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(54) CHARGING DEVICE INCLUDING A HEATER THAT DIRECTLY HEATS A HOUSING THAT HOUSES A CHARGING ROLL OR THE CHARGING ROLL

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(57) **ABSTRACT**

A charging device includes: a charging roll configured to charge a photoconductor; a housing that houses the charging roll; and a heating unit that directly heats the housing or the charging roll. In the charging device, the heating unit may be disposed in contact with an outside or inside of the housing, and at least a part of the outside or inside of the housing may be covered with a thermally conductive member.

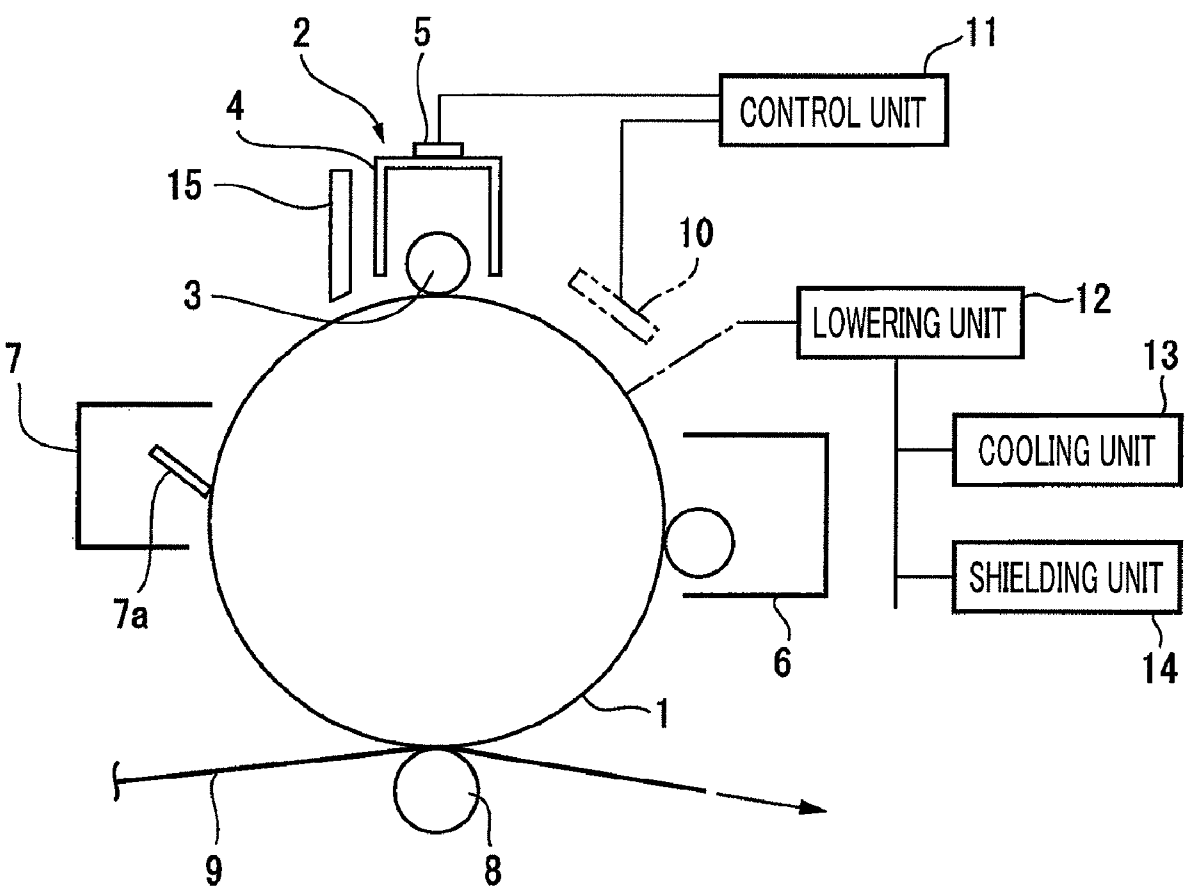


FIG. 1A

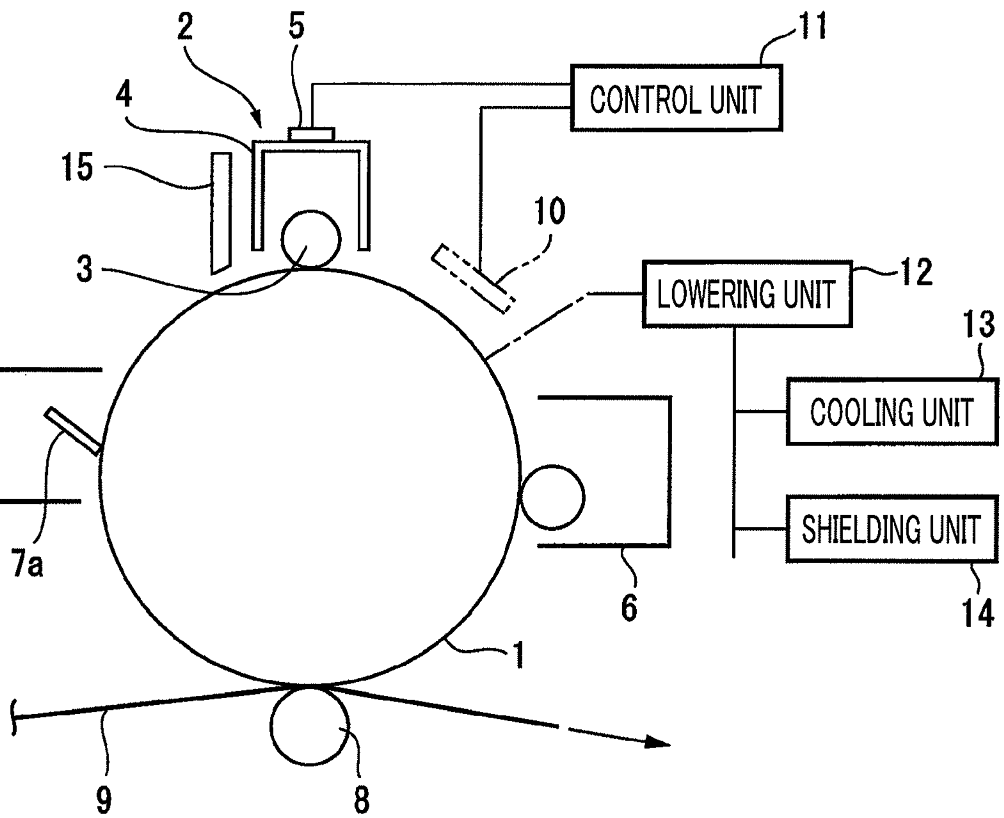

2
5
11
CONTROL UNIT
4
15
10
3
LOWERING UNIT
12
7
13
COOLING UNIT
SHIELDING UNIT
7a
6
14
1
9
8

FIG. 1B

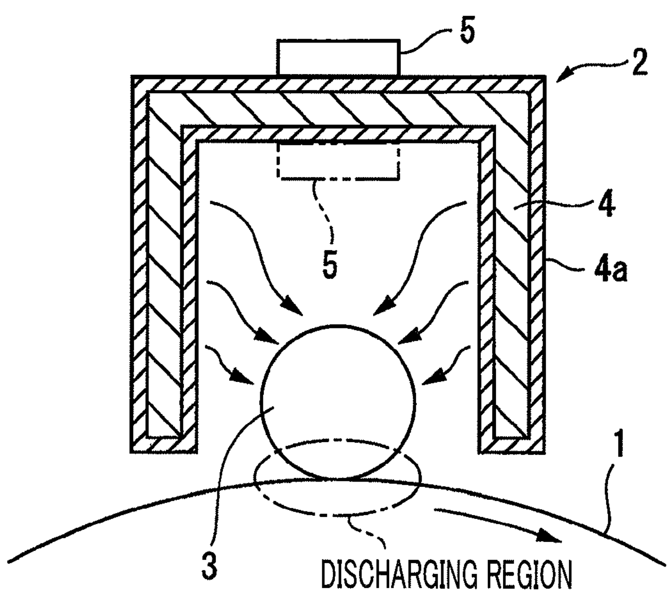

5
2
4
5
4a
1
3
DISCHARGING REGION

FIG. 2

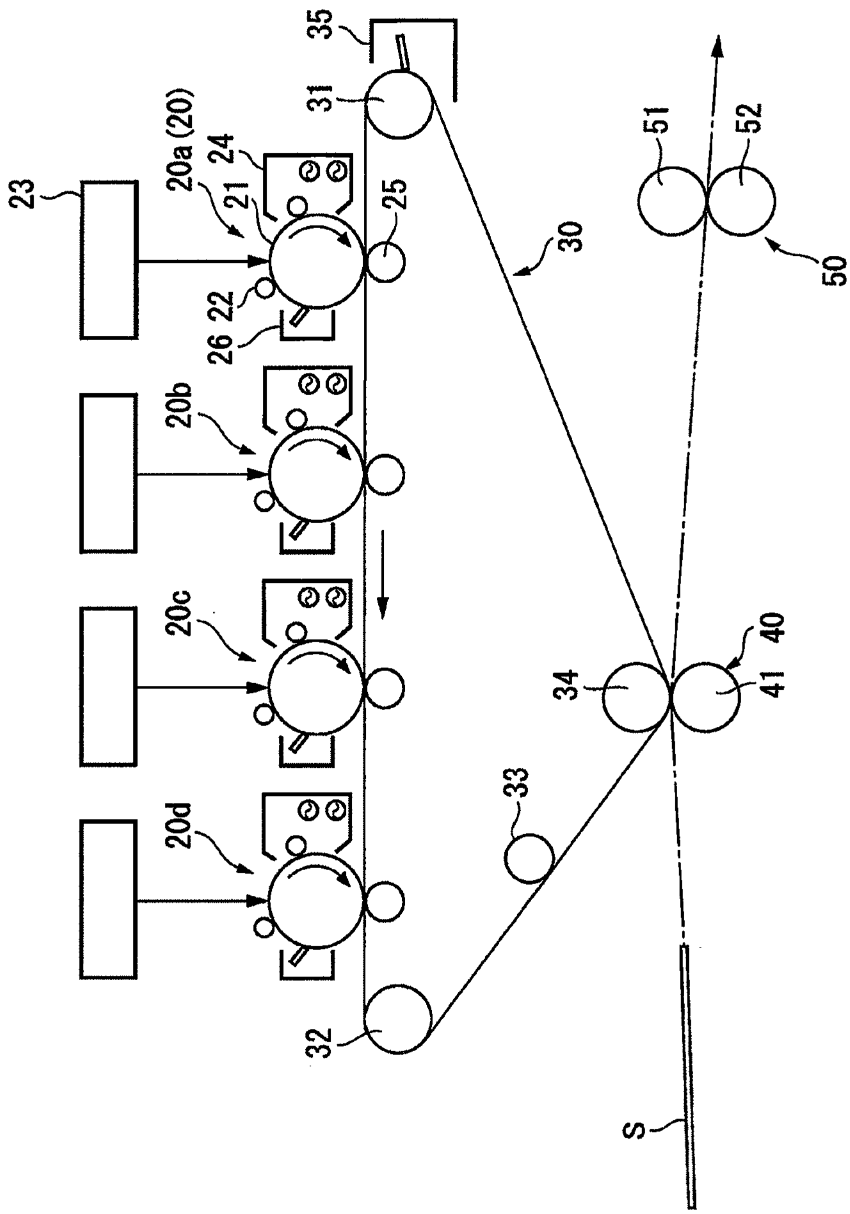
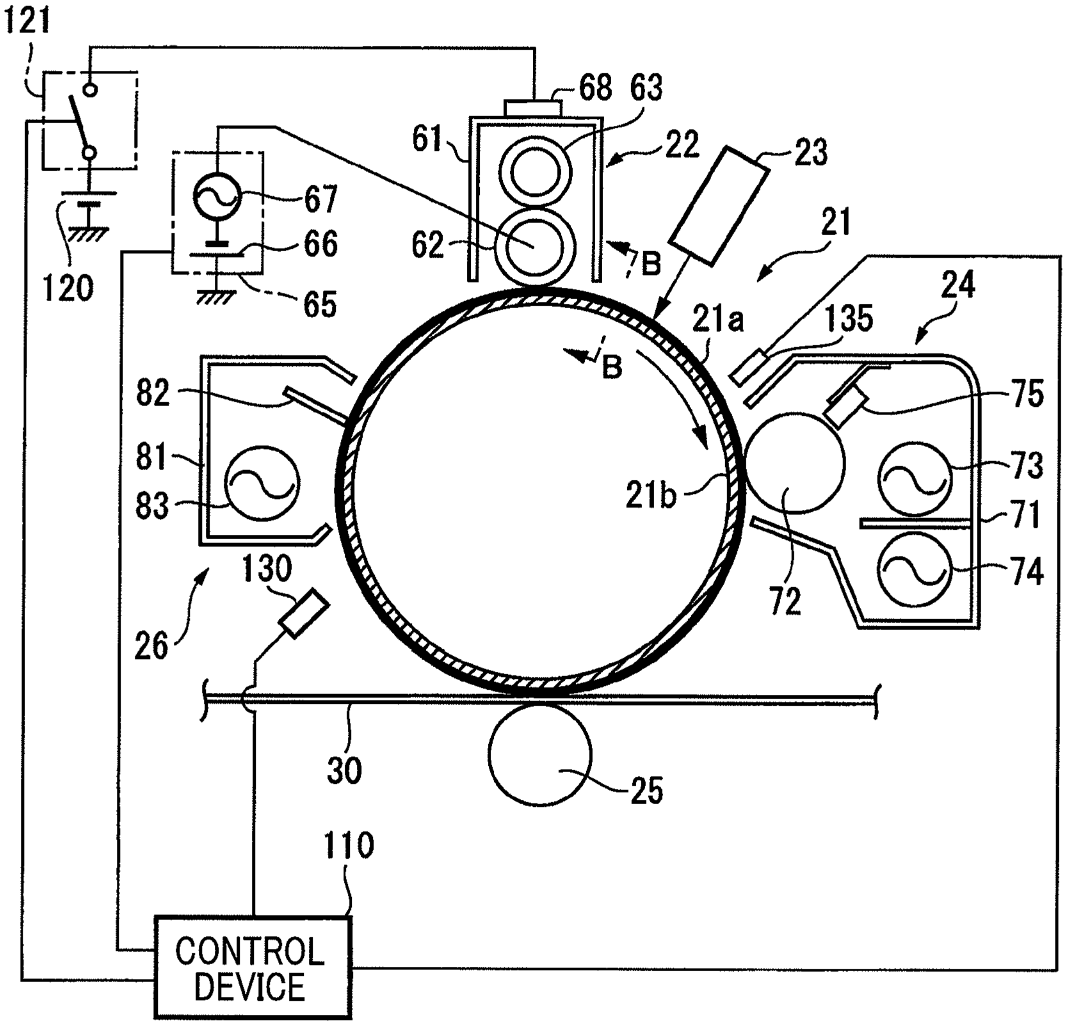


