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Image forming apparatus that applies a resistance force to a door of the image forming apparatus

Abstract

An image forming apparatus including an apparatus body, a door, and a resistance applying portion. The resistance applying portion includes a body support member, and a contact member. The contact member includes a first member supported by the door, and a second member supported by the first member. The second member is configured to be brought into the contracted position in a state where the door is in the closed position. The second member is configured to be brought into the extended position by the door having moved from the closed position to a first intermediate position located between the closed position and the opening position. In response to the door moving from the first intermediate position to the opening position, the second member is configured to apply the resistance force to the door by coming into contact with the body support member in the extended position.

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Background/Summary

BACKGROUND OF THE INVENTION

Field of the Invention

(1) This disclosure relates to an image forming apparatus such as a printer, a copier, a facsimile, or a multifunction machine.

Description of the Related Art

(2) In image forming apparatuses, opening/closing doors are disposed so as to allow workers to access inside of apparatus bodies. The opening/closing doors allow the workers to perform the jam processing of removing sheets stuck in sheet conveyance paths within the apparatus bodies and the maintenance processing of various units housed in the apparatus bodies. The opening/closing doors are disposed pivotably around pivot axes arranged in the apparatus bodies as pivot centers. However, if the opening/closing doors are pivoted at a high speed, there is a possibility that the opening/closing doors may collide with the apparatus bodies with substantial forces and, thereby,

may create damage to such as the opening/closing doors and the apparatus bodies.
(3) Therefore, hitherto, damper units for applying resistance forces to the opening/closing doors that pivot are disposed (Japanese Patent Laid-Open No. 2016-109781). The damper units include rotary dampers disposed in the apparatus bodies and rack members disposed in the opening/closing doors, and are configured to apply the resistance forces to the opening/closing doors by engaging pinion gears of the rotary dampers with rack gears of the rack members.
(4) In the damper units described above, ranges in which the resistance forces can be applied to the opening/closing doors depend on the length of the rack members. That is, as the length of the rack members is increased, more extended areas in the rack members can be formed into the rack gears, so that the ranges in which the rotary dampers can apply the resistance forces can be enlarged. However, if the length of the rack members is enlarged, it is necessary to secure larger spaces for housing the rack members inside of the apparatus bodies when closing the opening/closing doors, so that the size of the apparatuses is increased. Therefore, there are some difficulties in applying the damper units.

SUMMARY OF THE INVENTION

(5) According to one aspect of the present invention, an image forming apparatus configured to form an image on a sheet, the image forming apparatus including an apparatus body, a door provided in a pivotable manner between a closed position and an opening position with respect to the apparatus body, and a resistance applying portion configured to apply a resistance force with respect to the door in response to the door being pivoted. The resistance applying portion includes a body support member supported by the apparatus body, and a contact member that receives the resistance force by coming into contact with the body support member. The contact member includes a first member supported by the door, and a second member supported by the first member in a contractable and extendable manner between a contracted position contracted with respect to the first member and an extended position extended with respect to the first member. The second member is configured to be brought into the contracted position with respect to the first member in a state where the door is in the closed position. The second member is configured to be brought into the extended position with respect to the first member by the door having moved from the closed position to a first intermediate position located between the closed position and the opening position. In response to the door moving from the first intermediate position to the opening position, the second member is configured to apply the resistance force to the door by coming into contact with the body support member in the extended position.
(6) 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

(1) FIG. **1** is a schematic diagram illustrating an image forming apparatus of the present embodiment.
(2) FIG. **2**A is a side view illustrating an opening/closing door and a damper unit.
(3) FIG. **2**B is an enlarged view illustrating the damper unit.
(4) FIG. **2**C is a cross-sectional view of a first member and a second member taken along a line A-A in FIG. **2**B.
(5) FIG. **2**D is an enlarged view illustrating a part of the first member.
(6) FIG. **2**E is an enlarged view illustrating a part of the second member.
(7) FIG. **3**A is a side view illustrating the opening/closing door that is in a closed position.
(8) FIG. **3**B is an enlarged view illustrating the damper unit in a case where the opening/closing door is in the closed position.

(9) FIG. **4**A is a side view illustrating the opening/closing door in a case where an opening of the opening/closing door is started.
(10) FIG. **4**B is an enlarged view illustrating the damper unit in a case where the opening of the opening/closing door is started.
(11) FIG. **5**A is a side view illustrating the opening/closing door that is in the middle of the opening.
(12) FIG. **5**B is an enlarged view illustrating the damper unit in a case where the opening/closing door is in the middle of the opening.
(13) FIG. **5**C is an enlarged view illustrating the first and second members in a case where the opening/closing door is in the middle of the opening.
(14) FIG. **6**A is a side view illustrating the opening/closing door that is in an opening position.
(15) FIG. **6**B is an enlarged view illustrating the damper unit in a case where the opening/closing door is in the opening position.
(16) FIG. **7**A is a side view illustrating the opening/closing door that is in the middle of closing.
(17) FIG. **7**B is an enlarged view illustrating the damper unit in a case where the opening/closing door is in the middle of the closing.
(18) FIG. **7**C is an enlarged view illustrating the first and second members in a case where the opening/closing door is in the middle of the closing.
(19) FIG. **8**A is a side view illustrating the opening/closing door that is in the middle of the closing.
(20) FIG. **8**B is an enlarged view illustrating the damper unit in a case where the opening/closing door is in the middle of further closing.
(21) FIG. **8**C is an enlarged view illustrating the first and second members in a case where the opening/closing door is in the middle of the further closing.
(22) FIG. **9** is a diagram illustrating a variant example that is in a state in which the opening of the opening/closing door is started.

