US Patent & Trademark Office
Patent Public Search | Text View

United States Patent Application Publication	20250264841
Kind Code	A1
Publication Date	August 21, 2025
Inventor(s)	AIHARA; RYO et al.

CHARGE ELIMINATING APPARATUS, IMAGE FORMING APPARATUS, AND CHARGE ADJUSTING APPARATUS

Abstract

A charge eliminating apparatus configured to remove charges from a sheet on which an image is formed by a printing apparatus, includes a charge eliminating roller pair including a first charge eliminating roller and a second charge eliminating roller configured to form a nip portion together with the first charge eliminating roller, the charge eliminating roller pair being configured to remove the charges from the sheet in a state of contacting the sheet at the nip portion, a first setting unit configured to set a value of a voltage applied to the charge eliminating roller pair, and a second setting unit configured to set whether to apply the voltage to the charge eliminating roller pair, wherein the second setting unit is configured to set whether to apply the voltage to the charge eliminating roller pair without changing the value of the voltage set by the first setting unit.

Inventors: **AIHARA; RYO (Chiba, JP), ONO; SHIN (Ibaraki, JP), KAKEHI; YUTAKA (Chiba, JP), CHIYODA; YASUHARU (Chiba, JP), MOGI; KEISUKE (Chiba, JP), IWAMI; SHINGO (Tokyo, JP), TSURUGA; RYOSUKE (Chiba, JP)**

Applicant: **CANON KABUSHIKI KAISHA** (Tokyo, JP)

Family ID: **1000008578136**

Appl. No.: **19/200518**

Filed: **May 06, 2025**

Foreign Application Priority Data

JP	2023-011451	Jan. 30, 2023
JP	2023-197019	Nov. 20, 2023

Related U.S. Application Data

parent US continuation 18424583 20240126 parent-grant-document US 12321123 child US 19200518

Publication Classification

Int. Cl.: **G03G15/00** (20060101); **B65H29/12** (20060101)

U.S. Cl.:

CPC **G03G15/6573** (20130101); **B65H29/125** (20130101); **G03G15/5037** (20130101); B65H2301/5133 (20130101)

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application is a Continuation of co-pending U.S. patent application Ser. No. 18/424,583 filed Jan. 26, 2024, which claims priority benefit of Japanese Application No. 2023-011451, filed Jan. 30, 2023, and No. 2023-197019, filed Nov. 20, 2023, all of which are hereby incorporated by reference herein in their entireties.

BACKGROUND OF THE INVENTION
Field of the Invention
[0002] The present invention relates to a charge eliminating apparatus for removing electric charges from a sheet, and an image forming apparatus including the charge eliminating apparatus, and a charge adjusting apparatus.
Description of the Related Art
[0003] In an image forming apparatus, such as a copying machine, there may be a case where sheets are electrically charged when images are formed thereon, and the discharged sheets stick to each other due to electrostatic force generated between the discharged sheets, which causes an improper stack. In view of the foregoing, Japanese Patent Application Laid-open No. 2019-167169 discusses an image forming apparatus including a charge eliminating apparatus for removing charges (electric charges) from a sheet. The charge eliminating apparatus discussed in Japanese Patent Application Laid-open No. 2019-167169 includes a contact type charge eliminating device (charge eliminating roller) that removes charges by contacting a conveyed sheet, and a non-contact type charge eliminating device that removes charges without contacting the conveyed sheet. Further, Japanese Patent Application Laid-open No. 2022-171206 discusses a charge adjusting apparatus in which a voltage is applied to every other conveyed sheet to electrically charge surfaces of the sheets so that the surfaces have a same polarity to improve the improper stack when the sheets are stacked.
[0004] Since charging characteristics of the sheets are different depending on materials and basis weights thereof, it is desirable that a charge removal voltage be appropriately set depending on a sheet type. Further, depending on the sheet type, some sheets do not need the charge removal with the charge eliminating (charge removal) roller. Accordingly, an operator needs to set an appropriate charge removal voltage every time depending on the type of sheet used for a print job, which raises an issue of a complicate operation when the operator makes settings of the charge eliminating apparatus. Further, similarly, in the charge adjusting apparatus that applies a voltage to every other sheet, since an appropriate voltage has to be set every time depending on the sheet type, there is an issue that an operator has to perform a complicate operation to set the charge adjusting apparatus.
SUMMARY OF THE INVENTION

[0005] The present invention is directed to a charge eliminating apparatus, an image forming apparatus, and a charge adjusting apparatus for improving an operation performed when a setting relating to a sheet electric charge removal or a sheet electric charge adjustment is performed.
[0006] According to an aspect of the present invention, a charge eliminating apparatus configured to remove charges from a sheet on which an image is formed by a printing apparatus, includes a charge eliminating roller pair including a first charge eliminating roller and a second charge eliminating roller configured to form a nip portion together with the first charge eliminating roller, the charge eliminating roller pair being configured to remove the charges from the sheet in a state of contacting the sheet at the nip portion, a first setting unit configured to set a value of a voltage applied to the charge eliminating roller pair, and a second setting unit configured to set whether to apply the voltage to the charge eliminating roller pair, wherein the second setting unit is configured to set whether to apply the voltage to the charge eliminating roller pair without changing the value of the voltage set by the first setting unit.
[0007] According to another aspect of the present invention, a charge adjusting apparatus configured to adjust charges on a sheet on which an image is formed by a printing apparatus, includes a bias application roller pair configured to provide charges opposite in polarity to a surface potential of the sheet on which the image is formed, so that the surface potential of the sheet on which the image is formed is reversed, a first setting unit configured to set a value of a voltage to be applied to the bias application roller pair, and a second setting unit configured to set whether to apply the voltage to the bias application roller pair, wherein the second setting unit is configured to set whether to apply the voltage to the bias application roller pair without changing the value of the voltage set by the first setting unit.
[0008] Further features of the present invention will become apparent from the following description of embodiments with reference to the attached drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0009] FIG. **1** is a diagram illustrating an entire image forming system.
[0010] FIG. **2** is a block diagram illustrating a system configuration of an image forming apparatus.
[0011] FIG. **3** is a cross-section diagram of the image forming apparatus.
[0012] FIG. **4** is a cross-section diagram of a contact type charge eliminating unit.
[0013] FIGS. **5**A and **5**B are cross-section diagrams of a non-contact type charge eliminating unit.
[0014] FIG. **6** is a top view of an operation unit of a charge eliminating apparatus.
[0015] FIG. **7** is a table illustrating relationships respectively between settings of the operation unit and operations performed by the charge eliminating apparatus.
[0016] FIG. **8** is a flowchart illustrating an operation performed by the charge eliminating apparatus.
[0017] FIG. **9** is a top view illustrating a modification example of the operation unit of the charge eliminating apparatus.
[0018] FIG. **10** is a diagram illustrating an example of an operation screen of the charge eliminating apparatus.
[0019] FIG. **11** is a cross-section diagram illustrating an image forming apparatus according to another embodiment.
[0020] FIG. **12** is a cross-section diagram of a charge adjusting unit.
[0021] FIG. **13** is a diagram illustrating a state of stacked sheets according to the other embodiment.
[0022] FIG. **14** is a table illustrating relationships respectively between settings of an operation unit and operations performed by a charge adjusting apparatus according to the other embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0023] Hereinbelow, embodiments of the present disclosure will be described with reference to the attached drawings. Dimensions, materials, shapes of components, and their relative arrangements described in the following embodiments are not intended to limit the range of the present technique to the embodiments unless otherwise specifically described.