FIG. 3A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63
61
22
23
67
66
62
B
21
120
65
21a
135
24
82
B
75
81
73
83
21b
71
74
130
72
26
30
25
110
CONTROL DEVICE

FIG. 3B

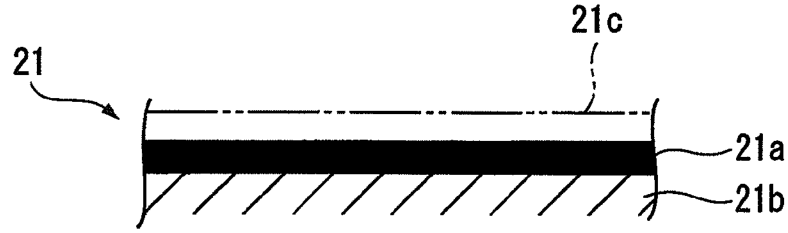

21c
21
21a
21b

FIG. 4A

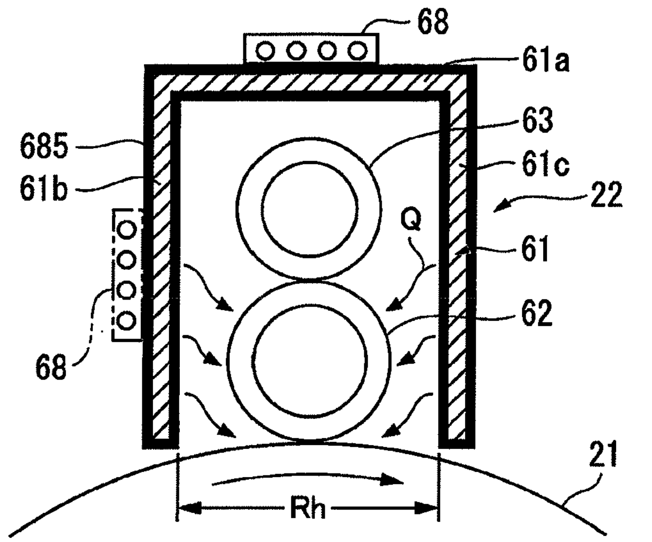


FIG. 4B

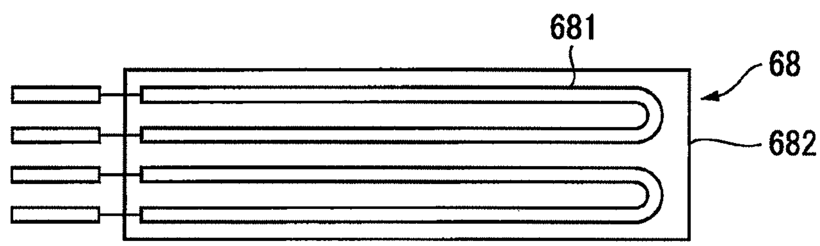


FIG. 4C

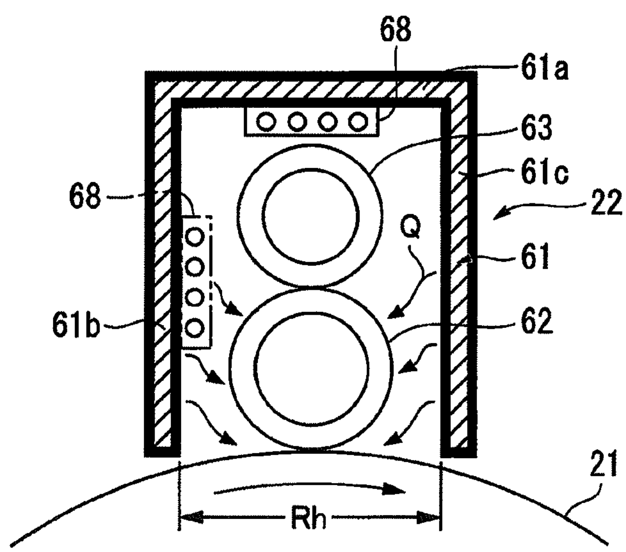


FIG. 5A

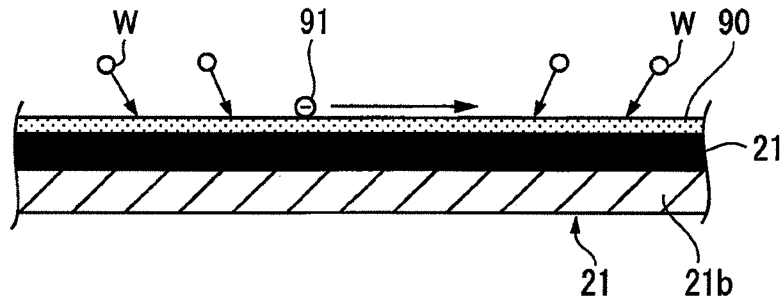


FIG. 5B

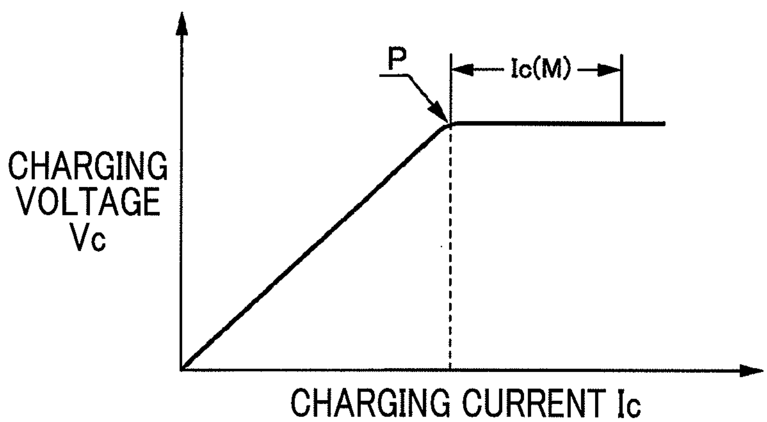


FIG. 5C

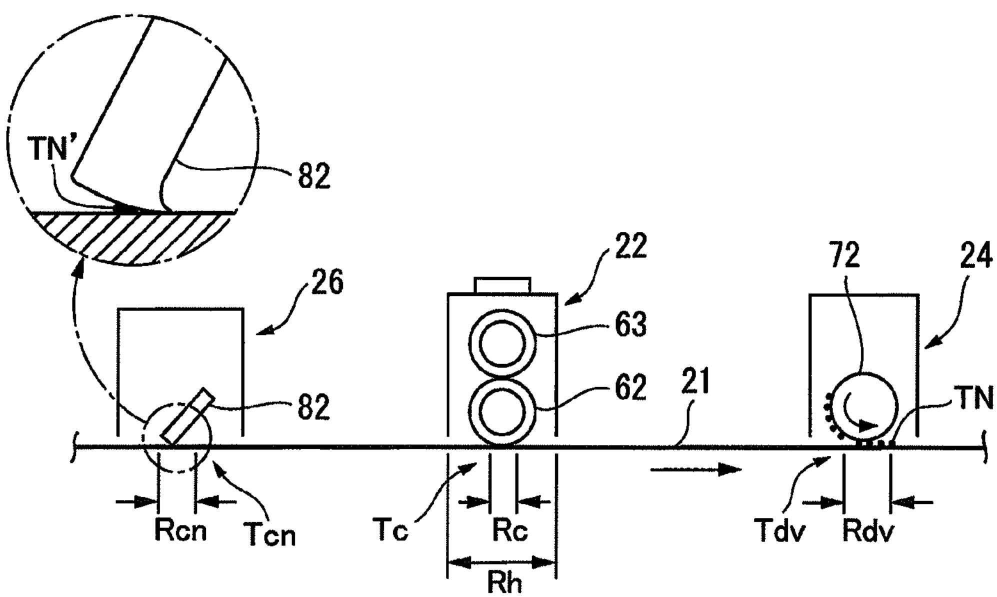


FIG. 6

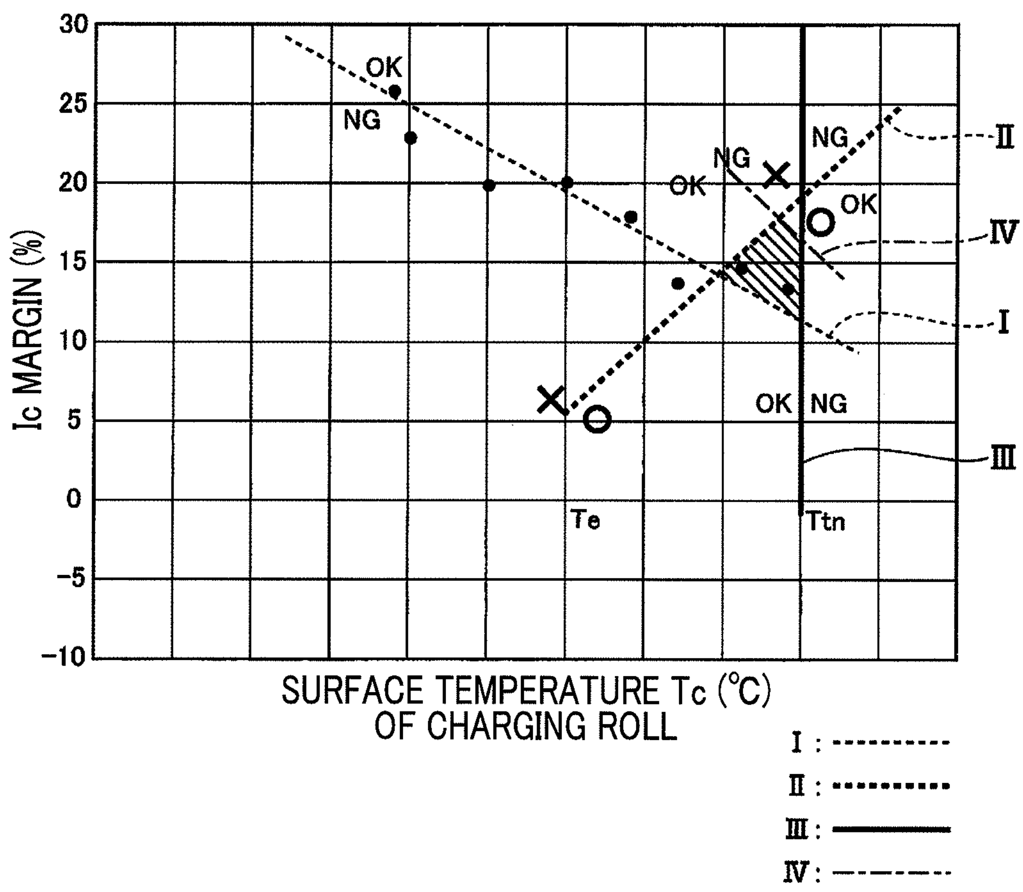

30
25
20
15
10
5
0
−5
−10
Ic MARGIN (%)
OK
NG
NG
OK
NG
OK
OK
NG
Te
Ttn
II
IV
I
III
SURFACE TEMPERATURE Tc (°C)
OF CHARGING ROLL
I :
II :
III :
IV :

