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IMAGE FORMING APPARATUS CAPABLE OF SHIFTING FIXING UNIT VERTICALLY UPWARD IN CONJUNCTION WITH BEHAVIOR OF SWITCHING STATE OF FIXING MEMBER AND PRESSING MEMBER

Abstract

An image forming apparatus includes: a drum unit; a fixing unit including a fixing member and a pressing member; a fixing pressure release unit disposed below the fixing unit; a body frame including a lateral support plate and a partition plate; a cooling fan; a first cooling duct; and a shifting mechanism. The first cooling duct is provided on an outside of the lateral support plate. The lateral support plate is provided with an air outlet. The fixing pressure release unit includes a nip pressure adjustment gear and a rotary gear. The fixing unit performs a switching behavior of switching a state of the fixing member and the pressing member between a pressed state and a released state by a rotary drive force supplied from the rotary gear to the nip pressure adjustment gear. The shifting mechanism shifts the fixing unit vertically upward in conjunction with the switching behavior.

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Background/Summary

INCORPORATION BY REFERENCE

[0001] This application claims priority to Japanese Patent Application No. 2024-023264 filed on 19 Feb. 2024, the entire contents of which are incorporated by reference herein.

BACKGROUND

[0002] The present disclosure relates to image forming apparatuses and particularly relates to a technique for reducing temperature loss of a fixing unit.

[0003] A general image forming apparatus includes: a photosensitive drum as an image carrier; a charging device that electrically charges the photosensitive drum; an exposure device that irradiates the charged surface of the photosensitive drum with laser light based on an original document to form a latent image of the original document on the surface of the photosensitive drum; a developing device that visualizes the latent image with toner; a transfer roller that transfers a toner image formed by the visualization to a recording paper sheet; a fixing device that fixes the transferred toner image on the recording paper sheet; and a cleaning device that removes residual toner on the surface of the photosensitive drum.

[0004] Recently, with the downsizing of image forming apparatuses, the space between units in the interior of such an apparatus has become narrower and, thus, a drum unit including a photosensitive drum has been disposed near a fixing unit including a fixing device. When heat for fixing in the fixing device is transferred to the drum unit, the drum unit may be adversely affected.

[0005] As a solution to the above problem, there is generally known a technique in which a heat insulating member is provided between the fixing unit and the drum unit (a process cartridge) to insulate between the drum unit and the fixing unit, thus preventing heat transfer from the fixing unit to the drum unit.

SUMMARY

[0006] A technique improved over the aforementioned technique is proposed as one aspect of the present disclosure.

[0007] An image forming apparatus according to an aspect of the present disclosure includes a drum unit, a fixing unit, a fixing pressure release unit, a body frame, a cooling fan, and a first cooling duct. The drum unit includes an image carrier capable of carrying a toner image. The fixing unit includes a fixing member and a pressing member forming a fixing nip together with the fixing member and fixes at the fixing nip the toner image formed on a recording sheet. The fixing pressure release unit is disposed below the fixing unit and switches a state of the fixing member and the pressing member between a pressed state where pressure is applied on the fixing nip and a released state where the pressure on the fixing nip is released. The body frame includes: a vertically extending lateral support plate; and a partition plate disposed above the fixing unit and serving as a partition between the drum unit from the fixing unit. The cooling fan produces a cooling air flow. The first cooling duct is provided on an outside of the lateral support plate and allows the air blown by the cooling fan to flow therethrough. The lateral support plate is provided with an air outlet through which the air in the cooling duct is to be blown into a space between the drum unit and the fixing unit. The fixing pressure release unit includes: a nip pressure adjustment gear located toward

the fixing unit; and a rotary gear located below and meshing with the nip pressure adjustment gear. The fixing unit performs a switching behavior of switching between the pressed state and the released state by a rotary drive force supplied by rotation from the rotary gear to the nip pressure adjustment gear. The image forming apparatus further includes a shifting mechanism that shifts the fixing unit vertically upward in conjunction with the switching behavior.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a perspective view showing an appearance of an image forming apparatus.

[0009] FIG. **2** is a cross-sectional side view schematically showing an image forming device and its surrounding components in the image forming apparatus.