DESCRIPTION OF THE EMBODIMENTS

(23) Image Forming Apparatus
(24) Hereinafter, an image forming apparatus of the present embodiment will be described. FIG. **1** is a schematic diagram illustrating the image forming apparatus **100** of the present embodiment. The image forming apparatus **100** is an image forming apparatus of an intermediate transfer tandem system in which a plurality of image forming stations (Y, M, C, and Bk) are arranged in sequence along an endless intermediate transfer belt **145**. In the present embodiment, the image forming stations (Y, M, C, and Bk) are disposed for each color of yellow, magenta, cyan, and black.
(25) A sheet S is supplied from a cassette **115** by a sheet feed unit **110** in synchronization with a timing of image formation. The sheet S supplied by the sheet feed unit **110** is conveyed to a registration roller **120** by passing through a conveyance path. After having performed skew correction and timing correction in the registration roller **120**, the sheet S is sent to a secondary transfer portion **130**.
(26) The secondary transfer portion **130** is formed by a secondary transfer inner roller **131** and a secondary transfer outer roller **132** arranged substantially opposite to each other across the intermediate transfer belt **145**. The secondary transfer portion **130** serves as a toner image transfer portion transferring the toner image onto the sheet S. In the secondary transfer portion **130**, when the sheet S is nipped and conveyed, a secondary transfer voltage is applied to either the secondary transfer inner roller **131** or the secondary transfer outer roller **132**, and the toner image that has been primarily transferred onto the intermediate transfer belt **145** is secondarily transferred onto the sheet S as described below.
(27) Next, an image forming process to form the toner image on the intermediate transfer belt **145**, which is performed in parallel with the conveyance process, described above, of the sheet S to the secondary transfer portion **130**, will be described. In each of the image forming stations (Y, M, C, and Bk), a charge unit **146**, a developing unit **143**, and a primary transfer roller **144** are arranged

around a rotating photosensitive drum **141** as a center.
(28) In the present embodiment, the image forming stations (Y, M, C, and Bk) are configured substantially similarly except that different colors of toners, namely yellow, magenta, cyan, and black are used in the developing units. Therefore, hereinafter, the image forming station Y will be described by putting reference characters only on the image forming station Yin FIG. **1**, and descriptions of the other image forming stations (M, C, and Bk) will be omitted.
(29) The photosensitive drum **141** is an electrophotographic photosensitive member, and rotatably driven by a drive motor, not shown, in a counter-clockwise direction in FIG. **1**. The charge unit **146** uniformly charges a surface of the photosensitive drum **141**. An exposing unit **142** forms an electrostatic latent image on the surface of the photosensitive drum **141** by scanning, using a rotating mirror, a laser beam which has been On-Off modulated with scan line image data developed from a decomposed color image of each color. To be noted, in the present embodiment, the exposing unit **142** is disposed separately from the image forming station Y, and forms the electrostatic latent images on the photosensitive drums of not only the image forming station Y but also the other image forming stations (M, C, and Bk).
(30) The electrostatic latent image formed on the photosensitive drum **141** is developed to the toner image by the developing unit **143** using developer. The primary transfer roller **144** comes into contact with the intermediate transfer belt **145**, and forms a primary transfer portion between the photosensitive drum **141** and the intermediate transfer belt **145**. By applying a primary transfer voltage to the primary transfer roller **144**, the toner image on the photosensitive drum **141** is primarily transferred onto the intermediate transfer belt **145**.
(31) The intermediate transfer belt **145** is rotatably driven in an arrow A direction in FIG. **1**. The image forming process executed in parallel by each of the image forming stations (Y, M, C, and BK) is performed in a timing of superimposing the toner image on an upstream toner image that has been primarily transferred onto the intermediate transfer belt **145**. Consequently, eventually, a full color toner image is formed on the intermediate transfer belt **145**, and conveyed to the secondary transfer portion **130**.
(32) Through the conveyance process of the sheet S and the image forming process each described above, the full color toner image is secondarily transferred onto the sheet S in the secondary transfer portion **130**. Thereafter, the sheet S is conveyed to a fixing unit **150**. While applying a predetermined pressing force to the sheet S using opposing rollers, the fixing unit **150** fixes the toner image on the sheet S by heating the sheet S using a heater, not shown, via a roller.
(33) In accordance with a switch of the conveyance path by a first switching flapper D**1**, the sheet S on which the toner image has been fixed by the fixing unit **150** is discharged onto either a first sheet discharge tray **170** by a first sheet discharge roller **160** or a second sheet discharge tray **171** by a second sheet discharge roller **161**. Alternatively, the sheet S on which the toner image has been fixed is discharged onto a third sheet discharge tray **180** by a third sheet discharge roller **162**. In this case, the second sheet discharge roller **161** can convey the sheet S, which has been conveyed from the fixing unit **150**, toward the third sheet discharge roller **162** by reversing the sheet S after having switched the conveyance path using a second switching flapper D**2**. Further, in a case of duplex printing to form the toner image also on the back of the sheet S, the sheet S on which the toner image has been fixed on one surface, is reversed by the second sheet discharge roller **161**, and is conveyed to a reconveyance path **175** by a switch of the second switching flapper D**2**. Thereafter, after the toner image has been formed and fixed on the other surface, the sheet S is discharged to one of the first, second, and third sheet discharge trays **170**, **171**, and **180**.
(34) An opening/closing door **190** is disposed in an apparatus body **100***a* of the image forming apparatus **100** (refer to a dashed line portion in FIG. **1**). The opening/closing door **190** is supported by a pivot shaft **191**, and disposed in the apparatus body **100***a* in a manner pivotable between a closed position and an opening position around the pivot shaft **191** as a pivot center. While an illustration is omitted, the opening/closing door **190** is maintained in a closed state (closed position)