FIG. 7

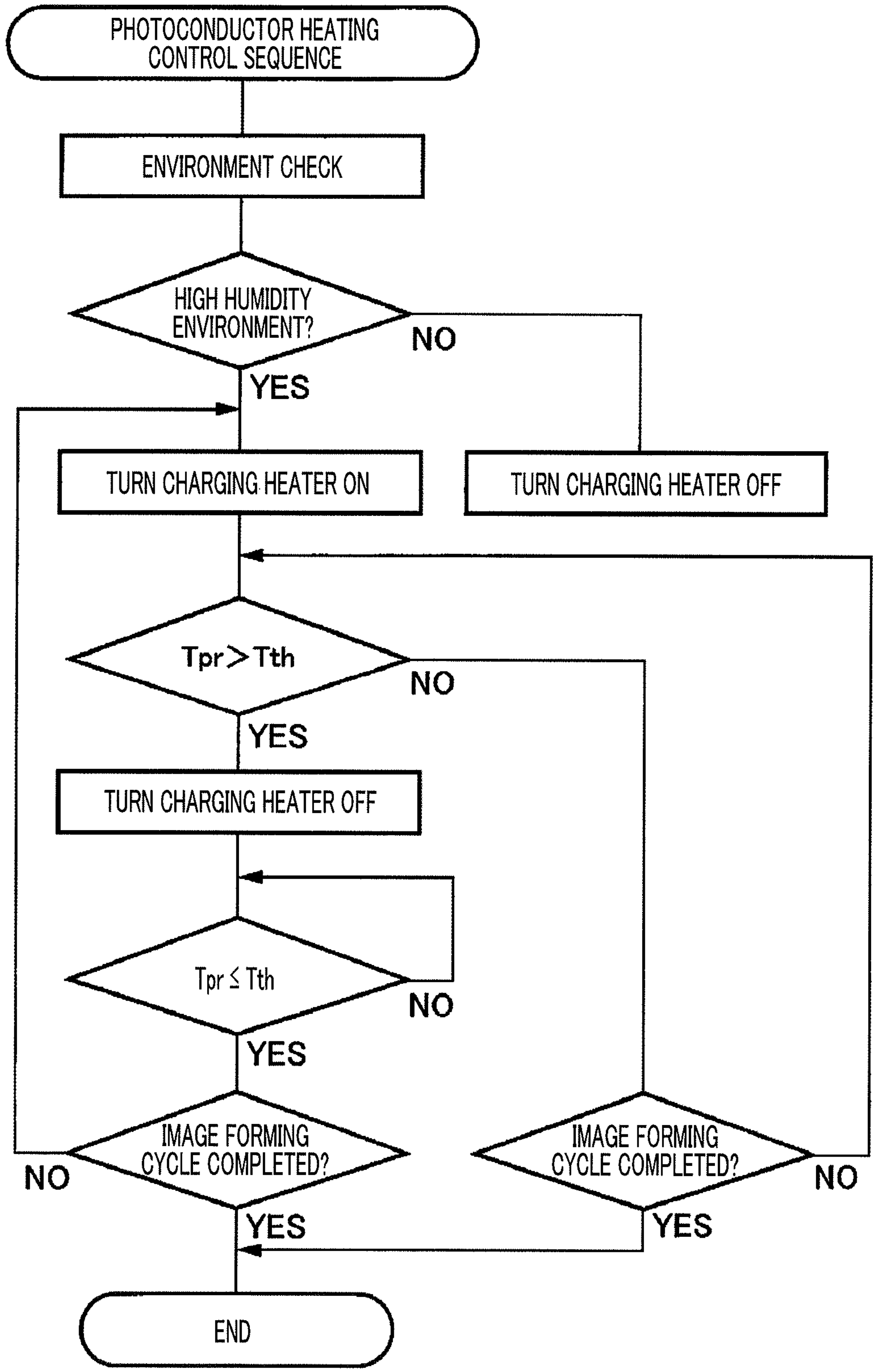

PHOTOCONDUCTOR HEATING CONTROL SEQUENCE
ENVIRONMENT CHECK
HIGH HUMIDITY ENVIRONMENT?
NO
YES
TURN CHARGING HEATER ON
TURN CHARGING HEATER OFF
Tpr>Tth
NO
YES
TURN CHARGING HEATER OFF
Tpr ≤ Tth
NO
YES
IMAGE FORMING CYCLE COMPLETED?
NO
YES
IMAGE FORMING CYCLE COMPLETED?
NO
YES
END

FIG. 8

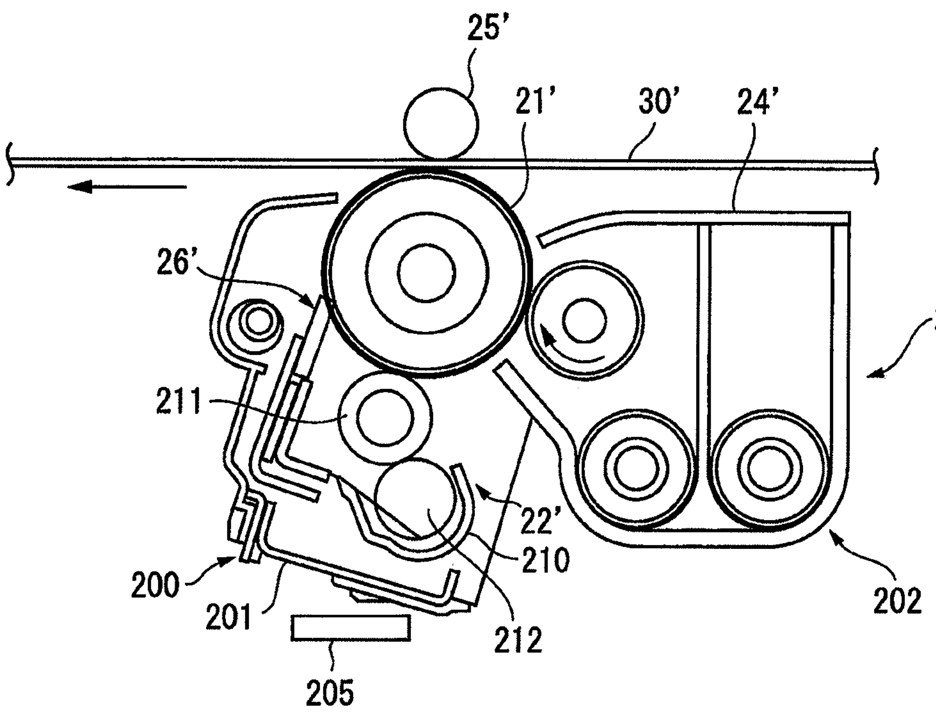
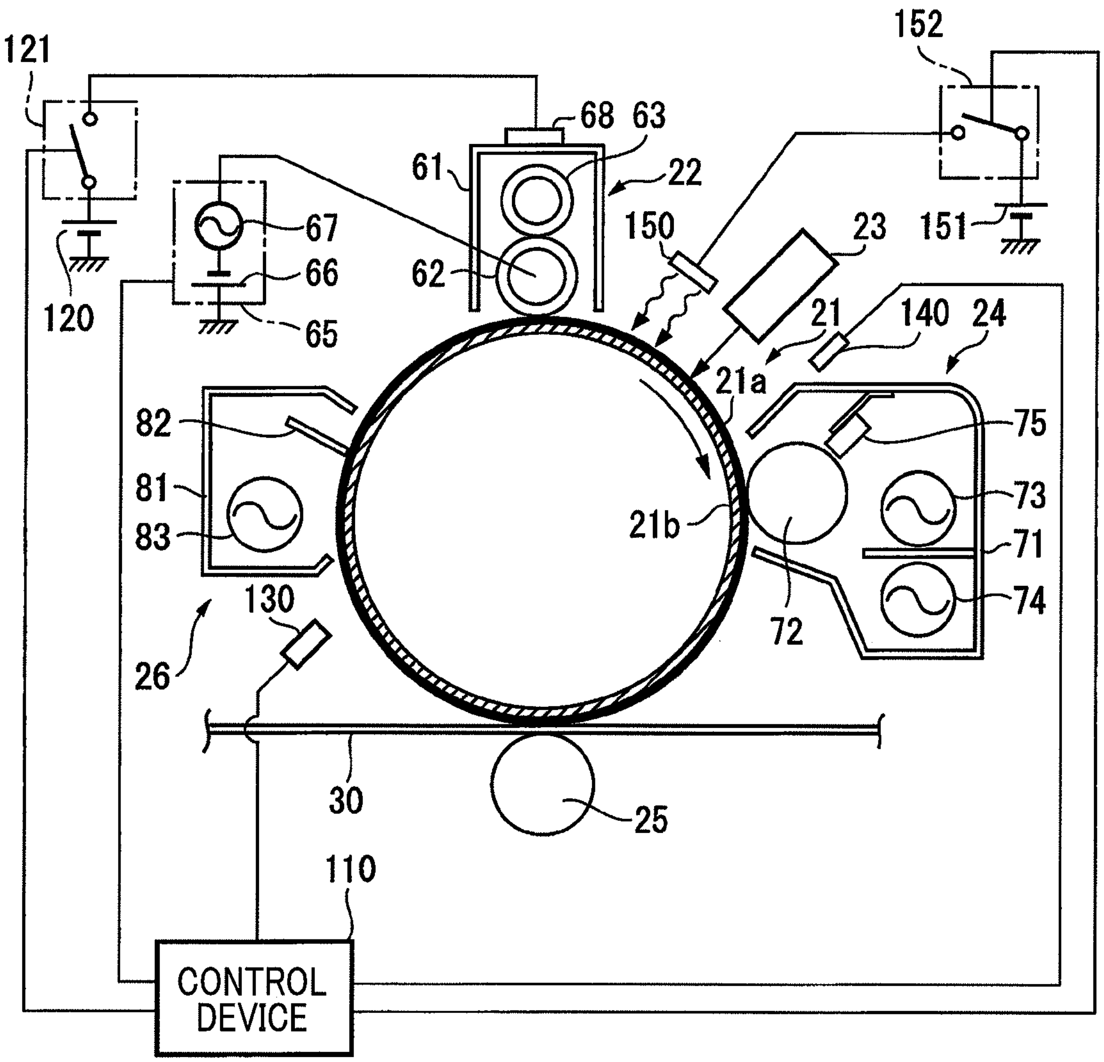


FIG. 9



121
152
68
63
61
22
67
150
23
151
120
66
62
65
21
140
24
21a
82
75
81
73
83
21b
71
130
74
72
26
30
25
110
CONTROL DEVICE

FIG. 10

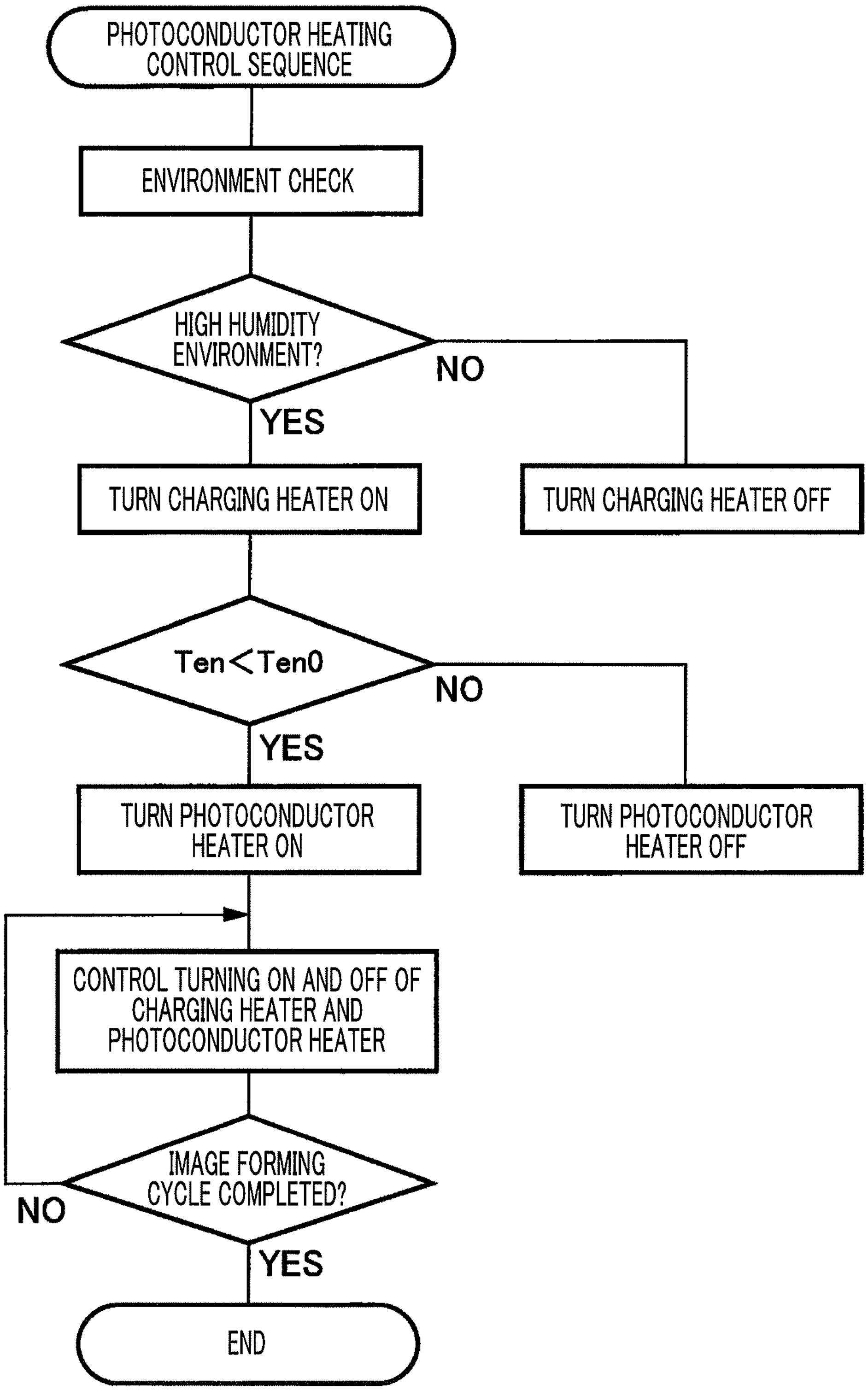
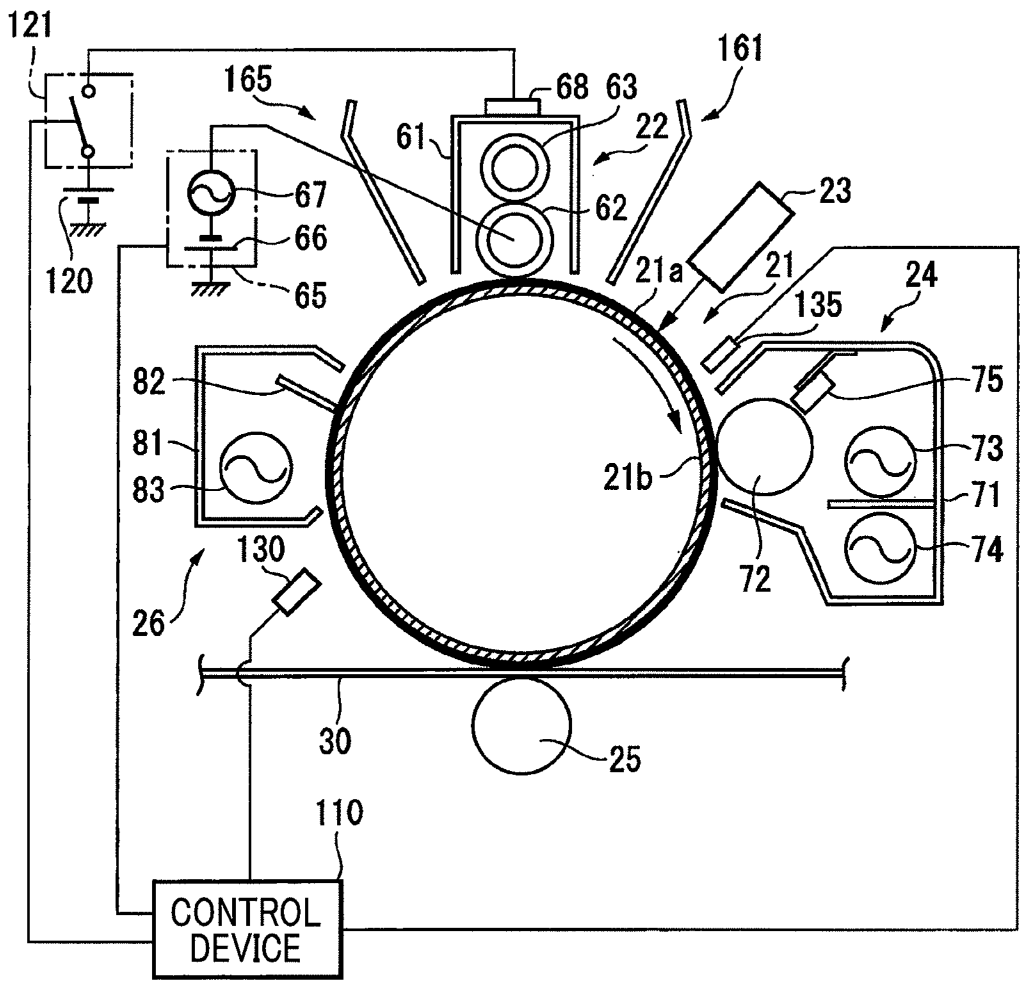

