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(54) **CHARGE ELIMINATING APPARATUS AND IMAGE FORMING SYSTEM**

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B65H 37/00 (2006.01)
G03G 21/20 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 15/6573*** (2013.01); ***B65H 37/00*** (2013.01); ***G03G 21/206*** (2013.01); *B65H 2301/5133* (2013.01); *G03G 2215/00417* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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(57) **ABSTRACT**

A charge eliminating apparatus includes a conveyance path configured to convey a sheet with an image formed thereon by an image forming apparatus, a non-contact charge eliminating device having an ion generation unit configured to generate ions and a control unit configured to control the ion generation unit, the non-contact charge eliminating device being configured to remove charges from the sheet conveyed in the conveyance path in a non-contact state, a surrounding member configured to surround the control unit, a separating portion configured to separate a first space where the control unit is surrounded by the surrounding member and a second space where the ion generation unit is disposed, and a fan configured to generate an air flow in the first space.

16 Claims, 7 Drawing Sheets

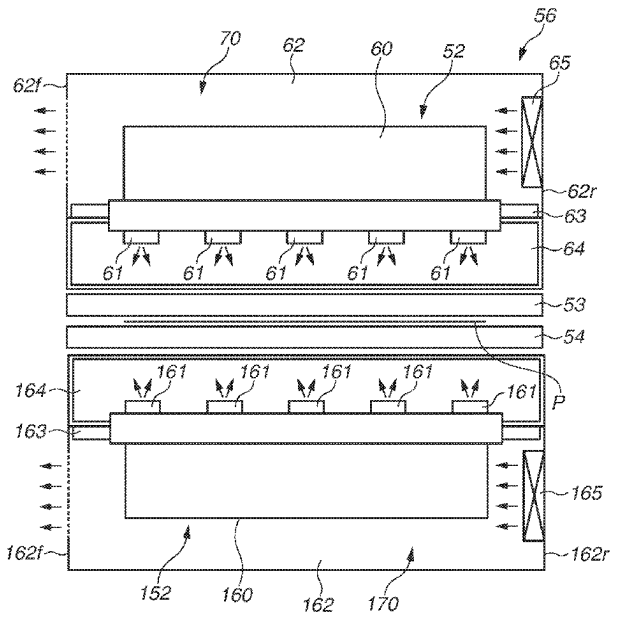
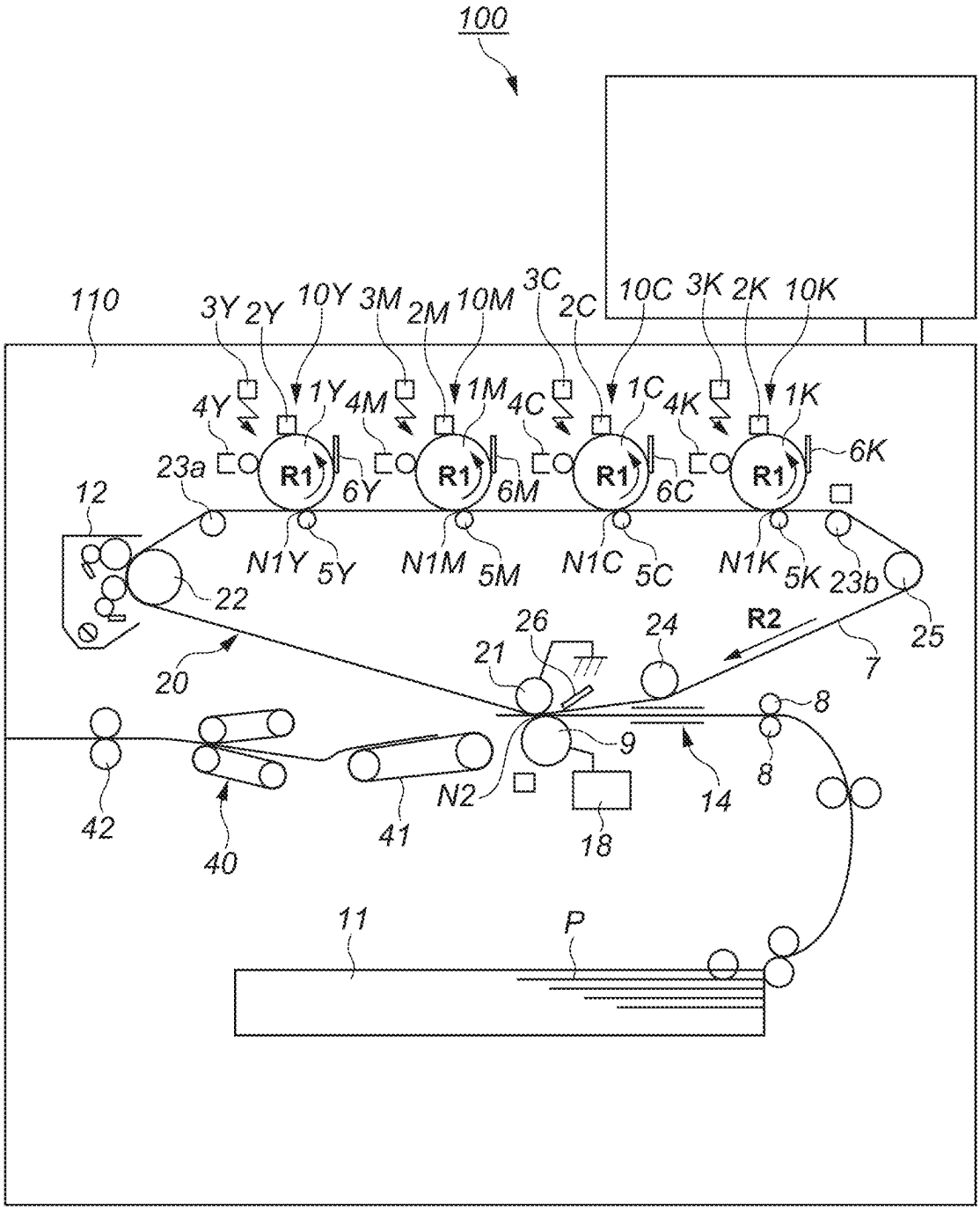


FIG.1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10Y
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2M
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10C
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1M
4C
1C
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1K
6K
23a
R1
6Y
6M
6C
12
N1Y
5Y
N1M
5M
N1C
5C
N1K
5K
23b
22
26
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R2
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N2
18
14
11
P

