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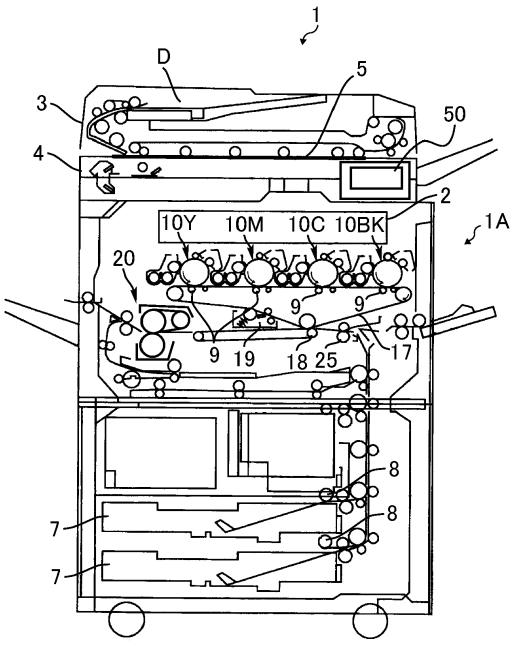
(54) LUBRICANT SUPPLY DEVICE, PROCESS CARTRIDGE, AND IMAGE FORMING APPARATUS

(57) A lubricant supply device (15) supplies a lubricant to a surface of an image bearer (11) at a position downstream from a cleaning blade (14a) in a rotation direction of the image bearer (11). The lubricant supply device (15) includes a conveying path (15g, 15h) configured to feed the lubricant from an inside of the lubricant supply device (15) to an inside of a cleaning device (14) in which the cleaning blade (14a) configured to contact the image bearer (11) is disposed, without passing through the image bearer configured to bear a toner image. The conveying path (15g, 15h) is configured to feed the lubricant to the surface of the image bearer (11) at a position upstream from the cleaning blade (14a) in the rotation direction of the image bearer (11).

FIG. 1



EP 3 951 507 A1

Description

BACKGROUND

Technical Field

[0001] Embodiments of the present disclosure relate to a lubricant supply device that supplies a lubricant to a surface of an image bearer on which a toner image is borne, a process cartridge including the lubricant supply device, and an image forming apparatus including the process cartridge, such as a copier, a printer, a facsimile machine, or a multifunction peripheral including at least two of the copier, the printer, and the facsimile machine.

Related Art

[0002] In image forming apparatuses such as copying machines and printers, there has been known a technique in which a lubricant supply device for supplying a lubricant to a surface of an image bearer such as a photoconductor drum or a cleaning blade is installed for the purpose of reducing deterioration with time or occurrence of an abnormal image due to wear of the image bearer or the cleaning blade (for example, refer to Japanese Unexamined Patent Application Publication No. 2008-046301 and Japanese Unexamined Patent Application Publication No. 2010-019982).

[0003] On the other hand, Japanese Unexamined Patent Application Publication No. 2008-046301 discloses a technique in which a lubricant application device is disposed on each of an upstream side and a downstream side from a cleaning blade in a rotation direction of a photoconductor drum in order to uniformly supply a lubricant to a surface of the photoconductor drum (image bearer) over a width direction.

[0004] Further, Japanese Unexamined Patent Application Publication No. 2010-019982 discloses a technique in which, for the purpose of removing toner accumulated on a portion formed by a cleaning blade (cleaning unit) and a photoconductor drum (image bearer), the cleaning blade is separated from the photoconductor drum at a predetermined timing to cause the accumulated toner to fall into a cleaning device.

[0005] The image forming apparatus disclosed in Japanese Unexamined Patent Application Publication No. 2008-046301 includes two lubricant supply devices and thus can be expected that a lubricant is supplied to the surface of the image bearer by utilizing the characteristics of the two lubricant supply devices. However, since two lubricant supply devices are provided, the size and cost of the image forming apparatus are increased.

SUMMARY

[0006] The present invention is made to solve the above-described problem and an object of the present invention is to provide a lubricant supply device, a process cartridge, and an image forming apparatus capable of efficiently supplying a lubricant to a surface of an image bearer without employing two lubricant supply devices.

[0007] According to an embodiment of the present disclosure, there is provided a lubricant supply device supplies a lubricant to a surface of an image bearer at a position downstream from a cleaning blade in a rotation direction of the image bearer. The lubricant supply device includes a conveying path to feed the lubricant from an inside of the lubricant supply device to an inside of a cleaning device in which the cleaning blade configured to contact the image bearer is disposed, without passing through the image bearer configured to bear a toner image. The conveying path feeds the lubricant to the surface of the image bearer at a position upstream from the cleaning blade in the rotation direction of the image bearer.