<Configuration of Image Forming System>

[0024] FIG. **1** is a diagram illustrating a configuration of an image forming system **100** including an image forming apparatus **101** according to an embodiment. The image forming system **100** includes the image forming apparatus **101** and an external controller **105**. The image forming apparatus **101** and the external controller **105** are communicably connected via an internal local area network (LAN) **108** and a video cable **109**. The external controller **105** is connected to a client personal computer (PC) **106** via an external LAN **107**. The external controller **105** acquires a print instruction (print job) from the client PC **106**.

[0025] A printer driver having a function of converting an image into a page description language processable by the external controller **105** is installed in the client PC **106**. A user can issue an instruction for printing using various kinds of applications via the printer driver. The printer driver transmits a print job including image data to the external controller **105** based on a print instruction from the user. The external controller **105** receives the print job from the client PC **106**, performs data analysis processing and rasterizing processing on the image data included in the print job, and instructs the image forming apparatus **101** to perform printing (image forming) based on the image data.

[0026] The image forming apparatus **101** includes a printing apparatus **102**, a charge eliminating apparatus **103**, and a finisher **104**. The printing apparatus **102** forms an image on a sheet based on an instruction from the external controller **105**. The charge eliminating apparatus **103**, disposed downstream of the printing apparatus **102**, removes charges (electric charges) from the sheet with the image formed thereon by the printing apparatus **102**. The finisher **104**, disposed downstream of the charge eliminating apparatus **103**, stacks, on a stack tray **137**, the sheet with the image formed thereon by the printing apparatus **102**.

[0027] The image forming system **100** has a configuration in which the external controller **105** is connected to the image forming apparatus **101**, but the external controller **105** is not always necessary. For example, the image forming apparatus **101** may be configured to acquire the print job including the image data directly from the client PC **106** via the external LAN **107**. In this case, the image forming apparatus **101** is to perform the data analysis processing and the rasterizing processing performed by the external controller **105**. In other words, the image forming apparatus **101** and the external controller **105** may be integrally configured.

<System Configuration of Image Forming Apparatus>

[0028] FIG. **2** is a block diagram illustrating a system configuration of the image forming apparatus **101**. First, a configuration of the printing apparatus **102** of the image forming apparatus **101** will be described. The printing apparatus **102** includes a communication interface (I/F) **201** to communicate with other apparatuses. The printing apparatus **102** also includes a hard disk drive (HDD) **202**, a central processing unit (CPU) **203**, a memory **204**, and an on-belt-image reading unit **212**, to control operation of the printing apparatus **102**. The printing apparatus **102** also includes a laser exposure unit **207**, an image formation unit **208**, a fixing unit **209**, and a sheet feed unit **210**, to form an image. The printing apparatus **102** also includes an operation unit **205** and a display **206** as user interfaces. These components are communicably connected with each other via a system bus **213**.

[0029] The communication I/F **201** is connected to the charge eliminating apparatus **103** via a communication cable **229** and controls communications between the printing apparatus **102** and the charge eliminating apparatus **103**. In a case where the printing apparatus **102** and the charge eliminating apparatus **103** operate in conjunction with each other, information and data are

transmitted and received via the communication I/F **201**.

[0030] The CPU **203** performs image processing and image forming processing (print control) in a comprehensive manner by executing a computer program stored in the HDD **202**. The memory **204** provides a work area for the CPU **203** to execute various kinds of processing. In a case where the image forming processing is performed, the CPU **203** controls the laser exposure unit **207**, the image formation unit **208**, the fixing unit **209**, and the sheet feed unit **210**.

[0031] The laser exposure unit **207** includes a photosensitive member, a charging wire for charging the photosensitive member, and a light source for exposing the photosensitive member to light to form an electrostatic latent image on the photosensitive member. The photosensitive member is, for example, a photosensitive belt in which a photoconductive layer is formed on a belt-shaped elastic member, or a photosensitive drum in which a photoconductive layer is formed on a surface of a cylinder. Further, instead of the charging wire, a charging roller may be used. The laser exposure unit **207** charges the surface of the photosensitive member to a uniform negative potential by the charging wire. The laser exposure unit **207** emits a laser beam from the light source based on the image data. The laser beam scans the uniformly charged surface of the photosensitive member. In this way, the potential at a position of the photosensitive member irradiated with the laser beam changes, and an electrostatic latent image is formed on the surface thereof. In practice, the printing apparatus **102** includes four photosensitive members corresponding to four colors of yellow (Y), magenta (M), cyan (C), and black (K). Four different electrostatic latent images corresponding to the different colors are formed on the four photosensitive members, respectively.