FIG.2

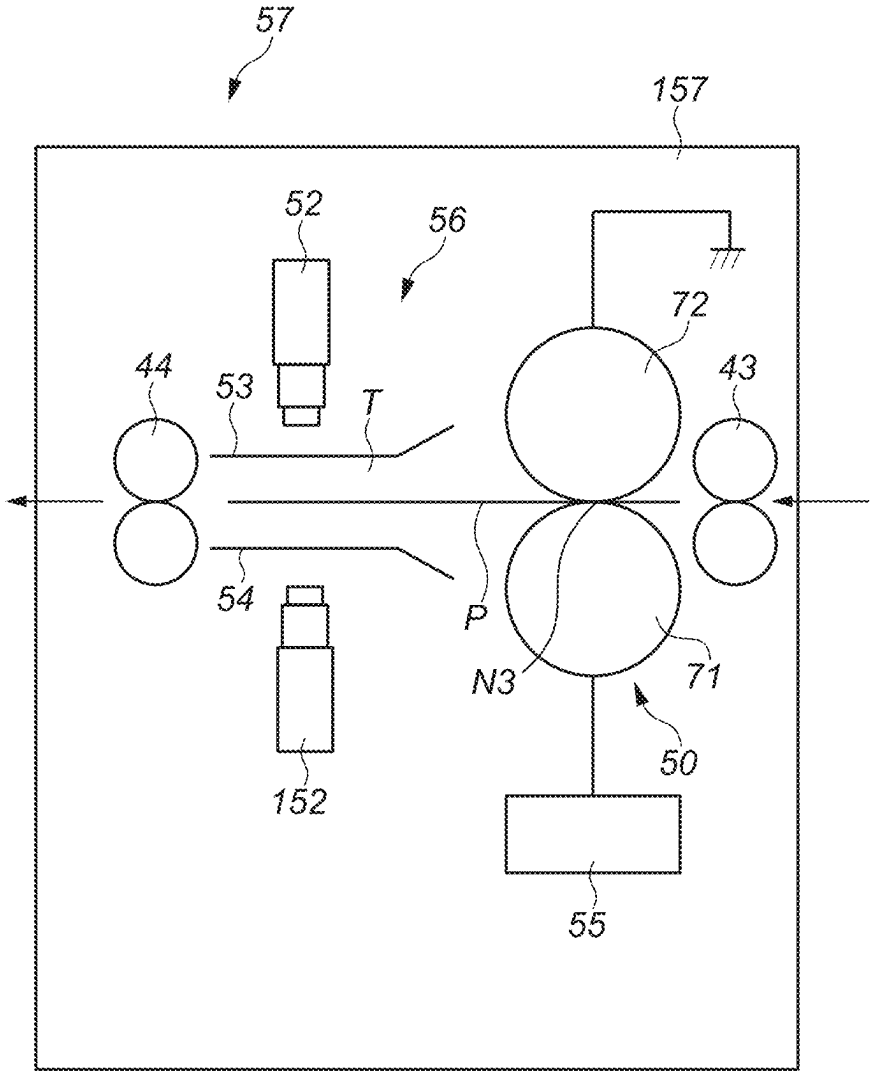

FIG.3B

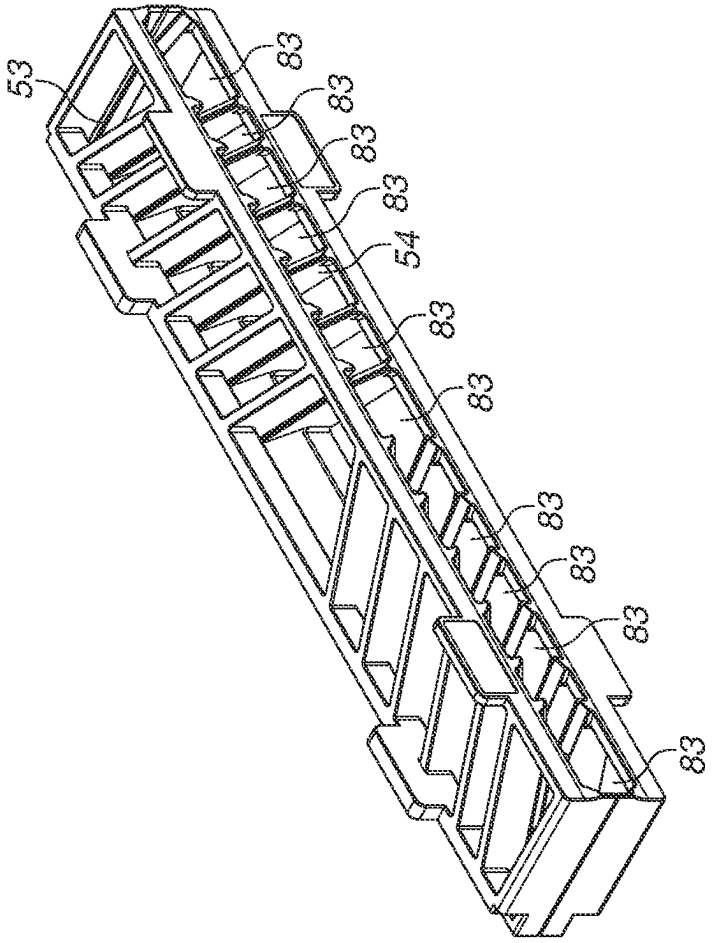
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FIG.3A

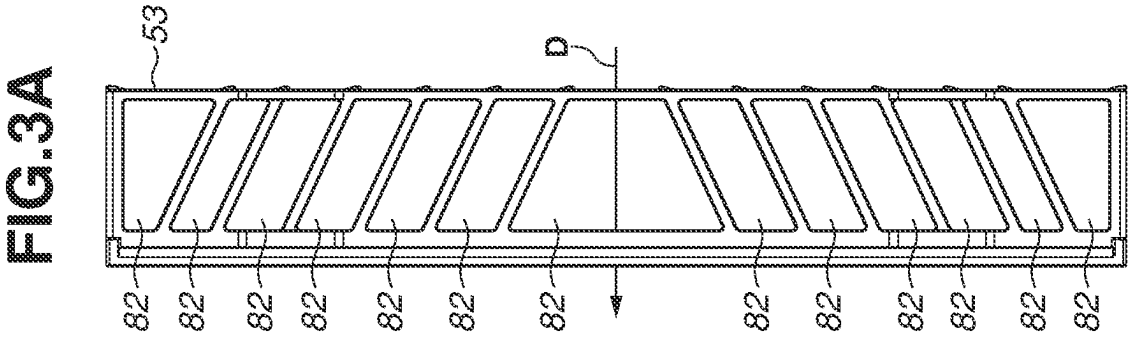
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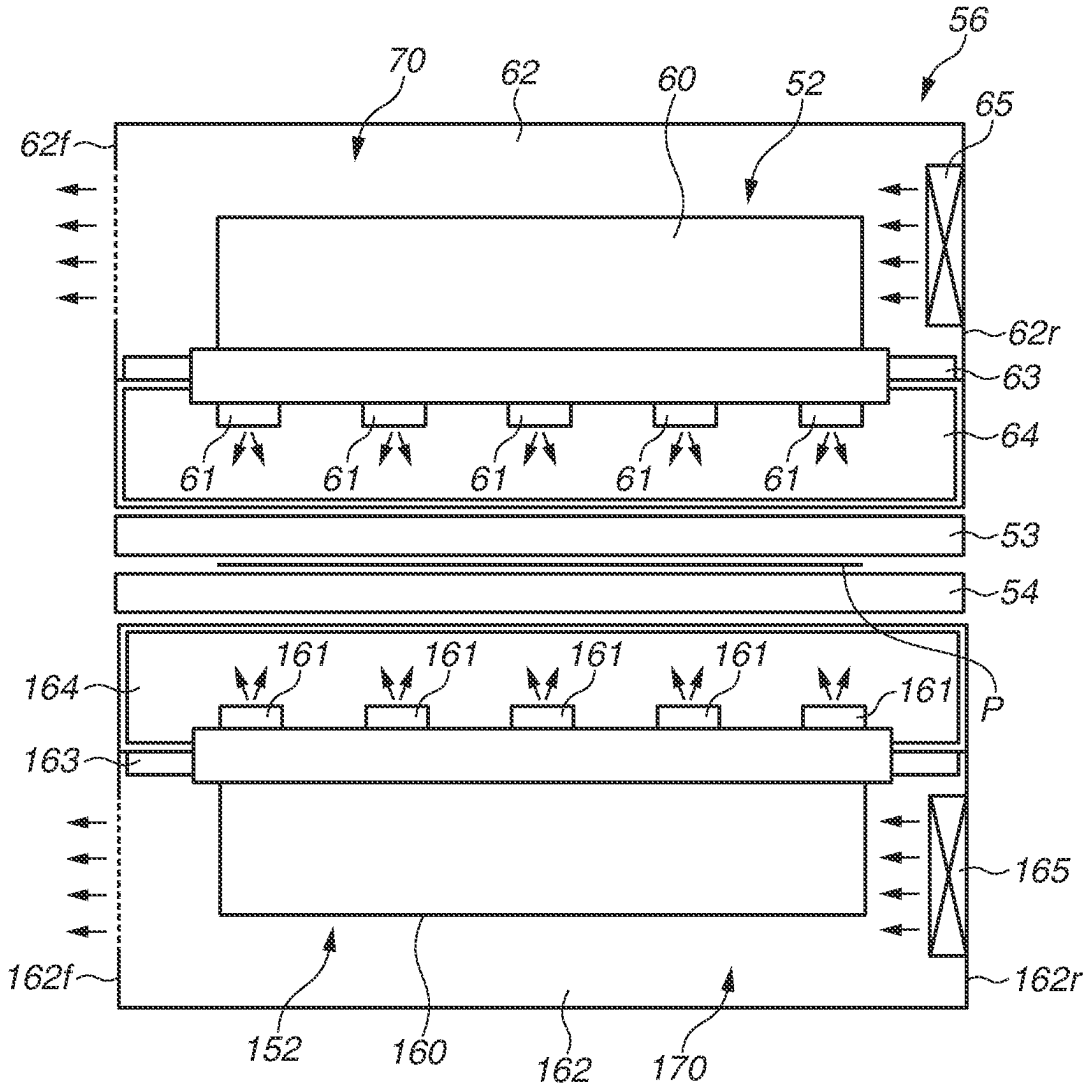
FIG.4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70
62
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52
65
62f
62r
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64
61
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164
P
163
165
162f
162r
152
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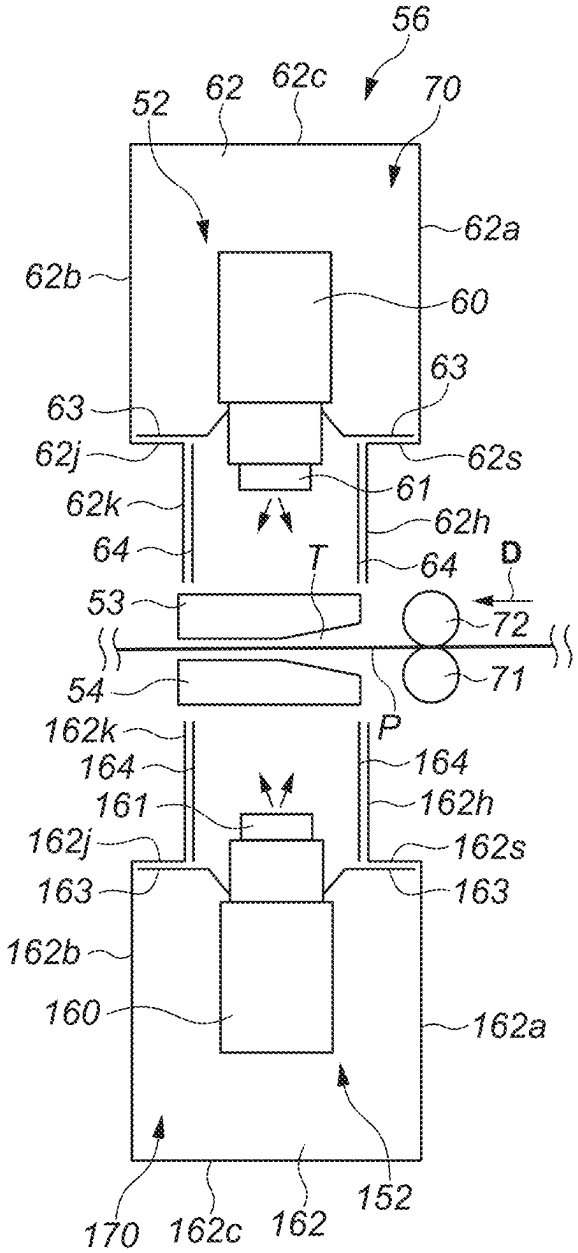
162
170