[0010] FIG. **3** is a side view schematically showing a fixing unit and its surrounding components.

[0011] FIG. **4**A is a perspective view showing the fixing unit.

[0012] FIG. **4**B is a perspective view showing a fixing pressure release unit.

[0013] FIG. **5**A is a perspective view showing the structure of a body frame of the image forming apparatus.

[0014] FIG. **5**B is a front view showing the structure of the body frame.

[0015] FIG. **6**A is a side view showing the structure of a lateral support plate of the body frame.

[0016] FIG. **6**B is a view showing a state where a cooling duct is removed from the lateral support plate.

[0017] FIG. **7**A is a side view showing the cooling duct.

[0018] FIG. **7**B is a perspective view showing the inside of the cooling duct.

[0019] FIG. **8** is a perspective view of an air outlet and its surrounding portions, with a drum unit removed from the body frame, when viewed from the right front.

[0020] FIGS. **9**A and **9**B are enlarged views of a portion of FIG. **8**.

DETAILED DESCRIPTION

[0021] Hereinafter, a description will be given of an image forming apparatus according to an embodiment of the present disclosure with reference to the drawings. FIG. **1** is a perspective view showing an appearance of an image forming apparatus **1** according to an embodiment of the present disclosure. FIG. **2** is a cross-sectional side view schematically showing an image forming device **12** and its surrounding components in the image forming apparatus **1**. The image forming apparatus **1** is, for example, a printer.

[0022] The image forming apparatus **1** contains an image forming device **12** in the interior of a body frame **2** (see FIG. **5**A). The body frame **2** includes respective openings formed in the front side, the top side, and the back side thereof and these openings are covered with a front cover **3**, a top cover **4**, and a back cover **5**, respectively. The right and left sides of the image forming apparatus **1** are covered with respective side covers **6**.

[0023] Each of the front cover **3** and the top cover **4** is pivotally supported by the body frame **2** and can be thus opened and closed between a position to uncover the associated opening of the body frame **2** and a position to cover it. With the front cover **3** and the top cover **4** opened, a toner container **171**, a developing device **124**, and a drum unit **120** can be removed and attached through the openings of the body frame **2**.

[0024] The image forming device **12** forms a toner image on a recording paper sheet as a recording sheet. The image forming device **12** includes a photosensitive drum **121**, a charging device **122**, an exposure device **123**, the developing device **124**, a transfer roller **126**, a cleaning device **60**, and the toner container **171**. The photosensitive drum **121**, the charging device **122**, and the cleaning device **60** are formed into a unit to form the drum unit **120**.

[0025] The photosensitive drum **121** is an image carrier capable of carrying a toner. The

photosensitive drum **121** is formed rotatably about an axis of rotation and is capable of carrying a toner image on its surface. The charging device **122** has the function of electrically charging the surface of the photosensitive drum **121**. The exposure device **123** irradiates the surface of the photosensitive drum **121** with laser light L based on image data sent from an external device (for example, a personal computer) to form a latent image on the surface of the photosensitive drum **121**.

[0026] The developing device **124** includes a developing roller **1241**. The developing device **123** visualizes, with toner, the latent image formed on the surface of the photosensitive drum **121**. The transfer roller **126** forms a transfer nip N**1** together with the photosensitive drum **121**. The transfer roller **126** transfers the toner image to a recording paper sheet.

[0027] The cleaning device **60** includes a cleaning roller **61** and a cleaning blade **62**. The cleaning roller **61** and the cleaning blade **62** make contact with the surface of the photosensitive drum **121** and remove residual toner, deposits, and the like on the surface of the photosensitive drum **121** to clean the surface of the photosensitive drum **121**.

[0028] The fixing unit **13** fixes the toner image on the recording paper sheet by the application of heat and pressure. The fixing unit **13** includes: a heat roller **131** with a heater **132** built therein; and a pressure roller **133**. The heat roller **131** and the pressure roller **133** are opposed to each other. While the recording paper sheet is nipped and conveyed in a fixing nip N**2** formed by the heat roller **131** and the pressure roller **133**, the unfixed toner image is melted by heat from the heater **132** and fixed on the recording paper sheet by pressure from the heat roller **131** and the pressure roller **133**. The heat roller **131** and the pressure roller **133** are respective examples of the fixing member and the pressing member defined in CLAIMS.