[0032] The image formation unit **208** transfers a toner image formed on the photosensitive member to a sheet. The image formation unit **208** includes a development unit, a transfer unit, and a toner supply unit. The development unit causes negatively charged toner to be attached from a developing cylinder to the electrostatic latent image formed on the surface of the photosensitive member, to form a toner image. In practice, the printing apparatus **102** includes four development units corresponding to four colors of yellow (Y), magenta (M), cyan (C), and black (K). Each of the development units visualizes the electrostatic latent image on the photosensitive member using a corresponding color. The toner supply unit replenishes the development unit with toner when a toner amount in the development unit runs short due to formation of toner images.

[0033] The transfer unit includes an intermediate transfer belt, and the toner images are transferred from the respective photosensitive members to the intermediate transfer belt. Primary transfer rollers are disposed opposing the respective photosensitive members across the intermediate transfer belt. By a positive potential being applied to each of the primary transfer rollers, the toner images are transferred respectively from the four photosensitive members to the intermediate transfer belt in an overlapped manner. In this way, a full color toner image is formed on the intermediate transfer belt. The toner image formed on the intermediate transfer belt is transferred to a sheet by a secondary transfer roller described below. The secondary transfer roller transfers the full color toner image from the intermediate transfer belt to the sheet by being applied with a positive potential.

[0034] The fixing unit **209** fixes the transferred toner image to the sheet. The fixing unit **209** includes a heater and a roller pair. The fixing unit **209** heats and presses the toner image on the sheet by the heater and the roller pair to melt and fix the toner image to the sheet. In this way, an image is formed on the sheet. The sheet feed unit **210** includes conveyance rollers and various sensors on a conveyance path to control a sheet feeding operation.

[0035] The on-belt-image reading unit **212** reads an image formed on the intermediate transfer belt of the transfer unit based on an instruction from the CPU **203**. For example, when an image formation condition is adjusted, the CPU **203** reads an adjustment image formed on the intermediate transfer belt for adjusting the image formation condition using the on-belt-image reading unit **212**. The operation unit **205** is an input device for receiving an input of various settings or an operation instruction from the user. The operation unit **205** is, for example, various input keys

or a touch panel. The display **206** serving as a display unit is an output device for displaying setting information of the image forming apparatus **101** or a processing status (status information) of the print job.

[0036] Next, a configuration of the charge eliminating apparatus **103** will be described. The charge eliminating apparatus **103** includes a communication I/F **221**, a contact charge eliminating control unit **222**, and a non-contact charge eliminating control unit **223**. These components are connected with each other via a system bus **225**.

[0037] The communication I/F **221** is connected to the printing apparatus **102** via the communication cable **229** and controls communications between the printing apparatus **102** and the charge eliminating apparatus **103**. Further, the communication I/F **221** is connected to the finisher **104** via a communication cable **239** and controls communications between the charge eliminating apparatus **103** and the finisher **104**.

[0038] The contact charge eliminating control unit **222** and the non-contact charge eliminating control unit **223** each perform various kinds of controls based on control instructions received from the CPU **203** via the communication cable **229**. The contact charge eliminating control unit **222** includes a charge eliminating control switching unit **251** and a charge eliminating voltage adjusting unit **252** and controls the charge eliminating voltage of a contact type charge eliminating unit **129** (described below). The charge eliminating control switching unit **251** obtains a state of a mode lever **141** (described below) and switches the contact type charge eliminating unit **129** on and off based on the state of the mode lever **141**. The charge eliminating voltage adjusting unit **252** acquires a setting value set with a dial **142** (described below) and controls a magnitude of voltage (voltage value and high voltage value) to be applied to the contact type charge eliminating unit **129** based on the setting value. The non-contact charge eliminating control unit **223** controls charge eliminating by a non-contact type charge eliminating unit **131** (described below). In the present embodiment, the charge eliminating apparatus **103** operates based on the control instructions from the CPU **203** mounted on the image forming apparatus **101**, but the operation of the charge eliminating apparatus **103** is not limited thereto, and the control instructions may be provided by, for example, a CPU mounted on the charge eliminating apparatus **103**.

[0039] Next, a configuration of the finisher **104** will be described. The finisher **104** includes a communication I/F **231**, a CPU **232**, a memory **233**, and a sheet discharge control unit **234**. These components are connected with each other via a system bus **235**.

[0040] The communication I/F **231** is connected to the charge eliminating apparatus **103** via the communication cable **239** and controls communications between the charge eliminating apparatus **103** and the finisher **104**. The CPU **232** performs various kinds of controls required for discharging the sheet based on a control program stored in the memory **233**. The memory **233** is a storage device storing the control program. The sheet discharge control unit **234** performs control to discharge the conveyed sheet to the stack tray **137** based on an instruction from the CPU **232**.

<Configuration of Image Forming Apparatus>

[0041] FIG. **3** is a cross-section diagram of the image forming apparatus **101**. The display **206** is provided on an upper portion of a housing of the printing apparatus **102**. The display **206** displays information about a printing status and information for settings of the image forming apparatus **101**.

[0042] The printing apparatus **102** includes sheet feed decks **111** and **112**, conveyance paths **113**, **122**, **124**, and **125**, a reversing conveyance path **126**, a two-sided conveyance path **127**, and various rollers. The sheet feed decks **111** and **112**, which are the sheet feed unit **210**, can store different types of sheets. A topmost sheet of the sheets stored in the sheet feed deck **111** or **112** is separated and fed to the conveyance path **113**. The printing apparatus **102** includes, as the laser exposure unit **207**, image forming units **114**, **115**, **116**, and **117** each for forming an image, and forms a color image on the sheet. The image forming unit **114** forms an image (toner image) of black (K). The image forming unit **115** forms an image of cyan (C). The image forming unit **116** forms an image