[0008] According to the present invention, there can be provided a lubricant supply device, a process cartridge, and an image forming apparatus capable of efficiently supplying a lubricant to a surface of an image bearer without employing two lubricant supply devices.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic view illustrating a configuration of an image forming apparatus according to an embodiment of the present disclosure;
FIG. 2 is a schematic view of a process cartridge of the image forming apparatus illustrated in FIG. 1 and a surrounding structure of the process cartridge;
FIG. 3 is a schematic view of a main part of a lubricant supply device according to an embodiment of the present disclosure;
FIG. 4 is a schematic view of a main part of a lubricant supply device according to a first variation;
FIG. 5 is a schematic view of a main part of a lubricant supply device according to a second variation; and
FIG. 6 is a schematic view of a main part of a lubricant supply device according to a third variation.

[0010] The accompanying drawings are intended to depict embodiments of the present disclosure and should not be interpreted to limit the scope thereof. The accompanying drawings are not to be considered as drawn to scale unless explicitly noted.

DETAILED DESCRIPTION

[0011] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent specifi-

cation is not intended to be limited to the specific terminology so selected and it is to be understood that each specific element includes all technical equivalents that operate in a similar manner and achieve similar results.

[0012] Although the embodiments are described with technical limitations with reference to the attached drawings, such description is not intended to limit the scope of the disclosure and all of the components or elements described in the embodiments of this disclosure are not necessarily indispensable.

[0013] Referring now to the drawings, embodiments of the present disclosure are described below. In the drawings for explaining the following embodiments, the same reference codes are allocated to elements (members or components) having the same function or shape and redundant descriptions thereof are omitted below.

[0014] Next, a description is given of the configuration and functions of an image forming apparatus and an image forming system, according to an embodiment of the present disclosure, with reference to the drawings. Note that identical reference numerals are assigned to identical components or equivalents and a description of those components is simplified or omitted.

[0015] With reference to FIGS. 1 and 2, a configuration and operation of an image forming apparatus 1 is described below.

[0016] FIG. 1 is a schematic view illustrating a configuration of the image forming apparatus 1 according to the present embodiment. FIG. 2 is a cross-sectional view illustrating a configuration of a process cartridge (image forming unit) 10Y for yellow installed in the image forming apparatus 1 illustrated in FIG. 1.

[0017] Note that the four process cartridges 10Y, 10M, 10C, and 10BK (serving as image forming units) have a similar configuration except for the color of toner used in image forming processes, and thus the process cartridge 10Y is illustrated as a representative in FIG. 2.

[0018] In FIG. 1, the image forming apparatus 1, which is a tandem color copier in the present embodiment, includes a writing device 2, a document conveyance device 3, a document reading device 4, a sheet feeding device 7, and a registration roller pair 25. The writing device 2 emit a laser beam based on input image data. The document conveyance device 3 conveys an original document D to the document reading device 4. The document reading device 4 reads image data of the original document D. The sheet feeding device 7 contains sheets such as paper sheets. The registration roller pair 25 adjusts the timing of conveyance of the sheet.

[0019] The image forming apparatus 1 also includes the process cartridges 10Y, 10M, 10C, and 10BK, an intermediate transfer belt 17, and primary transfer rollers 9. The process cartridges 10Y, 10M, 10C, and 10BK form toner images of respective colors of yellow, magenta, cyan, and black on photoconductor drums 11 of the process cartridges 10Y, 10M, 10C, and 10BK. The primary transfer rollers 9 primarily transfer and superimpose the toner images formed on the respective photoconductor drums 11 onto the intermediate transfer belt 17, thereby forming a multicolor toner image.

[0020] The image forming apparatus 1 further includes a secondary transfer roller 18, an intermediate-transfer-belt cleaning device 19, a fixing device 20, and an operation display panel 50. The secondary transfer roller 18 secondarily transfers the multicolor toner image on the intermediate transfer belt 17 onto the sheet. The intermediate-transfer-belt cleaning device 19 cleans the intermediate transfer belt 17. The fixing device 20 fixes the multicolor toner image (unfixed image) on the sheet. The operation display panel 50 displays information relating to printing operation (image forming operation) and allows a user to perform operation relating to the printing operation.

[0021] A description is provided below of operation of the image forming apparatus 1 to form a normal color image.

[0022] Conveyance rollers of the document conveyance device 3 convey the original document D on a document table onto an exposure glass 5 of the document reading device 4. The document reading device 4 optically reads the image data of the document D placed on the exposure glass 5.

[0023] The yellow, magenta, cyan, and black image data are transmitted to the writing device 2. The writing device 2 irradiates the photoconductor drums (image bearers) 11 of the corresponding process cartridges 10Y, 10M, 10C, and 10BK with laser beams (exposure light) L based on the yellow, magenta, cyan, and black image data, respectively.

