. **12**A to **13**B, the first lock mechanism **250** will be described. As illustrated in FIGS. **7**A to **7**C and FIG. **12**B, the first lock mechanism **250** includes the lever lock member **227**, a lever lock release link **229**, and a pressing spring **228**. The lever lock release link **229** includes a contact surface **229***b* that comes into contact with the lever lock member **227**, and the lever lock member **227**, serving as a second regulation member, is pressed to the contact surface **229***b* by the pressing spring **228**. At a time when the replenishment pack **210** is not attached, the operation portion **201** is regulated in the rotational direction by the first lock mechanism **250**, and is in the operating position, serving as an initial position.

[0114] Ata time when the lever lock member **227** is locked by being positioned in a regulation position F**1**, serving as a second regulation position, a bottom view and a cross-sectional view of the operation portion **201** and the first lock mechanism **250** are respectively illustrated in FIGS. **12**A and **12**B. At a time when the lever lock member **227** is unlocked by being positioned in a release position F**2**, serving as a second regulation release position, a bottom view and a cross-sectional view of the operation portion **201** and the first lock mechanism **250** are respectively illustrated in FIGS. **13**A and **13**B.

[0115] As illustrated in FIGS. **12**A and **12**B, in a case where the first lock mechanism **250** is in a lock state, the lever lock member **227** is pressed by the pressing spring **228** and positioned in the regulation position F**1**. Then, the lever lock press portion **227***a* of the lever lock member **227** is inserted into the opening portion **201** of the operation portion **201**. When the operation portion **201** is pivoted in that state, as illustrated in FIG. **12**A, an inner wall of the opening portion **201** pivots along pivot loci R**1** and R**2**. P**1** indicates a switching portion between a rotation regulation surface **227***b* and an inclined surface **227***d*, and P**2** indicates a switching portion of a rotation regulation surface **227***c*. In the case where the first lock mechanism **250** is in the lock state, P**1** and P**2** are disposed so as to be located inside of the pivot loci R**1** and R**2**. Therefore, the inner wall of the opening portion **201***e* comes into contact with and locks the rotation regulation surfaces **227***b* and **227***c* that are surfaces perpendicular with respect to the rotational direction, and a pivot of the operation portion **201** is regulated. That is, the lever lock member **227** regulates the movement of the operation portion **201** in the regulation position F**1**.

[0116] As illustrated in FIGS. **13**A and **13**B, when the replenishment pack **210** is attached, the lever lock release rib **214***a* passes through the lock release concave portion **201***f*, and comes into contact with the lever lock release link **229**. The lever lock release link **229** includes an inclined surface shape **229***a* that comes into contact with the lever lock release rib **214***a*. The lever lock release link **229** receives force, for moving the lever lock member **227** from the regulation position F**1** to the release position F**2**, from the pack shutter portion **214** through contact between the inclined surface shape **229***a* and the lever lock release rib **214***a*. The inclined surface shape **229***a* has a shape of being inclined with respect to the insertion direction of the replenishment pack **210** into the operation portion **201**. That is, the inclined surface shape **229***a* is configured to be inclined such that a component force that acts in a direction of moving the lever lock release link **229** to a pressing position is included in force received from the lever lock release rib **214***a*.

[0117] As illustrated in FIG. **13**B, the lever lock release link **229** is brought into a state in which the inclined surface shape **229***a* is pressed in an arrow direction by the force received from the lever lock release rib **214***a* and an end portion, on which the inclined surface portion **229***a* is disposed,

rides on a side surface of the lever lock release rib **214***a*. Thereby, the lever lock release link **229** moves to the pressing position in which the contact surface **229***b* moves the lever lock member **227** to the release position F**2**. Thereby, while resisting against the urging force of the pressing spring **228**, the lever lock member **227** that is in contact with the lever lock release link **229** moves to the release position F**2** in the arrow direction.

[0118] As illustrated in FIG. **13**A, when the lever lock member **227** is positioned in the release position F**2**, P**1** moves outside of the pivot locus R**1**, and P**2** is retained inside of the pivot locus R**2**. Therefore, when the lever portion **201***b* is pivoted in the arrow direction, the inclined surface **227***d* comes into contact with the inner wall of the opening portion **201***e*, and, by the component force, the lever lock member **227** can ride over the inclined surface **227***d* by receding further outward than the release position F**2** in the radial direction. Therefore, by allowing the lever portion **201***b* to pivot in the arrow direction, the lever lock member **227** can pivot the operation portion **201** to the replenishing position.