of magenta (M). The image forming unit **117** forms an image of yellow (Y).
[0043] The printing apparatus **102** includes, as the image formation unit **208**, an intermediate transfer belt **118** to which a toner image is transferred from each of the image forming units **114**, **115**, **116**, and **117**, and a secondary transfer roller **119**.
[0044] The intermediate transfer belt **118** rotates clockwise in FIG. **3**, and toner images are transferred (primarily transferred) thereto in an overlapped manner in order of the image forming units **117**, **116**, **115**, and **114**. In this way, a full color toner image is formed on the intermediate transfer belt **118**. The intermediate transfer belt **118** rotates to convey the toner image to the secondary transfer roller **119**. A sheet is conveyed on the conveyance path **113** in synchronization with a timing at which the toner image is conveyed to the secondary transfer roller **119**. The secondary transfer roller **119** transfers (secondarily transfers) the toner image on the intermediate transfer belt **118** to the conveyed sheet.
[0045] An on-belt-image reading sensor **120** serving as the on-belt-image reading unit **212** is provided near the intermediate transfer belt **118**. The on-belt-image reading sensor **120** is located downstream of the image forming units **114**, **115**, **116**, and **117** in a rotation direction of the intermediate transfer belt **118**. The on-belt-image reading sensor **120** reads the image transferred to the intermediate transfer belt **118** from the image forming units **114**, **115**, **116**, and **117**. The on-belt-image reading sensor **120** is, for example, an optical sensor that emits light to the image on the intermediate transfer belt **118** and receives the reflected light to read the image. For example, the on-belt-image reading sensor **120** reads an adjustment image formed on the intermediate transfer belt **118** for adjusting an image formation condition. The CPU **203** analyzes a read result of the adjustment image read by the on-belt-image reading sensor **120**, and feeds back the analyzed read result to the image formation condition to perform calibration.
[0046] The printing apparatus **102** includes a first fixing unit **121** and a second fixing unit **123** as the fixing unit **209**. The first fixing unit **121** and the second fixing unit **123** have a same configuration and fix a toner image on a sheet. Thus, each of the first fixing unit **121** and the second fixing unit **123** includes a pressure roller and a heating roller. The toner image is heated and pressed to be melted and pressure-fixed on the sheet by passing through between the pressure roller and the heating roller. The sheet that has passed through the second fixing unit **123** is conveyed to the conveyance path **124**. The second fixing unit **123** is disposed downstream of the first fixing unit **121** in a sheet conveyance direction and used to add gloss to the image on the sheet that has been subjected to fixing processing by the first fixing unit **121**, or to secure fixability. For this reason, the second fixing unit **123** may not be used depending on the type of sheet and the content of the print job. The conveyance path **122** is provided to convey the sheet that has been subjected to the fixing processing by the first fixing unit **121** thereon without passing the sheet via the second fixing unit **123**.
[0047] The conveyance path **125** and the reversing conveyance path **126** are disposed at positions after the conveyance paths **124** and **122** join together. In a case where an instruction for two-sided printing is issued, the sheet is conveyed to the reversing conveyance path **126**. The conveyance direction of the sheet conveyed to the reversing conveyance path **126** is reversed in the reversing conveyance path **126** and conveyed to the two-sided conveyance path **127**. The surface (first surface) of the sheet on which an image is formed is reversed by the reversing conveyance path **126** and the two-sided conveyance path **127**. The sheet is conveyed again to the conveyance path **113** via the two-sided conveyance path **127**, and an image is formed on a second surface by passing the secondary transfer roller **119**. In a case of one-sided printing, or in a case where images have been formed on both sides in the two-sided printing, the sheet is conveyed to the charge eliminating apparatus **103** via the conveyance path **125**.
[0048] The charge eliminating apparatus **103** includes a conveyance path **128**, the contact type charge eliminating unit **129**, the non-contact type charge eliminating unit **131**, and a plurality of rollers that receives a sheet from the printing apparatus **102** and conveys the received sheet. The

secondary transfer roller **119** in the present embodiment applies a negative voltage to the sheet, so that the upper surface of the sheet is negatively charged and the lower surface of the sheet is positively charged due to the induced polarization. For this reason, when sheets are stacked on the stack tray **137** without being subjected to charge eliminating processing, there is a possibility of the stacked sheets sticking to each other due to electrostatic force. To prevent the sticking of the sheets due to the electrostatic force, the charge eliminating apparatus **103** in the present embodiment removes electric charges from the surface of the sheet by the contact type charge eliminating unit **129** and the non-contact type charge eliminating unit **131**.

[0049] The contact type charge eliminating unit **129** (contact charge eliminating unit) includes a charge eliminating roller pair of a charge eliminating roller **130***a* and a charge eliminating roller **130***b*, and removes charges from the sheet in a state of contacting the sheet (contact state) at a nip portion between the two charge eliminating rollers **130***a* and **130***b*. The charge eliminating roller **130***b* is an example of a first charge eliminating roller, and the charge eliminating roller **130***a* is an example of a second charge eliminating roller.

[0050] The non-contact type charge eliminating unit **131** (non-contact charge eliminating unit) provided downstream of the contact type charge eliminating unit **129** removes electric charges from the conveyed sheet in a state of not contacting the sheet (non-contact state). Further, an operation unit **132** for an operator to switch the contact type charge eliminating unit **129** on and off or make a setting regarding a voltage value (charge eliminating voltage) of the contact type charge eliminating unit **129** is provided on a top surface **103***a* that constitutes an apparatus top surface of the housing of the charge eliminating apparatus **103**.

[0051] The sheet conveyed from the printing apparatus **102** to the charge eliminating apparatus **103** passes through the conveyance path **128** and is subjected to the charge eliminating processing by the contact type charge eliminating unit **129** and the non-contact type charge eliminating unit **131**. Then, the sheet having been subjected to the charge eliminating processing is conveyed to the finisher **104**.

[0052] The finisher **104** stacks the sheet transferred from the printing apparatus **102**. The finisher **104** includes a conveyance path **135** and the stack tray **137** for stacking sheets. The conveyance path **135** is provided with conveyance sensors **133**, **134**, and **136**. The sheet conveyed from the printing apparatus **102** is discharged to the stack tray **137** via the conveyance path **135**. The conveyance sensors **133**, **134**, and **136** detect passing of the sheet conveyed on the conveyance path **135**.

[0053] The CPU **232** determines that a conveyance jam (conveyance failure) has occurred in the finisher **104** in a case where the conveyance sensor **133**, **134**, or **136** does not detect the leading edge or the trailing edge in the conveyance direction of the sheet after a predetermined time has elapsed since the start of the sheet conveyance. In this case, the CPU **232** notifies the printing apparatus **102** that a conveyance jam has occurred.