[0029] FIG. **3** is a side view schematically showing the fixing unit **13** and its surrounding components. A space SP is a space formed between the drum unit **120** and the fixing unit **13**.

[0030] The fixing pressure release unit **14** is provided below the fixing unit **13**. The fixing pressure release unit **14** switches the state of the fixing nip N**2** by switching the state of the heat roller **131** and the pressure roller **133** between a pressed state where pressure is applied on the fixing nip N**2** (a state where the pressure roller **133** presses against the heat roller **131**) and a released state where the pressure on the fixing nip N**2** is released (a state where the upward pressing of the pressure roller **133** against the heat roller **131** is released).

[0031] The fixing pressure release unit **14** includes: a gear train composed of a first gear **141**, a second gear **142** (an example of the rotary gear), and so on; and a drive motor **143** capable of forward and backward rotation. The fixing pressure release unit **14** transmits a drive force from the drive motor **143** via the gear train to the fixing unit **13**.

[0032] The fixing unit **13** includes the heat roller **131**, the pressure roller **133**, a third gear **134** (an example of the nip pressure adjustment gear), and a guide member **135**. For example, when the drive force from the drive motor **143** of the fixing pressure release unit **14** is transmitted via the first gear **141**, the second gear **142**, the third gear **134**, and so on to an eccentric cam provided in the interior of the fixing unit **13** to drive the eccentric cam into rotation, the state of the fixing nip N**2** switches to the pressed state or the released state.

[0033] When the pressure roller **133** is pressed against the heat roller **131** by a biasing member, the fixing nip N**2** reaches the pressed state. When the eccentric cam is rotated a predetermined angle forwardly and backwardly, the state of the fixing nip N**2** switches between the released state where the pressure roller **133** is disengaged from the heat roller **131** and the pressed state where the pressure roller **133** presses against the heat roller **131**.

[0034] In driving the eccentric cam into rotation for the purpose of switching from the pressed state to the released state, a driving force acts between the third gear **134** and the second gear **142** in order to rotate the eccentric cam. On the other hand, in driving the eccentric cam into rotation for the purpose of switching from the released state to the pressed state, a turning moment acts on the eccentric cam by the biasing member and, thus, a braking force acts between the third gear **134** and

the second gear **142**. By the driving force or braking force between the third gear **134** and the second gear **142**, a force acting upward is transmitted to the fixing unit **13**.

[0035] When the second gear **142** rotates clockwise in FIG. **3**, the third gear **134** meshing with the second gear **142** rotates counterclockwise in FIG. **3** and, thus, a drive force from the drive motor **143** is transmitted from the tooth flanks of the second gear **142** to the tooth flanks of the third gear **134**. On the other hand, when the second gear **142** rotates counterclockwise to rotate the third gear **134** clockwise, the third gear **134** pushes the tooth flanks of the second gear **142** and, thus, a braking force is transmitted to the third gear **134**.

[0036] The arrow F in FIG. **3** vectorially represents a force transmitted from the tooth flanks of the second gear **142** to the tooth flanks of the third gear **134** in association with the drive force and braking force acting on the third gear **134**. The direction indicated by the arrow F is a direction of the vector of the transmitted force.

[0037] In the combinational structure of the fixing unit **13** and the fixing pressure release unit **14** shown in FIG. **3**, the transmitted force F is inclined upwardly to the right in FIG. **3** and therefore has a rightward component and an upward component. Hence, the transmitted force F applies to the fixing unit **13** a force to move the fixing unit **13** upward.

[0038] The guide member **135** extends in a direction orthogonal to the direction of conveyance of a recording paper sheet (in a direction along the depth of the plane of FIG. **3**), holds down the top surface of a recording paper sheet being conveyed from the drum unit **120**, and guides the recording paper sheet to the entrance of the fixing nip N**2**.