[0024] The photoconductor drum 11 (see FIG. 2) in each of the four process cartridges 10Y, 10M, 10C, and 10BK rotates in a predetermined direction (i.e., counterclockwise in FIG. 2). A charging device 12 uniformly charges a surface of the photoconductor drum 11 at a position facing the photoconductor drum 11 (charging process). Thus, a charging potential is formed on the surface of the photoconductor drum 11. In the present embodiment, the charging potential on the photoconductor drum 11 is approximately -900 V. Subsequently, the surface of the photoconductor drum 11 thus charged reaches a position where the surface of the photoconductor drum 11 is scanned by the laser beam L.

[0025] The writing device 2 emits the laser beam L from each of four light sources according to the image data. The respective laser beams L pass through different optical paths for components of yellow, magenta, cyan, and black (exposure process).

[0026] The laser beam L for the yellow component is directed to the surface of the photoconductor drum 11 as an image bearer that is the first from the left among the photoconductor drums 11 (see FIG. 2) of the four process cartridges 10Y, 10M, 10C, and 10BK in FIG. 1. At that time, a polygon mirror rotates at high speed to deflect the laser beam L for the yellow component in an axial direction of rotation of the photoconductor drum 11 (i.e., the main scanning direction) so that the laser beam

L scans the photoconductor drum 11. Thus, an electrostatic latent image for yellow with an exposure potential of-50 V to 100 V is formed on the photoconductor drum 11 charged by the charging device 12.

[0027] Similarly, the laser beam L for the magenta component is directed to the surface of the photoconductor drum 11 of the process cartridge 10M that is the second from the left in FIG. 1, thus forming an electrostatic latent image for magenta thereon. The laser beam L for the cyan component is directed to the surface of the photoconductor drum 11 of the process cartridge 10C that is the third from the left in FIG. 1, thus forming an electrostatic latent image for cyan thereon. The laser beam L for the black component is directed to the surface of the photoconductor drum 11 of the process cartridge 10BK that is the fourth from the left in FIG. 1, thus forming an electrostatic latent image for black thereon.

[0028] Then, the surface of the photoconductor drum 11 having the electrostatic latent image reaches a position opposite the developing device 13. The developing device 13 supplies toner of each color onto the surface of the photoconductor drum 11 and develops the electrostatic latent image on the photoconductor drum 11 into a visible toner image (a development process).

[0029] Subsequently, the surface of the photoconductor drum 11 after the development process reaches a position facing the intermediate transfer belt 17 (i.e., a primary transfer nip). The primary transfer rollers 9 are disposed at positions where the photoconductor drums 11 face the intermediate transfer belt 17 and in contact with an inner surface of the intermediate transfer belt 17, respectively. At the positions of the primary transfer rollers 9, the toner images on the photoconductor drums 11 are transferred to and superimposed on the intermediate transfer belt 17, forming a multicolor toner image thereon (primary transfer process).

[0030] After the primary transfer process, the surface of the photoconductor drum 11 reaches a position opposite the cleaning device 14. At this position, a cleaning blade 14a (see FIG. 2) mechanically removes untransferred toner remaining on the photoconductor drum 11, and the removed untransferred toner is collected in the cleaning device 14 (a cleaning process). A waste-toner conveying screw 14c (see FIG. 2) delivers the untransferred toner collected in the cleaning device 14 outside the cleaning device 14, and the untransferred toner is collected as waste toner into a waste-toner collection receptacle.

[0031] Then, the surface of the photoconductor drum 11 passes through a lubricant supply device 15 and a charge neutralizer to complete a series of image forming processes performed on the photoconductor drum 11.

[0032] As described above, the multicolor toner image is formed on the intermediate transfer belt 17 by transferring and superimposing the respective single-color toner images formed on the photoconductor drums 11. Then, the intermediate transfer belt 17 bearing the multicolor toner image moves clockwise in FIG. 1 to reach a position opposite the secondary transfer roller 18 (i.e., a secondary transfer nip). At the secondary transfer nip, the secondary transfer roller 18 transfers the toner images of yellow, magenta, cyan, and black from the intermediate transfer belt 17 onto a sheet (sheet of paper) as a multicolor toner image in a secondary transfer process.

[0033] After the secondary transfer process, the surface of the intermediate transfer belt 17 reaches a position opposite the intermediate-transfer-belt cleaning device 19. The intermediate-transfer-belt cleaning device 19 collects untransferred toner adhering to the intermediate transfer belt 17 to complete a series of transfer processes performed on the intermediate transfer belt 17.

[0034] The sheet is conveyed from the sheet feeding device 7 via the registration roller pair 25 to the secondary transfer nip between the intermediate transfer belt 17 and the secondary transfer roller 18.