by the engagement of an engagement portion of the apparatus body **100***a* with a hook portion of the opening/closing door **190**. Upon an operation to pull a handle **192** (refer to FIG. **2**A) of the opening/closing door **190**, the engagement between the engagement portion and the hook portion is released, and the opening/closing door **190** is brought into a state pivotable between the closed position and an opening direction (arrow B direction) in FIG. **1**.

(35) When the opening/closing door **190** is opened, access to an interior of the apparatus body **100***a* by a worker is enabled. In a case where, for example, the worker wants to perform jam processing of removing the sheet S stuck in the conveyance path or maintenance such as replacing parts, the worker merely needs to open the opening/closing door **190** by pulling the handle **192**.

(36) Configuration of Damper Unit

(37) The image forming apparatus **100** of the present embodiment includes a damper unit **200**, serving as a resistance applying portion that applies a resistance force with respect to the opening/closing door **190** when the opening/closing door **190** is pivoted. A configuration of the damper unit **200** will be described using FIGS. **2**A to **2**D. As illustrated in FIG. **2**A, the damper unit **200** includes a rotary damper **201** and a rack member **220**. The rotary damper **201**, serving as a body support member, is supported by the apparatus body **100***a*. The rack member **220**, serving as a contact member, is secured to the opening/closing door **190**, and moves with respect to the rotary damper **201** in accordance with the opening and closing of the opening/closing door **190**.

(38) As illustrated in FIG. **2**B, the rotary damper **201** includes a shaft center **201***a* secured to the apparatus body **100***a*, a damper portion **201***b*, and a pinion gear **202**. The pinion gear **202** is rotatably supported with respect to the shaft center **201***a*, and the damper portion **201***b*, by being interposed between the shaft center **201***a* and the pinion gear **202**, attenuates a force in a rotational direction of the pinion gear **202**.

(39) The rack member **220** is constituted from a first member **203** including a rack gear **205** and a second member **204** including a rack gear **206**. The second member **204** is supported by the first member **203** in a contractable and extendable manner between a contracted position in a state of being contracted with respect to the first member **203** and an extended position in a state of being extended with respect to the first member **203**. In a case of the present embodiment, the first member **203** is secured to the opening/closing door **190**. Further, the first and second members **203** and **204** are fitted to each other in such a manner that, when viewed in an axial direction of the pivot shaft **191**, the second member **204** can contract and extend with respect to the first member **203** between the contracted position and the extended position described above along an arc-shaped path around the center of the pivot shaft **191** as a center.

(40) As illustrated in FIG. **2**C, in the second member **204**, a retention portion **208** is disposed in a manner projecting toward the first member **203**, and the detachment of the first member **203** from the second member **204** is prevented by the retention portion **208**. That is, an elongated hole **209** extending along the arc-shaped path is formed in the first member **203**, and the retention portion **208** is passed through this elongated hole **209**, so that the first and second members **203** and **204** are fitted to each other in a manner of being prevented from being detached.

(41) As illustrated in FIG. **2**D, in the first member **203**, a stopper **203***a* is disposed upright toward the second member **204** on a side of an end opposite to a side secured to the opening/closing door **190**. On the other hand, as illustrated in FIG. **2**E, in the second member **204**, engaging hooks **2041**, **2042**, and **2043** are disposed upright with respect to the second member **204**. The engaging hook **2043** is arranged on a far side from the opening/closing door **190**.

