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IMAGE FORMING APPARATUS

Abstract

Disclosed is an image forming apparatus including: a door configured to open a conveying path between a transfer portion for forming a toner image on a recording material and a fixing portion for fixing the toner image, the door facing a surface of the recording material traveling through the conveying path; a duct provided on the door, the duct having an intake inlet and an exhaust outlet; a fan provided inside the duct, which generates the air flow travelling from the intake inlet to the exhaust outlet; and a filter provided detachably attachable to the duct, which collects particles with a predetermined particle diameter, wherein the filter has a width that is equal to or greater than an image width of a recording material with a maximum width passing through a fixing nip portion in a widthwise direction perpendicular to a conveying direction of the recording material.

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Background/Summary

BACKGROUND OF THE INVENTION
Field of the Invention
[0001] This invention relates to an image forming apparatus provided with a fixing portion that fixes an image on a recording material.
Description of the Related Art
[0002] In an image forming apparatus using the electrophotographic system, a recording material bearing a toner image is heated and pressurized at the nip portion of the fixing portion to fix the toner image onto the recording material. It is known that fine particles with a diameter less than 100 [nm] such as Volatile Organic Compounds (VOC) and Ultra Fine Particles (UFP) are discharged by the heating of the fixing process.
[0003] Japanese Patent Application Laid-open No. 2019-164193 discloses the configuration for reducing these fine particles. The configuration disclosed in this document includes an exhaust duct disposed in the vicinity of the fixing nip portion that takes in air and exhausts the air outside the apparatus, a fan disposed in an exhaust path of the exhaust duct, and a filter disposed between the fan and the exhaust outlet in a path of the exhaust duct for collecting UFP. When the fan exhausts the air outside the apparatus, UFP contained in the exhausted air are collected by the filter during the air passing through the filter.
SUMMARY OF THE INVENTION
[0004] A representative configuration of the present invention is an image forming apparatus for forming an image on a recording material, comprising: [0005] a transfer portion configured to form a toner image on the recording material using toner containing release agent; [0006] a fixing portion configured to fix the toner image formed on the recording material by the transfer portion by nipping and conveying the recording material at a fixing nip portion formed with a pair of rotating members; [0007] a door configured to open a conveying path between the transfer portion and the fixing portion, the door being opposed to a surface of the recording material traveling through the conveying path; [0008] a duct provided on the door, the duct having an intake inlet for taking in air and an exhaust outlet for exhausting the air taken in from the intake inlet outside the image forming apparatus, the duct forming a closed space for an air flow travelling from the intake inlet to the exhaust outlet; [0009] a fan provided inside the duct, the fan being configured to generate the air flow travelling from the intake inlet to the exhaust outlet; and [0010] a filter provided detachably attachable to the duct, the filter being configured to collect particles with a predetermined particle diameter that are caused by the release agent, [0011] wherein the filter has a width that is equal to or greater than an image width of a recording material with a maximum width passing through the fixing nip portion in a widthwise direction perpendicular to a conveying direction of the recording material.
[0012] 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
[0013] FIG. **1** is a diagram showing a cross-sectional view of an image forming apparatus.
[0014] FIG. **2** is a diagram showing a cross-sectional view of the vicinity of a fixing portion of the image forming apparatus.
[0015] FIG. **3** is a diagram showing a cross-sectional view of the vicinity of a fixing portion of the image forming apparatus.

[0016] FIGS. **4**A and **4**B are diagrams showing cross-sectional views of an arrangement of an exhaust duct and a filter.
[0017] FIG. **5** is a diagram showing a distribution of the amount of passing air at an intake inlet of a reference example.
[0018] FIG. **6** is a diagram showing a distribution of the amount of passing air at an intake inlet (filter) of an embodiment of an embodiment of the present invention.
[0019] FIG. **7** is a diagram showing a distribution of the amount of passing air at the intake inlet (filter) of the embodiment when changing a spatial distance between the filter and the fan.

DESCRIPTION OF THE EMBODIMENTS

[0020] Hereinafter, with reference to the drawings, preferred embodiments of the present invention will be exemplarily described in detail. However, the dimensions, materials, shapes and relative positions of the components of the image forming apparatus described in the following embodiments should be varied as appropriate according to the configuration of an apparatus to which the present invention is applied and the various conditions, and the following description is not intended to limit the scope of the invention to them alone.