[0039] The guide member **135** is pivotally movable about a rotational shaft A extending in the direction orthogonal to the direction of conveyance of a recording paper sheet. The guide member **135** shifts between a first position (the position shown in FIG. **3**) to guide a recording paper sheet to the entrance to the fixing nip N**2** and a second position to close the entrance to the fixing nip N**2**.

[0040] The guide member **135** is pivotally moved about the rotational shaft A by a link mechanism. For example, when the drum unit **120** is fitted into the body frame **5**, part of the drum unit **120** works on the link mechanism to pivotally move the guide member **135** about the rotational axis A and thus shift the guide member **135** from the second position to the first position.

[0041] Alternatively, a structure may be adopted in which the rotational shaft A is connected to the first gear **134**, the guide member **135** shifts to the first position when the fixing nip N**2** reaches the pressed state, and the guide member **135** shifts to the second position when the fixing nip N**2** reaches the released state.

[0042] A controller formed of a CPU or the like governing the operation control of the image forming apparatus **1** controls a drive source to shift the guide member **135** to either the first position or the second position. When the fixing pressure release unit **14** puts the fixing nip N**2** of the fixing unit **13** into the pressed state, the controller controls the drive source to shift the guide member **135** to the first position. On the other hand, when the fixing pressure release unit **14** puts the fixing nip N**2** of the fixing unit **13** into the released state, the controller controls the drive source to shift the guide member **135** to the second position.

[0043] FIG. **4**A is a perspective view showing the fixing unit **13** and FIG. **4**B is a perspective view showing the fixing pressure release unit **14**. The fixing unit **13** includes the guide member **135**, a case **136** extending in the right-to-left direction, a pair of right and left covers **137**R and **137**L, a conveyance guide **138**, and shield members **139**R and **139**L (hereinafter, also referred to simply as "shield members **139**"). The conveyance guide **138** guides a recording paper sheet conveyed from the drum unit **120** to the fixing nip N**2**. The shield members **139**R and **139**L will be described in detail later.

[0044] FIG. **5**A is a perspective view showing the structure of the body frame **2** of the image forming apparatus **1** and FIG. **5**B is a front view showing the structure of the body frame **2**. The body frame **2** includes a pair of lateral support plates **21**L, **21**R extending in the vertical direction. The lateral support plate **21**L is provided on the left side of the body frame **2**, while the lateral

support plate **21**R is provided on the right side of the body frame **2**. The drum unit **120** and the fixing unit **13** are fitted into a space defined by the lateral side plates **21**L and **21**R.

[0045] FIG. **6**A is a side view showing the structure of the lateral support plate **21**L of the body frame **2**. The outside surface of the lateral support plate **21**L is provided with: a cooling fan **22** capable of producing a cooling air flow; and a cooling duct **23** through which the air blown by the cooling fan **22** flows.

[0046] FIG. **6**B is a view showing a state where the cooling duct **23** is removed from the lateral support plate **21**L. FIG. **7**A is a side view showing the cooling duct **23** and FIG. **7**B is a perspective view showing the inside of the cooling duct **23**. As shown in FIG. **6**B, the lateral support plate **21**L is provided with an air outlet **24** through which the air in the cooling duct **23** is to be blown into the space between the drum unit **120** and the fixing unit **13**.

[0047] FIG. **8** is a perspective view of the air outlet **24** and its surrounding portions, with the drum unit **120** removed from the body frame **2**, when viewed from the right front. FIGS. **9**A and **9**B are enlarged views of a portion of FIG. **8**. In FIG. **9**B, the arrows show a direction of flow of a cooling air from the air outlet **24**.

[0048] The cooling air from the air outlet **24** flows through the space SP (see FIG. **3**) formed between the drum unit **120** and the fixing unit **13**. As shown in FIGS. **8**, **9**A, and **9**B, the body frame **2** includes a partition plate **25**. The partition plate **25** is disposed above the fixing unit **13** and serves as a partition between the drum unit **120** from the fixing unit **13**. The shield members **139** included in the fixing unit **13** block openings formed between the body of the fixing unit **13** and the partition plate **25**. A clearance CL is a clearance produced between each of the shield members **139** (the fixing unit **13**) and the partition plate **25**.