(42) The engaging hook **2043** is disposed so as to engage the second member **204** with the apparatus body **100***a*. While described below, in the present embodiment, by engaging the second member **204** with the apparatus body **100***a* when opening the opening/closing door **190**, the second member **204** is held with respect to the apparatus body **100***a*. Thereby, the second member can move from the contracted position to the extended position with respect to the first member **203**.

(43) The engaging hook **2041** is arranged on a side close to the opening/closing door **190**. The

engaging hook **2042** is arranged on a side farther from the opening/closing door **190** than the engaging hook **2041**, and is arranged with a gap from the engaging hook **2041** in between. The size of the gap between the engaging hooks **2041** and **2042** is such that the stopper **203***a* of the first member **203** can engage. It is acceptable if the gap between the engaging hooks **2041** and **2042** is slightly larger than the thickness of the stopper **203***a*. The engaging hooks **2041** and **2042** and the stopper **203***a* are disposed so as to engage the first member **203** with the second member **204** and hold the second member **204** by the first member **203** in a state in which the second member **204** is extended. In a state in which the first and second members **203** and **204** are engaged with each other, the first and second members **203** and **204** move integrally in a state in which the combined length of the first and second members **203** and **204** is longest.

(44) Further, in the second member **204**, a regulation portion **212** is disposed to a side surface portion on a side opposite to the rack gear **206**, described below. In the apparatus body **100***a*, a contacted portion **211** (refer to FIG. **2**B) against which the regulation portion **212** abuts is disposed. While described below, in the present embodiment, by abutting the regulation portion **212** against the contacted portion **211** when closing the opening/closing door **190**, a movement of the second member **204** with respect to the apparatus body **100***a* is regulated, and the second member **204** is contracted with respect to the first member **203**.

(45) As illustrated in FIG. **2**B, the rotary damper **201** includes the shaft center **201***a* secured to the apparatus body **100***a*, the damper portion **201***b*, and the pinion gear **202**. The pinion gear **202** is rotatably supported with respect to the shaft center **201***a*, and, by being interposed between the shaft center **201***a* and the pinion gear **202**, the damper portion **201***b* attenuates the force in the rotational direction of the pinion gear **202**.

(46) In the present embodiment, the rack gear **205** that engages with the pinion gear **202** is disposed in the first member **203**, and the rack gear **206** that engages with the pinion gear **202** is disposed in the second member **204**. When viewed in the axial direction of the pivot shaft **191** (refer to FIG. **2**A), the rack gear **205**, serving as a first contact portion, and the rack gear **206**, serving as a second contact portion, are arranged along a circumscribing circle circumscribing the pinion gear **202**. The center of the pivot shaft **191** is a center of this circumscribing circle, and this configuration allows the rack gears **205** and **206** to engaged with the pinion gear **202**. When opening and closing the opening/closing door **190**, in accordance with pivots of the first and second members **203** and **204**, the pinion gear **202** which is in a state engaging with either the rack gear **205** or **206** rotates. As described above, the force in the rotational direction of the pinion gear **202** is attenuated by the damper portion **201***b*, and the first and second members **203** and **204** receive the resistance force via the pinion gear **202**. Thereby, the resistance force is applied to the opening/closing door **190**.

(47) Further, as illustrated in FIG. **2**B, on a side (secured side) closer to the opening/closing door **190** than the rack gear **205**, the first member **203** includes a gearless portion **207** that does not engage with the pinion gear **202**. That is, the rack gear **205** whose length from the center of the pivot shaft **191**, at the time of being positioned on a straight line H that, when viewed in the axial direction of the pivot shaft **191**, passes through the shaft center **201***a* of the rotary damper **201** and the center of the pivot shaft **191** of the opening/closing door **190** becomes a first length is formed in the first member **203**. Further, in the first member **203**, the gearless portion **207** of a second length, which is shorter than the first length from the center of the pivot shaft **191** at the time of being positioned on the straight line H, is formed continuously with the rack gear **205** on a side closer to the opening/closing door **190**.

(48) When the pinion gear **202** faces the gearless portion **207** and is not engaged with the rack gear **205**, the pinion gear **202** does not rotate, and the resistance force is not applied to the first member **203** by the damper portion **201***b* via the pinion gear **202**. That is, the resistance force is not applied to the opening/closing door **190**. The purpose of this is to allow the worker to start opening the opening/closing door **190** without exerting a large force.

(49) Operation of Damper Unit

(50) Next, an operation of the damper unit **200** will be described by dividing cases in accordance with an opening and closing operation of the opening/closing door **190**. First, the operation of the damper unit **200** at the time of an opening operation for opening the opening/closing door **190** from the closed position to the opening position will be described using FIGS. **3**A to **5**C.