Image Forming Apparatus

[0021] The image forming apparatus according to an embodiment of the present invention will be described with reference to FIG. **1**. FIG. **1** is a schematic diagram showing a cross-sectional view of the image forming apparatus of the embodiment.
[0022] The image forming apparatus **100** shown in FIG. **1** is a color image forming apparatus of the intermediate transfer tandem system. In the main body of the image forming apparatus **100**, the image forming portions PY, PM, PC and PK for four colors (yellow, cyan, magenta and black) are disposed being opposed to the intermediate transfer belt **8**. The recoding materials S that can be used for image forming apparatus **100** include various kinds of sheet materials such as plain paper, thick paper, rough paper, emboss paper, coated paper, OHP sheet, plastic film and cloth. The image forming apparatus is controlled by the controller **500**.
[0023] The image forming apparatus **100** includes the image forming portions PY to PK that form images on the photosensitive drums **1**, the intermediate transfer unit **120** with the intermediate transfer belt **8** bearing images formed on the photosensitive drums **1**, the sheet feeding portion **800** that feeds the recording material S and the fixing portion **101**. The image forming unit **130** for forming an image on the recording material S in the present embodiment is constituted by the image forming portions PY to PK, the primary transfer rollers **5**Y to **5**K, the intermediate transfer belt **8**, the secondary transfer inner roller **76** and the secondary transfer outer roller **77**. The intermediate transfer unit **120** is constituted by the intermediate transfer belt **8** that is an endless belt, the tension roller **10** that tensions the intermediate transfer belt **8**, the secondary transfer inner roller **76**, the idler rollers **7***a* and **7***b*, and so on. The intermediate transfer unit **120** is a transfer portion that transfers the images formed in the image forming portions PY to PK on the the recording material S at the transfer nip portion (secondary transfer portion T**2**). The sheet feeding portion **800** is constituted by the cassette **72**, the sheet feeding roller **73**, the conveying path **74** and the registration roller **75**.
[0024] The conveying process of the recording materials S in the image forming apparatus **100** will be described. The recording materials S are accommodated in the cassette **72** such that the recording materials S are stacked. The recording materials S are fed by the sheet feeding roller **73** one by one in synchronism with the image forming operation. The conveying path **74** is formed by guide members that guide the recording materials S. When the recording materials S are conveyed to the registration roller **75** disposed in the middle of the conveying path **74**, the skew feeding adjustment and the timing adjustment are performed for the recording materials S by the registration roller **75** and after that the recording materials S are conveyed to the secondary transfer portion T**2**. The secondary transfer portion T**2** is a transfer nip portion formed via the intermediate transfer belt **8** by the secondary transfer inner roller **76** and the secondary transfer outer roller **77**

that are opposed to each other. In the secondary transfer portion T**2**, images are secondarily transferred from the intermediate transfer belt **8** to the recording materials S.

[0025] The image forming process of the image conveyed to the secondary transfer portion T**2** in synchronism with the conveying process of the recoding material S to the secondary transfer portion T**2** will be described. The configurations of the image forming portions PY, PM, PC and PK are substantially the same as each other except for the difference in colors yellow, magenta, cyan and black of toner used in developing devices **4**Y, **4**M, **4**C and **4**K. Therefore, in the following description, only the configuration of the image forming portion PY for color yellow will be exemplarily described and those of the other image forming portions PM, PC and PK will be omitted.

[0026] The image forming portion PY is mainly constituted by the photosensitive drum **1**Y as image bearing member, the charging device **2**Y as process portion working on the photosensitive drum **1**Y, the developing device **4**Y and the photosensitive drum cleaner **6**Y. During the image formation, the photosensitive drum **1**Y is driven to rotate at a predetermined process speed (circumferential speed) in the direction of arrow R**1**. A charging voltage is applied to the charging device **2**Y by a high voltage power supply (not shown), so that a current flows between the charging device **2**Y (charging roller) and the photosensitive drum **1**Y. As a result, the surface of the photosensitive drum **1**Y is uniformly charged to a predetermined polarity and potential. An electrostatic latent image is formed on the charged photosensitive drum **1**Y by the exposure of the exposure device **3** based on the image information. The toner is attached to the electrostatic latent image by the developing device **4**Y so that the electrostatic latent image is developed into a toner image. The primary transfer roller **5**Y is disposed facing the image forming portion PY via the intermediate transfer belt **8**. A predetermined pressure force and a primary transfer voltage are applied to the image formed on the photosensitive drum **1**Y so that the image formed on the photosensitive drum **1**Y is primarily transferred onto the intermediate transfer belt **8**. The toner slightly remaining on the photosensitive drum **1**Y after the primary transfer is removed by the photosensitive drum cleaner **6**Y to be ready for the next image forming process.

[0027] The intermediate transfer belt **8** is tensioned by the tension roller **10**, the secondary transfer inner roller **76** and the idler rollers **7***a* and **7***b* as tension rollers and is driven to move in the direction of arrow R**2** in the figure. In the present embodiment, the secondary transfer inner roller **76** also works as a driving roller for driving the intermediate transfer belt **8**. The image forming processes for the respective colors are performed by the image forming portions PY to PK in synchronism such that each image is superimposed in a sequential manner with an upstream toner image or upstream toner images in the direction of the movement primarily transferred on the intermediate transfer belt **8**. As a result, a full color toner image is finally formed on the intermediate transfer belt **8** and this full color toner image is conveyed to the secondary transfer portion T**2**. The remaining toner after passing the secondary transfer portion T**2** is removed from the intermediate transfer belt **8** by the transfer cleaner **11**.

[0028] By the above described conveying process and image forming process, at the time when the recording material arrives at the secondary transfer portion T**2**, the toner image is secondarily transferred from the intermediate transfer belt **8** to the recording material S. After that, the recording material S on which the toner image has been transferred is conveyed to the fixing portion **101** disposed above the intermediate transfer unit **120** in the vertical direction through the conveying path **74**.