PHOTOCONDUCTOR HEATING CONTROL SEQUENCE
ENVIRONMENT CHECK
HIGH HUMIDITY ENVIRONMENT?
NO
YES
TURN CHARGING HEATER ON
TURN CHARGING HEATER OFF
Ten<Ten0
NO
YES
TURN PHOTOCONDUCTOR HEATER ON
TURN PHOTOCONDUCTOR HEATER OFF
CONTROL TURNING ON AND OFF OF CHARGING HEATER AND PHOTOCONDUCTOR HEATER
IMAGE FORMING CYCLE COMPLETED?
NO
YES
END

FIG. 11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161
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120
65
21a
21
135
24
82
75
81
83
73
21b
71
74
130
72
26
30
25
110
CONTROL DEVICE

FIG. 12A

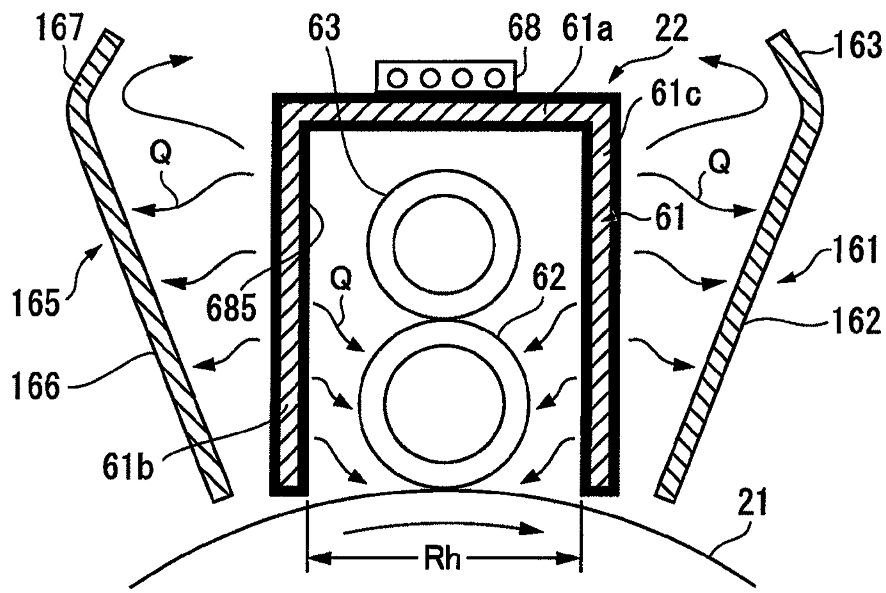


FIG. 12B

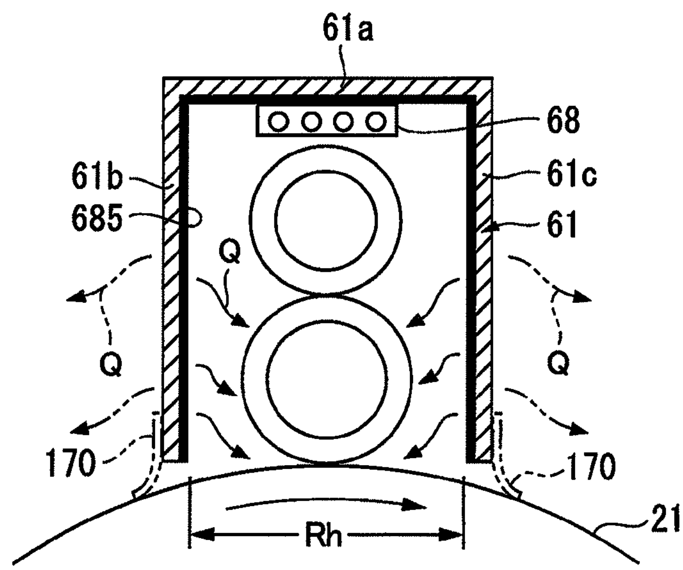
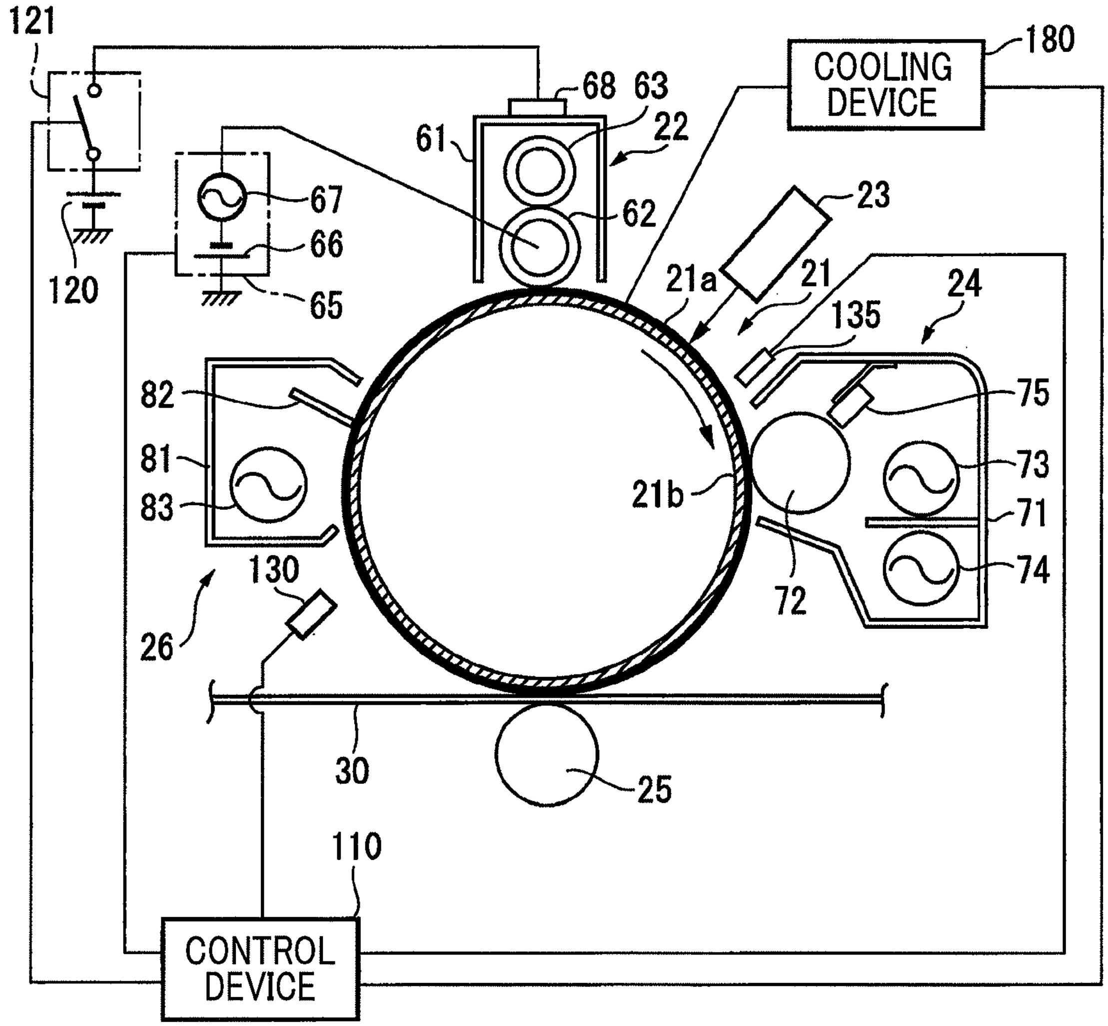


FIG. 13


121
180
COOLING DEVICE
68
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61
22
67
23
62
66
120
65
21a
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135
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82
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81
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83
21b
71
130
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26
30
25
110
CONTROL DEVICE

FIG. 14A

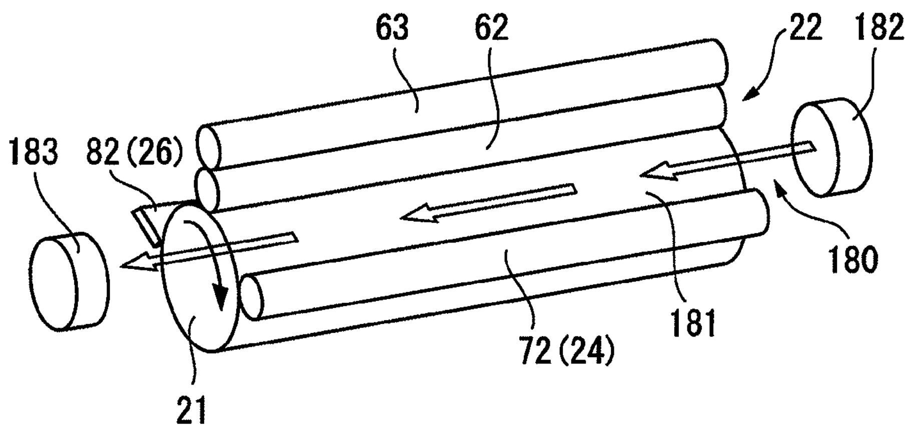
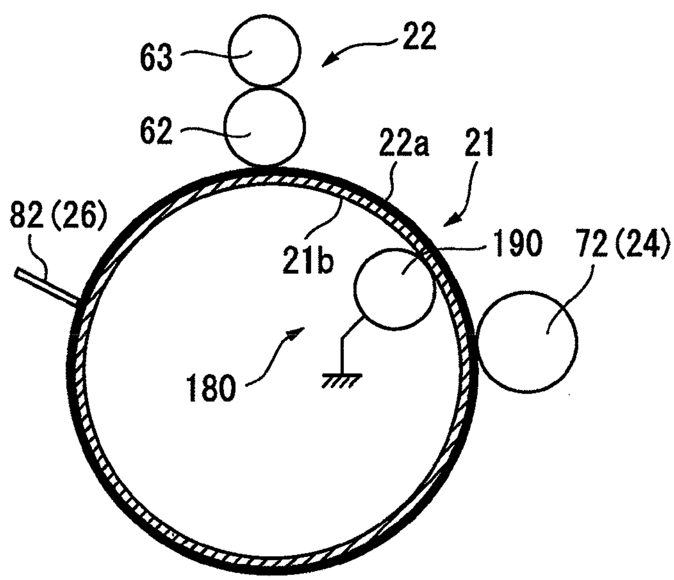


FIG. 14B



CHARGING DEVICE INCLUDING A HEATER THAT DIRECTLY HEATS A HOUSING THAT HOUSES A CHARGING ROLL OR THE CHARGING ROLL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on and claims priority under 35 USC 119 from Japanese Patent Application No. 2019-162665 filed Sep. 6, 2019.

BACKGROUND

(i) Technical Field

[0002] The present disclosure relates to a charging device and an image forming apparatus having the same.

(ii) Related Art

[0003] In the related art, as this type of image forming apparatus, for example, those disclosed in JP-A-2011-53440, JP-A-2005-345796, JP-A-2006-258974, and JP-A-2013-88769 are already known.

[0004] JP-A-2011-53440 discloses an image forming apparatus including a charging charger having a grid that controls a charging potential in the vicinity of a photosensitive drum, and a heater disposed along a major scanning direction of the photosensitive drum, which is the longitudinal direction of the charging charger, in which the heater is not in contact with the grid of the charging charger and a portion facing the grid of the photosensitive drum, and is at least as long as the image forming region in the major scanning direction.

[0005] JP-A-2005-345796 discloses an image forming apparatus in which in a case of a standby state in which image formation is not performed for a long time, a thermostat switch is turned on and a heat source is constantly energized to prevent the temperature in the image forming apparatus main body from becoming lower than 40° C., and in a case of a processing execution state in which the toner image is heated and fixed, the thermostat switch is turned off, and the energization time to the heat source is controlled to be short with another thermostat, thereby reducing power consumption and preventing the temperature from rising excessively.

[0006] JP-A-2006-258974 discloses an image forming apparatus including a temperature measuring unit that measures a temperature of a tip end of a cleaning blade; and a blade temperature control unit that heats the tip end so that the temperature of the tip end is higher than a Tan δ peak temperature of a rubber material constituting the tip end and lower than a glass transition temperature of toner in a case where after receiving the measurement result of the temperature measuring unit, the temperature of the tip end of the cleaning blade is equal to or lower than the Tan δ peak temperature.

[0007] JP-A-2013-88769 discloses an image forming apparatus including a blowing unit that is provided with a first air passage for cooling a developing device, and a second air passage for sending air to a charging device, and sends the air that has cooled the developing device in the first air passage to the second air passage, in which while preventing a decrease in developing performance, the occurrence of image flow is prevented by heating and drying the air leading to the charging device to a temperature higher than the outside air.