FIG.5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54
71
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FIG.6

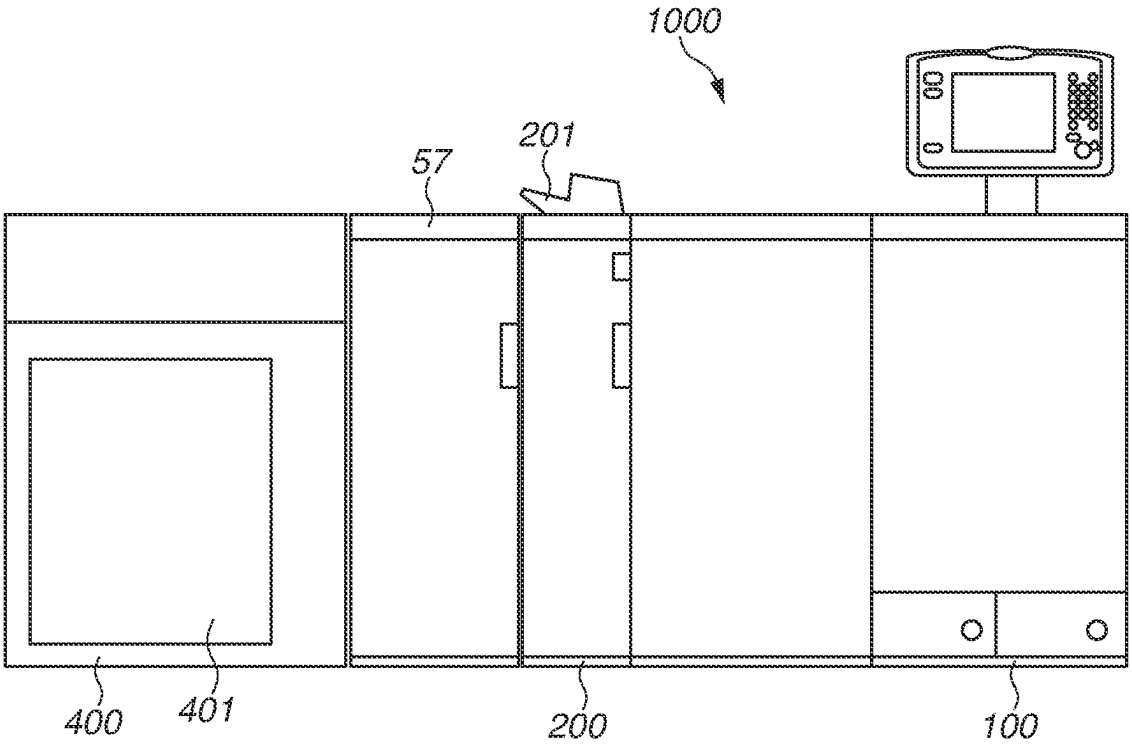
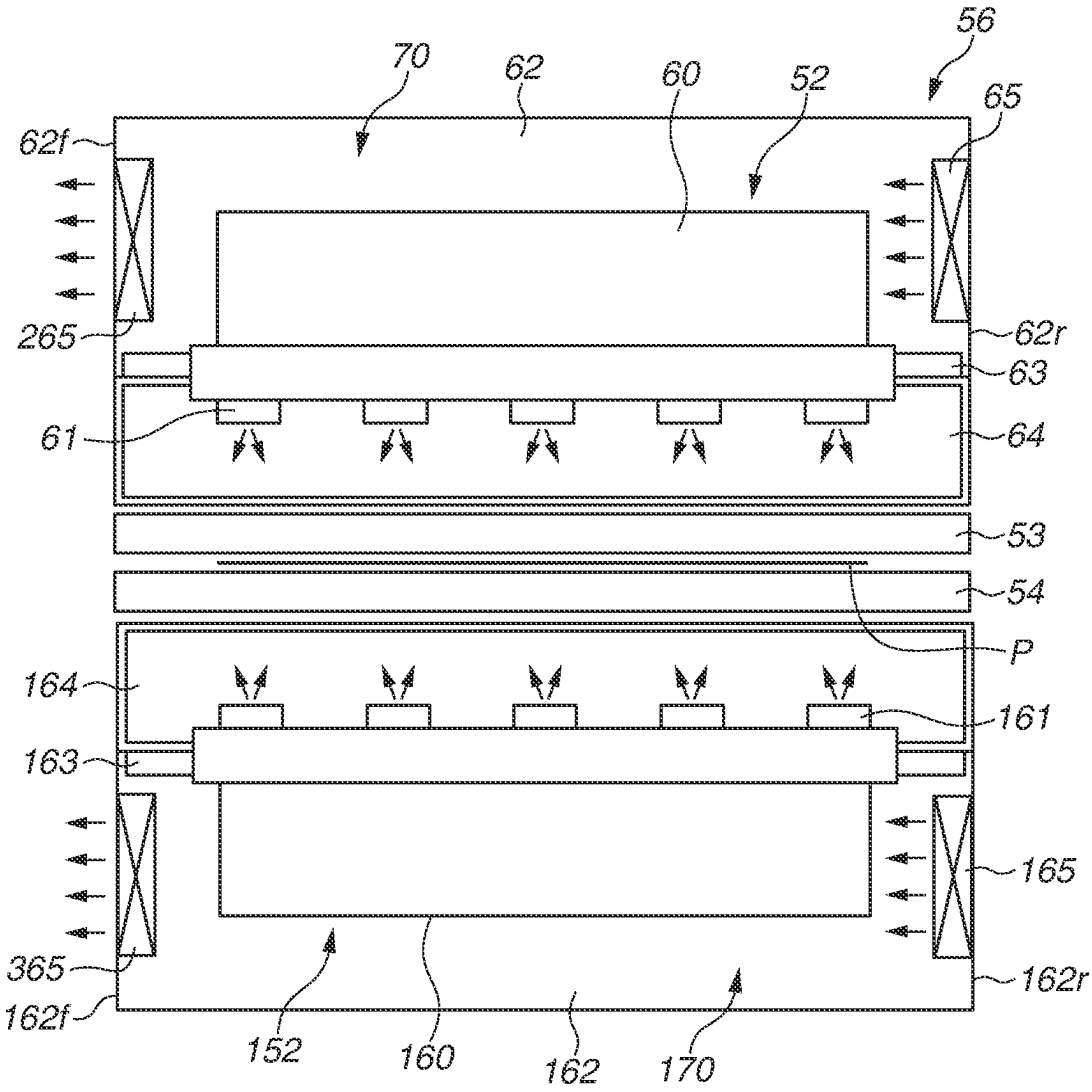


FIG.7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54
P
164
161
163
165
365
162r
162f
152
160
162
170

CHARGE ELIMINATING APPARATUS AND IMAGE FORMING SYSTEM

BACKGROUND

Field of the Disclosure

The present disclosure relates to a charge eliminating apparatus for charge eliminating a sheet with an image formed thereon by an image forming apparatus.

Description of the Related Art

In an image forming system, a sheet electrostatically adsorbed to a sheet guide may cause a conveyance failure, or electrostatic force generated between sheets may cause a stacking failure of sheets when the sheet is discharged out of an apparatus.