[0029] The fixing portion **101** is constituted by the pair of rotating members **114** including the endless belt **107** and the conveying rollers **108**. In the fixing portion **101**, the recording material bearing a toner image transferred at the intermediate transfer unit **120** is nipped and conveyed at the fixing nip portion T**3** formed by the pair of rotating members **114** to fix the toner image. The endless belt **107** is a first rotating member that is heated by the heater **109** to a high temperature and that heats the recording material S bearing an image. The conveying roller **108** is a second rotating member that abuts on the belt **107** to form the fixing nip portion T**3**. When the recording material S is nipped and conveyed at the fixing nip portion T**3**, the belt **107** is heated by the heater **109** to a high temperature. As a result, heat and pressure are applied to the recording material S and the toner image is fixed onto the recording material S. Then, the recording material S on which the toner image has been fixed is discharged on the discharge tray **601** by the discharge roller **78**.

[0030] In the present embodiment, the inlet of the fixing portion **101** (fixing nip portion T**3**) for the recording material S is disposed more downwardly in the vertical direction than the outlet, so that the recording material S is conveyed from the lower portion to the upper portion in the vertical direction. In the following description, the downstream side of the fixing nip portion T**3** in the conveying direction of the recording material S is referred to as downstream side and the upstream side of the fixing nip portion T**3** in the conveying direction of the recording material S is referred to as upstream side.

[0031] In FIG. **1**, the direction from the back surface to the top surface of the drawing sheet is defined as forward direction, and the direction from the top surface to the back surface of the drawing sheet is defined as backward direction. With respect to the image forming apparatus **100**, the top side of the drawing sheet shown in FIG. **1** is defined as front side and the side opposite to the top side is defined as back side. With respect to the photosensitive drum **1**K on which an electrostatic latent image for a black toner image is formed, the side on which the photosensitive drum **1**Y on which an electrostatic latent image for a yellow toner is formed is disposed is defined as left side. With respect to the photosensitive drum **1**Y on which an electrostatic latent image for a yellow toner image is formed, the side on which the photosensitive drum **1**K on which an electrostatic latent image for a black toner is formed is disposed is defined as right side. The upward direction in the vertical directions that are perpendicular to the forward/backward directions and the rightward/leftward directions defined above is defined as upward direction. The downward direction in the vertical directions that are perpendicular to the forward/backward directions and the rightward/leftward directions defined above is defined as downward direction. The forward direction F, the backward direction B, the rightward direction R, the leftward direction L, the upward direction U, the downward direction D are shown in FIG. **1** and so on.

Mechanism of Generation of Fine Particles

[0032] Next, the mechanism of generation of the fine particles due to release agent included in toner will be described. In the following, the fine particles are exemplified as Ultra Fine Particles (UFP) with a diameter of 100 [nm] or less.

[0033] As described above, in the fixing portion **101**, the recording material S is brought into contact with the belt **107**, which is of a high temperature, to fix the toner image. When the fixing process is performed using such a configuration, a part of the toner may be transferred (attached) to the belt during the fixing process. This phenomenon is referred to as offset phenomenon, which causes image defects and is required to be delt with.

[0034] In view of this, the toner used in image forming apparatuses generally includes wax as release agent. When the toner is heated, the inside wax is melted to exude. Therefore, when the fixing process is performed for the toner image, the melted wax convers the surface of the belt **107**. As a result, it becomes hard for the toner to be attached to the belt **107** whose surface is covered with wax owing to the releasing effect of the wax.

[0035] In the present embodiment, compounds including the molecular structure of the wax are also referred to as wax in addition to the pure wax. For example, the compounds resulting from the interaction of the resin molecules and the molecular structure of the wax are referred to as wax. Further, substances having the release effect such as silicon oil instead of wax can be used as release agent.

[0036] When the wax is melted, a part of the wax is vaporized. This is considered to be due to the variation in the size of the molecule components of the wax. Namely, the wax includes low-molecular components with short molecular chain and low boiling point and high-molecular components with long molecular chain and high boiling point, and the low-molecular components with low boiling point are considered to be vaporized first.

[0037] When the vaporized wax components are cooled in the air, fine particles with a diameter of several nanometers to several hundreds of nanometers are produced. Many of these particles seemingly have a diameter of several nanometers to several tens of nanometers and these particles are the above described UFP.

[0038] As described above, UFP is produced due to the heating during the fixing process. Therefore, it is understood that UFP is produced mainly from the fixing nip portion T**3** where the heat is applied to the wax. Further, taking into consideration the rotation of the belt **107** and the disposition of the heater **109**, the belt **107** becomes of the highest temperature on the upstream side of the fixing nip portion T**3**. Therefore, it is understood that UFP is produced most at the upstream side of the fixing nip portion T**3**. Further, UFP is also produced from the toner image transferred onto the recording material S. Therefore, it is understood that UFP is produced in the entire region for image width in the longitudinal direction of the fixing nip portion T**3**.

[0039] The longitudinal directions of the fixing nip portion T**3** coincide with the widthwise directions perpendicular to the conveying direction of the recording material S, and with the forward and backward directions as shown in FIG. **4**B.

Structure for Reduction of UFP

[0040] Generally, the filter **102** disposed in the image forming apparatus is used for collecting UFP in the air to reduce the amount of UFP exhausted outside the image forming apparatus.