[0119] When the lever lock member **227** is positioned in the release position F**2**, since P**2** is retained inside of R**2**, a pivot of the lever portion **201***b* in a direction opposite to an arrow direction in FIG. **13**A is regulated. That is, the lever lock member **227** releases regulation on the movement of the operation portion **201** in the release position F**2**. In the present embodiment, by disposing an assembly phase of the operation portion **201** in a direction in which the pivot is regulated, after assembly, the operation portion **201** is prevented from pivoting to the assembly phase, while, simultaneously, being allowed to pivot to the replenishing position.

Procedure for Replenishing Toner

[0120] Next, using FIGS. **6**A to **14**, a procedure for replenishing the toner using the replenishment pack **210** will be described. First, as illustrated in FIGS. **6**A to **6**C, the user detaches the recording material P on the sheet discharge tray **14**, and opens the sheet discharge tray **14** from the closed position to the opening position. Thereby, the replenishment portion **200** is exposed. Since the replenishment portion **200** is disposed on an upper front surface of the image forming apparatus **1**, it is easy to perform the replenishment of the toner.

[0121] In a state where the sheet discharge tray **14** is opened to the opening position and the replenishment portion **200** is exposed, the pivot of the operation portion **201** is regulated by the first lock mechanism **250** described above. Then, the operation portion **201** is positioned in the operating position.

[0122] Then, the user attaches the replenishment pack **210** to the replenishment portion **200** by aligning the operation portion drive transmission projection **201***d* (refer to FIG. **7**A) disposed to the replenishment portion **200** with the positioning portion **217** (refer to FIG. **11**B) disposed in the replenishment pack **210**. It is configured such that, in a case where positions of the operation portion drive transmission projection **201***d* and the positioning portion **217** do not match, the replenishment pack **210** interferes with the operation portion drive transmission projection **201***d* and the insertion of the replenishment pack **210** is not allowed.

[0123] FIG. **6**C is a perspective view illustration a state in which the replenishment pack **210** is attached to the replenishment portion **200**. In the present embodiment, as illustrated in FIG. **6**C, at a time when an arrow D direction that is an extending direction of the pouch end portion **216** is parallel to the X direction, it is possible to attach the replenishment pack **210** to the replenishment portion **200**. When the replenishment pack is inserted to the back of the replenishment portion **200**, the drive transmission surfaces **214***b* forming the positioning portion **217** engage with the operation portion drive transmission projection **201***d* of the operation portion **201**. Further, the drive transmission surfaces **214***b* of the pack shutter portion **214** engage with the apparatus body shutter portion drive transmission projection **206***a*.

[0124] That is, the rotation of the operation portion **201** is transmitted to the pack shutter portion **214**, and the rotation of the pack shutter portion **214** is transmitted to the apparatus body shutter portion **206**. Thereby, the apparatus body shutter portion **206** and the pack shutter portion **214** are

brought into an integrated state by engaging with each other, and the pack shutter portion **214** and the apparatus body shutter portion **206** are interlocked. Further, when the replenishment pack **210** is attached to the replenishment portion **200**, the lock of the operation portion **201** by the first lock mechanism **250** is released, and the operation portion **201** becomes rotatable. To be noted, in a state in which the replenishment pack **210** is not attached to the replenishment portion **200**, the operation portion **201** and the apparatus body shutter portion **206** are not interlocked with each other.

[0125] FIG. **14** is a cross-sectional view illustrating the state in which the replenishment pack **210** is attached to the replenishment portion **200**. In FIG. **14**, the operation portion **201** is positioned in the operating position, and the apparatus body shutter portion **206** and the pack shutter portion **214** are positioned in the closed position. As illustrated in FIG. **14**, an apparatus body contact **170**, serving as an electrical contact, is disposed in the toner receiving portion **202**. When the replenishment pack **210** is attached to the back of the replenishment portion **200**, the memory tag **219** secured to the tip of the replenishment pack **210** comes into electrical contact with the apparatus body contact **170**. Thereby, the apparatus body contact **170** communicates with the memory tag **219**, and can read the authentication information as a predetermined information of the memory tag **219**.

[0126] Then, as illustrated in FIG. **7**C, the user rotates the lever portion **201***b* of the operation portion **201** by 90 degrees in a counter-clockwise direction. Thereby, the operation portion **201** rotates from the operating position to the replenishing position, and the pack shutter portion **214** and the apparatus body shutter portion **206** rotate from the closed position to the opening position. As a result, the opening **214***c* of the pack shutter portion **214**, the opening **213** of the insertion portion **212** of the replenishment pack **210**, the opening **207** of the apparatus body shutter portion **206**, and the side opening **205** of the toner receiving portion **202** overlap. Thereby, the toner in the interior of the replenishment pack **210** is discharged to the storage portion **18** by passing through the replenishment path portion **203**.