[0049] The image forming apparatus **1** includes a shifting mechanism **200**. The shifting mechanism **200** shifts the fixing unit **13** vertically upward in conjunction with the operation of the fixing pressure release unit **14** for switching the fixing nip N**2** between the pressed state and the released state. When the shifting mechanism **200** shifts the fixing unit **13** vertically upward, the shield members **130** move upward.

[0050] Thus, the clearances CL formed between the fixing unit **13** and the partition plate **25** are covered by the shield members **139** and, as a result, become narrower than when the fixing nip N**2** is in the released state before the fixing unit **13** shifts upward.

[0051] In other words, the fixing unit **13** performs a switching behavior of switching between the pressed state and the released state by a rotary drive force supplied by rotation from the second gear **142** to the third gear **134**. The structure in the interior of the image forming apparatus **1** for shifting, at this time, the fixing unit **13** vertically upward in conjunction with the switching behavior is the shifting mechanism **200**.

[0052] As thus far described, the fixing unit **13** receives, from the second gear **142** via the third gear **134**, a force to move the fixing unit **13** upward, the force originating from a drive force of the drive motor **143** of the fixing pressure release unit **14**. This force to move the fixing unit **13** upward enables the fixing unit **13** to vertically shift. Specifically, in order to transmit to the fixing unit **13** the force to move it upward contained in the transmitted force F, the shifting mechanism **200** restricts horizontal movement of the fixing unit **13** resulting from a horizontal moving force to move the fixing unit **13** horizontally, the horizontal moving force being contained in the transmitted force F.

[0053] In this embodiment, a raised portion **130** is provided on the side of the fixing unit **13** facing in the horizontal direction which is a direction in which the fixing unit **13** is to be moved by the above horizontal moving force contained in the transmitted force F. In the interior of the apparatus body (the body frame **2**) of the image forming apparatus **1**, a restriction member **102** is provided in abutment or abuttably via a gap d against the raised portion **130** in the horizontal direction. The gap d has a predetermined magnitude of distance that allows the fixing unit **13** to move horizontally.

[0054] When the fixing unit **13** attempts to horizontally move by the above horizontal moving

force contained in the transmitted force F, the restriction member **101** restricts horizontal movement of the fixing unit **13**. Thus, only the force to move the fixing unit **13** upward contained in the transmitted force F acts on the fixing unit **13** and, as a result, the fixing unit **13** shifts upward. The raised portion **130** and the restriction member **101** constitute the shifting mechanism **200**.
[0055] Furthermore, in a state where the fixing nip N**2** is put into the pressed state by the above switching behavior of the fixing unit **13**, the clearances CL are covered with the shield members **139**. At this time, the guide member **135** having shifted to the first position forms, together with the outside wall surface of the drum unit **120** facing to the fixing unit **13** and the outside wall surface of the fixing unit **13** facing to the drum unit **120**, a cooling duct that leads a cooling air blown out through the air outlet **24** toward the drum unit **120**.
[0056] In other words, when the clearances CL are covered with the shield members **139**, the guide member **135** having shifted to the first position takes a position where the above cooling duct can be formed. Although in this embodiment a structure in which the guide member **135** pivotally moves about the rotational shaft A to form a cooling duct is adopted as an example, the fixing unit **13** may be provided with an alternative member for forming a cooling duct instead of the guide member **135**.
[0057] If, as in the general technique described previously, a heat insulating member is disposed between the fixing unit and the drum unit, this makes it difficult to downsize the apparatus.
[0058] For the purpose of providing heat insulation between the drum unit and the fixing unit, an alternative technique of passing a cooling air flow between the drum unit and the fixing unit can be proposed. However, if a fixing belt in the fixing unit is cooled by the cooling air flow, there may arise another problem of a decrease in energy saving performance of the fixing unit.
[0059] If the body frame of the image forming apparatus is provided with a partition plate serving as a partition between the drum unit and the fixing unit, it may be possible to prevent the cooling air passing between the drum unit and the fixing unit from flowing into the fixing unit. However, even in this case, the cooling air may flow into the fixing unit through clearances formed between the fixing unit and the partition plate and, thus, the fixing unit may be cooled. These clearances are necessary for the convenience of assembly of the apparatus.
[0060] This problem can be solved in the above embodiment, wherein the clearances CL formed between the fixing unit **13** and the partition plate **25** can be narrowed to reduce the amount of cooling air flowing into the fixing unit **13**. In addition, since the clearances CL are covered with the shield members **139**, this makes it possible to allow the cooling air to flow through the space SP between the drum unit **120** and the fixing unit **13**. Therefore, the temperature rise of the drum unit **120** can also be reduced. Hence, the above embodiment enables effective reduction in temperature loss of the fixing unit **13** and reduction in temperature rise of the drum unit **120**.
[0061] Furthermore, since the outside wall surface of the drum unit **120** facing to the fixing unit **13**, the outside wall surface of the fixing unit **13** facing to the drum unit **120**, and the guide member **135** included int he fixing unit **13** serve as a cooling duct that leads the cooling air toward the drum unit **120**, the drum unit **120** can be effectively cooled by the cooling air flow from the cooling fan **22**.
[0062] The present disclosure is not limited to the structure of the above embodiment and can be modified in various ways. The structure and processing of the above embodiment described with reference to FIGS. **1** to **9**B is merely an embodiment of the present disclosure and is not intended to limit the present disclosure to the above structure and processing.
[0063] While the present disclosure has been described in detail with reference to the embodiments thereof, it would be apparent to those skilled in the art the various changes and modifications may be made therein within the scope defined by the appended claims.