[0041] The image forming apparatus **100** according to the present embodiment is provided with the duct **104**, the fan **103** and the filter **102** and these components will be described in the following with reference to FIGS. **2**, **3** and **4**.

[0042] FIG. **2** is a diagram showing a cross-sectional view illustrating the disposition of the filter, the duct and the fan in the vicinity of the fixing portion in the state where the door is closed. FIG. **3** is a diagram showing a cross-sectional view illustrating the disposition of the filter, the duct and the fan in the vicinity of the fixing portion in the state where the door is opened. FIG. **4**A is a schematic diagram showing a cross-sectional view of the image forming apparatus for illustrating the disposition of the filter, the duct and the fan. FIG. **4**B is a diagram showing an A-A cross-sectional view of FIG. **4**A.

Structure of Duct

[0043] The duct **104** is provided with the intake inlet **110** that takes in air, and the exhaust outlet **111** that exhausts the air taken in from the intake inlet **110** outside the image forming apparatus **100**. The duct **104** forms a closed space for the air flow travelling from the intake inlet **110** to the exhaust outlet **111**.

[0044] The duct **104** is located between the fixing portion **101** and the apparatus side surface **115** on which the door **112** for opening the conveying path **74** is provided. The door **112** is provided such that the door **112** is rotatable around the hinge portion **113** with respect to the image forming apparatus **100**. The duct **104** is provided on the door **112**. In this way, the duct **104** forming a path for exhausting air is provided between the fixing portion **101** and the door **112** for opening the conveying path **74**, enabling the fine particles such as steam and UFP produced in the fixing portion **101** to be efficiently exhausted outside the apparatus for the shortest path.

[0045] The fan **103** is provided inside the duct **104**. The fan **103** generates an air flow travelling from the intake inlet **110** to the exhaust outlet **111**. In this embodiment, the configuration is exemplified in which the fan **103** is provided inside the duct **104** between the intake inlet **110** and the exhaust outlet **111**, however, the invention is not limited to this disposition.

[0046] The intake inlet **110** of the duct **104** is an opening disposed between the fixing nip portion T**3** and the transfer nip portion T**2**, and the opening faces the side on which the fixing nip portion T**3** is located. The exhaust outlet **111** of the duct **104** is connected to the louver **105** provided on the door **112** on the apparatus side surface **115**. The louver **105** includes a plurality of the long plate-like members **105***a*. Each of the plurality of the long plate-like members **105***a* extends in the directions (forward and backward directions) perpendicular to the drawing surface of FIG. **1** as the longitudinal direction. The long plate-like members **105***a* are provided being distant from each other in parallel along the vertical directions such that the longitudinal directions of the long plate-like members **105***a* are the same as each other. As illustrated in FIG. **2**, the long plate-like members **105***a* are disposed in a direction in which air flows towards the side on which the lower part of the apparatus is located. The fan **103** generates an air flow from the intake inlet **110** to the exhaust outlet **111**, so that the air around the fixing nip portion T**3** is forcibly exhausted outside the apparatus.

[0047] The side of the duct **104** on which the exhaust outlet **111** is located is connected to the door **112**, so that the duct **104** is integrally provided with the door **112**. The door **112** is configured to be openable and closable such that the door **112** takes a closed position (indicated in FIG. **2**) in which the conveying path **74** is covered by the door **112** and an opened position (indicated in FIG. **3**) in which the conveying path **74** is opened. As indicated in FIG. **3**, when the door **112** is opened, the duct **104** is relocated from within the apparatus to the exterior of the apparatus in conjunction with the door **112**. In this case, the duct **104** is opened to the exterior of the apparatus from the side on which the intake inlet **110** is located. As a result, the filter **102**, which will be described later, is exposed from the side of the duct **104** on which the intake inlet **110** is located. Namely, when the door **112** is located in the opened position, the filter **102** is exposed. The filter **102** is provided in the image forming apparatus **100** in a detachably attachable manner. Therefore, when the door **112** is opened, the filter **102** can be easily exchanged.

[0048] The duct **104** is disposed between the secondary transfer portion T**2**, which is a transfer nip portion, and the fixing portion T**3** in the vertical directions of the image forming apparatus **100**. The intake inlet **110** of the duct **104** is disposed between the fixing nip portion T**3** of the pair of rotating members **114** and the secondary transfer portion T**2** as a transfer nip portion. More specifically, the intake inlet **110** of the duct **104** is disposed close to the upstream side of the fixing nip portion T**3** in the conveying direction of the recording material S. With this configuration, the fine particles included in the air can be collected at the upstream side of the fixing nip portion T**3** where UFP is considered to be generated most by the heat during the fixing process.

[0049] The guide member **74***a* forms the conveying path **74** in the vertical directions between the secondary transfer portion T**2** and the fixing nip portion T**3**. The guide member **74***a* is connected to the side of the duct **104** on which the intake inlet **110** is located and is provided integrally with the door **112**. Therefore, as illustrated in FIG. **3**, when the door **112** is opened, the guide member **74***a* is relocated from inside the apparatus towards the exterior of the apparatus in conjunction with the door **112** and the conveying path **74** is opened. With this configuration, the jam recovery for the recording material in the conveying path **74** can be easily performed and the above described filter **102** can be easily exchanged.