To avoid such an issue, there has been proposed a charge eliminating apparatus as discussed in Japanese Patent Application Laid-Open No. 2019-167169. The charge eliminating apparatus disclosed in Japanese Patent Application Laid-Open No. 2019-167169 includes two types of charge eliminating devices, such as a contact charge eliminating device in contact with a conveyed sheet and a non-contact charge eliminating device disposed downstream of the contact charge eliminating device in the conveyance direction.

However, a non-contact charge eliminating device may possibly be subjected to an operation failure due to the temperature rise of the non-contact charge eliminating device.

SUMMARY

According to an aspect of the present disclosure, a charge eliminating apparatus includes a conveyance path configured to convey a sheet with an image formed thereon by an image forming apparatus, a non-contact charge eliminating device having an ion generation unit configured to generate ions and a control unit configured to control the ion generation unit, the non-contact charge eliminating device being configured to remove charges from the sheet conveyed in the conveyance path in a non-contact state, a surrounding member configured to surround the control unit, a separating portion configured to separate a first space where the control unit is surrounded by the surrounding member and a second space where the ion generation unit is disposed, and a fan configured to generate an air flow in the first space.

Further features of various embodiments of the present disclosure will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** schematically illustrates an image forming apparatus.

FIG. **2** schematically illustrates a charge eliminating apparatus.

FIGS. **3**A and **3**B schematically illustrate a conveyance guide.

FIG. **4** schematically illustrates a non-contact charge eliminating unit viewed from a sheet conveyance direction.

FIG. **5** schematically illustrates the non-contact charge eliminating unit viewed from a direction perpendicular to the sheet conveyance direction.

FIG. **6** schematically illustrates an image forming system.

FIG. **7** illustrates a modification.

DESCRIPTION OF THE EMBODIMENTS

An exemplary embodiment of the present disclosure will be described below with reference to the accompanying drawings. Dimensions, materials, shapes, relative arrangements, and the like of components described in the following embodiments are not intended to limit the scope of the present technology only thereto unless otherwise specified.

Image Forming System

FIG. **6** illustrates an overall hardware configuration of an image forming system **1000** according to the present exemplary embodiment. The image forming system **1000** includes an image forming apparatus **100**, an inserter **200**, a charge eliminating apparatus **57**, and a large-capacity stacker **400**. The image forming apparatus **100** forms an image on a sheet based on an instruction from an external apparatus. The inserter **200** conveys the sheet conveyed from the image forming apparatus **100** to the charge eliminating apparatus **57**. The inserter **200** also feeds a sheet inserted from a feed tray **201** and inserts the sheet between a plurality of sheets conveyed from the image forming apparatus **100**.

The charge eliminating apparatus **57** discharges the sheet conveyed from the image forming apparatus **100** via the inserter **200**. The large-capacity stacker **400** stacks a large amount of sheets conveyed from the charge eliminating apparatus **57**. The sheet conveyed from the image forming apparatus **100** through the inserter **200** and the charge eliminating apparatus **57** is discharged to a discharge tray **401** of the large-capacity stacker **400**.

Although the image forming system **1000** according to the present exemplary embodiment includes the image forming apparatus **100**, the inserter **200**, the charge eliminating apparatus **57**, and the large-capacity stacker **400**, the configuration of the image forming system **1000** is not limited thereto. For example, the image forming system **1000** may include another finisher downstream of the large-capacity stacker **400**. In the image forming system **1000**, the charge eliminating apparatus **57** may be directly connected with the image forming apparatus **100**, and the inserter **200** or the large-capacity stacker **400** may not be provided. In the image forming system **1000**, the charge eliminating apparatus **57** may be integrally provided in a housing **110** (FIG. **1**) of the image forming apparatus **100**.

Image Forming Apparatus

FIG. **1** is a cross-sectional view schematically illustrating the image forming apparatus **100**. The image forming apparatus **100** according to the present exemplary embodiment is a tandem type multifunction peripheral (having functions of a copying machine, a printer, and a facsimile apparatus) employing an intermediate transfer method. For example, the image forming apparatus **100** can form a full-color image on a sheet P (e.g., transfer material, sheet material, recording medium, and other media), such as paper, by using an electrophotographic method according to an image signal transmitted from an external apparatus.

The image forming apparatus **100** includes a plurality of image forming units (stations), i.e., four different image forming units **10**Y, **10**M, **10**C, and **10**K for forming a yellow (Y) image, a magenta (M) image, a cyan (C) image, and a black (K) image, respectively. The image forming units **10**Y,

10M, 10C, and 10K are disposed in a row along the moving direction of an image transfer surface on an intermediate transfer belt 7 (described below), which is approximately horizontally disposed. Elements having an identical or corresponding function or configuration in the image forming units 10Y, 10M, 10C, and 10K may be comprehensively described below. In this case, trailing letters "Y", "M", "C", and "K" of reference numerals indicating respective colors may be omitted. The image forming unit 10 includes photosensitive drums 1 (1Y, 1M, 1C, and 1K), charging devices 2 (2Y, 2M, 2C, and 2K), exposure devices 3 (3Y, 3M, 3C, and 3K), developing devices 4 (4Y, 4M, 4C, and 4K), primary transfer rollers 5 (5Y, 5M, 5C, and 5K), and cleaning devices 6 (6Y, 6M, 6C, and 6K).

The photosensitive drum 1 for carrying a toner image is rotatably driven in the direction of the arrow R1 in FIG. 1 (counterclockwise direction) by a driving force transmitted from a drum drive motor (not illustrated). The surface of the rotating photosensitive drum 1 is uniformly charged to a predetermined potential having a predetermined polarity (negative polarity according to the present exemplary embodiment) by the charging device 2 (charging unit). In the charge process, the charging device 2 is applied with a predetermined charge voltage by a charging power source (not illustrated). The surface of the charged photosensitive drum 1 is subjected to scanning exposure by the exposure device 3 (exposure unit) according to an image signal, and an electrostatic latent image is formed on the photosensitive drum 1. According to the present exemplary embodiment, the exposure device 3 includes a laser scanner device for irradiating the photosensitive drum 1 with a laser beam modulated according to image information. An electrostatic image formed on the photosensitive drum 1 is supplied with toner (developer) to be developed by the developing device 4 (developing unit), and a toner image is formed on the photosensitive drum 1. According to the present exemplary embodiment, toner charged to the same polarity as the charging polarity of the photosensitive drum 1 adheres to exposure portions on the photosensitive drum 1 which have been uniformly charged and then exposed to provide low absolute potential values. The developing device 4 includes a developing roller serving as a rotatable developer carrier for conveying the developer to the developing position facing the photosensitive drum 1. The developing roller is rotatably driven by a driving force transmitted from, for example, the drive system of the photosensitive drum 1. In the development process, the developing roller is applied with a predetermined developing voltage by a developing power source (not illustrated).

The intermediate transfer belt 7, a rotatable intermediate transfer member formed of an endless belt, is disposed to face the four photosensitive drums 1Y, 1M, 1C, and 1K. The intermediate transfer belt 7 functions as a second image carrier for carrying a toner image. The intermediate transfer belt 7 is wound around a plurality of support rollers and stretched with a predetermined tension. The plurality of support rollers includes a drive roller 22, an upstream auxiliary roller 23*a*, a downstream auxiliary roller 23*b*, a tension roller 25, a secondary pre-transfer roller 24, and an inner roller 21. The drive roller 22 transmits a driving force to the intermediate transfer belt 7. The tension roller 25 applies a predetermined tension to the intermediate transfer belt 7 to maintain a constant tension of the intermediate transfer belt 7. The secondary pre-transfer roller 24 forms the surface of the intermediate transfer belt 7 in the vicinity of the upstream of a secondary transfer nip N2 in the rotational direction of the intermediate transfer belt 7. The inner roller 21 functions as a counter member of an outer roller 9. The upstream auxiliary roller 23*a* and the downstream auxiliary roller 23*b* form the image transfer surface, which is substantially horizontally disposed. The drive roller 22 is rotatably driven by a driving force transmitted from a belt drive motor (not illustrated). The intermediate transfer belt 7 is thereby driven by the drive roller 22 to rotate in the direction of the arrow R2 in FIG. 1 (clockwise rotation). According to the present exemplary embodiment, the intermediate transfer belt 7 is rotatably driven with a circumferential speed of 150 to 470 mm/sec. The plurality of support rollers other than the drive roller 22 are driven to rotate according to the rotation of the intermediate transfer belt 7. The inner circumferential surface of the intermediate transfer belt 7 is provided with the primary transfer rollers 5Y, 5M, 5C, and 5K that correspond to the photosensitive drums 1Y, 1M, 1C, and 1K, respectively. The primary transfer rollers 5Y, 5M, 5C, and 5K are roller-shaped primary transfer members as primary transfer units. The primary transfer roller 5 presses the intermediate transfer belt 7 toward the photosensitive drum 1 to form a primary transfer nip N1 (N1Y, N1M, N1C, and N1K) (primary transfer portion) as a contact point between the photosensitive drum 1 and the intermediate transfer belt 7. The inner circumferential surface of the intermediate transfer belt 7 is provided with a pressing member 26 upstream of the inner roller 21 and downstream of the secondary pre-transfer roller 24 in the rotational direction of the intermediate transfer belt 7. The pressing member 26 comes into contact with the inner circumferential surface of the intermediate transfer belt 7 to press the intermediate transfer belt 7 from the inner circumferential surface to the outer circumferential surface.