[0127] In other words, when the operation portion **201** is positioned in the replenishing position, the replenishment portion **200** is brought into a replenishable state in which it is possible to replenish the toner from the replenishment pack **210** to the storage portion **18**. At this time, the opening **213** of the replenishment pack **210** and the side opening **205** of the toner receiving portion **202** communicate.

[0128] When the replenishment of the toner from the replenishment pack **210** to the storage portion **18** has been completed, the user returns the operation portion **201** from the replenishing position to the operating position. That is, the user rotates the lever portion **201***b* of the operation portion **201** by 90 degrees in a clockwise direction. Thereby, the pack shutter portion **214** and the apparatus body shutter portion **206** rotate from the opening position to the closed position.

[0129] In other words, when the operation portion **201** is positioned in the operating position, the replenishment portion **200** is brought into a non-replenishable state in which it is impossible to replenish the toner from the replenishment pack **210** to the storage portion **18**. At this time, the opening **213** of the replenishment pack **210** and the side opening **205** of the toner receiving portion **202** do not communicate with each other.

[0130] Then, the user detaches the replenishment pack **210** from the replenishment portion **200**. As described above, since, in a state in which the replenishment pack **210** is detached from the replenishment portion **200**, the pack shutter portion **214** is positioned in the closed position, it is possible to prevent the leakage of the toner from the opening **213** of the replenishment pack **210**.

Description of Second Lock Mechanism

[0131] Next, with reference to FIGS. **15** to **25**B, a second lock mechanism **400** will be described. In the present embodiment, the operation portion **201** is regulated in the rotation by the second lock mechanism **400** in addition to the first lock mechanism **250**. The first lock mechanism **250** regulates the rotation of the operation portion **201** in the state in which the replenishment pack **210** is not attached to the replenishment portion **200**. Even in the state in which the replenishment pack

210 is attached to the replenishment portion **200**, the second lock mechanism **400** regulates the rotation of the operation portion **201** under predetermined conditions.

[0132] As illustrated in FIGS. **15** to **17**B, the second lock mechanism **400** is secured to a side plate **500** that is a frame member of the image forming apparatus **1**. To be noted, in FIGS. **15** to **17**B, only part of the side plate **500** is shown. The second lock mechanism **400** includes a holding member **401** secured to the side plate **500**, a solenoid unit **402**, a lock lever **403**, a lock spring **404**, and a display member **405** (refer to FIG. **18**A).

[0133] The holding member **401** includes positioning portions **401***a* and **401***b* and a holding portion **401***c* holding the lock lever **403**, and, by inserting the positioning portions **401***a* and **401***b* into holes **500***a* and **500***b* of the side plate **500**, is positioned with respect to the side plate **500**. The solenoid unit **402** includes a plunger **402***a*, a solenoid **402***b* that can draw the plunger **402***a* by being energized, and a solenoid frame **402***c*. The solenoid frame **402***c* holds the solenoid **402***b*, serving as an actuator.

[0134] The holding member **401** and the solenoid frame **402***c* are secured with respect to the side plate **500** by being fastened together with screws **501** and **502** with respect to fixation holes **500***c* and **500***d* of the side plate **500**. The lock lever **403**, serving as a regulation member and a first regulation member, includes a lock portion **403***a* that is locked to a pin **402***d* of the plunger **402***a*, and is rotatably held with respect to the holding portion **401***c* of the holding member **401**. More particularly, the holding portion **401***c* includes a shaft supporting portion **401***d* rotatably supporting a shaft portion **403***b* of the lock lever **403**, and the lock lever **403** is configured to be pivotable around the shaft portion **403***b*, supported by the shaft supporting portion **401***d*, as a center.

[0135] The lock spring **404** is a coil spring held by the shaft portion **403***b*, and a first end and a second end are respectively locked to the holding portion **401***c* of the holding member **401** and the lock lever **403**. The lock lever **403** is urged by the lock spring **404** in an arrow LC**1** direction, and, by the plunger **402***a* that is drawn by the solenoid **402***b*, pivots in an arrow LC**2** direction opposite to the arrow LC**1** direction.

[0136] Further, an abutment portion **401** against which the lock lever **403** abuts is formed in the holding portion **401***c* of the holding member **401**. In a state in which the solenoid **402***b* is in a non-energized state, the lock lever **403** abuts against the abutment portion **401** by the urging force of the lock spring **404**. Thereby, the lock lever **403** is held in a lock position illustrated in FIG. **17**. By drawing the plunger **402***a* by the solenoid **402***b* which is in an energized state, the lock lever **403** pivots in the arrow LC**2** direction, and moves to an unlock position E**2** illustrated in FIG. **11**B.