Configuration of Filter

[0050] The filter **102** is provided in the duct **104** and has the aeration resistance larger than that in the inside of the duct **104**. The filter **102** filtrates UFP from the air passing through the filter **102**. The filter **102** also functions as a collecting member that collects the fine particles such as steam and UFP included in the passing air.

[0051] When collecting UFP resulting from the wax (release agent) included in toner, it is desirable that filter **102** is made from the electrostatic unwoven fabrics. The electrostatic unwoven fabrics are made by creating a static charge on the fibers of the unwoven fabrics. The electrostatic unwoven fabrics can efficiently collect (filtrate) UFP. The higher the density of the fibers is, the higher the collecting (filtrating) performance is, however, the larger the pressure loss is likely to become. This relationship also applies to the case where the thickness of the electrostatic unwoven fabrics is increased. Further, when the charging strength of the fibers (strength of static charge) is increased, the filtration performance can improve with the pressure loss being constant. It is desirable to set as appropriate the thickness of the electrostatic unwoven fabrics, the density of the fibers, and the charging strength of the fibers in response to the filtration performance required for the filter **102**. The density of the fibers, the thickness, and the charging strength for the electrostatic unwoven fabrics used in the filter **102** of the present embodiment are set such that the aeration resistance is about 40 [Pa] and the collecting rate is 95 [%] when the passing air flow speed is 10 [cm/s].

[0052] The filter **102** is disposed between the intake inlet **110** of the duct **104** and the fan **103**. The filter **102** is disposed such that the filter **102** covers the entire region of the closed space in the duct **104** along the length of the fixing nip portion T**3** in the longitudinal direction.

[0053] In the present embodiment, the filter **102** is disposed on the intake inlet **110**. The filter **102** is provided such that the filter **102** covers the entire region of the intake inlet **110** provided along the length of the fixing nip portion T**3** in the longitudinal direction.

[0054] Taking the collecting efficiency of UFP into consideration, it is desirable that the filter **102** is located as close as possible to the fixing nip portion T**3**. In particular, it is desirable that the filter **102** is disposed on the upstream side of the fixing nip portion T**3** where the UFP is produced most. However, when the filter **102** is located too close to the fixing nip portion T**3**, the filter **102** may be thermally deteriorated due to the heat produced by the radiation from the heater **109** of the fixing portion **101**, so that the filtrating performance may be lowered. Therefore, it is desirable that the filter **102** is located at an appropriate distance from the fixing nip portion T**3**. Specifically, it is desirable that the shortest distance between the filter **102** and the fixing nip portion T**3** is equal to or larger than 5 [mm]. In another point of view, it is desirable that the filter **102** is disposed within 100 [mm] from the fixing nip portion T**3** in order to surely collect UFP. Therefore, it is desirable that the shortest distance between the filter **102** and the heater **109** is equal to or larger than 5 [mm] and equal to or smaller than 100 [mm]. Namly, it is desirable that the shortest distance between the filter **102** and the fixing nip portion T**3** is equal to or larger than 5 [mm] and equal to or smaller than 100 [mm].

[0055] The intake inlet **110** of the duct **104** is provided so as to extend until the outside regions of the both end portions of the recording material S that has the largest size that can be used for the image forming apparatus **100** in the longitudinal direction of the fixing nip portion T**3**. The filter **102**, which covers the entire region of the intake inlet **110**, is therefore disposed to extend in the longitudinal direction of the fixing portion **101** as shown in FIG. **4**B.

[0056] Specifically, likewise the intake inlet **110**, the filter **102** is provided so as to extend until the outside regions of the both end portions of the recording material S that has the largest size that can be used for the image forming apparatus **100** in the longitudinal direction of the fixing nip portion T**3**.

[0057] In the fixing portion **101** according to the present embodiment, the recording material S is positioned and conveyed with reference to the center of the widthwise direction perpendicular to the rotational moving direction of the belt **107**. Therefore, in the region (width Wp_Max) for the recording material S has the largest size that can be used for the image forming apparatus **100**, UFP is easily produced irrespective of the width size of the recording material S. Therefore, it is preferable to surely collect UFP at least in this region. Therefore, the width Wf of the filter **102** in the longitudinal direction is equal to or greater than the width Wp_Min of the smallest recording material S. Further, UFP can be produced in the region (width Wp_Max) of the largest size that can be used for the image forming apparatus **100**. Therefore, it is desirable that UFP is collected in the entire region in order to surely collect UFP. Therefore, it is desirable that the width Wf of the filter **102** in the longitudinal direction is equal to or greater than the width Wp_Max of the largest size of the recording material S (equal to or greater than the greatest width).

[0058] In the present embodiment, the largest size of the usable recording material is the A3 size, whereas the smallest size of the usable recording material is the postcard size. The width of the recording material S in the direction perpendicular to the conveying direction is 297 [mm] and 100 [mm] in the cases of the A3 size and the postcard size, respectively.

[0059] Therefore, the width Wf (intake inlet **110**) of the filter **102** in the longitudinal direction is equal to or greater than the width Wp_Min of the recording material S having the smallest size and is equal to or greater than the width Wp_Max of the recording material S having the largest size (Wp_Min<Wp_Max<Wf).