SUMMARY

[0008] Aspects of non-limiting embodiments of the present disclosure relate to preventing image quality defects caused by water absorption by a discharge product generated between a photoconductor and a charging roll in a system where the charging roll is configured to charge the photoconductor.

[0009] Aspects of certain non-limiting embodiments of the present disclosure address the above advantages and/or other advantages not described above. However, aspects of the non-limiting embodiments are not required to address the advantages described above, and aspects of the non-limiting embodiments of the present disclosure may not address advantages described above.

[0010] According to an aspect of the present disclosure, there is provided a charging device including: a charging roll configured to charge a photoconductor; a housing that houses the charging roll; and a heating unit that directly heats the housing or the charging roll.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Exemplary embodiments of the present invention will be described in detail based on the following figures, wherein:

[0012] FIG. **1**A is an explanatory diagram illustrating an outline of an exemplary embodiment of an image forming apparatus to which the present disclosure is applied, and FIG. **1**B is an explanatory diagram illustrating major parts of a charging device used in FIG. **1**A;

[0013] FIG. **2** is an explanatory diagram illustrating an overall configuration of an image forming apparatus according to a first exemplary embodiment;

[0014] FIG. **3**A is an explanatory diagram illustrating a configuration example of each image forming portion illustrated in FIG. **2**, and FIG. **3**B is a sectional explanatory diagram taken along line B-B in FIG. **3**A;

[0015] FIG. **4**A is an explanatory diagram illustrating a major part of the charging device illustrated in FIG. **3**A, FIG. **4**B is an explanatory diagram illustrating a configuration example of a charging heater used in FIG. **4**A, and FIG. **4**C is explanatory diagram illustrating modification exemplary embodiment of the charging device illustrated in FIG. **4**A;

[0016] FIG. **5**A is an explanatory diagram illustrating a technical background in which the charging device used in the first exemplary embodiment is employed, FIG. **5**B is a schematic explanatory diagram illustrating a relationship between a charging voltage Vc applied to the charging device and a charging current Ic, and FIG. **5**C is an explanatory diagram illustrating temperature conditions necessary in a charging area of the charging device, a developing area of the developing machine, and a cleaning area of the cleaning device;

[0017] FIG. **6** is an explanatory diagram illustrating an example of setting a margin of the charging current Ic of the charging device employed in the first exemplary embodiment;

[0018] FIG. **7** is a flowchart illustrating a photoconductor heating control sequence used in the image forming apparatus according to the first exemplary embodiment;

[0019] FIG. **8** is an explanatory diagram illustrating a configuration example of an image forming portion according to a first comparative exemplary embodiment;

[0020] FIG. **9** is an explanatory diagram illustrating major parts around an image forming portion of an image forming apparatus according to a second exemplary embodiment;

[0021] FIG. **10** is a flowchart illustrating a photoconductor heating control sequence used in the image forming apparatus according to the second exemplary embodiment;

[0022] FIG. **11** is an explanatory diagram illustrating major parts around an image forming portion of an image forming apparatus according to a third exemplary embodiment;

[0023] FIG. **12**A is an explanatory diagram illustrating a configuration example around a charging device employed in the third exemplary embodiment, and FIG. **12**B is an explanatory diagram illustrating the modification exemplary embodiment around the charging device employed in the third exemplary embodiment;

[0024] FIG. **13** is an explanatory diagram illustrating major parts around an image forming portion of an image forming apparatus according to a fourth exemplary embodiment; and

[0025] FIG. **14**A is an explanatory diagram illustrating a configuration example of a cooling device employed in the fourth exemplary embodiment, and FIG. **14**B is an explanatory diagram illustrating another configuration example of the same cooling device.

DETAILED DESCRIPTION

Outline of Exemplary Embodiment

[0026] FIG. **1**A illustrates an outline of the exemplary embodiment of an image forming apparatus to which the present disclosure is applied.

[0027] In FIG. **1**A, the image forming apparatus is provided with a photoconductor **1** on which an image is held; a charging device **2** that charges the photoconductor **1**; a developing machine **6** that is provided downstream of the charging device **2** in a rotational direction of the photoconductor **1** and develops an electrostatic latent image formed after charging the photoconductor **1** with a developer; a cleaning device **7** that is provided upstream of the charging device **2** in the rotational direction of the photoconductor **1** and cleans a residue remaining on the photoconductor **1**.

[0028] In particular, in this exemplary embodiment, as illustrated in FIGS. **1**A and **1**B, the charging device **2** includes a charging unit **3** disposed in contact with the photoconductor **1**, a housing **4** that houses the charging unit **3**, and a heating unit **5** that directly heats the housing **4** or the charging unit **3**. The word "house" as used herein refers to a state in which it is disposed so as to face at least a part of an outer peripheral surface of the charging unit **3**.

[0029] Note that, in this exemplary embodiment, a latent image writing unit (not shown) that writes an electrostatic latent image on the photoconductor **1** is provided downstream of the charging device **2** in the rotational direction of the photoconductor **1** and upstream of the developing machine **6** in the rotational direction of the photoconductor **1**, and a developed image on the photoconductor **1** developed by the developing machine **6** is transferred to a transfer medium **9** (including an intermediate transfer body without limiting to a recording material) by a transfer unit **8**.

[0030] In such technical units, the photoconductor **1** may be in any form having a photosensitive layer on a conductive substrate, and a protective layer may be provided on a surface layer, or an undercoat layer may be appropriately provided between the base body and the photosensitive layer. In addition, an organic photoconductor using an organic photosensitive material is often used as the photosensitive layer; however, the exemplary embodiment is not limited thereto, and a photosensitive layer using an inorganic photosensitive material such as an amorphous silicon layer may be used. Furthermore, the form of the photoconductor **1** is not limited to a drum shape, but includes a belt shape.

[0031] As for the configuration of the charging device **2**, the charging unit **3** may be disposed in contact with a photoconductor **1**, or a small gap may exist between the charging unit **3** and the photoconductor **1** as long as the charging unit **3** is configured to charge the photoconductor **1**. In addition, an aspect in which a charging voltage including an AC component is applied between the charging unit **3** and the photoconductor **1** is usually employed.

[0032] Further, the housing **4** may be open at least on the photoconductor **1** side, and may hold the charging unit **3** to face the opening.

[0033] Furthermore, the heating unit **5** includes an aspect in which the charging unit **3** is directly heated and an aspect in which the housing **4** is directly heated to heat the charging unit **3** in the housing **4**. The expression "directly heated" as used herein refers to that there is a line segment which does not intersect the heating unit **5** and a shielding member other than the heating target when the heating unit **5** and the heating target (the housing **4** or the charging unit **3**) are connected by a line segment. For this reason, the aspect in which the housing **4** is directly heated is an aspect in which the housing **4** is disposed in contact with the housing **4**, but includes an aspect in which the housing **4** is disposed in a non-contact manner via a bracket. In addition, as the aspect in which the charging unit **3** is directly heated, the charging unit **3** may be disposed in contact or non-contact manner as long as the charging unit **3** is disposed in a portion in the housing **4** where the charging unit **3** is directly heated.

[0034] Next, a typical aspect of the charging device **2** will be described.

[0035] First, as a typical aspect of the heating unit **5**, an aspect in which the heating unit **5** is disposed in contact with the outside or the inside of the housing **4** can be exemplified. In this exemplary embodiment, the housing **4** of the charging device **2** is directly heated.

[0036] In this exemplary embodiment, as a typical aspect of the heating unit **5**, as illustrated in FIG. **1**B, an aspect in which the housing **4** is at least partially covered with a thermally conductive member **4*a*** on the outside or inside, and the heating unit **5** is disposed in contact with the thermally conductive member **4*a*** can be exemplified. In this exemplary embodiment, the heat of the heating unit **5** is transmitted to the housing **4** through the thermally conductive member **4*a***. The "thermally conductive member **4*a***" as used herein means a metal such as copper having a higher heat conduction coefficient than the material of the housing **4**.

[0037] Alternatively, the heating unit **5** may be disposed to directly heat the surface of the photoconductor **1** as well. In this exemplary mode, the surface of the photoconductor **1** is also directly heated, except that the surface of the photoconductor **1** is indirectly heated by raising the internal temperature in the vicinity of the photoconductor **1**.

[0038] Furthermore, the housing **4** may also have a heat shielding portion (not illustrated in FIGS. **1**A and **1**B) that shields heat from the heating unit **5** at least either upstream or downstream of the photoconductor **1** in the rotational direction. In this exemplary mode, the heat shielding portion is provided in at least a part of the housing **4** upstream or downstream of the photoconductor **1** in the rotational direction so that the heat from the heating unit **5** does not reach a region other than a region facing the charging device **2** of the photoconductor **1**. The heat shielding portion as referred herein includes an aspect in which a heat shielding wall portion protrudes from an opening edge of the housing **4** (storing container) and an aspect in which the thermally conductive member **4***a* is not provided on an outer wall of the housing **4**.

[0039] Further, a typical aspect of the image forming apparatus will be described.

[0040] First, in the exemplary embodiment, a typical aspect of the image forming apparatus includes an aspect in which the charging device **2** includes the heating unit **5**. However, the exemplary embodiment is not limited thereto, and as another typical aspect of the image forming apparatus, an aspect in which a photoconductor heating unit **10** that is disposed in non-contact with the charging device **2** and is provided separately from the heating unit **5** of the charging device **2** to heat the surface of the photoconductor **1** is exemplified. This exemplary embodiment is an aspect of including the photoconductor heating unit **10** that heats the surface of the photoconductor **1** separately from the heating unit **5** that heats the charging unit **3** or the housing **4**.

[0041] In this exemplary embodiment, the photoconductor heating unit **10** directly heats the surface of the photoconductor **1**. In addition, the photoconductor **1** may be indirectly heated by heating the environment surrounding the photoconductor **1**.

[0042] Further, the control unit **11** may also be provided to control the heating unit **5** and the photoconductor heating unit **10** in the charging device **2**.

[0043] Here, as a typical aspect of the control unit **11**, there is an aspect in which the heating conditions of the heating unit **5** and the photoconductor heating unit **10** are controlled depending on the information on humidity at or around the photoconductor **1**. This exemplary embodiment also includes an aspect in which the heating unit **5** is operated in a predetermined high humidity environment and the heating unit **5** is not operated in a low humidity environment.

[0044] Further, the image forming apparatus may include a lowering unit **12** that lowers the surface temperature of the photoconductor **1** in a region between the charging device **2** and the developing machine **6** downstream of the photoconductor **1** in the rotational direction. In this exemplary embodiment, the surface temperature of the photoconductor **1** is lowered by the lowering unit **12** so that the photoconductor **1** heated in the charging area does not reach the developing area in the high temperature state as it is, thereby preventing excessive overheating of the developer (or toner) in the developing area by the developing machine **6**.

[0045] Here, there is an aspect in which the lowering unit **12** is typically a cooling unit **13** that cools the surface of the photoconductor **1** in such a manner as not to be in contact with the surface of the photoconductor **1**. The cooling unit **13** referred herein is not limited to air cooling, but includes an aspect in which a heat dissipation member is brought into contact with the back surface of the base body of the photoconductor **1**.

[0046] Further, as another typical aspect of the lowering unit **12**, there is an aspect in which the shielding unit **14** is provided between the charging device **2** and the developing machine **6** so as to shield heat from the heating unit **5** of the charging device **2**.

[0047] Furthermore, the lowering unit **12** may lower the temperature of the surface of the photoconductor **1** facing the developing machine **6** to a temperature equal to or lower than the allowable heat-resistant temperature of the developer. The allowable heat-resistant temperature of the developer means the softening point of the toner contained in the developer, and the measurement method may be appropriately selected.

[0048] The image forming apparatus may further include a shielding unit **15** provided so that the heat from the heating unit **5** of the charging device **2** is shielded in a region between the charging device **2** and the cleaning device **7** upstream of the photoconductor **1** in the rotational direction. In this exemplary mode, the heat of the heating unit **5** is not affected by the cleaning device **7**. Here, when the heat of the heating unit **5** becomes a factor for heating the cleaning unit **7***a*, there is a concern that the developer (toner) residue cleaned by the cleaning unit **7***a* is melted and accumulated between the cleaning unit **7***a* and the photoconductor **1**, and the frictional resistance at a contact portion between the cleaning unit **7***a* and the photoconductor **1** is increased, and excessive torque acts on the photoconductor **1**.

[0049] Hereinafter, the exemplary embodiment will be described in more detail with reference to the accompanying drawings.

First Exemplary Embodiment

[0050] FIG. **2** illustrates an overall configuration of an image forming apparatus according to a first exemplary embodiment.

[0051] Overall Configuration of Image Forming Apparatus

[0052] In FIG. **2**, in an apparatus housing (not shown), the image forming apparatus is provided with an image forming portion **20** (specifically, **20***a* to **20***d*) that forms plural color component images (yellow, magenta, cyan, and black in the exemplary embodiment); a belt-shaped intermediate transfer body **30** that sequentially transfers (primary transfer) and holds each color component image formed in each image forming portion **20**; a secondary transfer device (collective transfer device) **40** that secondarily transfers (collectively transfers) each color component image transferred onto the intermediate transfer body **30** to a paper S as a recording medium; and a fixing device **50** that fixes the secondarily transferred image on the paper S.

[0053] Image Forming Portion

[0054] In this exemplary embodiment, each image forming portion **20** (**20***a* to **20***d*) includes a drum-shaped photoconductor **21**, and in the vicinity of each photoconductor **21**, a charging device **22** in which the photoconductor **21** is charged; an exposure device **23** such as a laser scanning device in which an electrostatic latent image is written on the charged photoconductor **21**; a developing machine **24** that develops the electrostatic latent image written on the photoconductor **21** with each color component toner; a primary transfer device **25** such as a transfer roll for transferring a toner image on the photoconductor **21** to the intermediate transfer body **30**; and a cleaning device **26** that cleans residual toner on the photoconductor **21** are arranged.