[0137] FIGS. **17**A and **18**A are perspective views illustrating the second lock mechanism **400** in a state in which the lock lever **403** is positioned in the lock position. FIGS. **17**B and **18**B are perspective views illustrating the second lock mechanism **400** in a state in which the lock lever **403** is positioned in the unlock position E**2**. As illustrated in FIGS. **17**A to **18**B, the lock lever **403** includes a first engagement portion **403***c* and a second engagement portion **403***d* formed so as to project farther upward than the first engagement portion **403***c* and outward from the shaft portion **403***b* in a radial direction.

[0138] At a time when the lock lever **403** is positioned in the lock position E**1**, serving as a regulation position and a first regulation position, the first engagement portion **403***c*, serving as an engagement portion, is positioned in a position that projects to a movement locus **420** (refer to FIG. **24**B) of the engaged portion **201***k*. Further, at a time when the lock lever **403** is positioned in the unlock position E**2**, serving as a regulation release position and a first regulation release position, the engagement portion **403***c* is positioned in a position that is receded from the movement locus **420** (refer to FIG. **23**B) of the engaged portion **201***k*. That is, at the time when the lock lever **403** is positioned in the lock position E**1**, the first engagement portion **403***c* becomes possible to engage with the engaged portion **201***k* of the operation portion **201**. By the engagement of the engaged portion **201***k* with the first engagement portion **403***c*, the operation portion **201** is regulated in the rotation. Then, since, at the time when the lock lever **403** is positioned in the unlock position E**2**,

the engaged portion **201***k* does not engage with the first engagement portion **403***c*, the operation portion **201** is not regulated in the rotation by the first engagement portion **403***c*.

[0139] FIG. **19**A is a bottom view illustrating the display member **405** at the time when the lock lever **403** is positioned in the lock position E**1**. FIG. **19**B is an enlarged view of FIG. **19**A. FIG. **19**C is a bottom view illustrating the display member **405** at the time when the lock lever **403** is positioned in the unlock position E**2**. FIG. **20**A is a perspective view from an upper surface side, illustrating the display member **405** and the top surface portion **240** at the time when the lock lever **403** is positioned in the lock position E**1**. FIG. **20**B is a perspective view from the upper surface side, illustrating the display member **405** and the top surface portion **240** at the time when the lock lever **403** is positioned in the lock position E**1**.

[0140] As illustrated in FIGS. **18**A to **19**B, the display member **405** is rotatably supported with respect to the top surface portion **240** around a pivot shaft **405***a* as a center. The display member **405** includes a display portion **405***b* formed in a substantially fan-shaped plate shape and a boss portion **405***c* projecting downward from the display portion **405***b*. The display member **405** is urged in an arrow LC**3** direction by a coil spring **406** held by the pivot shaft **405***a*. A first end and a second end of the coil spring **406** are respectively locked to the top surface portion **240** and the display member **405**.

[0141] At the time when the lock lever **403** is positioned in the lock position E**1**, the boss portion **405***c* of the display member **405** that is urged in the arrow LC**3** direction by the coil spring **406** abuts against an abutment surface **240***c* disposed on a bottom surface side of the top surface portion **240**. Thereby, the display member **405** is positioned in a lock display position G**1**, serving as a first position. As illustrated in FIGS. **20**A and **20**B, a hole-shaped window portion **240***b* is formed in the top surface portion **240**, serving as a cover, and a first display **405***d* and a second display **405***e* are disposed on an upper surface of the display portion **405***b* of the display member **405**.

[0142] The first display **405***d* and the second display **405***e* are arranged in positions different from each other in a pivot direction (LC**3** and LC**4** directions) of the display member **405**. In the present embodiment, the first display **405***d* has an inscription “Lock” signifying that, as the lock lever **403** is positioned in the lock position E**1**, the movement regulation of the operation portion **201** is applied. The second display **405***e* has an inscription “Unlock” signifying that, as the lock lever **403** is positioned in the unlock position E**2**, the movement regulation of the operation portion **201** is not applied.

[0143] As illustrated in FIG. **20**A, at the time when the display member **405** is positioned in the lock display position G**1**, it is possible to visually confirm the first display **405***d* from an upper surface side of the image forming apparatus **1** via the widow portion **240***b*. To be noted, while, in the present embodiment, by an abutment of the boss portion **405***c* of the display member **405** against the abutment surface **240***c* of the top surface portion **240**, the display member **405** is positioned in the lock display position G**1**, it is not limited to this. For example, it is acceptable to position the display member **405** in the lock display position G**1** by an abutment of a part of the display member **405**, other than the boss portion **405***c*, against the top surface portion **240**. Further, it is acceptable to position the display member **405** in the lock display position G**1** by an abutment of any part of the display member **405** with respect to the side plate **500**.