<Configuration of Contact Type Charge Eliminating Unit>

[0054] FIG. **4** is a cross-section diagram illustrating a configuration of the contact type charge eliminating unit **129**. As described above, the contact type charge eliminating unit **129** includes the two charge eliminating rollers **130***a* and **130***b* serving as the charge eliminating roller pair that contacts a sheet P. The charge eliminating roller **130***a* is electrically grounded (connected to the ground). Further, the contact type charge eliminating unit **129** is provided with a charge eliminating high-voltage substrate **230**. The contact charge eliminating control unit **222** applies a voltage to the charge eliminating roller pair to remove charges from the sheet using the charge eliminating high-voltage substrate **230**. More specifically, the contact charge eliminating control unit **222** applies a negative voltage to the charge eliminating roller **130***b* to remove positive charges existing on the lower surface of the sheet P, using the charge eliminating high-voltage substrate **230**. Then, when the positive charges existing on the lower surface of the sheet P are reduced, negative charges existing on the upper surface of the sheet P are also reduced via the charge eliminating roller **130***a*.

In other words, to remove charges means to reduce charges existing on the sheet P. The contact type charge eliminating unit **129** in the present embodiment is high in charge eliminating effect because the contact type charge eliminating unit **129** contacts the sheet P to apply the voltage directly. On the other hand, the contact type charge eliminating unit **129** has a characteristic in that unevenness of the surface potential of the sheet P with the charges removed therefrom is large and the charge eliminating tends to become uneven.

[0055] In the present embodiment, the charge eliminating high-voltage substrate **230** applies a negative voltage to the charge eliminating roller **130***b*. Accordingly, in the case of one-sided printing, the sheet needs to be conveyed in a state where the image-formed surface of the sheet is the upper surface. Thus, in a case where the charge eliminating processing by the contact type charge eliminating unit **129** is to be performed in the job, the display **206** displays a notification prompting the user to make a face-up sheet discharge setting. However, the arrangement of the charge eliminating high-voltage substrate **230** is not limited thereto. The negative charges existing on the upper surface of the sheet P may be removed by electrically grounding the charge eliminating roller **130***b* (connecting the charge eliminating roller **130***b* to the ground), and the charge eliminating high-voltage substrate **230** applying a positive voltage to the charge eliminating roller **130***a*. In addition, two charge eliminating high-voltage substrates may be respectively connected to the charge eliminating rollers **130***a* and **130***b*.

<Configuration of Non-Contact Type Charge Eliminating Unit>

[0056] FIGS. **5**A and **5**B are cross-section diagrams illustrating a configuration of the non-contact type charge eliminating unit **131**. The non-contact type charge eliminating unit **131** in the present embodiment can make even the surface potential of the sheet P that has become uneven caused by the charge eliminating processing performed by the above-described contact type charge eliminating unit **129**. The non-contact type charge eliminating unit **131** includes a discharging wire **140***a* and a ground electrode **140***b*. The ground electrode **140***b* is electrically grounded (connected to the ground). Further, the non-contact type charge eliminating unit **131** is provided with a non-contact type charge eliminating high-voltage substrate **240**. The non-contact charge eliminating control unit **223** applies a positive voltage to the discharging wire **140***a* using the non-contact type charge eliminating high-voltage substrate **240**.

[0057] As illustrated in FIG. **5**A, when the positive voltage is applied to the discharging wire **140***a*, positive charges are generated due to corona discharge. Then, as illustrated in FIG. **5**B, the positive charges generated by the discharging wire **140***a* neutralize the negative charges on the upper surface of the sheet P. Further, the positive charges on the lower surface of the sheet P are drawn near the ground electrode **140***b* that is at zero potential.

[0058] With the above-described action, the non-contact type charge eliminating unit **131** removes charges from the sheet P. The charge eliminating effect for the sheet P by the non-contact type charge eliminating unit **131** according to the present embodiment is smaller than that by the contact type charge eliminating unit **129**, but the unevenness of the surface potential of the sheet P after the charge eliminating processing is smaller. For this reason, the non-contact type charge eliminating unit **131** can improve the surface potential state of the sheet P that has become uneven by the contact type charge eliminating unit **129**. In the present embodiment, an alternating-current (AC) corotron charger is employed as the non-contact type charge eliminating unit **131**, but it is not limited thereto. For example, an ionizer including a charge eliminating needle that emits ions to the sheet may be used as the non-contact type charge eliminating unit **131**. Further, in the present embodiment, the discharging wire **140***a* is arranged only on the upper surface side of the sheet in the non-contact type charge eliminating unit **131**, but it is not limited thereto. For example, the non-contact type charge eliminating unit **131** may have a configuration in which discharging wires or ionizers are arranged on both the upper surface side and the lower surface side of the conveyance path **128**.

<Configuration of Operation Unit of Charge Eliminating Apparatus>

[0059] The charge eliminating apparatus **103** in the present embodiment includes two charge eliminating units of the contact type charge eliminating unit **129** and the non-contact type charge eliminating unit **131** to remove charges from the sheet. However, the charge eliminating apparatus **103** can remove charges from the sheet using only one of the contact type charge eliminating unit **129** and the non-contact type charge eliminating unit **131**. For example, charges of a sheet with a small electric resistance, such as plain paper, can be sufficiently removed using only the non-contact type charge eliminating unit **131** without using the contact type charge eliminating unit **129**. On the other hand, charges of a sheet with a large electric resistance, such as synthetic paper, are desirably removed by both the contact type charge eliminating unit **129** and the non-contact type charge eliminating unit **131**. Thus, an operator can optionally change settings of the charge eliminating apparatus **103** using the operation unit **132** depending on the type of sheet to be printed in the job.

[0060] FIG. **6** is a top view illustrating the operation unit **132** of the charge eliminating apparatus **103**. The charge eliminating apparatus **103** is provided with the operation unit **132** for setting the operation of the contact type charge eliminating unit **129**. The operation unit **132** is arranged on the top surface **103***a* (apparatus top surface) of the housing of the charge eliminating apparatus **103**. The operation unit **132** includes the mode lever **141** and the dial **142**.