[0055] Intermediate Transfer Body

[0056] The intermediate transfer body **30** is stretched over plural (four in this exemplary embodiment) tension rolls **31** to **34**. For example, the tension roll **31** is used as a drive roll, which is driven by a drive motor (not shown), to circulate the intermediate transfer body **30**. Further, the tension rolls **32** to **34** are all used as driven rolls, and the tension roll **33** functions as a tension roll that applies a predetermined tension to the intermediate transfer body **30**. Furthermore, an intermediate transfer body cleaning device **35** for removing a residual toner on the intermediate transfer body **30** after the secondary transfer is provided on a portion of the peripheral surface of the intermediate transfer body **30** facing the tension roll **31**.

[0057] Secondary transfer device (collective transfer device) Further, in the secondary transfer device (collective transfer device) **40**, a transfer roll **41** is disposed in a portion of the periphery of the intermediate transfer body **30** facing the tension roll **34** so as to be in contact with the surface of the intermediate transfer body **30**, and a predetermined transfer electric field is applied between the transfer roll **41** and the tension roll **34** using the tension roll **34** as a counter electrode.

[0058] In this exemplary embodiment, the transfer roll **41** has a configuration in which a metal shaft is covered with an elastic layer in which carbon black or the like is blended with foamed urethane rubber or EPDM, and while a metal shaft is installed, a predetermined transfer voltage is applied to the tension roll **34** that is a counter electrode.

[0059] Fixing Device

[0060] The fixing device **50** includes a heat fixing roll **51** that is rotatably disposed in contact with the paper S on the image holding surface side, and a pressure fixing roll **52** that is press-contact with the heat fixing roll **51** and rotates following the heat fixing roll **51**, in which the image held on the paper S is passed through the transfer region between the two fixing rolls **51** and **52** to heat, press, and fix the image.

Configuration Example of Photoconductor

[0061] In the exemplary embodiment, as illustrated in FIGS. **3**A and **3**B, for example, the photoconductor **21** having a photosensitive layer **21***a* on the surface of a drum-shaped base body **21***b* is used. In this exemplary embodiment, the photosensitive layer **21***a* is formed of an organic material such as an organic photosensitive material, and may be a function separation type that is divided into a charge generation layer and a charge transport layer, or may be a function integration type.

[0062] This type of photosensitive layer **21***a* may be exposed and used as it is on the surface layer of the photoconductor **21**, but is easily worn, and therefore, a protective layer **21***c* may be provided on the photosensitive layer **21***a* as indicated by a virtual line in FIG. **3**B.

[0063] The photoconductor **21** may be provided with an undercoat layer (not shown) between the base body **21***b* and the photosensitive layer **21***a* as necessary. Of course, the design may be changed as appropriate, such as providing other functional layers between the photosensitive layer **21***a* and the protective layer **21***c*.

[0064] Here, the protective layer **21***c* is provided, for example, for the purpose of preventing scratches on the surface of the photoconductor **21**, preventing variations in polishing, preventing adsorption of nitride oxide, or the like, improving resistance to an oxidizing atmosphere by ozone or nitride oxide, and the like. The protective layer **21***c* may be a film that is highly transparent, dense, and excellent in hardness.

Configuration Example of Charging Device

[0065] In the exemplary embodiment, as illustrated in FIG. **3**A, the charging device **22** includes a charging housing **61** as a housing having a substantially U-shaped cross section that opens at a portion facing the photoconductor **21**, and provided with a charging roll **62** as a charging unit that contacts the surface of the photoconductor **21** in the charging housing **61**, and a cleaning roll **63** as a cleaning unit that cleans the charging roll **62**.

[0066] Here, the charging roll **62** has, for example, a conductive metal shaft, and a charging layer is formed at a portion except for the support portions at both ends of this shaft; however, this exemplary embodiment is not limited to this, and the design may be changed as appropriate.

[0067] On the other hand, the cleaning roll **63** has, for example, a conductive metal shaft, and a sponge layer is formed by, for example, spirally winding a sponge material as a cleaning material around the shaft. This type of sponge layer is selected from those made of foamable resin or rubber such as polyurethane, polyethylene, polyamide, or polypropylene. Note that, the configuration of the cleaning roll **63** is not limited to this, and the design may be changed as appropriate.

[0068] In this exemplary embodiment, the cleaning roll **63** is pressed against the charging roll **62** with a predetermined load, and the sponge layer is elastically deformed along the peripheral surface of the charging roll **62** to form a contact area. When the photoconductor **21** is rotationally driven by a drive motor (not shown), the charging roll **62** is driven to rotate by the rotation of the photoconductor **21**, and the cleaning roll **63** is driven to rotate by the rotation of the charging roll **62**.

[0069] As described above, when the cleaning roll **63** is driven to rotate, foreign matters such as toner and external additives attached to the surface of the charging roll **62** are cleaned by the cleaning roll **63**.

[0070] Further, in this exemplary embodiment, a charging power supply **65** is connected to the charging roll **62** as illustrated in FIG. **3**A. The charging power supply **65** is formed by connecting a DC power supply **66** and an AC power supply **67** in series, and both the power supplies **66** and **67** are configured to be variably adjustable. For this reason, a charging voltage Vc in which an AC component is superimposed on a DC component is applied to the charging roll **62**.

[0071] Furthermore, in this exemplary embodiment, a charging heater **68** is provided as a heating unit that heats the charging housing **61** and the charging roll **62**. Note that, the details of the charging heater **68** will be described later.

Configuration Example of Developing Machine

[0072] The developing machine **24** includes a developing container **71** in which a portion facing the photoconductor **21** is opened and a developer containing, for example, a toner and a carrier is stored, and provided with a developing roll **72** capable of holding the developer at a portion facing the opening of the developing container **71**, stirring and transporting members **73** and **74** in which the developer is stirred to be circulated and transported on the back side of the developing roll **72** of the developing container **71**, and a layer thickness regulating member **75** that regulates the layer thickness of the developer that can be held on the developing roll **72** at a portion facing the developing roll **72**.

[0073] In this exemplary embodiment, a developing power supply (not shown) is connected to the developing roll **72**. The developing power supply is formed, for example, by connecting a DC power supply and an AC power supply in series, and both the power supplies are configured to be variably adjustable. For this reason, a developing voltage in which an AC component is superimposed on a DC component is applied to the developing roll **72**.

Configuration Example of Cleaning Device

[0074] As illustrated in FIG. **3**A, the cleaning device **26** includes a cleaning container **81** having an opening at a portion facing the photoconductor **21**, and provided with a plate-shaped clean member **82** that is elastically in contact with the photoconductor **21** at a portion facing the opening along the longitudinal direction of the cleaning container **81**, and a transport member **83** that transports residues such as toner scraped off by the clean member **82** along the longitudinal direction of the cleaning container **81** and outputs the residues to the outside in the cleaning container **81**.

[0075] Heating Mechanism with Charging Heater

[0076] In this exemplary embodiment, as illustrated in FIGS. **3**A and **4**A, the charging heater **68** is disposed in contact with the outer surface of a back surface portion **61***a* facing the opening of the charging housing **61** in the charging housing **61** having a substantially U-shaped cross section.

[0077] As illustrated in FIG. **4**B, the charging heater **68** includes, for example, an electric heating resistance wire **681** attached to a flat sheet **682** so that the surface in contact with the heating target can be substantially uniformly heated. However, the charging heater **68** is not limited to this and may be any of various flat heaters such as a silicon rubber heater, a flat thin plate space heater, and a polyimide flat heater. As a matter of course, the charging heater **68** may be other than the flat heater.

[0078] In particular, in this exemplary embodiment, the outer surface and the inner surface of the charging housing **61** are covered with a thermally conductive member **685** made of copper having a higher heat conduction coefficient than the charging housing **61**, and the charging heater **68** is disposed on the outer surface of the covered thermally conductive member **685**. Therefore, in this exemplary embodiment, the heat from the charging heater **68** heats the charging housing **61** via the thermally conductive member **685**, and further, the surface of the photoconductor **21** is heated by radiant heat Q from the charging housing **61** in a region Rh facing the openings of the charging roll **62** and the charging housing **61**.

[0079] In addition, the installation location of the charging heater **68** is not limited to the position indicated by a solid line in FIG. **4**A. For example, as indicated by a virtual line in FIG. **4**A, it may be disposed in contact with the outer surface of the side surface portion **61***b* (or **61***c*) of the charging housing **61** which is adjacent to the opening of the charging housing **61**. Furthermore, the installation location of the charging heater **68** is not limited to the outside of the charging housing **61**, as indicated by the solid line in FIG. **4**C, the charging heater **68** may be disposed in contact with the inner surface of the back surface portion **61***a* of the charging housing **61** which faces the opening of the charging housing **61**. Alternatively, as indicated by the virtual line in FIG. **4**C, the charging heater **68** may be disposed in contact with the inner surface of the side surface portion **61***b* (or **61***c*) of the charging housing **61** which is adjacent to the opening of the charging housing **61**. Note that, as compared with the case of disposing the charging heater **68** in contact with the outer surface of the charging housing **61** as indicated by the solid line or virtual line in FIG. **4**A, when the charging heater **68** is disposed in contact with the inner surface of the charging housing **61** as indicated by the solid line or virtual line in FIG. **4**C, the charging roll **62** can be efficiently heated.

[0080] Necessity of Installing a Charging Heater

[0081] As illustrated in FIG. **5**A, in general, in the charging area between the charging roll **62** and the photoconductor **21** of the charging device **22**, discharge due to charging voltage application occurs, and as a result, a discharge product **90** such as ozone or nitrogen oxide is generated and attached to the surface of the photoconductor **21**.

[0082] At this time, for example, in a high humidity environment, since there is a lot of moisture W in the environment surrounding the photoconductor **21**, the opportunity for the moisture W to be attached to the surface of the photoconductor **21** is increased. In this state, since the discharge product **90** has water absorbency, it is assumed that when the moisture W is absorbed, it is ionized like electrolytic water, and as a result, a charged electric charge **91** on the surface of the photoconductor **21** is conducted along the surface of the surface of the photoconductor **21**, which may lead to an image defect that causes image flow.

[0083] Therefore, in this exemplary embodiment, in order to prevent this type of image defect, as a countermeasure that the moisture W is not absorbed by the discharge product **90** generated in the charging area between the charging roll **62** and the photoconductor **21**, it is intended to remove the moisture W in the vicinity of the charging area by locally heating the charging roll **62** and the photoconductor **21** opposed thereto. Further, it is intended to reduce the amount of discharge product **90** by reducing the amount of current required for charging by heating the charging roll **62**.

[0084] Points to Note when Selecting Charging Current

[0085] In this exemplary embodiment, when examining the relationship between the charging voltage Vc of the charging device **22** and the charging current Ic, as illustrated in FIG. **5**B, the charging voltage Vc is increased in proportion to an increase in the charging current Ic; however, when the charging voltage Vc reaches a predetermined peak value, no increase in the charging voltage Vc is observed even if the charging current Ic increases thereafter. Therefore, when using a stable charging voltage Vc, a predetermined peak value is employed as the charging voltage Vc. Immediately after the charging voltage Vc reaches a predetermined peak value, an abnormal discharge occurs and a white spot occurs, and thus it is necessary to select the charging current Ic by taking a predetermined margin (Ic (M): %) from a boundary point P at which the charging voltage Vc reaches the predetermined peak value. On the other hand, if the margin Ic (M) of the charging current Ic is excessively large, a large amount of discharge product **90** may be produced. Thus, the margin Ic (M) of the charging current Ic should be reduced as much as possible. Therefore, it is necessary to obtain a margin Ic (M) of the charging current Ic that prevents the generation of the discharge product **90** while preventing the white spot. Here, it has been clarified by the inventors that when the charging roll **62** is heated to a high temperature, a white spot does not occur even if the margin Ic (M) of the charging current Ic is small. Therefore, in order to obtain the optimum margin Ic (M) of the charging current Ic, it is important to take the temperature of the charging roll **62** into consideration, and as described above, it is necessary to heat the charging roll **62** by installing the charging heater **68**.

[0086] Restriction of Heating Operation by Charging Heater

[0087] In the exemplary embodiment, as illustrated in FIG. **5**C, a developing machine **24** is installed around the photoconductor **21** downstream of the charging device **22** in the rotational direction of the photoconductor **21**, and a cleaning device **26** is installed upstream of the charging device **22** in the rotational direction of the photoconductor **21**.

[0088] Here, in a developing area Rdv of the developing machine **24**, a developing operation is performed in which the electrostatic latent image formed on the photoconductor **21** is developed by the toner TN of the developer held on the developing roll **72**. At this time, a surface temperature Tdv of the photoconductor **21** facing the developing area Rdv needs to be at least lower than a toner heat resistance limit temperature Ttn. For this reason, the heating operation by the charging heater **68** of the charging device **22** heats the photoconductor **21** in the region Rh facing the opening of the charging roll **62** and the charging housing **61**, but the surface temperature of the photoconductor **21** should be within a range that is lower than the toner heat resistance limit temperature Ttn at the stage where the surface temperature reaches the developing area Rdv. In FIGS. **5**A to **5**C, Tc represents the surface temperature of the charging roll **62**, and Rc represents the charging area by the charging roll **62**.

[0089] The term of "toner heat resistance limit temperature Ttn" in this exemplary embodiment means, for example, the softening point of the toner. As a method for measuring the softening point of the toner, for example, ½ descent rate (temperature corresponding to ½ of the height from the outflow start point to the end point when the toner sample is melted out) which is measured under the conditions of a die pore diameter of 0.5 [mm], a pressure load of 0.98 [MPa], and a rate of temperature increase of 1 [° C./Min] by using a flow tester: CFT500 (manufactured by Shimadzu Corporation) may be used as the softening point of the toner.

[0090] The surface temperature Tcn of the photoconductor **21** facing an area Rcn to be cleaned by the clean member **82** of the cleaning device **26** may be such that a residual toner TN' removed by the clean member **82** is prevented from melting and staying in the vicinity of the cleaning area Rcn between the clean member **82** and the photoconductor **21**. If the residual toner TN' is melted and stayed at the tip end portion of the clean member **82**, there is a concern in that the contact pressure of the clean member **82** is excessively applied to the rotational drive of the photoconductor **21**, and the rotational torque of the photoconductor **21** is unnecessarily bulky. In this exemplary embodiment, an allowable range is determined in advance as the rotational torque of the photoconductor **21**, the surface temperature Tcn of the photoconductor **21** corresponding to the maximum value of the allowable range is set as a torque guarantee temperature Ttq, and the surface temperature Tcn of the photoconductor **21** in the cleaning area Rcn is set to be equal to or lower than the torque guarantee temperature Ttq.