[0144] As illustrated in FIGS. **18***b*, **19**B, and **20**B, when the solenoid **402***b* has been energized and the lock lever **403** has moved from the lock position E**1** to the unlock position E**2**, the boss portion **405***c* is pressed by the second engagement portion **403***d* of the lock lever **403**. Thereby, while resisting against the urging force of the coil spring **406**, the display member **405** pivots in the arrow LC**4** direction opposite to the arrow LC**3** direction. Then, by holding the boss portion **405***c* by the second engagement portion **403***d* of the lock lever **403** positioned in the unlock position E**2**, the display member **405** is held in an unlock display position G**2**, serving as a second position illustrated in FIGS. **18**B, **19**B, and **20**B. At this time, since the boss portion **405***c* comes into pressure contact with the second engagement portion **403***d* by the urging force of the coil spring

406, the display member **405** is not displaced from the unlock display position G**2**.
[0145] As illustrated in FIG. **20**B, at a time when the display member **405** is positioned in the unlock display position G**2**, it is possible to visually confirm the second display **405***e* from the upper surface side of the image forming apparatus **1** via the window portion **240***b*. When the solenoid **402***b* has been brought into the non-energized state from the energized state, by the urging force of the lock spring **404**, the lock lever **403** moves from the unlock position E**2** to the lock position E**1**. Thereby, the engagement of the second engagement portion **403***d* of the lock lever **403** with the boss portion **405***c* of the display member **405** is disengaged, and, by the urging force of the coil spring **406**, the display member **405** moves from the unlock display position G**2** to the lock display position G**1**.
[0146] That is, the display member **405** is configured to move in conjunction with the operation of the solenoid **402***b* such that, when the lock lever **403** is in the lock position E**1**, the display member **405** is in the lock display position G**1** and, when the lock lever **403** is in the unlock position E**2**, the display member **405** is in the unlock display position G**2**.
Control Block
[0147] FIG. **21** is a block diagram illustrating a function of the circuit board **100** of the present embodiment. The circuit board **100** includes a low voltage power supply portion **110** and a high voltage power supply portion **120**. The low voltage power supply portion **110** acquires power from an external power source via a power input portion, not shown, attached onto an end portion of the board, and converts an alternating voltage into a stable direct current voltage via a rectifying/smoothing circuit including an electrolytic capacitator. Thereafter, after having converted the direct current voltage into a high frequency alternating voltage by a switching element such as a transistor, the low voltage power supply portion **110** inputs the high frequency alternating voltage to a low voltage power transformer. The low voltage power transformer converts the high frequency alternating voltage that is an input voltage into an alternating voltage (output voltage) that has a desired voltage value. The low voltage power supply portion **110** again converts the alternating voltage into the direct current voltage, and outputs the obtained direct current voltage to the high voltage power supply portion **120**. Further, since losses in each circuit component appear as heat, a heat sink, not shown, manufactured of aluminum and iron is disposed in the low voltage power supply portion **110** for dissipating the heat.
[0148] The high voltage power supply portion **120** converts voltage (for example, 24 volts (V)) supplied from the low voltage power supply portion **110** into a high voltage required for image forming processes such as charging, developing, and transferring. The voltage supplied from the low voltage power supply portion **110** is converted into a charging voltage by a charging transformer, and supplied to the charge roller **17**. The voltage supplied from the low voltage power supply portion **110** is converted into a developing voltage by a developing transformer **123**, and supplied to the developing roller **12**. The voltage supplied from the low voltage power supply portion **110** is converted into a transferring voltage by a transferring transformer **124**, and supplied to the transfer roller **7**.
[0149] The low voltage power supply portion **110** supplies the voltage (for example, 3.3 V or 5V) not only to the high voltage power supply portion **120** but also to the scanner unit **50**, the drive motor **311**, the engine controller **130**, and a video controller **140**. Here, the engine controller **130**, serving as a control unit, has a role of coordinating and controlling various process members, and controls the solenoid **402***b*. The engine controller **130** includes a central processing unit (CPU), not shown, a random access memory (RAM), not shown, used for calculations and the temporary storage of data required for controlling the image forming apparatus **1**, and the ROM, not shown, storing programs and various data for controlling the image forming apparatus **1**. The video controller **140** receives print data by communicating with external apparatuses such as a personal computer, and has a role of notifying the engine controller **130** of a result obtained by analyzing the print data. To be noted, it is acceptable to dispose the engine controller **130** and the video controller