[0061] The mode lever **141** is a selector switch for manually switching on and off (enabled and disabled) of a voltage application to the charge eliminating roller **130***b* by the charge eliminating high-voltage substrate **230**. More specifically, the mode lever **141** is a setting unit for switching between a first mode that enables the contact type charge eliminating unit **129** and a second mode that disables the contact type charge eliminating unit **129**. In addition, in the present embodiment, the state in which the contact type charge eliminating unit **129** is on (enabled) is a state in which a voltage is applied to the charge eliminating roller **130***b*, and the state in which the contact type charge eliminating unit **129** is off (disabled) is a state in which a voltage is not applied to the charge eliminating roller **130***b*. FIG. **6** illustrates a state in which the mode lever **141** is set to off, and an operator can switch the mode lever **141** to an on state by turning the mode lever **141** clockwise in FIG. **6**.

[0062] The dial **142** is a thumb rotary switch for manually setting a voltage value to be applied to the charge eliminating roller **130***b* by the charge eliminating high-voltage substrate **230**. The dial **142** includes a button **142***a* and a display portion **142***b*, and the number displayed in the display portion **142***b* is changed by an operator pressing the button **142***a*. In the descriptions below, the setting value set by the dial **142** and displayed on the display portion **142***b* will be sometimes referred to as a dial value. The dial **142** in the present embodiment can set the dial value from **0** to **99**. The contact charge eliminating control unit **222** applies, to the charge eliminating roller **130***b*, a voltage at a voltage level corresponding to the setting value (dial value) of the dial **142**.

[0063] In the present embodiment, the operation unit **132** includes two manual setting units of the dial **142** serving as a first setting unit and the mode lever **141** serving as a second setting unit. Thus, an operator can change the setting of the mode lever **141** without changing the setting of the dial **142**. In other words, when the operator switches the contact type charge eliminating unit **129** from on to off using the mode lever **141**, the setting value of the dial **142** is not changed.

<Operation of Charge Eliminating Apparatus>

[0064] FIG. **7** is a table illustrating relationships respectively between settings of the mode lever **141** and the dial **142**, and the operations performed by the contact type charge eliminating unit **129** and the non-contact type charge eliminating unit **131**. As illustrated in FIG. **7**, when the mode lever **141** is in an on state, a voltage of the dial value x−100 V is applied to the contact type charge eliminating unit **129**. However, even when the mode lever **141** is in an on state, if the dial value is 0, the contact type charge eliminating unit **129** becomes off (no voltage is applied). Then, when the mode lever **141** is in an off state, the contact type charge eliminating unit **129** becomes off (no voltage applied) regardless of the dial value. On the other hand, the non-contact type charge

eliminating unit **131** is always in an on state regardless of the settings of the mode lever **141** and the dial **142** of the operation unit **132**. In other words, even when the mode lever **141** is in the off state, a voltage is applied to the non-contact type charge eliminating unit **131** by the non-contact charge eliminating control unit **223**.

[0065] FIG. **8** is a flowchart illustrating an operation performed by the charge eliminating apparatus **103**. In the present embodiment, processing of each step illustrated in FIG. **8** is executed by the contact charge eliminating control unit **222** and the non-contact charge eliminating control unit **223** of the charge eliminating apparatus **103**. Upon starting a job, in step S**1001**, the non-contact charge eliminating control unit **223** turns on the non-contact type charge eliminating unit **131**. Accordingly, a high voltage is applied to the discharging wire **140***a* from the non-contact type charge eliminating high-voltage substrate **240**. Then, in step S**1002**, the charge eliminating control switching unit **251** of the contact charge eliminating control unit **222** acquires the state of the mode lever **141** and determines whether the mode lever **141** is in an on state or an off state. In a case where the mode lever **141** is in an on state (YES in step S**1002**), the processing proceeds to step S**1003**. In step S**1003**, the charge eliminating voltage adjusting unit **252** of the contact charge eliminating control unit **222** acquires the setting value (dial value) of the dial **142**. Then, in step S**1004**, the contact charge eliminating control unit **222** determines whether the acquired setting value is a value other than 0 (zero). In a case where the setting value is a value other than 0 (YES in step S**1004**), the processing proceeds to step S**1005**. In step S**1005**, the contact charge eliminating control unit **222** applies a high voltage corresponding to the setting value of the dial **142** to the contact type charge eliminating unit **129**. On the other hand, in a case where the mode lever **141** is in an off state (NO in step S**1002**), or the setting value is 0 (NO in step S**1004**), the processing proceeds to step S**1006**. In step S**1006**, the contact charge eliminating control unit **222** turns off the contact type charge eliminating unit **129**. Then, the contact charge eliminating control unit **222** and the non-contact charge eliminating control unit **223** end the processing.

[0066] In the present embodiment, the setting of the charge eliminating apparatus **103** set by the operation unit **132** before the start of the print job is maintained until the job is completed. More specifically, even in a case where an operator changes the setting value of the dial **142** in the middle of the job, the contact charge eliminating control unit **222** does not change the value of the voltage applied to the contact type charge eliminating unit **129** until the job ends. Then, after the job ends, the contact charge eliminating control unit **222** changes the value of the voltage applied to the contact type charge eliminating unit **129**. In this way, even in a case where an operator changes the setting of the charge eliminating apparatus **103** in the middle of the job by mistake, it is possible to remove charges from the sheet during the job.

[0067] With the operation unit **132** configured as described above, it is possible to set whether to apply a voltage to the contact type charge eliminating unit **129** by the mode lever **141**, without changing the setting value (dial value) of the dial **142**. In other words, even in a case where the contact type charge eliminating unit **129** is switched from on to off by the mode lever **141**, the setting value (dial value) of the dial **142** is maintained without being changed.

[0068] A description is given of a case, for example, where the image forming apparatus **101** executes a first job of performing printing on synthetic paper, a second job of performing printing on plain paper after the first job, and then a third job of performing printing on synthetic paper after the second job. Herein, the synthetic paper is an example of a type of sheet that requires charge removal therefrom by the contact type charge eliminating unit **129**, and the plain paper is an example of a type of sheet that does not require charge removal therefrom by the contact type charge eliminating unit **129**. In a case where the operation unit **132** of the charge eliminating apparatus **103** has a configuration not including the mode lever **141**, an operator needs to start the first job after setting the dial value to an appropriate value, and after the first job is completed, the operator needs to start the second job after setting the dial value to 0. Then, after the second job is completed, the operator needs to set the dial value to an appropriate value by operating the dial **142**

again before starting the third job. On the other hand, the operator can start the second job by setting the mode lever **141** to an off state without changing the dial value after the first job, because the operation unit **132** according to the present embodiment has the two manual operation units of the mode lever **141** and the dial **142**. Since the dial value is maintained after the second job is completed, the operator can start the third job by only setting the mode lever **141** to an on state. Thus, the charge eliminating rollers **130***a* and **130***b* convey the sheet P even when the mode lever **141** is in an off state.