The toner image formed on the photosensitive drum 1 in this way is primarily transferred onto the rotating intermediate transfer belt 7 at the primary transfer nip N1 by the action of the primary transfer roller 5.

In the primary transfer process, the primary transfer roller 5 is applied with a primary transfer voltage (direct-current (DC) voltage) by a primary transfer power source (not illustrated). This voltage has the polarity (positive polarity according to the present exemplary embodiment) opposite to the normal charging polarity of the toner. In the full-color image forming process, for example, a yellow toner image, a magenta toner image, a cyan toner image, and a black toner image formed on the photosensitive drums 1 are primarily transferred sequentially onto the intermediate transfer belt 7 so that these images are superimposed in the same image forming region. According to the present exemplary embodiment, the primary transfer nip N1 is located at the image forming position where a toner image is formed on the intermediate transfer belt 7. The intermediate transfer belt 7 is an example of a rotatable endless belt for conveying the toner image carried at the image forming position.

The outer circumferential surface of the intermediate transfer belt 7 is provided with the outer roller 9 (secondary transfer unit) at the position facing the inner roller 21. The outer roller 9 is pressed toward the inner roller 21 via the intermediate transfer belt 7 to form a secondary transfer nip N2 (secondary transfer portion) as a contact point between the intermediate transfer belt 7 and the outer roller 9. At the secondary transfer nip N2, the toner image formed on the intermediate transfer belt 7 in this way is secondarily transferred onto the sheet P by the action of the outer roller 9. The sheet P is conveyed while being pinched by the intermediate transfer belt 7 and the outer roller 9. In the secondary transfer process, the outer roller 9 is applied with a secondary transfer voltage (DC voltage) by a secondary

transfer power source **18**. This voltage is subjected to constant-voltage control and has the polarity (positive polarity according to the present exemplary embodiment) opposite to the normal charging polarity of the toner. According to the present exemplary embodiment, for example, when a secondary transfer voltage of +1 to +7 kV is applied to the outer roller **9**, a secondary transfer current of +40 to +120 μA is applied thereto. The toner image on the intermediate transfer belt **7** is thereby secondarily transferred onto the sheet P. According to the present exemplary embodiment, the inner roller **21** is electrically grounded (connected to ground).

The inner roller **21** may also be used as a secondary transfer member. In this case, the inner roller **21** is applied with the secondary transfer voltage having the same polarity as the normal charging polarity of the toner, and the outer roller **9** may be electrically grounded to be used as an opposed electrode.

The sheet P is conveyed to the secondary transfer nip N**2** in synchronization with the toner image on the intermediate transfer belt **7**. More specifically, the sheet P stored in a recording material cassette **11** as a recording material storage unit is conveyed to a registration roller pair **8** by a feed roller and then temporarily stopped. The registration roller pair **8** is then rotatably driven to feed the sheet P to the secondary transfer nip N**2** so that the toner image on the intermediate transfer belt **7** coincides with the desired image forming region on the sheet P. A conveyance guide **14** for guiding the sheet P to the secondary transfer nip N**2** is provided downstream of the registration roller pair **8** and upstream of the secondary transfer nip N**2** in the sheet P conveyance direction.

The sheet P with a toner image transferred thereon is conveyed to a fixing device **40** (fixing unit) by a pre-fixing conveyance unit **41**. In the process of conveying the sheet P carrying the non-fixed image while pinching the sheet P with a fixing rotary member pair, the fixing device **40** heats and pressurizes the sheet P (melting and bonding process) to fix the toner image onto the surface of the sheet P. Thereafter, the sheet P with the toner image fixed thereon is conveyed to the inserter **200** by an outlet roller pair **42**.

Meanwhile, the toner remaining on the photosensitive drum **1** after the primary transfer process is removed from the photosensitive drum **1** and collected by a cleaning device **6** (cleaning unit). Residual toner on the intermediate transfer belt **7** and paper dust and other substances adhering thereto from the sheet P after the secondary transfer process are removed from the intermediate transfer belt **7** and collected by a belt cleaning device **12** (intermediate transfer member cleaning unit). According to the present exemplary embodiment, the belt cleaning device **12** electrostatically collects the adhering substances, such as secondary transfer residual toner, on the intermediate transfer belt **7** to clean the intermediate transfer belt **7**.

According to the present exemplary embodiment, the intermediate transfer belt **7** (which is stretched by the plurality of support rollers), the primary transfer rollers **5**, the belt cleaning device **12**, and frames for supporting these parts form an intermediate transfer belt unit **20** as a belt conveyance unit. The intermediate transfer belt unit **20** is supported to be attachable to and detachable from the housing **110** of the image forming apparatus **100** for maintenance or parts replacement. The intermediate transfer belt **7** may be formed of a single- or multi-layer structure made of a resin material, or a multi-layer structure having elastic layers made of an elastic material.

According to the present exemplary embodiment, the primary transfer roller **5** is formed of a metallic core and an elastic layer made of ion conductive foam rubber wrapped around the metallic core. According to the present exemplary embodiment, the primary transfer roller **5** has an outer diameter of 15 to 20 mm and an electrical resistance of 1×10^5 to $1\times10^8\Omega$ measured when applied with a 2 kV voltage in an environment with 23° C. and 50% RH.

According to the present exemplary embodiment, the outer roller **9** is formed of a metallic core and an elastic layer made of ion conductive foam rubber wrapped around the metallic core. According to the present exemplary embodiment, the outer roller **9** has an outer diameter of 20 to 25 mm and an electrical resistance of 1×10^5 to $1\times10^8\Omega$ measured when applied with a 2 kV voltage in an environment with 23° C. and 50% RH. The outer roller **9** comes into contact with the inner roller **21** across the intermediate transfer belt **7** with a predetermined pressure to form the secondary transfer nip N**2**.

According to the present exemplary embodiment, the inner roller **21** is formed of a metallic core and an elastic layer made of electronic conductive rubber wrapped around the metallic core. According to the present exemplary embodiment, the inner roller **21** has an outer diameter of 20 to 22 mm and an electrical resistance of 1×10^5 to $1\times10^8\Omega$ measured when applied with a 50 V voltage in an environment with 23° C. and 50% RH. The secondary pre-transfer roller **24** can be configured, for example, in a similar way to the inner roller **21**. According to the present exemplary embodiment, the rotation axis directions of the support rollers of the intermediate transfer belt **7** including the inner roller **21** and the rotation axis direction of the outer roller **9** are approximately parallel to each other.

Overview of Charge Eliminating Apparatus

The charge eliminating apparatus **57** according to the present exemplary embodiment will now be described with reference to FIG. **2**. FIG. **2** is a cross-sectional view schematically illustrating the charge eliminating apparatus **57**. In the image forming system **1000**, the charge eliminating apparatus **57** is disposed downstream of the image forming apparatus **100** and the inserter **200**. The sheet P may be charged in the above-described image forming process of the image forming apparatus **100**. In such a case, a plurality of sheets P discharged to the discharge tray **401** sticks to each other by static electricity, possibly resulting in a stacking failure. According to the present exemplary embodiment, the charge eliminating apparatus **57** is therefore configured to remove charges from the sheet P with an image formed thereon by using the image forming apparatus **100**.

The charge eliminating apparatus **57** includes, inside a housing **157**, a charge eliminating roller pair **50** (contact charge eliminating device) for removing electric charges from the sheet P while in contact with the sheet P, and a non-contact charge eliminating unit **56** for removing electric charges from the sheet P without being in contact with the sheet P. The charge eliminating apparatus **57** also includes an inlet roller pair **43** for receiving the sheet P from the inserter **200** and conveying the sheet P along a conveyance path T, and an outlet roller pair **44** for discharging the sheet P subjected to the charge elimination by using the charge eliminating roller pair **50** and the non-contact charge eliminating unit **56**, to a large-capacity stacker **400**. The inlet

roller pair **43** and the outlet roller pair **44** are examples of the conveyance units according to the present exemplary embodiment.