140 either on a different board from the circuit board **110** or on the same board.
[0150] Further, the alternating-current power that the power supply input portion has received from a commercial power supply is supplied not only to the low voltage power supply portion **110** but also to the fixing heater **9***c*. To be noted, the drive of such as rollers in the fixing unit **9** is performed by the drive motor **311**.
Energization of Solenoid
[0151] Next, using a flowchart of FIG. **22**, an energization judgement process of the solenoid **402***b* will be described. In other words, energization conditions of the solenoid **402***b* are determined along the flowchart of FIG. **22**, and, if the energization conditions, serving as predetermined conditions, are met, an energization is performed.
[0152] As illustrated in FIG. **22**, upon starting the energization judgement process of the solenoid **402***b*, the engine controller **130** judges whether or not the power supply of the image forming apparatus **1** is on (STEP S**1**). In a case where it is judged that the power supply of the image forming apparatus **1** is on (STEP S**1**: Yes), the engine controller **130** judges whether or not the opening/closing detection sensor **80** is on (STEP S**2**). As described in FIGS. **3**A to **3**C, when the opening/closing detection sensor **80** is on, it means that the back cover **73** is in the closed position.
[0153] In a case where it is judged that the opening/closing detection sensor **80** is on (STEP S**2**: Yes), the engine controller **130** judges whether or not communication with the memory tag **219** has been succeeded (STEP S**3**). The communication with the memory tag **219** means that replenishment pack **210** has been attached to the replenishment portion **200**, and that the authentication information of the memory tag **219** disposed in the replenishment pack **210** has been read by the apparatus body contact **170**.
[0154] In a case where the communication with the memory tag **219** has been succeeded (STEP S**3**: Yes), the engine controller **130** judges whether or not the remaining amount of the toner in the interior of the storage portion **18** detected by the remaining amount detection sensor **312** is not full, that is, not a filled full state (STEP S**4**). In a case where the remaining amount of the toner in the interior of the storage portion **18** is less than a predetermined amount, it is judged that the remaining amount of the toner is considered to be not full. More particularly, in a case where signal strength (voltage) transmitted by the remaining amount detection sensor **312** is within a predetermined range, it is considered that the remaining amount of the toner is not full. In a case where it is judged that the remaining amount of the toner is not full (STEP S**4**: Yes), the engine controller **130** energizes the solenoid **402**, and brings the second lock mechanism **400** into the unlock state in which the lock lever **403** is positioned in the unlock position E**2**.
[0155] That is, the abovementioned predetermined conditions include that the power supply of the image forming apparatus **1** is on, that the opening/closing detection sensor **80** is on, that the communication with the memory tag **219** has been succeeded, and that the remaining amount of the toner is not full. Then, in a case where the predetermined conditions are met, the engine controller **130** controls the solenoid **402***b* to release the movement regulation of the operation portion **201**.
[0156] At this time, as illustrated in FIG. **23**A, when the image forming apparatus **1** with the sheet discharge tray **14** opened is viewed from the upper surface side, it is possible to visually confirm the second display **405***e* of the display member **405** via the window portion **240***b*. Therefore, the user can easily visually confirm that it is possible to perform the replenishment of the toner to the replenishment portion **200** by the replenishment pack **210**, so that it is possible to improve usability. Further, in the case where the image forming apparatus **1** with the sheet discharge tray **14** opened is viewed from the upper surface side, it is not possible to visually confirm the engaged portion **201***k* of the operation portion **201** and the lock lever **403**. Therefore, it is possible to suppress the accidental contact of the lock lever **403** by the user.
[0157] Since. as illustrated in FIG. **23**B, the first engagement portion **403***c* of the lock lever **403** positioned in the unlock position E**2** is receded from the movement locus **420** of the engaged portion **201***k* of the operation portion **201**, the operation portion **201** is not regulated in the rotation

by the lock lever **403**. Further, the second engagement portion **403***d* of the lock lever **403** positioned in the unlock position E**2** holds the boss portion **405***c* of the display member **405** positioned in the unlock display position G**2**.

[0158] On the other hand, in a case where it is judged that the power supply of the image forming apparatus **1** is not on (STEP S**1**: No), or in a case where it is judged that the opening/closing detection sensor **80** is off (STEP S**2**: No), the engine controller **130** does not energize the solenoid **402***b*. This is because, since it is not possible to supply power to the agitation member **60** and the opening/closing detection sensor **80** when the power supply of the image forming apparatus **1** is off, it is not possible to detect the remaining amount of the toner in the interior of the storage portion **18**.

[0159] Further, also in a case where the communication with the memory tag **219** has not been succeeded (STEP S**3**: No), or in a case where it is judged that the remaining amount of the toner is full (STEP S**4**: No), the engine controller **130** does not energize the solenoid **402***b*. In the case where the communication with the memory tag **219** has not been succeeded, for example, there is a possibility that the replenishment pack **210** is not firmly attached to the replenishment portion **200**. In the case where the remaining amount of the toner is full, it is not possible to smoothly discharge the toner in the interior of the replenishment pack **210** to the storage portion **18**. In a case of the non-energization state in which the solenoid **402***b* is not energized, the second lock mechanism **400** becomes the lock state in which the lock lever **403** is positioned in the lock position E**1**.