[0069] As described above, since the operation unit **132** according to the present embodiment includes both the mode lever **141** and the dial **142**, it is possible to simplify the operation when the operator changes the setting of the charge eliminating apparatus **103**. In particular, in the present embodiment, the operator can switch the contact type charge eliminating unit **129** on and off without changing the setting value of the charge eliminating voltage of the contact type charge eliminating unit **129** using the operation unit **132**.

[0070] In the present embodiment, the operation unit **132** is arranged on the top surface **103***a* of the charge eliminating apparatus **103**, but the operation unit **132** may be arranged on a front surface of the housing of the apparatus.

[0071] Further, in the present embodiment, a voltage is not applied to the charge eliminating roller **130***b* when the contact type charge eliminating unit **129** is in an off state, but the voltage value applied when the contact type charge eliminating unit **129** is off does not exactly need to be 0. More specifically, a state where a small voltage is applied to the contact type charge eliminating unit **129** can also be said that the contact type charge eliminating unit **129** is disabled because there is almost no charge eliminating effect by the contact type charge eliminating unit **129**. In other words, the mode lever **141** may be configured to switch the contact type charge eliminating unit **129** between the “enabled state” and “a (disabled) state where a small voltage is applied”. Even with this configuration, the similar effect to that of the present embodiment described above can be obtained.

[0072] FIG. **9** is another example of the operation unit **132**. The mode lever **141** in the above-described embodiment is configured to switch “ON” and “OFF” the voltage application to the charge eliminating roller **130***b* by the charge eliminating high-voltage substrate **230**. However, the mode lever **141** may have a different setting other than “ON” and “OFF” (e.g., “A” in FIG. **9**). For example, in a case where the mode lever **141** is set to “A”, a value of a voltage applied to the charge eliminating roller **130***b* is set to a predetermined value regardless of the setting of the dial **142**. With such a configuration, an operator can easily set the contact type charge eliminating unit **129** to a frequently used voltage value, which improves the operability.

[0073] Further, the operation unit **132** for changing the setting of the charge eliminating apparatus **103** may be configured as an operation screen displayed on the display **206**. FIG. **10** is an example of the operation screen displayed on the display **206**. On the operation screen in FIG. **10**, a mode setting unit **143** serving as the second setting unit, and a voltage setting unit **144** serving as the first setting unit are displayed. The mode setting unit **143** is, similar to the above-described mode lever **141**, a software key for switching on and off the voltage application to the charge eliminating roller **130***b* by the charge eliminating high-voltage substrate **230**. The voltage setting unit **144** is, similar to the above-described dial **142**, a software key for setting a value of a voltage applied to the charge eliminating roller **130***b* by the charge eliminating high-voltage substrate **230**. In this way, even with the configuration in which the mode setting unit **143** and the voltage setting unit **144** are displayed on the display **206**, similar to the above-described embodiment, the operation performed by an operator when the operator changes the setting of the charge eliminating apparatus **103** can be simplified.

[0074] FIG. **11** illustrates an example of an image forming apparatus **101** of another embodiment. The printing apparatus **102** and the finisher **104** of the image forming apparatus **101** in FIG. **11** are similar to those of the image forming apparatus **101** in FIG. **3**, and thus the descriptions thereof are

omitted. Hereinbelow, a charge adjusting apparatus **303** will be described. While the charge eliminating apparatus **103** in FIG. **3** includes the contact type charge eliminating unit **129** and the non-contact type charge eliminating unit **131**, the charge adjusting apparatus **303** in FIG. **11** includes only a charge adjusting unit **329**. More specifically, the charge adjusting apparatus **303** includes a conveyance path **328**, the charge adjusting unit **329**, an operation unit **332**, an applied bias control unit **400**, and a plurality of rollers that receives a sheet from the printing apparatus **102** and conveys the received sheet. In other words, the charge adjusting apparatus **303** does not include the non-contact type charge eliminating unit **131**. In the present embodiment, the charge adjusting unit **329** uses a contact type roller, but it is not limited thereto. A non-contact type discharging wire or an ionizer may be used instead of using the contact type charge eliminating unit.

[0075] FIG. **12** is a cross-section diagram illustrating a configuration of the charge adjusting unit **329** of the image forming apparatus **101** in FIG. **11**. The charge adjusting unit **329** includes two bias application rollers **330***a* and **330***b* serving as a bias application roller pair that contacts the sheet P. The bias application roller **330***a* is electrically grounded (connected to the ground). Further, the bias application roller **330***b* is provided with a high-voltage substrate **430**. A description is provided of a charge adjustment of the sheet P in a case where the lower surface of the sheet P is positively charged by application of a secondary transfer voltage. When images are consecutively formed on a plurality of sheets, the applied bias control unit **400** performs control so that the high-voltage substrate **430** applies a negative voltage to the bias application roller **330***b* to charge the surface of every other sheet to inverse the electrostatic polarity. More specifically, the bias application roller pair applies, to the sheet P, charges opposite in polarity to the surface potential of the image-formed sheet. In this way, the surface potential of the sheet P before passing through the bias application roller pair and that after passing through the bias application roller pair are reversed. FIG. **13** illustrates a state of stacked sheets P in the case where the reverse polarity charges is applied to every even-numbered sheet P. When the first to fourth sheets are respectively referred to as sheets P**1** to P**4**, the sheets P**1** and P**3** are stacked in a state where the upper surface of each of the sheet P**1** and P**3**, to which the voltage is not applied by the charge adjusting unit **329**, is negatively charged, and the lower surface thereof is positively charged. The sheets P**2** and P**4** are stacked in a state where the upper surface of each of the sheets P**2** and P**4**, which is charged by the charge adjusting unit **329** so that the electrostatic polarity of the sheet surface is reversed with respect to the sheets P**1** and P**3**, is positively charged and the lower surface thereof is negatively charged. Since the surfaces of the sheets are charged so as to repel each other in this way when the sheets are stacked, it is possible to prevent the sheets from sticking to each other due to electrostatic force. However, the arrangement of the high-voltage substrate **430** is not limited thereto. The bias application roller **330***b* may be electrically grounded (connected to the ground) and the high-voltage substrate **430** may apply a positive voltage to the bias application roller **330***a*. In addition, two high-voltage substrates may be respectively connected to the bias application rollers **330***a* and **330***b*.