The charge eliminating roller pair **50** includes a charge eliminating roller **71** rotating while in contact with the lower surface of the sheet P, and a charge eliminating counter roller **72** rotating while in contact with the upper surface of the sheet P. The charge eliminating counter roller **72** is an example of a first charge eliminating roller, and the charge eliminating roller **71** is an example of a second charge eliminating roller. The charge eliminating roller **71** is formed of a metallic core and an elastic layer made of ion conductive foam rubber wrapped around the metallic core. According to the present exemplary embodiment, the charge eliminating roller **71** has an outer diameter of 20 to 25 mm and an electrical resistance of 1×10 to $1\times10^{8}\Omega$ measured when applied with a 2 kV voltage in an environment with 23° C. and 50% RH. The charge eliminating roller **71** is a similar member to the above-described outer roller **9**. The charge eliminating counter roller **72** having an outer diameter of 20 to 25 mm forms a charge eliminating nip portion with the charge eliminating roller **71**. The sheet P conveyed from the image forming apparatus **100** is initially subjected to coarse charge eliminating at the charge eliminating nip portion N**3** formed by the charge eliminating roller pair **50**. The charge eliminating roller **71** is applied with a charge eliminating voltage (DC voltage) by a charge eliminating power source **55** as a charge eliminating high-voltage application unit. This voltage is subjected to constant-voltage control and has the polarity (negative polarity according to the present exemplary embodiment) opposite to the polarity of the secondary transfer member (outer roller **9**). The sheet P having passed through the charge eliminating roller pair **50** is then subjected to charge elimination that is performed by the non-contact charge eliminating unit **56** disposed downstream of the charge eliminating roller pair **50**. The non-contact charge eliminating unit **56** removes electric charges on the sheet P which have not been removed by charge elimination performed by the charge eliminating roller pair **50**. The non-contact charge eliminating unit **56** includes a first ionizer **52** (non-contact charge eliminating device) disposed above the conveyed sheet P and includes a second ionizer **152** disposed below the sheet P. The non-contact charge eliminating unit **56** further includes a first conveyance guide **53** and a second conveyance guide **54** disposed below the first conveyance guide **53**. The non-contact charge eliminating unit **56** further includes surrounding members **62** and **162** (described below, see FIGS. **4** and **5**), sealing members **63** and **163** as separating portions, resin sheets **64** and **164**, a first fan **65**, and a second fan **165**. Also, the non-contact charge eliminating unit **56** may include the first conveyance guide **53**, the second conveyance guide **54**, the first ionizer **52** disposed above the sheet P, the surrounding member **62**, the sealing member **63**, the resin sheet **64**, and the first fan **65**. Likewise, the non-contact charge eliminating unit **56** may include the first conveyance guide **53**, the second conveyance guide **54**, the second ionizer **152** disposed below the sheet P, the surrounding member **162**, the sealing member **163**, the resin sheet **164**, and the second fan **165**.

FIG. **3**A is a top view illustrating the first conveyance guide **53**. FIG. **3**B is a perspective view illustrating the first conveyance guide **53** and the second conveyance guide **54**. The first conveyance guide **53** is provided with an opening **82** so that the ions generated by ion generation units **61** (electrode needles) of the first ionizer **52** can reach the conveyed sheet without being physically blocked. Like the first conveyance guide **53**, the second conveyance guide **54** is provided with an opening **83** so that the ions generated by ion generation units **161** (electrode needles) of the second ionizer **152** can reach the conveyed sheet without being physically blocked.

The sheet conveyed by the image forming apparatus **100** is subjected to coarse charge eliminating by the charge eliminating roller pair **50**. As described above, the high voltage applied to the charge eliminating roller **71** by the charge eliminating power source **55** has the polarity opposite to the polarity of the voltage applied to the outer roller **9**. The non-contact charge eliminating unit **56** disposed on the downstream side then removes, from the sheet P, electric charges not having been removed at the charge eliminating nip portion, and the sheet P is discharged out of the charge eliminating apparatus **57**. Although the positional relation between the charge eliminating roller pair **50** and the first conveyance guide **53** and the second conveyance guide **54** is close in the example, the distances between these components are not prescribed.

Cooling Configuration of First Ionizer and Second Ionizer

FIGS. **4** and **5** illustrate the non-contact charge eliminating unit **56** in detail. FIG. **4** illustrates the non-contact charge eliminating unit **56** viewed from the sheet conveyance direction D. FIG. **5** illustrates the non-contact charge eliminating unit **56** viewed from a direction perpendicular to the sheet conveyance direction D. The first ionizer **52** is disposed above the first conveyance guide **53**, and the second ionizer **152** is disposed below the second conveyance guide **54**.

The first ionizer **52** includes an ionizer control unit **60** and ion generation units (ion irradiation units) **61** for generating ions. The first ionizer **52** generates ions when the ion generation units **61** as electrode needles are applied with a high voltage. The ionizer control unit **60** includes a substrate for controlling the ion generation units **61** and a housing for supporting the substrate. The length of the first ionizer **52** in the sheet widthwise direction (front-rear direction of the charge eliminating apparatus **57**) perpendicular to the sheet conveyance direction D is larger than the length of the first ionizer **52** in the sheet conveyance direction D. At the lower part of the first ionizer **52**, a plurality of the ion generation units **61** is disposed in line in the sheet widthwise direction, as illustrated in FIG. **4**. Alternatively, the ion generation unit **61** may be a single member.

The surrounding member **62** that surrounds the first ionizer **52** is disposed in the housing **157** of the charge eliminating apparatus **57** (see FIG. **2**). As illustrated in FIG. **5**, the surrounding member **62** includes a first side portion **62***a* facing one side surface of the first ionizer **52** and includes a second side portion **62***b* facing the other side surface of the first ionizer **52**. The surrounding member **62** connects the first side portion **62***a* and the second side portion **62***b* and includes an upper portion **62***c* disposed above the first ionizer **52**. The surrounding member **62** includes a vertically extending first wall **62***h* that is disposed vertically closer to the first conveyance guide **53** than the first side portion **62***a* is and that is upstream of the ion generation units **61** in the conveyance direction D. The surrounding member **62** includes a first connecting portion **62***s* for connecting the first wall **62***h* and the first side portion **62***a*. The surrounding member **62** includes a vertically extending second wall **62***k* that is disposed vertically closer to the first conveyance guide **53** than the second side portion

62*b* is and that is downstream of the ion generation units **61** in the conveyance direction D. The surrounding member **62** includes a second connecting portion **62***j* for connecting the second wall **62***k* and the second side portion **62***b*.

As illustrated in FIG. **4**, the surrounding member **62** includes a back wall **62***r* disposed more on one side (back side of the charge eliminating apparatus **57**) than the first ionizer **52** is in the sheet widthwise direction. The back wall **62***r* is provided with a first fan **65** for sending air toward the ionizer control unit **60** for the first ionizer **52**. The surrounding member **62** further includes a front wall **62***f* disposed more on the other side (front side of the charge eliminating apparatus **57**) than the first ionizer **52** is in the sheet widthwise direction. Air passing openings are formed on the front wall **62***f*.

The first fan **65** is configured to introduce fresh air to make an air flow along the sheet widthwise direction (longitudinal direction of the first ionizer **52**) in the space where the ionizer control unit **60** is disposed. Air sent from the first fan **65** and having passed through the ionizer control unit **60** passes through the openings on the front wall **62***f*.

As illustrated in FIG. **5**, one end of the sealing member **63** as a resin insulator is stuck on the first connecting portion **62***s* of the surrounding member **62**. The sealing member **63** is a flexible or elastically deformable resin sheet. The sealing member **63** is provided so that the bent other end comes into contact with the first ionizer **52**, in a deformed state. The sealing member **63** with one end in contact with the first ionizer **52** is also stuck on the second connecting portion **62***j*.

The sealing member **63**, and the upper portion **62***c*, the first side portion **62***a*, and the second side portion **62***b* of the surrounding member **62** regulate an air passing space (first space) **70** through which the air from the fan **65** for cooling the ionizer control unit **60** passes. The ionizer control unit **60** as a part of the first ionizer **52** is disposed in the air passing space **70**. The ionizer control unit **60** is thus cooled by the air flow generated by the first fan **65**, in the air passing space **70**.

The sealing member **63** as a separating portion spatially separates the ion generation units **61** and the air passing space **70** to prevent the air flowing in the air passing space **70** from drifting toward the ion generation units **61**.

The resin sheets **64** are stuck on the inner surfaces of the first wall **62***h* and the second wall **62***k*. The resin sheet **64** is an example of a regulation member for regulating the space for connecting the ion generation units **61** and the conveyance path T (hereinafter this space is referred to as an ion passing space). The ions generated by the ion generation units **61** are radiated onto the sheet having passed through the ion passing space and then passing through the conveyance path T.

The lower side of the surrounding member **62** is open to allow the ion generation units **61** and the first conveyance guide **53** to communicate with each other. The ion generation units **61** and the conveyance path T communicate with each other via the opening **82** of the first conveyance guide **53**.