[0160] At this time, when the image forming apparatus **1** with the sheet discharge tray **14** opened is viewed from the upper surface side, it is possible to visually confirm the first display **405***d* of the display member **405** via the window portion **240***b*. Therefore, the user can easily visually confirm that it is not possible to replenish the toner to the replenishment portion **200** by the replenishment pack **210**, and it is possible to improve the usability.

[0161] Further, as illustrated in FIG. **6**D, even in the state in which the replenishment pack **210** is attached to the replenishment portion **200**, the user can visually confirm the first display **405***d* via the window portion **240***b*. Therefore, even after the replenishment pack **210** has been attached to the replenishment portion **200**, the user can recognize that the second lock mechanism is in the lock state, and it is possible to improve the usability. To be noted, also in a case where the second display **405***e* is displayed via the window portion **240***b* in the state in which the replenishment pack **210** has been attached to the replenishment portion **200**, similarly, it is possible to visually confirm the second display **405***e*.

[0162] As illustrated in FIG. **24**B, the first engagement portion **403***c* of the lock lever **403** positioned in the lock position E**1** projects to the movement locus **420** of the engaged portion **201***k* of the operation portion **201**. At this time, the first engagement portion **403***c* of the lock lever **403** is separated with respect to the engaged portion **201***k* of the operation portion **201** by leaving a predetermined gap GP in the circumferential direction of the operation portion **201**. By disposing the gap GP between the first engagement portion **403***c* and the engaged portion **201***k* as described above, when the solenoid **402***b* is energized, friction force is not generated between the first engagement portion **403***c* and the engaged portion **201***k*, so that it is possible to reduce the output and the size of the solenoid **402***b*.

[0163] Here, in the state in which the replenishment pack **210** is not attached to the replenishment portion **200**, the operation portion **201** is positioned in the operating position by the first lock mechanism **250**. More particularly, by inserting the lever lock press portion **227***a* of the lever lock member **227** into the opening portion **201***e* of the operation portion **201**, the operation portion **201** is positioned in the operating position. Therefore, in the state in which the replenishment pack **210** is not attached to the replenishment portion **200**, the operation portion **201** is always positioned in the operating position, and the gap GP is secured between the first engagement portion **403***c* and the engaged portion **201***k*.

[0164] In other words, when the lock lever **403** is in the lock position E**1** and the lever lock

member **227** is in the regulation position F**1**, the lever lock member **227** regulates the movement of the operation portion **201** such that the operation portion **201** does not come into contact with the first engagement portion **403***c* of the lock lever **403**. Therefore, by energizing the solenoid **402***b*, the lock lever **403** of the second lock mechanism **400** can be easily moved from the lock position E**1** to the unlock position E**2**.

[0165] When the lever portion **201***b* of the operation portion **201** is pivoted toward the replenishing position at the time when the second lock mechanism **400** is in the lock state, as illustrated in FIG. **25**B, the engaged portion **201***k* of the operation portion **201** moves only by the extent of the gap GP, and abuts against the second engagement portion **403***d*. Thereby, the operation portion **201** is regulated in the rotation. To be noted, since, at this time, the lock lever **403** does not move from the lock position E**1**, also the display member **405** that moves concurrently with the lock lever **403** is retained in the lock display position G**1**. Therefore, as illustrated in FIG. **25**A, also the first display **405** that is visually confirmed via the widow portion **240***b* does not move.

[0166] As described above, in the present embodiment, it is possible to regulate the movement of the operation portion **201** by the second lock mechanism **400** that is switched between the lock state and the unlock state by the solenoid **402***b*. Since it is undesirable to perform the toner replenishment when the predetermined conditions described above are not met, by regulating an operation (rotation) of the operation portion **201**, it is possible to easily regulate the toner replenishment to the image forming apparatus **1**.

Second Embodiment

[0167] While, next, a second embodiment of the present invention will be described, in the second embodiment, only the first and second displays **405***d* and **405***e* of the display member **405** of the first embodiment are changed. Therefore, configurations similar to the first embodiment will be described by omitting illustrations or by putting the same reference characters on drawings.

[0168] A display member **605** of the present embodiment includes a display portion **605***b*, and a first display **605***d* and a second display **605***e* are disposed on an upper surface of the display portion **605***b*. The first display **605***d* and the second display **605***e* are colored in colors different from each other, and, in FIG. **26**, are shown in different hatch patterns.

[0169] At a time when the display member **605** is positioned in the lock display position G**1**, it is possible to visually confirm the first display **605***d* from the upper surface side of the image forming apparatus **1** via the window portion **240***b* (refer to FIG. **20**A). At a time when the display member **605** is positioned in the unlock display position G**2**, it is possible to visually confirm the second display **605***e* from the upper surface side of the image forming apparatus **1** via the window portion **240***b* (refer to FIG. **20**A). The first display **605***d* is a mark provided with a warm color, for example, such as red. The second display **605***e* is a mark provided with a cold color, for example, such as blue.