[0060] Further, both end portions of the filter **102** in the longitudinal direction are provided in the region outside the both end portions of the width W of the fixing nip portion T**3** in the longitudinal direction. Namely, the width Wf (intake inlet **110**) of the filter **102** in the longitudinal direction is equal to or greater than the width Wp_Min of the recording material S having the smallest size, is equal to or greater than the width Wp_Max of the recording material S having the largest size, and is equal to or greater than the width Wt of the fixing nip portion T**3** in the longitudinal direction (Wp_Min<Wp_Max<Wt<Wf).

[0061] The positional relationship between the width Wf (intake inlet **110**) of the filter **102** in the longitudinal direction, the width Wp_Min of the recording material S having the smallest size, the width Wp_Max of the recording material S having the largest size, and the width Wt of the fixing nip portion T**3** in the longitudinal direction are shown in FIG. **4**B. Namly, the width Wf (intake inlet **110**) of the filter **102** in the longitudinal direction, the width Wp_Min of the recording material S having the smallest size, the width Wp_Max of the recording material S having the largest size, and the width Wt of the fixing nip portion T**3** in the longitudinal direction overlap with each other in the longitudinal direction of the fixing nip portion T**3**.

[0062] The filter **102** is detachably attachable to the image forming apparatus **100**. In the present embodiment, the filter **102** is attached to the duct **104** in a detachable manner. As described above, the duct **104** is provided integrally with the door **112** which rotates about the hinge portion **113**. Further, an attaching frame for attaching the filter **102** is disposed on the intake inlet **110** of the duct **104**. After the filter **102** is attached to the attaching frame, the filter **102** is secured by pinching the filter between the attaching frame and the securing frame. Therefore, when the door **112** is opened, the duct **104** and the guide member **74***a* are relocated towards the exterior of the apparatus in conjunction with the door **112**. As a result, the filter **102** is exposed from the side on which the intake inlet **110** is located, so that the exchanging work can be easily performed.

Uniformity of Aeration at Filter Portion

[0063] As described above, the filter **102** is disposed on the intake inlet **110** provided along the length of the fixing nip portion T**3** in the the longitudinal direction to cover the entire region of the intake inlet **110**. The filter **102** has the aeration resistance greater than that of the inside of the duct **104**. In this case, the intake can be uniformly performed in the longitude direction of the intake inlet **110**.

[0064] As described above, the filter **102** with fine grain of fibers for collecting UFP has the property of suppressing the air passing. When the exhaustion by the fan **103** is performed in the state where the air passing is suppressed by the filter **102**, the space between the filter **102** and the fan **103** becomes in the state of negative pressure. In the state of negative pressure in the space between the fan **103** and the filter **102**, suction force is uniformly applied to the entire region of the filter **102** in the longitudinal direction, so that the air passes uniformly through the entire region of the filter **102**. Namely, the entire region of the back surface region of the filter **102** can be maintained at a constant negative pressure by disposing the filter **102**, which is an aeration resistance, on the intake inlet **110**.

Confirmation of Aeration Amount Distribution at Intake Inlet

[0065] The aeration amount distribution at the intake inlet according to the present embodiment will be described by way of comparison with a reference example with reference to FIGS. **5** to **7**.

[0066] FIG. **5** is a graph showing the aeration amount distribution at the intake inlet according to the reference example. FIG. **6** is a graph showing the aeration amount distribution at the intake inlet (filter) according to the present embodiment. FIG. **7** is a graph showing the aeration amount distribution at the intake inlet (filter) while the spatial distance between the filter and the fan is changed in the present embodiment.

[0067] In the configuration of the reference example, the fan is disposed at the side of the duct on which the intake inlet is located and the filter is disposed at the side of the duct on which the exhaust outlet is located. FIG. **5** shows the aeration amount distribution of the reference example in the longitudinal direction of the intake inlet. Namely, in the reference example, the filter is disposed between the exhaust outlet and the fan inside the duct.

[0068] In contrast, in the present embodiment, the filter is disposed at the side of the duct on which the intake inlet is located and the fan is disposed at the side of the duct on which the exhaust outlet is located. FIG. **6** shows the aeration amount distribution of the present embodiment in the longitudinal direction of the intake inlet. Namely, in the present embodiment, the filter is disposed between the intake inlet and the fan inside the duct.

[0069] In FIGS. **5** and **6**, the vertical axis represents the aeration amount and the horizontal axis represents the position of the filter in the longitudinal direction. The reference characters “B” and “C” respectively represent the positions of the end portions f1 and f2 of the filter **102** (intake inlet **110**) shown in FIG. **4**B in the longitudinal direction. In the figures, the aeration amount discharged outside the apparatus is represented as negative value.

[0070] The fan **103** is an axial fan with 60 [mm] square having the predetermined PQ characteristics (P represents static pressure [Pa], Q represents air amount [m.sup.3/min]). The rated voltage is 24 [V] and the rated number of revolution is 5300 [rpm]. The height of the intake inlet is 60 [mm], which is the same as that of the fan **103**. Taking into consideration the width of the recording material of the largest size, the width of the intake inlet in the longitudinal direction is set to 300 [mm]. In the present embodiment, the filter **102** of the same size as that of the intake inlet is disposed on the intake inlet. As an example, the spatial distance between the intake inlet **110** and the fan **103** is 50 [mm]. Further, the fan **103** is disposed in the position corresponding to the center of the intake inlet **110** in the longitudinal direction.