The second ionizer **152** has the same configuration as the first ionizer **52**. In other words, the second ionizer **152** includes an ionizer control unit **160** and ion generation units (ion irradiation units) **161**. The second ionizer **152** generates ions by applying a high voltage to the ion generation units **161** as electrode needles. The length of the second ionizer **152** in the sheet widthwise direction (front-rear direction of the charge eliminating apparatus **57**) perpendicular to the conveyance direction D is larger than the length of the second ionizer **152** in the sheet conveyance direction D. A plurality of the ion generation units **161** is disposed in line in the sheet widthwise direction at the upper part of the second ionizer **152**, as illustrated in FIG. **4**. Alternatively, the ion generation unit **161** may be a single member.

The second ionizer **152** is surrounded by the surrounding member **162** having the same configuration as the surrounding member **62** for the first ionizer **52**. More specifically, the surrounding member **162** that surrounds the second ionizer **152** is disposed in the housing of the charge eliminating apparatus **57**. The surrounding member **162** includes a first side portion **162***a* facing one side of the second ionizer **152** and includes a second side portion **162***b* facing the other side of the second ionizer **152**. The surrounding member **162** connects the first side portion **162***a* and the second side portion **162***b* and includes a lower portion **162***c* positioned below the second ionizer **152**.

The surrounding member **162** further includes a vertically extending first wall **162***h* that is disposed vertically closer to the second conveyance guide **54** than the first side portion **162***a* is and that is upstream of the ion generation units **161** in the conveyance direction D. The surrounding member **162** includes the first connecting portion **162***s* for connecting the first wall **162***h* and the first side portion **162***a*. The surrounding member **162** includes a vertically extending second wall **162***k* that is disposed vertically closer to the second conveyance guide **54** than the second side portion **162***b* is and that is downstream of the ion generation units **161** in the conveyance direction D. The surrounding member **162** includes a second connecting portion **162***j* for connecting the second wall **162***k* and the second side portion **162***b*.

As illustrated in FIG. **4**, the surrounding member **162** includes a back wall **162***r* disposed more on one side (back side of the charge eliminating apparatus **57**) than the second ionizer **152** is in the sheet widthwise direction. The back wall **162***r* is provided with the second fan **165** for sending air toward the ionizer control unit **160** for the second ionizer **152**. The surrounding member **162** includes a front wall **162***f* disposed more on the other side (front side of the charge eliminating apparatus **57**) than the second ionizer **152** is in the sheet widthwise direction. On the front wall **162***f*, air passing openings are formed. The second fan **165** is configured to introduce fresh air to make an air flow in the sheet widthwise direction along the ionizer control unit **160**. Air sent from the second fan **165** and having passed through the ionizer control unit **160** passes through the openings on the front wall **162***f*.

As illustrated in FIG. **5**, one end of the sealing member **163** as a resin insulator is stuck on the first connecting portion **162***s* of the surrounding member **162**. The sealing member **163** is disposed so that the bent other end comes into contact with the second ionizer **152**. The sealing member **163** with one end in contact with the second ionizer **152** is also stuck on the second connecting portion **162***j*.

The sealing member **163**, and the lower portion **162***c*, the first side portion **162***a*, and the second side portion **162***b* of the surrounding member **162** regulate an air passing space **170** through which the air from the second fan **165** for cooling the ionizer control unit **160** passes.

The sealing member **163** as a separating portion spatially separates the ion generation units **161** and the air passing space **170** to prevent the air flowing in the air passing space **170** from drifting toward the ion generation units **161**. The sealing member **163** as a flexible resin sheet is disposed to come into contact with the second ionizer **152**.

The resin sheets **164** are stuck on the inner surfaces of the first wall **162***h* and the second wall **162***k*. The resin sheets **164** disposed on the first wall **162***h* and the second wall **162***k*

form regulation members for regulating the ion passing space for connecting the ion generation units **161** and the conveyance path T.

The upper side of the surrounding member **162** is open to allow the ion generation units **161** and the second conveyance guide **54** to communicate with each other. The ion generation units **161** and the conveyance path T communicate with each other via the opening **83** of the second conveyance guide **54**.

The ionizer control units **60** and **160** adjust the voltage according to a set charge eliminating amount to control electric charges to be generated by the ion generation units **61** and **161**. These units need to be maintained at a predetermined temperature or lower to operate normally. The ionizers **52** and **152** according to the present exemplary embodiment need to be maintained at a temperature lower than 40° C.

In the charge eliminating apparatus **57**, a sheet P heated by the fixing device **40** is continually conveyed.

The temperature inside the charge eliminating apparatus **57** may therefore rise by the sheet P and exceed the operating temperature ranges of the ionizer control units **60** and **160** depending on the operation environment (ambient temperature). Thus, the ionizer control units **60** and **160** need to be cooled to ensure the normal operation.

According to the present exemplary embodiment, the first fan **65** thus sends fresh air toward the ionizer control unit **60** to cool the ionizer control unit **60**, and the second fan **165** sends fresh air toward the ionizer control unit **160** to cool the ionizer control unit **160**.

If the fans **65** and **165** send air toward the ionizers **52** and **152**, respectively, the following concern may arise. More specifically, if fresh air from the fan **65** or **165** flows in the space between the ion generation unit **61** or **161** and the sheet P in the conveyance path T, the ions generated by the ion generation unit **61** or **161** are assumed to drift because of the air flow from the fan **65** or **165**, respectively. In this case, there is a concern that the ions may not reach the sheet, preventing the suitable sheet charge elimination.

According to the present exemplary embodiment, the sealing member **63** spatially separates the ion generation units **61** and the ionizer control unit **60**, and the sealing member **163** spatially separates the ion generation units **161** and the ionizer control unit **160**. More specifically, the air passing space **70**, through which the air from the first fan **65** passes, and the ion generation units **61** are separated by the sealing member **63**. Even in a state where the ionizer control unit **60** is cooled by the air flowing through the air passing space **70**, the sealing member **63** can prevent the air flow of the fan **65** from adversely affecting the sheet charge elimination by the first ionizer **52**. More specifically, the sealing member **63** enables preventing the air from adversely affecting the ion generation units **61** while ensuring the normal operation of the ionizer control unit **60**. The sealing member **163** in contact with the second ionizer **152** also exhibits functions and effects similar to those of the sealing member **63**.

As described above, one end of each of the sealing members **63** and **163** as flexible resin sheets are stuck on the surrounding members **62** and **162**, and the bent other ends come into contact with the ionizers **52** and **152**, respectively. Even if the positions of the ionizers **52** and **152** relative to the surrounding members **62** and **162** vary, the sealing members **63** and **163** are deformed by the positional variations, ensuring the allocation of the air passing spaces **70** and **170**, respectively.

If a conductor exists in periphery, the ions generated by the ion generation units **61** are absorbed by the conductor and do not reach the sheet P, disturbing suitable sheet charge elimination. Since the surrounding member **62** according to the exemplary embodiment is made of a metal, the resin sheets (insulating members) **64** are stuck on the surfaces of the first wall **62***h* and the second wall **62***k*. The sealing member **63** and the conveyance guide **53** are also resin insulators. According to the present exemplary embodiment, members around the ion generation units **61** are thus made of insulators, allowing the ions to reliably reach the sheet P and enabling suitable sheet charge elimination. The above description of the first ionizer **52** also applies to the periphery of the ion generation units **161** of the second ionizer **152**.

The above-described exemplary embodiment is configured to prevent the conductor from being exposed by sticking the resin sheets **64** as insulators on the surrounding member **62** as a conductor. Alternatively, the first wall **62***h* and the second wall **62***k* in the surrounding member **62** may also be made of insulating members.

The configurations, functions, and effects of the above-described exemplary embodiment will be summarized below.

(1) The first fan **65** sends air to the first ionizer **52**. This prevents the temperature rise of the first ionizer **52** and also prevents malfunctions due to the temperature rise of the first ionizer **52**. In particular, when a high-temperature sheet having been subjected to the processing of the fixing device **40** passes through the charge eliminating apparatus **57**, the sheet may cause the temperature rise of the first ionizer **52**. If the first ionizer **52** is disposed in the housing of the charge eliminating apparatus **57**, the temperature rise may possibly occur in the first ionizer **52**. According to the present exemplary embodiment, the air from the first fan **65** enables maintaining the first ionizer **52** to the temperature, or lower, at which the first ionizer **52** can stably operate.

(2) The sealing member **63** for preventing the air from the first fan **65** from flowing toward the ion generation units **61** of the first ionizer **52** is disposed as a regulation member. If the air from the first fan **65** for preventing the temperature rise of the first ionizer **52** flows toward the ion generation units **61**, the ions drift because of the air, possibly degrading the sheet charge eliminating capability. According to the present exemplary embodiment, the sealing member **63** regulates the air flow toward the ion generation units **61**, making it possible to prevent the charge eliminating capability degradation. According to the exemplary embodiment, the sealing member **63** in contact with the first ionizer **52** is an example of a regulation member that can be elastically deformed to effectively limit the air flow toward the ion generation units **61**. However, the regulation member is not limited to the sealing member **63**. For example, the connecting portion **62***j* of the surrounding member **62** may be brought close to the first ionizer **52** for use as a regulation member.