[0170] As described above, in the present embodiment, whether the second lock mechanism **400** is in the lock state or the unlock state is indicated by the first display **605***d* or the second display **605***e* of the display member **605**. The first display **605***d* and the second display **605***e* are respectively colored in the warm color and the cold color, and the warm color such as red generally represents the prohibition of the manipulation, and the cold color such as blue generally represents the permission of the manipulation. Therefore, the user can sensuously recognize the availability of the manipulation of the operation portion **201** and the toner replenishment to the replenishment portion **200**. To be noted, the warm color includes, for example, red, orange and yellow, and the cold color includes, for example, blue-green, blue, and blue-violet. The first display **605***d* is preferably colored in red, and the second display **605***e* is preferably colored in blue.

OTHER EMBODIMENTS

[0171] To be noted, while, in any of the embodiments described above, the attraction type solenoid **402***b* is used as the actuator to drive the second lock mechanism **400**, it is not limited to this. For example, in place of the solenoid **402***b*, it is acceptable to apply a push solenoid and a self-holding

solenoid. Further, in place of the solenoid **402***b*, it is acceptable to apply such as a motor and a linear actuator. Further, the interlock mechanism of the solenoid unit **402**, the lock lever **403**, and the display member **405** or **605** are not limited to the embodiments described above. For example, it is acceptable to move the display member **405** or **605** by being pressed, not with the second engagement portion **403***d* of the lock lever **403**, but with the plunger **402***a*.

[0172] Further, while, in any of the embodiments described above, each of the first displays **405***d* and **605***d* and the second displays **405***e* and **605***e* is constituted from a mark provided with a letter or a color, it is not limited to this. For example, it is acceptable that the first display includes a pictorial symbol of a secured key and the second display includes a pictorial symbol of an unsecured key. In addition, it is acceptable to display the lock state and the unlock state by the second lock mechanism **400** by differentiating the first and second displays using letters, colors, pictorial symbols, uneven patterns, and materials.

[0173] Further, in any of the embodiments described above, the solenoid **402***b* is energized in the case where that the power supply of the image forming apparatus **1** is on, that the opening/closing detection sensor **80** is on, that the communication with the memory tag **219** has been succeeded, and that the remaining amount of the toner is not full are met. However, the energization conditions of the solenoid **402***b* are not limited to this. For example, in a case where one to three conditions among the conditions shown in STEPS S**1** to S**4** of FIG. **22** are met, it is acceptable to energize the solenoid **402***b*.

[0174] Embodiment(s) of the present invention can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programs) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

[0175] While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

Claims

1-**13**. (canceled)

14. A display apparatus comprising: a cover provided with a window portion; and a display member including a first display portion and a second display portion which is disposed at a position different from that of the first display portion, the display member being movable with respect to the cover between a first position in which the first display portion is visible through the window portion, and a second position in which the second display portion is visible through the

window portion.

15. The display apparatus according to claim 14, further comprising an operation member configured to be moved by a user operation, the operation member being transitioned between a regulating state where a movement of the operation member is regulated and an allowable state where the movement of the operation member is allowable, wherein the display member is at the first position in a case where the operation member is in the regulating state, and the display member is at the second position in a case where the operation member is in the allowable state.

16. The display apparatus according to claim 15, wherein the first display portion includes a letter indicating that the movement of the operation member is regulated, and wherein the second display portion includes a letter indicating that the movement of the operation member is allowable.

17. The display apparatus according to claim 15, wherein the first display portion includes a mark colored in a warm color, and wherein the second display portion includes a mark colored in a cold color.

18. The display apparatus according to claim 15, further comprising a regulation member configured to move between a regulation position and an allowable position, the regulation position being a position in which the regulation member regulates the movement of the operation member, the allowable position being a position in which the regulation member allows the movement of the operation member, wherein the display member is configured to move in conjunction with the regulation member so that the display member is in the first position when the regulation member is in the regulation position, and so that the display member is in the second position when the regulation member is in the allowable position.

19. The display apparatus according to claim 18, further comprising: an actuator configured to move the regulation member between the regulation position and the allowable position; and a control unit configured to control the actuator such that the regulation member is moved from the regulation position to the allowable position in a case where a predetermined condition is met.

20. The display apparatus according to claim 19, further comprising an urging member configured to urge the display member in a direction from the second position to the first position, wherein the display member moves from the first position to the second position by being pressed by the regulation member against an urging force of the urging member in a case where the regulation member is moved from the regulation position to the allowable position.