(51) FIGS. **3**A and **3**B illustrate a case where the opening/closing door **190** is in the closed position. As illustrated in FIG. **3**A, in the case where the opening/closing door **190** is in the closed position, in the opening/closing door **190**, a gravitational force W that is an own weight acts on the center of gravity G which is separated upward from the center of pivot shaft **191** by a distance L in a vertical direction. Then, as illustrated in FIG. **3**B, the second member **204** is in the contracted position contracted with respect to the first member **203**, and the rack member **220** is housed in a space inside of the apparatus body **100***a* in a state in which the combined length of the first and second members **203** and **204** is shortest. Since, at this time, the engaging hooks **2041** and **2042**, serving as a second engagement portion, and the stopper **203***a* do not engage with each other, the first and second members **203** and **204** are not engaging with each other. Further, since the engaging hook **2043**, serving as a first engagement portion, and an apparatus body side stopper **210** do not engage with each other, the second member **204** is not engaging with the apparatus body **100***a*.

(52) FIGS. **4**A and **4**B illustrate a case where the opening of the opening/closing door **190** is started from the closed position. In particular, a case where the opening/closing door **190** is opened by a pivot angle d**1** from the closed position and the damper unit **200** begins to apply the resistance force T to the opening/closing door **190** is illustrated. In this case, as illustrated in FIG. **4**A, the center of gravity G of the opening/closing door **190** overlaps a vertical line K that passes through the center of the pivot shaft **191**. Along with the operation of opening the opening/closing door **190**, once the center of gravity G of the opening/closing door **190** passes across the vertical line K, the damper unit **200**, more specifically, the rotary damper **201** begins to apply the resistance force T to the opening/closing door **190**.

(53) Since, as illustrated in FIG. **4**B, the gearless portion **207** of the first member **203** faces the pinion gear **202** until the center of gravity G of the opening/closing door **190** has passed across the vertical line K, the damper unit **200**, more specifically, the rotary damper **201** does not apply the resistance force T to the opening/closing door **190**. In this case, without receiving the resistance force T, the opening/closing door **190** is brought into a state of being slowly opened by the own weight. Thereafter, when the center of gravity G of the opening/closing door **190** has passed across the vertical line K, since the rack gear **205** and the pinion gear **202** engage with each other, the rotary damper **201** begins to apply the resistance force T. From the state illustrated in FIG. **3**B to the state illustrated in FIG. **4**B, the first and second members **203** and **204** move integrally in the opening direction. To achieve this, the first and second members **203** and **204** are fitted together (refer to FIG. **2**C).

(54) Since, as described above, the first member **203** is not engaged with the pinion gear **202** until the opening/closing door **190** has moved from the closed position to a second intermediate position located between the closed position and a first intermediate position, described below, the resistance force T is not applied to the opening/closing door **190**. Then, since, in the first member **203**, the rack gear **205** is engaged with the pinion gear **202** when the opening/closing door **190** moves from the second intermediate position to the first intermediate position, the resistance force T is applied to the opening/closing door **190**. To be noted, since, in this case, the engaging hooks **2041** and **2042** do not engage with the stopper **203***a*, the first and second members **203** and **204** are not engaging with each other. In that case, the first and second members **203** and **204** move together. Then, since, when the engaging hook **2403** has engaged with the apparatus body side stopper **210**, the second member **204** is engaged with the apparatus body **100***a*, only the first member **203** is moved thereafter.

(55) To be noted, the torque of the damper portion **201***b* is set such that the resistance force T by

the rotary damper **201** is less than the moment generated by the gravitational force W that is the own weight of the opening/closing door **190**. That is, the relation that WL sin(d) is larger than T holds. Thereby, even if the worker releases a hand from the opening/closing door **190**, the opening/closing door **190** opens slowly by the own weight while receiving the resistance force T by the rotary damper **201**. Further, even if the opening/closing door **190** is opened while receiving a force by the worker in the opening direction, an excessive increase in a pivot speed of the opening/closing door **190** is prevented.

(56) FIGS. **5**A to **5**C illustrate a case where the opening/closing door **190** is in the middle of the opening. In particular, in this state, the opening/closing door **190** is in the middle of the opening while receiving the resistance force T. As illustrated in FIG. **5**A, the opening/closing door **190** is opened from the closed position at a pivot angle d**2** that is larger than the case illustrated in FIG. **4**A (d**2**>d**1**), and the engagement of the engaging hook **2043** and the apparatus body side stopper **210** is immediately before disengagement.

(57) By the opening/closing door **190** having moved from the closed position to the first intermediate position located between the closed position and the opening position, as illustrated in FIG. **5**C, the second member **204** is brought into the extended position of the extended state extended with respect to the first member **203**. That is, in a case where the opening/closing door **190** is opened from the state illustrated in FIG. **4**A to the state illustrated in FIG. **5**A, when in the state illustrated in FIG. **4**A, the second member **204** is engaged with the apparatus body **100***a* as described above. On the other hand, the first member **203** moves in a state in which the rack gear **205** is engaged with the pinion gear **202**. Thereby, by moving the first member **203** relatively with respect to the second member **204**, the stopper **203***a* of the first member **203** engages with the engaging hook **2041** of the second member **204**, and the first member **203** engages with the second member **204**.