Claims

1. An image forming apparatus comprising: a drum unit including an image carrier capable of carrying a toner image; a fixing unit that includes a fixing member and a pressing member forming a fixing nip together with the fixing member and fixes at the fixing nip the toner image formed on a recording sheet; a fixing pressure release unit which is disposed below the fixing unit and switches a state of the fixing member and the pressing member between a pressed state where pressure is applied on the fixing nip and a released state where the pressure on the fixing nip is released; a body frame including a vertically extending lateral support plate, and a partition plate disposed above the fixing unit and serving as a partition between the drum unit from the fixing unit; a cooling fan that produces a cooling air flow, and a first cooling duct which is provided on an outside of the lateral support plate and allows the air blown by the cooling fan to flow therethrough, wherein the lateral support plate is provided with an air outlet through which the air in the first cooling duct is to be blown into a space between the drum unit and the fixing unit, the fixing pressure release unit comprises a nip pressure adjustment gear located toward the fixing unit, and a rotary gear located below and meshing with the nip pressure adjustment gear, the fixing unit performs a switching behavior of switching between the pressed state and the released state by a rotary drive force supplied by rotation from the rotary gear to the nip pressure adjustment gear, and the image forming apparatus further comprises a shifting mechanism that shifts the fixing unit vertically upward in conjunction with the switching behavior.

2. The image forming apparatus according to claim 1, wherein the fixing unit comprises a shield member that blocks an opening formed between a body of the fixing unit and the partition plate, and when the fixing unit is shifted upward in conjunction with the switching behavior by the fixing pressure release unit and the shifting mechanism, the shield member moves to a position where a clearance formed between the shield member and the partition plate becomes narrower.

3. The image forming apparatus according to claim 1, wherein the fixing unit comprises a guide member extending in a direction orthogonal to a direction of conveyance of the recording sheet, the guide member guiding the recording sheet to an entrance to the fixing nip, the cooling fan is provided adjacent to the fixing unit, an apparatus body of the image forming apparatus is provided with the air outlet through which the cooling air from the cooling fan is to be blown into the space between the drum unit and the fixing unit, and when the drum unit is fitted into the body frame, the guide member forms, together with an outside wall surface of the drum unit facing to the fixing unit and an outside wall surface of the fixing unit facing to the drum unit, a second cooling duct through which the cooling air blown out through the air outlet flows.

4. The image forming apparatus according to claim 1, wherein the shifting mechanism comprises: a raised portion provided on a horizontal side of the fixing unit; and a restriction member provided in abutment or abuttable via a gap against the raised portion in the horizontal direction.