[0091] Heating Conditions with Charging Heater

[0092] In selecting the heating conditions of the charging heater **68**, some conditions for reducing the margin Ic (M) of the charging current Ic will be examined.

[0093] The following four boundary lines are listed as consideration items.

I: Allowable line between surface temperature change of charging roll capable of reducing white spot and margin Ic (M) of charging current Ic

II: Allowable line between surface temperature change of charging roll and image flow

III: Toner heat resistance tolerance line (corresponding to toner heat resistance limit temperature Ttn)

IV: Allowable line between surface temperature of charging roll and margin Ic (M) of charging current Ic for obtaining the allowable rotational torque

[0094] When the heating condition of the charging heater **68** is selected in consideration of these four boundary lines, the result illustrated in FIG. **6** is obtained.

[0095] In FIG. **6**, if the environmental temperature at which the charging heater **68** starts to be used is set as Te, regarding the boundary line I, it is suggested that when the surface temperature Tc of the charging roll **62** when the charging heater **68** is not used is set to be less than Te, the lower the surface temperature Tc of the charging roll **62**, the larger the margin Ic (M) of the charging current Ic needs to be secured, and when the surface temperature Tc of the charging roll **62** is increased with heating by the charging heater **68**, the margin Ic (M) of the charging current Ic may be small, and the margin Ic (M) of the charging current Ic is reduced with the heating of the charging heater **68**.

[0096] In addition, regarding the boundary line II, it is suggested that when the surface temperature Tc of the charging roll **62** is increased with the heating by the charging heater **68**, the margin Ic (M) of the charging current Ic for preventing image flow, for example, in 10 k image forming cycles, tends to be proportionally increased, and the range of use may be set to be equal to or lower than the boundary line II.

[0097] Further, it is suggested that the boundary line III needs to be selected so that the surface temperature of the charging roll **62** does not exceed the toner heat resistance boundary so as to be within the toner heat resistance limit temperature Ttn.

[0098] Furthermore, regarding the boundary line IV, when the surface temperature Tc of the charging roll **62** is increased with heating by the charging heater **68**, it is necessary to use a smaller margin Ic (M) of the charging current Ic, and if a large margin Ic (M) of the charging current Ic is used, there is a concern in that the torque allowable line may be exceeded.

[0099] From the above examination results, as illustrated in FIG. **6**, it is suggested that the surface temperature Tc of the charging roll **62** and the margin Ic (M) of the charging current Ic in the region (indicated by a dashed line in FIG. **6**) surrounded as an OK region of each of the boundary lines I to IV are selected as the heating conditions for the charging roll **62**.

[0100] System for Controlling Photoconductor Heating Control Sequence

[0101] As illustrated in FIGS. **3**A and **3**B, the system for controlling the sequence for controlling the heating of the photoconductor **21** is as follows. For example, it has a control device **110** provided with a microcomputer including a CPU, a RAM, a ROM, and an input/output port, and a program for controlling the sequence for heating the photoconductor **21** (refer to FIG. **7**) is installed in the ROM of the control device **110** in advance so that the CPU executes the program and sends a control signal to the charging heater **68** of the charging device **22**.

[0102] In particular, in this exemplary embodiment, a heating power supply **120** is connected to the charging heater **68** via a switch **121**, and the switch **121** is turned on and off by a control signal from the control device **110**.

[0103] In addition, an environment sensor **130** is installed in the vicinity of the periphery of the photoconductor **21** so that the sequence for controlling the heating of the photoconductor **21** is selectively performed according to the environment surrounding the photoconductor **21**. Here, the environment sensor **130** may be one that detects both temperature and humidity, or may be one that detects at least humidity.

[0104] Further, a temperature sensor **135** for detecting the surface temperature of the photoconductor **21** is installed in a region between the charging device **22** and the developing machine **24** downstream of the charging device **22** in the rotational direction of the photoconductor **21** in the periphery of the photoconductor **21**.

[0105] Action of Image Forming Apparatus

[0106] Image Forming Sequence

[0107] In the exemplary embodiment, in a case where the image forming apparatus is operated, a start switch (not shown) may be turned on, and as illustrated in FIG. **2**, each color component image is formed in each image forming portion **20** (**20***a* to **20***d*), and the image formed in each image forming portion **20** is transferred to the intermediate transfer body **30** and then transferred to the paper S in the secondary transfer area by the secondary transfer device **40**. The paper S on which the image has been transferred is discharged from an output potion (not shown) through a fixing process by the fixing device **50**.

[0108] Photoconductor Heating Control Sequence

[0109] Next, the sequence for controlling the heating of the photoconductor **21** will be described.

[0110] As illustrated in FIGS. **3** and **7**, the control device **110** performs the sequence for controlling the heating of the photoconductor **21** in parallel with the image forming sequence.

[0111] In this exemplary embodiment, the control device **110** performs an environment check. This environment check detects environmental information (temperature and humidity in this exemplary embodiment) of the environment sensor **130** and determines whether or not the environment surrounding the photoconductor **21** is a high humidity environment. The term of "high humidity environment" here means, for example, a high temperature and high humidity environment where the temperature is 28° C. or higher and the humidity is 85% or higher.

[0112] When it is determined that the environment surrounding the photoconductor **21** is the high humidity environment, the control device **110** supplies the heating voltage from the heating power supply **120** to the charging heater **68** by turning on the switch **121**. Then, the charging heater **68** is turned on.

[0113] In addition, the control device **110** monitors the temperature information detected from the temperature sensor **135**, when the surface temperature of the photoconductor **21** is set as Tpr and the target temperature of the photoconductor **21** is set as Tth (in this exemplary embodiment, for example, a temperature set slightly lower than the toner heat resistance limit temperature Ttn and the torque guarantee temperature Ttq), until the image forming cycle is completed, turning on/off of the charging heater **68** is controlled so that the surface temperature Tpr of the photoconductor **21** is maintained at the target temperature Tth.

[0114] In this way, when the sequence for controlling the heating of the charging heater **68** is performed, the heat from the charging heater **68** heats the charging housing **61** via the thermally conductive member **685**, and in the charging housing **61**, radiant heat from the charging housing **61** heats the charging roll **62**, and the surface of the photoconductor **21** facing the opening of the charging housing **61** is heated. For this reason, discharge is performed in the charging area Rc between the charging roll **62** and the photoconductor **21**, as illustrated in FIG. **5**A, the moisture W around the photoconductor **21** is evaporated and removed by heating the charging roll **62** and the photoconductor **21**, and as a result, the moisture W is prevented from being absorbed by the discharge product **90** on the photoconductor **21**. In this state, since the discharge product **90** on the photoconductor **21** does not become a state like electrolyzed water, it is difficult for the charged electric charge **91** to be conducted along the surface of the photoconductor **21**, and image quality defects such as image flow can be prevented.

[0115] In this exemplary embodiment, since the charging roll **62** and the surface of the photoconductor **21** are heated by the charging heater **68**, as illustrated in FIG. **6**, the margin Ic (M) of the charging current Ic applied to the charging roll **62** can be reduced to be small.

[0116] Furthermore, in this exemplary embodiment, since the surface temperature Tpr of the photoconductor **21** is adjusted to the target temperature Tth, the surface temperature Tpr of the photoconductor **21** does not exceed the toner heat resistance limit temperature Ttn and the torque guarantee temperature Ttq, and the developing performance with toner of the developing machine **24** is impaired. Alternatively, there is no concern in that excessive torque is generated in the photoconductor **21** at the contact portion with the clean member **82** in the cleaning device **26**.

[0117] If it is determined that the environment surrounding the photoconductor **21** is not the high humidity environment, the charging heater **68** is kept off. In this case, the sequence for controlling the heating of the photoconductor **21** is not performed when the environment surrounding the photoconductor **21** is not a high humidity environment. This is because, as compared with the case where the environment surrounding the photoconductor **21** is a high humidity environment, it is less necessary to perform the sequence for controlling the heating of the photoconductor **21**. That is, the fact that the environment surrounding the photoconductor **21** is not a high humidity environment means that the humidity W around the photoconductor **21** is small. In this situation, in the charging area of the charging device **22**, as illustrated in FIG. **5**A, the moisture W is hardly attached to the discharge product **90** on the photoconductor **21**, so that the charged electric charge **91** on the photoconductor **21** is conducted along the surface of the photoconductor **21** and rarely cause image flow.

Modification Exemplary Embodiment 1-1

[0118] In this exemplary embodiment, a method of selectively performing the sequence for controlling the heating of the photoconductor **21** according to the environment surrounding the photoconductor **21** is employed; however, the exemplary embodiment is not limited to this, and it goes without saying that the sequence for controlling the heating of the photoconductor **21** may be performed periodically or irregularly regardless of the environment surrounding the photoconductor **21**.

[0119] First comparative exemplary embodiment FIG. **8** illustrates a configuration example of the image forming portion of the image forming apparatus according to the first comparative exemplary embodiment.

[0120] In FIG. **8**, the basic configuration of the image forming apparatus is that plural (for example, four) image forming portions **20'** are installed below the intermediate transfer body **30'**, and as the image forming portion **20'**, a charging device **22'** (charging housing **210**, charging roll **211**, and cleaning roll **212**), a developing machine **24'**, and a cleaning device **26'** are arranged in the vicinity of a drum-shaped photoconductor **21'**. In this exemplary embodiment, the photoconductor **21'**, the charging device **22'**, and the cleaning device **26'** are housed in a cartridge case **201** as a photosensitive cartridge **200**, while the developing machine **24'** is configured as a developing cartridge **202** separately from the photosensitive cartridge **200**. Reference numeral **25'** denotes a primary transfer device.

[0121] In this exemplary embodiment, a photosensitive peripheral heater **205** is disposed outside the photosensitive cartridge **200** of the image forming portion **20'**. For example, the space in the vicinity of the image forming portion **20'** is heated by turning on the photosensitive peripheral heater **205** when the image forming apparatus is not operated in the high humidity environment.

[0122] In this exemplary embodiment, the photosensitive peripheral heater **205** is intended to remove moisture in the vicinity of the image forming portion **20'** in the high humidity environment. In the photosensitive cartridge **200**, the photosensitive peripheral heater **205** is installed on the back surface side of the charging device **22'** when viewed from the photoconductor **21'**, and a cartridge case **201** is provided outside the charging housing **210** of the charging device **22'**, and the heat from the photosensitive peripheral heater **205** is shielded by the cartridge case **201**.

[0123] For this reason, the "photosensitive peripheral heater **205**" according to the first comparative exemplary embodiment does not have an action of directly heating the charging housing **210** or the charging roll **211** of the charging device **22'** unlike the "charging heater **68**" according to the first exemplary embodiment, and it cannot be said that the moisture is removed in the charging area between the charging roll **211** and the photoconductor **21'**.

Second Exemplary Embodiment

[0124] FIG. **9** illustrates the major parts of the image forming portion of the image forming apparatus according to a second exemplary embodiment.

[0125] In FIG. **9**, the basic configuration of the image forming portion **20** is substantially the same as that of the first exemplary embodiment, but unlike the first exemplary embodiment, in the vicinity of the photoconductor **21**, a photoconductor heater **150** for heating the surface of the photoconductor **21** is installed between the charging device **22** and the developing machine **24** downstream of the charging device **22** in the rotational direction of the photoconductor **21**. Note that, components similar to those in the first exemplary embodiment are denoted by the same reference numerals as those in the first exemplary embodiment, and detailed description thereof will not be repeated here.

[0126] In this exemplary embodiment, the photoconductor heater **150** is disposed, for example, in a non-contact manner so as to face the surface of the photoconductor **21**, and directly heats the surface of the photoconductor **21**. In addition, a heating power supply **151** is connected to the photoconductor heater **150** via a switch **152**, and the switch **152** is turned on and off by a control signal from the control device **110**.

[0127] Note that, as the photoconductor heater **150**, it is also possible to use one that is disposed in the vicinity of the photoconductor **21** and indirectly heats the photoconductor **21** by heating the peripheral space of the photoconductor **21**.

[0128] In addition, in this exemplary embodiment, a humidity sensor that detects only humidity information is used as the environment sensor **130**. In the periphery of the photoconductor **21**, a temperature sensor **140** for detecting the temperature of the peripheral space of the photoconductor **21** is separately installed in a region between the charging device **22** and the developing machine **24** downstream of the charging device **22** in the rotational direction of the photoconductor **21**. Note that, in this exemplary embodiment, the temperature sensor **140** is provided separately from the environment sensor **130** for detecting information on the environment surrounding the photoconductor **21**. However, the temperature sensor **140** may also be used in consideration of the installation location of the environment sensor **130**.

[0129] According to the exemplary embodiment, the control device **110** first performs an environment check as illustrated in FIG. **10**. This environment check detects environmental information (humidity in this exemplary embodiment) of the environment sensor **130** and determines whether or not the environment surrounding the photoconductor **21** is a high humidity environment. The term of "high humidity environment" here means, for example, a high humidity environment where the humidity is 85% or higher.

[0130] When the control device **110** determines that the environment surrounding the photoconductor **21** is a high humidity environment, the charging heater **68** is turned on, and when the control device **110** determines that the environment surrounding the photoconductor **21** is not a high humidity environment, the charging heater **68** is kept off.

[0131] After that, the control device **110** compares a detection temperature Ten with a predetermined reference temperature Ten**0** based on the temperature information detected by the temperature sensor **140**. When Ten<Ten**0** is established, the photoconductor heater **150** is turned on, and when Ten≤Ten**0**, the photoconductor heater **150** is kept off.

[0132] Thereafter, the control device **110** performs on/off control of the charging heater **68** and the photoconductor heater **150** so as to maintain the respective target temperatures until the image forming cycle is completed.