[0071] In the configuration of the reference example, the filter **102** is disposed on the exhaust outlet **111**. With this configuration, as shown in FIG. **5**, the air is exhausted at the end portions f1 and f2 of the intake inlet **110**, which are distant from the fan **103**, only about **10** percent as compared with the central portion in the region between the end portions f1 and f2. It shows that there exits significant unevenness of aeration amount across the longitudinal direction.

[0072] In contrast, in the configuration of the present embodiment, the filter **102** is disposed on the intake inlet **110**. With this configuration, as shown in FIG. **6**, the air is exhausted at the end portions f1 and f2 of the intake inlet **110**, which are distant from the fan **103**, about 90 percent as compared with the central portion in the region between the end portions f1 and f2. It shows that unevenness of aeration amount is significantly improved across the longitudinal direction.

[0073] FIG. **7** is a diagram showing the aeration amount distribution in the case of changing the spatial distance X [mm] between the filter **102** and the fan **103** (see FIG. **4**B). The minimum spatial distance Xmin is 10 [mm] and the maximum spatial distance Xmax is 250 [mm]. When the filter **102** is provided too close to the fan **103**, the filter **102** is sucked to the fan **103**, so that the filter **102** functions as a resistance, leading to a significant reduction in the exhaust efficiency of the fan **103**. Therefore, it is desirable that the filter **102** is disposed to be away from the fan **103** for an appropriate distance.

[0074] Specifically, it is desirable for the spatial distance X between the filter **102** and the fan **103** to be equal to 10 [mm] or greater. Whereas when the filter is too distant from the fan, the duct itself has a high flow resistance, which decreases the exhaust performance. Therefore, it is desirable that the filter is disposed at an appropriate distance from the fan. Specifically, it is desirable that the spatial distance X between the filter **102** and the fan **103** is equal to 100 [mm] or less.

[0075] As shown in FIG. **7**, when the spatial distance X is 10 [mm], the air is exhausted at the end portions about 50 percent as compared with the central portion where the exhausted air amount is set to 100 percent. When the spatial distance X is 20 [mm], 30 [mm], and 40 [mm], the air is exhausted at the end portions about 70 percent, 80 percent, and 85 percent, respectively. In the case where the spatial distance X is equal to 50 [mm] or greater, even when the spatial distance X is equal to 100 [mm], the air is exhausted 90 percent or greater at the end portions. It is understood that the greater the spatial distance X is, the more the unevenness of the aeration amount can be improved across the longitudinal direction. This is because the space of negative pressure between the filter **102** and the fan **103** that is required for effecting the suction pressure evenly on the entire region of the filter **102** can be more easily kept when the spatial distance X becomes greater.

[0076] As describe above, according to the present embodiment, by disposing the filter **102** having the aeration resistance greater than that of the duct **104** at the intake inlet **110** as a duct inlet, the aeration is suppressed. When the air is exhausted by the fan **103** in this state, the space between the filter **102** and the fan **103** becomes the state of the negative pressure, so that the suction pressure works evenly on the entire region of the filter. As a result, the air flows through the entire region of the filter **102** without unevenness. With this configuration, the fine particles included in the air passing through the filter **102** can be collected across the longitudinal direction of the fixing nip portion T**3** without unevenness.

[0077] Further, this configuration prevents the intake pressure from becoming locally strong and suppresses the image unevenness caused by the locally low temperature of the belt **107**.

[0078] Furthermore, the filter **102** is disposed upstream of the fixing nip portion T**3** where UFP is produced most, and the entire region of the intake inlet **110** provided across the length of the fixing nip portion T**3** in the longitudinal direction is covered by the filter **102**. With this configuration, the air is taken in at the entire region of the filter **102** and UFP is collected very efficiently.

Modifications

[0079] Further, in the above-described embodiment, the electrostatic unwoven fabrics are exemplified as the filter **102** (collecting member, filtrating member), which collects the fine particles such as steam and UFP included in the passing air. However, the filter **102** is not limited to electrostatic unwoven fabrics. Another filter such as honeycomb filter can be used instead of the electrostatic unwoven fabrics.

[0080] Furthermore, in the above-described embodiment, the filter **102** is exemplified as to be disposed on the intake inlet **110**. However, the disposing position of the filter **102** is not limited to this configuration. The filter **102** may be disposed between the intake inlet **110** and the fan **103** in the duct **104** as to be closer to the fan **103** than the intake inlet **110** by a certain distance.

[0081] Moreover, in the above-described embodiment, an endless belt is used for the heating rotating member (first rotating member) for heating a toner image. However, the heating rotating member is not limited to an endless belt. For example, the heating rotating member may be a roller or a belt unit wound around rollers. However, the present invention becomes more effective for the heating rotating member in the above-described embodiment, whose surface becomes of a high temperature to be easier to produce UFP.