[0076] Similar to the above-described embodiment, the charge adjusting apparatus **303** includes the operation unit **332**. The operation unit **332** includes the mode lever **141** for manually switching "ON" and "OFF" of the voltage application, and the dial **142** for manually setting the voltage to be applied. FIG. **14** is a table illustrating relationships respectively between settings of the mode lever **141** and the dial **142**, and voltage application operations in the charge adjusting unit **329**, according to the present embodiment. When the mode lever **141** is in an on state, a voltage is applied to the bias application roller pair for every other sheet. For example, a voltage of the dial value x−100 V is applied to the bias application roller pair for every even-numbered sheet P, and no voltage is applied thereto for every odd-numbered sheet P. In an opposite way, the voltage may be applied to the bias application roller pair for every odd-numbered sheet P, and no voltage may be applied to the bias application roller pair for every even-numbered sheet P. However, in a case where the dial value is 0, no voltage is applied to the bias application roller pair, and no charge is provided to any

of the conveyed sheets P. Then, when the mode lever **141** is in an off state, regardless of the dial value of the dial **142**, no voltage is applied to the bias application roller pair, and no charge is provided to any of the conveyed sheets P. As described above, it is possible to obtain the similar effect to the above-described embodiment when the charge adjusting apparatus **303** includes the two manual setting units of the dial **142** serving as the first setting unit and the mode lever **141** serving as the second setting unit.

[0077] According to the present invention, it is possible to provide a charge eliminating apparatus, an image forming apparatus, and a charge adjusting apparatus in which the operation to perform the setting regarding the charge eliminating (charge removal) of the sheet or a sheet electric charge adjustment is improved.

[0078] While the present invention has been described with reference to embodiments, it is to be understood that the invention is not limited to the disclosed embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

Claims

1. A charge eliminating apparatus configured to remove charges from a sheet on which an image is formed by a printing apparatus, the charge eliminating apparatus comprising: a charge eliminating roller pair including a first charge eliminating roller and a second charge eliminating roller configured to form a nip portion together with the first charge eliminating roller, the charge eliminating roller pair being configured to remove the charges from the sheet in a state of contacting the sheet at the nip portion; and a first setting unit to allow a user to input information corresponding to a value of a voltage applied to the charge eliminating roller pair, wherein, in a case where a setting input to the first setting unit is changed from first information to second information during execution of a first job, a first voltage according to the first information is applied to the charge eliminating roller pair until the first job is completed.

2. The charge eliminating apparatus according to claim 1, wherein, in a case where the setting input to the first setting unit is changed from the first information to the second information during execution of the first job, a second voltage according to the second information is applied when a second job is executed after the first job.

3. The charge eliminating apparatus according to claim 1, further comprising a second setting unit configured to allow the user to select whether to apply the voltage to the charge eliminating roller pair, wherein, in a case where the user selects, on the second setting unit, not to apply the voltage to the charge eliminating roller pair, the sheet is conveyed in a state where the voltage is not applied to the charge eliminating roller pair regardless of the information input to the first setting unit.

4. The charge eliminating apparatus according to claim 3, wherein the second setting unit is configured to set whether to apply the voltage to the charge eliminating roller pair without the information that is input to the first setting unit and corresponds to a value of a voltage applied to the charge eliminating roller pair.

5. The charge eliminating apparatus according to claim 4, wherein the second setting unit is a selector switch.

6. The charge eliminating apparatus according to claim 1, wherein the first setting unit is a thumb rotary switch.

7. The charge eliminating apparatus according to claim 3, wherein the first setting unit and the second setting unit are arranged on an outer surface of the charge eliminating apparatus.

8. The charge eliminating apparatus according to claim 3, further comprising a non-contact charge eliminating unit configured to remove the charges from the sheet at a position downstream of the charge eliminating roller pair in a state of not contacting the sheet, wherein a voltage is applied to the non-contact charge eliminating unit even in a case where a setting by the second setting unit is

not to apply the voltage to the charge eliminating roller pair.

9. An image forming system, comprising: the charge eliminating apparatus according to claim 1; and the printing apparatus.

10. An image forming system, comprising: image formation units configured to form an image on a sheet; a charge eliminating roller pair including a first charge eliminating roller and a second charge eliminating roller configured to form a nip portion together with the first charge eliminating roller, the charge eliminating roller pair being disposed downstream of the image formation units in a sheet conveyance direction, and the charge eliminating roller pair being configured to remove the charges from the sheet in a state of contacting the sheet at the nip portion; and a first setting unit configured to allow a user to input information corresponding to a value of a voltage applied to the charge eliminating roller pair; and wherein, in a case where a setting input to the first setting unit is changed from first information to second information during execution of a first job, a first voltage according to the first information is applied to the charge eliminating roller pair until the first job is completed.

11. The image forming system according to claim 10, wherein, in a case where the setting input to the first setting unit is changed from the first information to the second information during execution of the first job, a second voltage according to the second information is applied when a second job is executed after the first job.

12. A charge adjusting apparatus configured to adjust charges on a sheet on which an image is formed by a printing apparatus, the charge adjusting apparatus comprising: a bias application roller pair configured to provide charges opposite in polarity to a surface potential of the sheet on which the image is formed, so that the surface potential of the sheet on which the image is formed is reversed; and a first setting unit to allow a user to input information corresponding to a value of a voltage applied to the bias application roller pair, wherein, in a case where a setting input to the first setting unit is changed from first information to second information during execution of a first job, a first voltage according to the first information is applied to the bias application roller pair until the first job is completed.

13. The charge adjusting apparatus according to claim 12, wherein the bias application roller pair provides, to every other sheet, charges opposite in polarity to the surface potential of the sheet on which the image is formed.