(58) That is, by the opening/closing door **190** having moved from the closed position to a third intermediate position located between the closed position and the first intermediate position described above, the engaging hook **2043** and the apparatus body side stopper **210** engage the second member **204** with the apparatus body **100***a*, and, thereby, the second member **204** is held by the apparatus body **100***a*. When the opening/closing door **190** has moved from the closed position to the third intermediate position, the engaging hook **2041** and the stopper **203***a* engage the first and second members **203** and **204**, and, thereby, the second member **204** is held in the extended position with respect to the first member **203**. The first and second members **203** and **204** move integrally in the opening direction in that state.

(59) As illustrated in FIG. **5**C, by the engagement of the engaging hook **2043** with the apparatus body side stopper **210**, an engagement force of the second member **204** and the apparatus body **100***a* becomes F**2**. Further, by the engagement of the engaging hook **2041** with the stopper **203***a*, an engagement force of the first and second members **203** and **204** becomes F**1**.

(60) FIGS. **6**A and **6**B illustrate a case where the opening/closing door **190** is in the opening position. As illustrated in FIG. **6**A, in the case where the opening/closing door **190** is in the opening position, the opening/closing door **190** comes into contact with a pivot regulation portion **22** disposed in the apparatus body **100***a*. The pivot regulation portion **22** regulates the pivot of the opening/closing door **190** in the opening direction from the opening position. Thereby, the opening/closing door **190** is held in the opening position. To be noted, the impact generated when the opening/closing door **190** is stopped by the pivot regulation portion **22** is mitigated to a small impact by the action of the damper unit **200**.

(61) As illustrated in FIG. **6**B, when the opening/closing door **190** is moved from the third intermediate position described above to the opening position, since the stopper **203***a* is engaged with the engaging hook **2041** as described above, the engagement of the engaging hook **2043** and the apparatus body side stopper **210** is released. That is, due to the movement of the first and second members **203** and **204** that move integrally in the opening direction, the engagement

between the engaging hook **2043** and the apparatus body side stopper **210** is released, and the second member **204** is drawn out from the space inside of the apparatus body **100***a*.

(62) As described above, the engagement force of the second member **204** and the apparatus body **100***a* is F**2**, and the engagement force of the first and second members **203** and **204** is F**1**. The engagement of the engaging hook **2043** and the apparatus body stopper **210** and the engagement of the engaging hook **2041** and the stopper **203***a* are arranged such that, when opening the opening/closing door **190**, the engagement force F**1** becomes larger than the engagement force F**2**. In the present embodiment, from the closed position illustrated in FIG. **3**B, through the state illustrated in FIG. **4**B, to the state illustrated in FIG. **5**B the worker can open the opening/closing door **190** with a force that is smaller than the engagement force F**2**. Then, in a case of opening the opening/closing door **190** further from the state illustrated in FIG. **5**B, the worker needs to apply a force that is larger than the engagement force F**2**.

(63) As described above, since the engagement force F**2** is smaller than the engagement force F**1**, the worker can open the opening/closing door **190** by applying the force larger than the engagement force F**2**, without applying a force equal to or larger than the engagement force F**1**. Thereafter, the worker can continue to open the opening/closing door **190** with the force smaller than the engagement force F**2**. Since, as described above, the engagement force F**2** is smaller than the engagement force F**1**, the engagement of the second member **204** and apparatus body **100***a* is released without releasing the engagement of the first and second members **203** and **204**, so that the second member **204** is drawn out from the space inside of the apparatus body **100***a*.

(64) As described above, when opening the opening/closing door **190**, the damper unit **200** transitions from the state in which the rack gear **205** of the first member **203** engages with the pinion gear **202** to the state in which the rack gear **206** of the second member **204** engages with the pinion gear **202**. Thereby, the resistance force is continuously applied to the opening/closing door **190** from the first member **203** to the second member **204**.

(65) Next, the operation of the damper unit **200** at the time of a closing operation for closing the opening/closing door **190** from the opening position to the closed position will be described using FIGS. **6**B to **8**C. FIGS. **7**A to **7**C illustrate a case where the opening/closing door **190** is in the middle of closing from the opening position. FIGS. **8**A to **8**C illustrate a case where the opening/closing door **190** is in the middle of further closing.

(66) In a case of closing the opening/closing door **190** from the opening position illustrated in FIG. **6**A, the stopper **203***a* of the first member **203** engages with the engaging hook **2041** of the second member **204** in the state illustrated in FIG. **6**B. Thereby, the first and second members **203** and **204** move integrally in the closing direction. At this time, the rack gear **206** of the second member **204** is in the state of engaging with the pinion gear **202**, and the resistance force is applied to the opening/closing door **190**. The engaging hook **2042** engages with the stopper **203***a*, and the engagement force of the first and second members **203** and **204** becomes F**3**.