[0082] Additionally, in the above-described embodiment, the door **112** for opening the conveying path **74** is disposed on the right side surface side of the image forming apparatus. However, the present invention is not limited to this configuration and the door **112** may be disposed on the left side surface side of the image forming apparatus, by reversing the right and left sides.

[0083] Further, in the above-described embodiment, the duct **104** is exemplified as being configured integrally with the door **112** on the apparatus side surface **115** for opening the conveying path **74**. However, the invention is not limited to this configuration. For example, the duct **104** may be provided integrally with the types of an opening and closing member such as a type in which a hinge portion is provided at the backside of the apparatus and an opening and closing member may be opened or closed by the rotation in the forward and backward directions and a type in which an opening and closing member can be drawn out by sliding movement in the right and left directions or the forward and backward directions.

[0084] In addition, in the above-described embodiment, the duct **104** is exemplified as being

linearly configured as shown in FIG. **2**. However, the duct **104** may be non- linearly configured.
[0085] Furthermore, in the above-described embodiment, the plate-like members **105***a* of the louver **105** connected to the exhaust outlet **111** of the duct **104** is exemplified as being disposed in the direction in which the air flows downwardly of the apparatus. However, the invention is not limited to this configuration. For example, the plate-like members **105***a* of the louver **105** may be configured as being disposed in the direction in which the air flows backwardly of the apparatus.
[0086] Moreover, in the above-described embodiment, a printer is exemplified as an image forming apparatus. However, the present invention is not limited to this configuration and the image forming apparatus may be another one such as a copying machine, facsimile and multifunctional apparatus combining the functions of these. In the above-described embodiment, an image forming apparatus is exemplified as being configured to have an intermediate transfer member, to transfer toner images of respective colors onto the intermediate transfer member in a sequentially superimposing manner, and to transfer in a batch the toner images on the intermediate transfer member onto a recording material. However, the invention is not limited to this configuration. The image forming apparatus may be configured to have a recoding material bearing member and to transfer in a sequentially superimposing manner the toner images of respective colors onto the recording material borne by the recording material bearing member. By applying the present invention to these configurations, the similar effect can be obtained.
[0087] Additionally, in the above-described embodiment, a recording system is exemplified as being the electrophotographic system. However, the present invention is not limited to this configuration. For example, the image forming apparatus may be one with another recording system such as an ink-jet type. Although the image forming apparatus of an ink-jet type does not have a fixing portion for applying heat and pressure, such apparatus has a drying unit for drying the recording material bearing an image, which has the same problem of exhausting heat and air as the one with the electrophotographic system in common. Therefore, when the present invention is applied to the ink-jet type image forming apparatus, the similar effect of the above-described embodiment can be expected.
[0088] 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.
[0089] This application claims the benefit of Japanese Patent Application No. 2024-19187, filed Feb. 13, 2024, which is hereby incorporated by reference herein in its entirety.

Claims

1. An image forming apparatus for forming an image on a recording material, comprising: a transfer portion configured to form a toner image on the recording material using toner containing release agent; a fixing portion configured to fix the toner image formed on the recording material by the transfer portion by nipping and conveying the recording material at a fixing nip portion formed with a pair of rotating members; a door configured to open a conveying path between the transfer portion and the fixing portion, the door being opposed to a surface of the recording material traveling through the conveying path; a duct provided on the door, the duct having an intake inlet for taking in air and an exhaust outlet for exhausting the air taken in from the intake inlet outside the image forming apparatus, the duct forming a closed space for an air flow travelling from the intake inlet to the exhaust outlet; a fan provided inside the duct, the fan being configured to generate the air flow travelling from the intake inlet to the exhaust outlet; and a filter provided detachably attachable to the duct, the filter being configured to collect particles with a predetermined particle diameter that are caused by the release agent, wherein the filter has a width that is equal to or greater than an image width of a recording material with a maximum width passing through the fixing nip portion in a widthwise direction perpendicular to a conveying direction of the recording material.

2. The image forming apparatus according to claim 1, wherein the intake inlet of the duct has a width equal to or greater than the maximum width of the recording material passing through the fixing nip portion in the widthwise direction.

3. The image forming apparatus according to claim 2, wherein the filter is provided on the intake inlet.

4. The image forming apparatus according to claim 3, wherein the door is configured to be openable and closable such that the door is in a closed position in which the conveying path is covered by the door and an opened position in which the conveying path is opened by the door, and wherein when the door is in the opened position, the filter is exposed.

5. The image forming apparatus according to claim 1, wherein the intake inlet is provided between the fixing nip portion and the transfer portion.

6. The image forming apparatus according to claim 1, wherein the filter is a collecting member configured to collect fine particles included in the air passing the filter.

7. The image forming apparatus according to claim 1, wherein a spatial distance between the filter and the fan inside the duct is equal to 10 [mm] or greater and equal to 100 [mm] or less.

8. The image forming apparatus according to claim 1, wherein the shortest distance between the filter and the fixing nip portion is equal to 5 [mm] or greater and equal to 100 [mm] or less.

9. The image forming apparatus according to claim 1, wherein the pair of the rotating members of the fixing portion includes: a first rotating member configured to heat the recording material bearing an image; and a second rotating member forming a fixing nip portion by abutting on the first rotating member.

10. The image forming apparatus according to claim 9, wherein the first rotating member is an endless belt.