[0133] As described above, in this exemplary embodiment, since a method of independently controlling the charging heater **68** and the photoconductor heater **150** is employed, the surface temperature of the photoconductor **21** can be easily adjusted as compared with a method of controlling the surface temperature of the photoconductor **21** by controlling only the charging heater **68**. That is, as a charging operation by the charging device **22**, the charging heater **68** is mainly used to construct an optimum charging environment, and as a developing operation by the developing machine **24** and a cleaning operation by the cleaning device **26**, the photoconductor heater **150** is mainly used to construct an optimum development environment and cleaning environment.

Third Exemplary Embodiment

[0134] FIG. **11** illustrates the major parts of the image forming portion of the image forming apparatus according to a third exemplary embodiment.

[0135] In FIG. **11**, the basic configuration of the image forming portion **20** is substantially the same as that of the first exemplary embodiment, but unlike the first exemplary embodiment, there is a countermeasure that the secondary trouble associated with the aspect in which the charging heater **68** is attached to the charging device **22** is prevented. Note that, components similar to those in the first exemplary embodiment are denoted by the same reference numerals as those in the first exemplary embodiment, and detailed description thereof will not be repeated here.

[0136] In this exemplary embodiment, the charging device **22** includes a charging heater **68** that directly heats the charging housing **61** and the charging roll **62**, but a situation in which heat from the charging heater **68** is released to the outside of the charging device **22** cannot be avoided. At this time, the developing machine **24** and the cleaning device **26** are installed in the vicinity of the charging device **22**. However, as described above, the developing area Rdv of the developing machine **24** is required to satisfy the temperature condition equal to or lower than the toner heat resistant limit temperature Ttn. Further, the cleaning area Rcn of the cleaning device **26** is required to satisfy a temperature condition equal to or lower than the torque guarantee temperature Ttq. For this reason, the heat from the charging heater **68** should have a reduced effect on the developing machine **24** and the cleaning device **26** positioned in the vicinity of the charging device **22**.

[0137] In this exemplary embodiment, as illustrated in FIG. **12**A, a first shielding member **161** as a shielding unit is installed downstream of the charging device **22** in the rotational direction of the photoconductor **21**, and a second shielding member **165** as a shielding unit is installed upstream of the charging device **22** in the rotational direction of the photoconductor **21**.

[0138] Here, the first shielding member **161** is provided near the charging device **22** in a region between the charging device **22** and the developing machine **24**, and includes flat shielding plate **162** facing the side surface portion **61***c* of the charging housing **61** of the charging device **22** and extending in the radial direction of the drum-shaped photoconductor **21**, and forms a bent portion **163** that bends toward the charging housing **61** on the side of the shielding plate **162** that is away from the photoconductor **21**.

[0139] On the other hand, the second shielding member **165** is provided near the charging device **22** in a region between the charging device **22** and the cleaning device **26**, and includes flat shielding plate **166** facing the side surface portion **61***b* of the charging housing **61** of the charging device **22** and extending in the radial direction of the drum-shaped photoconductor **21**, and forms a bent portion **167** that bends toward the charging housing **61** on the side of the shielding plate **166** that is away from the photoconductor **21**.

[0140] Note that, in this exemplary embodiment, aluminum that reflects radiant heat, an ABS resin having a low thermal conductivity, or the like is used as the shielding plates **162** and **166**.

[0141] Therefore, in this exemplary embodiment, as illustrated in FIG. **12**A, the heat from the charging heater **68** heats the charging housing **61** via the thermally conductive member **685**, radiant heat Q is generated from the heated charging housing **61**, and the surface of the photoconductor **21** is heated in a region Rh facing the openings of the charging roll **62** and the charging housing **61**.

[0142] Further, as the entire charging housing **61** is heated, the radiant heat Q is also released to the outside of the charging housing **61**. The propagation of the radiant heat Q is blocked by the first and second shielding members **161** and **165** installed on the side of the charging housing **61**. For this reason, the situation in which the heat from the charging heater **68** gets over the first and second shielding members **161** and **165** and propagates to the developing machine **24** side or the cleaning device **26** side can be prevented. In particular, in this exemplary embodiment, since the first and second shielding members **161** and **165** are formed with bent portions **163** and **167** on the side of the shielding plates **162** and **166** away from the photoconductor **21**, the radiant heat Q directed toward the side on the first and second shielding members **161** and **165** away from the photoconductor **21** is held by the bent portions **163** and **167**, and as a result, it is difficult to get over the first and second shielding members **161** and **165**.

Modification Exemplary Embodiment 3-1

[0143] In this exemplary embodiment, the first and second shielding members **161** and **165** are used as the shielding units, but are not limited to this, for example, as in the modification exemplary embodiment 3-1 illustrated in FIG. **12**B, those have a structure in which the thermally conductive member **685** is attached only to the inside of the charging housing **61**, and the thermally conductive member **685** is not attached to the outside of the charging housing **61**, and the charging heater **68** may be disposed in contact with the thermally conductive member **685** inside the charging housing **61**.

[0144] According to this modification exemplary embodiment, the heat from the charging heater **68** heats the inner surface portion of the charging housing **61** via the thermally conductive member **685**, and the surface of the photoconductor **21** is heated with the radiant heat Q in a region Rh facing the openings of the charging roll **62** and the charging housing **61**. On the other hand, since the thermally conductive member **685** is not attached to the outer surface of the charging housing **61**, the degree of heating of the outer surface of the charging housing **61** by the charging heater **68** is low as compared with the inner surface of the charging housing **61**. As a result, the radiant heat Q released from the outer surface of the charging housing **61** is small. As described above, the structure in which the thermally conductive member **685** is not attached to the outer surface of the charging housing **61** functions as a shielding unit that shields the release of the heat to the outside of the charging housing **61**.

[0145] In addition, in this exemplary embodiment, as indicated by the virtual line in FIG. **12**B, a sealing member **170** that can be elastically deformed is provided at an opening edge of the charging housing **61**, and a gap between the opening edge of the charging housing **61** and the photoconductor **21** may be closed by the sealing member **170** to prevent the heat in the charging housing **61** from leaking out of the charging housing **61**.

[0146] Note that, the charging heater **68** is installed on the inside of the charging housing **61**, but is not limited to this, for example, as in the modification exemplary embodiment 3-1 illustrated in FIG. **12**B, a structure may be employed in which the thermally conductive member **685** is also attached to the inner side of the charging housing **61** while installing the charging heater **68** on the outer side of the back surface portion **61***a* of the charging housing **61** via the thermally conductive member **685**, and the thermally conductive member **685** is not attached to the outer surfaces of the side surface portions **61***b* and **61***c* of the charging housing **61** so as to shield the release of the heat from the side surface portions **61***b* and **61***c* of the charging housing **61** to the outside.

Fourth Exemplary Embodiment

[0147] FIG. **13** illustrates the major parts of the image forming portion of the image forming apparatus according to a fourth exemplary embodiment.

[0148] In FIG. **13**, the basic configuration of the image forming portion **20** is substantially the same as in the third exemplary embodiment in that there is a countermeasure that the secondary trouble associated with the aspect in which the charging heater **68** is attached to the charging device **22** is prevented. However, unlike the shielding unit of the third exemplary embodiment, as a lowering unit that lowers the surface temperature of the photoconductor **21**, a cooling device **180** that cools the surface of the photoconductor **21** is installed. Note that, components similar to those in the third exemplary embodiment are denoted by the same reference numerals as those in the third exemplary embodiment, and detailed description thereof will not be repeated here.

[0149] In this exemplary embodiment, for example, the cooling device **180** is arranged as illustrated in FIG. **14**A, in which a cooling air passage **181** is secured along the axial direction of the photoconductor **21** at the periphery of the photoconductor **21** in a region between the charging device **22** and the developing machine **24** downstream of the charging device **22** in the rotational direction of the photoconductor **21**, a blower fan **182** is installed as an airflow generating unit on one side of the cooling air passage **181**, and an exhaust fan **183** is installed on the other side of the cooling air passage **181**. Note that, the blower fan **182** and the exhaust fan **183** may be installed exclusively, or may be shared with other units installed in the image forming apparatus.

[0150] According to this exemplary embodiment, when the charging device **22** is heated by the charging heater **68**, the surface of the photoconductor **21** is heated in the region Rh facing the charging roll **62** in the charging housing **61** and facing the opening of the charging housing **61**, and the heat from the charging heater **68** is released to outside the charging device **22**.

[0151] In this state, when the photoconductor **21** with high surface temperature reaches the developing area Rdv of the developing machine **24**, there is a concern that the developing operation by the developing machine **24** may be hindered, and thus in this exemplary embodiment, a method is employed in which the surface of the photoconductor **21** is cooled using the cooling device **180** to lower the surface temperature of the photoconductor **21**. For this reason, the surface temperature of the photoconductor **21** that has reached the developing area Rdv of the developing machine **24** is sufficiently lowered, and the developing operation by the developing machine **24** is appropriately performed.

[0152] In this exemplary embodiment, the cooling device **180** is installed in a region between the charging device **22** and the developing machine **24** downstream of the charging device **22** in the rotational direction of the photoconductor **21**. However, this exemplary embodiment is not limited to this, and a configuration may be employed in which the cooling device **180** is also configured to exert a cooling effect on the region between the charging device **22** and the cleaning device **26** upstream of the charging device **22** in the rotational direction of the photoconductor **21**.

Modification Exemplary Embodiment 4-1

[0153] In this exemplary embodiment, an air cooling type is adopted as the cooling device **180**, but is not limited to this. For example, as in the modification exemplary embodiment 4-1 illustrated in FIG. **14**B, the cooling roll **190** as a cooling member may be disposed in driven-rotationally contact with a part of the back surface of the drum-shaped base body **21***b* of the photoconductor **21**, for example, a portion positioned upstream of the developing area Rdv of the developing machine **24** in the rotational direction of the photoconductor **21**, so that the heat accumulated in the photoconductor **21** is released through the cooling roll **190**, and as a result, the surface temperature of the photoconductor **21** is lowered.

[0154] In this exemplary embodiment, the cooling member is not limited to the cooling roll **190**, and an elastically deformable cooling sheet may be elastically brought into contact with a part of the back surface of the drum-shaped base body **21***b*.

[0155] In the present exemplary embodiment, the cooling device **180** is employed as a lowering unit that lowers the surface temperature of the photoconductor **21**. For example, the shielding unit (first and second shielding members **161** and **165**) described in the third exemplary embodiment and the cooling device **180** may be used in combination.

[0156] The foregoing description of the exemplary embodiments of the present invention has been provided for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obviously, many modifications and variations will be apparent to practitioners skilled in the art. The embodiments were chosen and described in order to best explain the principles of the invention and its practical applications, thereby enabling others skilled in the art to understand the invention for various embodiments and with the various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the following claims and their equivalents.

1. A charging device comprising:
a charging roll configured to charge a photoconductor;
a housing that houses the charging roll; and
a heater configured to directly heat the housing or the charging roll,
wherein the heater is disposed in contact with an outside or inside of the housing,
wherein at least a part of the outside or inside of the housing is covered with a thermally conductive member, and
wherein the heater is disposed in contact with the thermally conductive member.

2. (canceled)

3. (canceled)

4. The charging device according to claim **1**, wherein the heater is disposed to directly heat a surface of the photoconductor as well.

5. A charging device comprising:
a charging roll configured to charge a photoconductor;
a housing that houses the charging roll; and
a heater configured to directly heat the housing or the charging roll, wherein the housing has a heat shielding portion that shields heat from the heater and is located at least either upstream or downstream of the photoconductor in a rotational direction.

6. An image forming apparatus comprising:
a photoconductor configured to hold an image;
a charging device configured to charge the photoconductor;
a developing machine that is provided downstream of the charging device in a rotational direction of the photoconductor and is configured to develop an electrostatic latent image formed after charging of the photoconductor with a developer; and
a cleaning device that is provided upstream of the charging device in the rotational direction of the photoconductor and is configured to remove a residue on the photoconductor,
wherein the charging device comprises:
a charging roll configured to charge the photoconductor;
a housing that houses the charging roll; and
a heater configured to directly heat the housing or the charging roll,
wherein the image forming apparatus further comprises:
a photoconductor heater that is disposed in non-contact with the charging device and is provided separately from the heater of the charging device, and
wherein the photoconductor heater is configured to heat a surface of the photoconductor.

7. (canceled)

8. The image forming apparatus according to claim **6**, wherein the photoconductor heater is configured to directly heat the surface of the photoconductor.

9. The image forming apparatus according to claim **6** wherein the image forming apparatus according is configured to control heating conditions of the heater and the photoconductor heater depending on information on humidity at or around the photoconductor.

10. An image forming apparatus comprising:
a photoconductor configured to hold an image;
a charging device configured to charge the photoconductor;
a developing machine that is provided downstream of the charging device in a rotational direction of the photoconductor and is configured to develop an electrostatic latent image formed after charging of the photoconductor with a developer; and
a cleaning device that is provided upstream of the charging device in the rotational direction of the photoconductor and is configured to remove a residue on the photoconductor,
wherein the charging device comprises:
a charging roll configured to charge the photoconductor;
a housing that houses the charging roll; and
a heater configured to directly heat the housing or the charging roll, and
wherein the image forming apparatus further comprises a lowering unit configured to lower a surface temperature of the photoconductor in a region between the charging device and the developing machine downstream of the photoconductor in the rotational direction.

11. The image forming apparatus according to claim **10**, wherein the lowering unit is a cooling unit configured to cool a surface of the photoconductor in such a manner as not to be in contact with the surface of the photoconductor.

12. The image forming apparatus according to claim **10**, wherein the lowering unit is a shielding unit that is provided between the charging device and the developing machine, and
wherein the shielding unit is configured to shield heat from the heater of the charging device.

13. The image forming apparatus according to claim **10**, wherein the lowering unit is configured to lower the surface temperature of the photoconductor facing the developing machine to a temperature equal to or lower than an allowable heat-resistant temperature of the developer.

14. The image forming apparatus according to claim **6**, further comprising:
a shielding unit that is provided in a region between the charging device and the cleaning device and upstream in the rotational direction of the photoconductor,
wherein the shielding unit is configured to shield heat from the heater of the charging device.

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