(3) A part of the surrounding member **62** configures a duct through which the air from the first fan **65** passes. This allows the first ionizer **52** to be efficiently cooled by using the first fan **65**.

(4) The first fan **65** and the surrounding member **62** are disposed so that the air from the first fan **65** flows along the longitudinal direction of the first ionizer **52**. This allows the first ionizer **52** to be efficiently cooled by using the first fan **65**.

(5) The sealing member **63** is disposed as a separating portion for separating the air passing space **70** where the air sent by the first fan **65** flows and the ion passing space where

the ion generation units **61** are disposed. This enables preventing the charge eliminating capability degradation due to the air from the first fan **65**. The separating portion is not limited to the elastically deformable sealing member **63**. For example, the connecting portion **62***j* of the surrounding member **62** may be brought close to the first ionizer **52** for use as a separating portion.

(6) The regulation member for regulating the ion passing space for connecting the ion generation units **61** and the conveyance path T for sheet passing is an insulator. Thus, the ions generated by the ion generation units **61** reliably reach the sheet passing through the conveyance path T.

The second ionizer **152** provides functions and effects similar to above (1) to (6) of the first ionizer **52**.

Although, in the above-described exemplary embodiment, the back wall **62***r* of the surrounding member **62** and the back wall of the housing **157** are different walls, the back wall **62***r* of the surrounding member **62** may also serve as the back wall of the housing **157**. Although, in the example, the front wall **62***f* of the surrounding member **62** and the front wall of the housing **157** are different walls, the front wall **62***f* of the surrounding member **62** may also serve as the front wall of the housing **157**. Like the surrounding member **62**, the back wall **162***r* of the surrounding member **162** for the second ionizer **152** may also serve as the back wall of the housing **157**. The front wall **162***f* may also serve as the front wall of the housing **157**.

Although, in the above-described exemplary embodiment, the surrounding member **62** is a single member, the surrounding member **62** may be formed by combining a plurality of members. For example, the member including the first side portion **62***a*, the second side portion **62***b*, and the upper portion **62***c*, the member including the first connecting portion **62***s* and the second connecting portion **62***j*, and the member including the first wall **62***h* and the second wall **62***k* may also be different members. In this case, the member including the first connecting portion **62***s* and second connecting portion **62***j* and the member including the first wall **62***h* and the second wall **62***k* may be insulating members. Like the surrounding member **62**, the surrounding member **162** for the second ionizer **152** may be formed by combining a plurality of members.

In the example, one end of the sealing member **63** is stuck on the first connecting portion **62***s*, and the other end of the sealing member **63** may be in contact with the first ionizer **52**. However, one end of sealing member **63** may be stuck on the first ionizer **52**, and the other end of the sealing member **63** may be in contact with the surrounding member **62**.

Likewise, one end of the sealing member **163** for the second ionizer **152** may be stuck on the second ionizer **152**, and the other end of the sealing member **163** may be in contact with the surrounding member **162**.

In some embodiments, the sealing member **63** preferably seals the entire range in the sheet widthwise direction to prevent air flow toward the ion generation units **61**. However, the sealing member **63** may seal at least the region where the ion generation units **61** are disposed in the sheet widthwise direction.

In the example, the elastically deformable sealing member **63** is used as a separating portion. However, for example, a resin plate may be provided as a separating portion to connect between the first ionizer **52** and the surrounding member **62** (or the surrounding member **162**) and separate the air passing space **70** and the ion passing space where the ion generation units **61** are disposed, in a state where the sealing member **63** is not deformed. Likewise, a resin plate may also be provided as a separating portion instead of the sealing member **163** for the second ionizer **152**.

According to the above-described exemplary embodiment, the first fan **65** disposed as a blower fan on the back wall **62***r* sends air toward the ionizer control unit **60** for the first ionizer **52**. More specifically, the first ionizer **52** is disposed downstream of the first fan **65** in the ventilation direction. Like the modification illustrated in FIG. **7**, a first exhaust fan **265** as another fan may be disposed on the front wall **62***f*, and a second exhaust fan **365** may be disposed on the front wall **162***f*. The first exhaust fan **265** also generates an air flow in the air passing space **70**, like the first fan **65**. The second exhaust fan **365** also generates an air flow in the air passing space **170**, like the second fan **165**.

To prevent the temperature rise of the first ionizer **52**, only the first exhaust fan **265** may be provided without providing the first fan **65**. To prevent the temperature rise of the second ionizer **152**, only the second exhaust fan **365** may be provided without providing the second fan **165**.

Although an electrophotographic image forming apparatus for forming an image on a sheet has been described above, an ink-jet image forming apparatus is also applicable.

The temperature rise in the charge eliminating unit is prevented by fans.

While the present disclosure has described exemplary embodiments, it is to be understood that some embodiments of the disclosure are 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.

This application claims priority to Japanese Patent Application No. 2023-011454, which was filed on Jan. 30, 2023 and which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A charge eliminating apparatus comprising:

a conveyance path configured to convey a sheet with an image formed thereon by an image forming apparatus;

a non-contact charge eliminating device having an ion generation unit configured to generate ions and a control unit configured to control the ion generation unit, the non-contact charge eliminating device being configured to remove charges from the sheet conveyed in the conveyance path in a non-contact state;

a surrounding member configured to surround the control unit;

a separating portion configured to separate a first space where the control unit is surrounded by the surrounding member and a second space where the ion generation unit is disposed; and

a fan configured to generate an air flow in the first space.

2. The charge eliminating apparatus according to claim **1**, wherein the surrounding member surrounds the ion generation unit.

3. The charge eliminating apparatus according to claim **1**, wherein the surrounding member and the separating portion are ducts, and

wherein the fan is disposed so that air sent by the fan flows through the ducts.

4. The charge eliminating apparatus according to claim **3**, further comprising a housing, wherein the non-contact charge eliminating device and the ducts are disposed in the housing.

5. The charge eliminating apparatus according to claim **1**, wherein the charge eliminating apparatus is configured so that air from the fan flows along a longitudinal direction of the non-contact charge eliminating device.

6. The charge eliminating apparatus according to claim 1, wherein the separating portion is an elastically deformable sealing member in contact with the surrounding member and the non-contact charge eliminating device.

7. The charge eliminating apparatus according to claim 6, wherein the sealing member as a sheet member is disposed so that one end of the sealing member is stuck on the surrounding member and the other end comes into contact with the non-contact charge eliminating device.

8. The charge eliminating apparatus according to claim 1, further comprising a regulation member for regulating a space for connecting the ion generation unit and the conveyance path, wherein the regulation member has an insulator.

9. The charge eliminating apparatus according to claim 8, further comprising a conveyance guide configured to form the conveyance path and have openings through which the ions generated by the ion generation unit pass, wherein the regulation member is disposed between the ion generation unit and the conveyance guide in a thickness direction of the conveyed sheet.

10. The charge eliminating apparatus according to claim 1, wherein the fan is a blower fan configured to send air toward the control unit.

11. The charge eliminating apparatus according to claim 10, further comprising another fan configured to generate an air flow in the first space, wherein the control unit is disposed between the blower fan and the another fan.

12. The charge eliminating apparatus according to claim 1, further comprising:

a second non-contact charge eliminating device configured to remove charges from the sheet conveyed in the conveyance path; and

a second fan configured to send air toward the second non-contact charge eliminating device.

13. The charge eliminating apparatus according to claim 1, further comprising a charge eliminating roller pair configured to remove charges from the sheet conveyed in the conveyance path.

14. The charge eliminating apparatus according to claim 1,

wherein the surrounding member has a shape formed of an upper portion, a side portion, and a lower side that is open where the conveyance path is disposed, and

wherein the first space is regulated by the separating portion, the upper portion of the surrounding member, and the side portion of the surrounding member.

15. An image forming system comprising:

an image forming apparatus configured to form an image on a sheet; and

a charge eliminating apparatus configured to remove charges from the sheet with the image formed thereon by the image forming apparatus,

wherein the charge eliminating apparatus includes:

a conveyance path configured to convey the sheet with the image formed thereon by the image forming apparatus,

a non-contact charge eliminating device having an ion generation unit configured to generate ions and a control unit configured to control the ion generation unit, the non-contact charge eliminating device being configured to remove charges from the sheet conveyed in the conveyance path in a non-contact state,

a surrounding member configured to surround the control unit,

a separating portion configured to separate a first space where the control unit is surrounded by the surrounding member and a second space where the ion generation unit is disposed, and

a fan configured to generate an air flow in the first space.

16. The image forming system according to claim 15, wherein the image forming apparatus comprises:

a transfer unit configured to transfer a toner image onto the sheet; and

a fixing unit configured to thermally fix to the sheet the toner image transferred onto the sheet.

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