(67) Then, as illustrated in FIGS. **7**B and **7**C, the engaging hook **2043** engages with the apparatus body side stopper **210**, and the second member **204** is engaged with the apparatus body **100***a*. As illustrated in FIG. **7**C, the engaging hook **2043** engages with the apparatus body side stopper **210**, and the engagement force of the second member **204** and the apparatus body **100***a* becomes F**4**.

(68) The engagement of the engaging hook **2043** and the apparatus body stopper **210** and the engagement of the engaging hook **2042** and the stopper **203***a* are arranged such that, when closing the opening/closing door **190**, the engagement force F**3** becomes larger than the engagement force F**4**. In the present embodiment, from the opening position illustrated in FIG. **6**B to the state illustrated in FIG. **7**B, the worker can close the opening/closing door **190** with a force that is smaller than the engagement force F**4**. Then, in a case of closing the opening/closing door **190** further from the state illustrated in FIG. **7**B, the worker needs to apply a force that is larger than the engagement force F**4**. By applying the force larger than the engagement force F**4**, the engagement of the engaging hook **2043** and the apparatus body side stopper **210** is released, and the second

member **204** is housed in the space inside of the apparatus body **100***a*.

(69) As described above, since, because the engagement force F**4** is smaller than the engagement force F**3**, the second member **204** is housed in the space inside of the apparatus body **100***a* by applying the force larger that the engagement force F**4**, without applying a force equal to or larger that the engagement force F**3**, the worker can close the opening/closing door **190**. Thereafter, the worker can continue to close the opening/closing door **190** with the force smaller than the engagement force F**4**. Since, as described above, the engagement force F**4** is smaller than the engagement force F**3**, the engagement of the second member **204** and the apparatus body **100***a* is released without releasing the engagement of the first and second members **203** and **204**, so that the first and second members **203** and **204** move integrally in the closing direction with the second member housed in the space inside of the apparatus body **100***a*. As described above, the damper unit **200** transitions from the state in which the rack gear **206** of the second member **204** engages with the pinion gear **202** to the state in which the rack gear **205** of the first member **203** engages with the pinion gear **202**.

(70) When the opening/closing door **190** is further closed from the state illustrated in FIG. **7**A, the damper unit **200** transitions to the state illustrated in FIG. **8**A. As illustrated in FIGS. **8**B and **8**C, the second member **204** includes the regulation portion **212** that, when the opening/closing door **190** moves from the third intermediate position described above to a fourth intermediate position located between the third intermediate position and the closed position, abuts against the contacted portion **211** disposed in the apparatus body **100***a*. When the regulation portion **212** abuts against the contacted portion **211**, the engagement of the engaging hook **2042** and the stopper **203***a* is released. By the regulation of the movement with respect to the apparatus body **100***a* by the regulation portion **212** as described above, the second member **204** is contracted with respect to the first member **203**.

(71) As described above, the engaging hook **2042** engages with the stopper **203***a*, and the engagement force of the first and second members **203** and **204** becomes F**3**. On the other hand, an abutment force that can release the movement regulation of the second member **204** by the regulation portion **212** is set to F**5** that is larger than F**3** (F**5**>F**3**). Therefore, when further closing the opening/closing door **190** from the state illustrated in FIG. **8**A, if the worker applies a force that is larger than F**3** and smaller than F**5**, the first member **203** moves relatively with respect to the second member **204** whose movement is regulated by the regulation portion **212**. Thereby, when the opening/closing door **190** has reached the closed position, the opening/closing door **190** returns to the state illustrated in FIGS. **3**A and **3**B described above.

(72) As described above, in the present embodiment, when opening the opening closing door **190**, the resistance force is continuously applied to the opening/closing door **190** from the first member **203** to the second member **204**. on the other hand, when closing the opening closing door **190**, the resistance force is continuously applied to the opening/closing door **190** from the second member **204** to the first member **203**. That is, since, in the damper unit **200**, a range in which the rack member **220** engages with the pinion gear **202** of the rotary member **201** becomes the sum of the length of the rack gear **205** of the first member **203** and the rack gear **206** of the second member **204**, it is possible to secure an extended range in which the resistance force can be applied to the opening/closing door **190**. Then, in the case where the opening/closing door **190** is in the closed position, the second member is in the contracted position contracted with respect to the first member **203**, and the rack member **220** is housed in the space inside of the apparatus body **100***a* in the state in which the combined length of the first and second members **203** and **204** is shortest. Therefore, it is not necessary to secure a large space so as to house the rack member **220** inside of the apparatus body **100***a*.

(73) Variant Example

(74) To be noted, while, in the embodiment described above, when opening the opening/closing door **190**, as illustrated in FIG. **4**B, only the first member **203** is moved after the second member

204 has been engaged with the apparatus body **100***a*, it is not limited to this. For example, it is acceptable to configure such that, as illustrated in FIG. **9**, the engaging hook **2041** of the second member **204** is first engaged with the stopper **203***a* of the first member **203**, and the second member **204** is drawn out from the space inside of the apparatus body **100***a*. That is, in a state in which the second member **204** is held by the apparatus body, only the first member **203** moves with respect to the second member **204**, and the stopper **203***a* engages with the engaging hook **2041** of the second member **204**. Then, by integrally moving the first and second members **203** and **204**, the second member **204** is drawn out from the space inside of the apparatus body **100***a*. In this case, when the opening/closing door **190** is in the opening position, the opening/closing door **190** is brought into the same state that is illustrated in FIG. **6**B described above.

(75) 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.

(76) This application claims the benefit of Japanese Patent Application No. 2022-172451, filed Oct. 27, 2022, which is hereby incorporated by reference herein in its entirety.

Claims

1. An image forming apparatus configured to form an image on a sheet, the image forming apparatus comprising: an apparatus body; a door provided in a pivotable manner between a closed position and an opening position with respect to the apparatus body; and a resistance applying portion configured to apply a resistance force with respect to the door in response to the door being pivoted, wherein the resistance applying portion includes a body support member supported by the apparatus body, and a contact member that receives the resistance force by coming into contact with the body support member, wherein the contact member includes a first member supported by the door, and a second member supported by the first member in a contractable and extendable manner between a contracted position contracted with respect to the first member and an extended position extended with respect to the first member, wherein the second member is configured to be brought into the contracted position with respect to the first member in a state where the door is in the closed position, wherein the second member is configured to be brought into the extended position with respect to the first member by the door having moved from the closed position to a first intermediate position located between the closed position and the opening position, and wherein, in response to the door moving from the first intermediate position to the opening position, the second member is configured to apply the resistance force to the door by coming into contact with the body support member in the extended position.

2. The image forming apparatus according to claim 1, wherein, by the door having moved from the closed position to the first intermediate position, the first member is configured to apply the resistance force to the door by coming into contact with the body support member.

3. The image forming apparatus according to claim 2, wherein, by the door having moved from the closed position to a second intermediate position located between the closed position and the first intermediate position, the first member is configured not to come into contact with the body support member, and wherein, in response to the door moving from the second intermediate position to the first intermediate position, the first member is configured to apply the resistance force to the door by coming into contact with the body support member.

4. The image forming apparatus according to claim 2, wherein the contact member includes a first engagement portion and a second engagement portion, wherein, by the door having moved from the closed position to a first position located between the closed position and the first intermediate position, the first engagement portion is configured to move the second member from the contracted position to the extended position with respect to the first member by engaging the

second member with the apparatus body and holding the second member with respect to the apparatus body, wherein, in response to the door having moved from the closed position to the first position, the second engagement portion is configured to hold the second member in the extended position with respect to the first member by engaging the first member with the second member, and wherein, in response to the door being moved from the first position to the opening position, the contact member is configured to release engagement of the first engagement portion by engaging the second engagement portion so that the second member moves integrally with the first member.

5. The image forming apparatus according to claim 4, wherein the second member includes a regulation portion configured to abut against a contacted portion disposed in the apparatus body in response to the door having moved from the first position to a second position located between the first position and the closed position, and wherein, in response to the door being moved from the second position to the closed position, a movement of the second member with respect to the apparatus body is regulated by the regulation portion, and the second member is configured to be contracted with respect to the first member by regulation of the movement of the second member by the regulation portion.

6. The image forming apparatus according to claim 2, further comprising a pivot regulation portion disposed in the apparatus body and configured to regulate a pivot of the door in an opening direction from the opening position.

7. The image forming apparatus according to claim 2, further comprising a pivot shaft configured to rotatably support the door with respect to the apparatus body, wherein, when viewed in an axial direction of the pivot shaft, the second member is configured to be contracted and extended with respect to the first member along an arc-shaped path around the pivot shaft as a center, wherein the first member includes a first contact portion configured to come into contact with the body support member, and the second member includes a second contact portion configured to come into contact with the body support member, and wherein, when viewed in the axial direction of the pivot shaft, the first contact portion and the second contact portion are arranged along a circumscribing circle circumscribing the body support member around a center of the pivot shaft as a center.

8. The image forming apparatus according to claim 7, wherein the body support member includes a shaft center secured to the apparatus body, a pinion gear rotatably supported with respect to the shaft center, and a damper portion interposed between the shaft center and the pinion gear so as to attenuate a force in a rotational direction of the pinion gear, and wherein the first contact portion and the second contact portion include rack gears configured to engage with the pinion gear, respectively.

9. The image forming apparatus according to claim 1, wherein the second member is configured to be brought into the extended position with respect to the first member by a relative movement between the first member and the second member occurring before the door, having moved from the closed position, reaches the first intermediate position.

10. The image forming apparatus according to claim 1, wherein the first member and the second member are configured to integrally move together as the door moves from the first intermediate position to the opening position.