[0035] More specifically, a sheet feeding roller 8 feeds the sheet from the sheet feeding device 7 that contains multiple sheets, and the sheet is then guided by a sheet guide to the registration roller pair 25 (i.e., timing roller pair). The sheet that has reached the registration roller pair 25 is conveyed toward the secondary transfer nip, timed to coincide with the multicolor toner image on the intermediate transfer belt 17.

[0036] Subsequently, the sheet carrying the multicolor image is guided to the fixing device 20 by a conveyance belt. The fixing device 20 includes a fixing belt and a pressure roller pressing against each other. In a nip therebetween, the multicolor image (toner image) is fixed on the sheet.

[0037] After the fixing process, output rollers eject the sheet as an output image outside the image forming apparatus 1 to complete a series of image forming processes (printing operation).

[0038] With reference to FIG. 2, the process cartridge 10Y is described in further detail below.

[0039] As illustrated in FIG. 2, in the process cartridge 10Y, the photoconductor drum 11 as the image bearer, the charging device 12, the developing device 13, the cleaning device 14, and the lubricant supply device 15 are combined together as a single unit. The replaceable process cartridge 10K is removably installed in an apparatus body 1A of the image forming apparatus 1. The process cartridge 10K is detached from the apparatus body 1A to be and either replaced or repaired as appropriate.

[0040] The photoconductor drum 11 as the image bearer used in the present embodiment is an organic photoconductor to be charged to a negative polarity and includes a photosensitive layer formed on a drum-shaped conductive support.

[0041] For example, the photoconductor drum 11 is multilayered and includes a base coat serving as an insulation layer, the photosensitive layer, and a surface layer (i.e., a protection layer) sequentially overlying the conductive support as a substrate. The photosensitive layer includes a charge generation layer and a charge

transport layer.

[0042] The photoconductor drum 11 is rotated counterclockwise in FIG. 2 by a drive motor.

[0043] With reference to FIG. 2, the charging device 12 is a charging roller including a conductive core metal and an elastic layer of moderate resistivity overlying the conductive core metal and is disposed so as to face the photoconductor drum 11 with a minute gap between the charging device 12 and the photoconductor drum 11. Receiving a predetermined voltage (i.e., a charging bias) from a charging power supply, the charging device 12 uniformly charges the surface of the photoconductor drum 11 facing the charging device 12.

[0044] In the present embodiment, the charging device 12 may be, for example, a contact-type charging roller to contact the photoconductor drum 11 or a charging charger having a grid using a corona discharge method.

[0045] The charging bias applied to the charging device 12 may be a direct current (DC) voltage superimposed with an alternating current (AC) voltage or may be only a DC voltage.

[0046] The developing device 13 includes a developing roller 13a disposed opposite the photoconductor drum 11, a first conveying screw 13b disposed opposite the developing roller 13a, a second conveying screw 13c disposed opposite the first conveying screw 13b via a partition, and a doctor blade 13d disposed opposite the developing roller 13a. The developing roller 13a includes multiple magnets and a sleeve that rotates around the magnets. The magnets are stationary and generate magnetic poles around the circumference of the developing roller 13a. The magnets generate a plurality of magnetic poles on the developing roller 13a (sleeve) to bear a developer G on the developing roller 13a. The developing device 13 contains two-component developer G including carrier CR and toner T.

[0047] The developing roller 13a, the first conveying screw 13b, and the second conveying screw 13c are rotationally driven together with the photoconductor drum 11 by a drive motor.

[0048] The cleaning device 14 is provided with a cleaning blade 14a that contacts the surface of the photoconductor drum 11 to clean the surface of the photoconductor drum 11.

[0049] The cleaning blade 14a is a blade-shaped member made of a rubber material such as urethane rubber and is in contact with the photoconductor drum 11 at a predetermined angle and with a predetermined force. With this configuration, untransferred toner adhering to the photoconductor drum 11 are mechanically scraped off and collected in the cleaning device 14 by the cleaning blade 14a. The untransferred toner adhering to the photoconductor drum 11 includes paper dust arising from sheets, discharge products arising on the photoconductor drum 11 during electrical discharge by the charging device 12, and additives added to toner. In the present embodiment, the cleaning blade 14a is in contact with the photoconductor drum 11 in a counter direction with respect to a traveling direction (rotation direction) of the photoconductor drum 11.

[0050] Thus, untransferred toner adhering to the photoconductor drum 11 are mechanically scraped off and collected in the cleaning device 14 by the cleaning blade 14a. The untransferred toner adhering to the photoconductor drum 11 includes paper dust arising from sheets, discharge products arising on the photoconductor drum 11 during electrical discharge by the charging device 12, and additives added to toner.

[0051] In the present embodiment, the cleaning device 14 is configured such that the lubricant is supplied from the lubricant supply device 15 toward the inside of the cleaning device 14, which will be described later in detail.

[0052] The cleaning device 14 is provided with a second lubricant supply roller 14b (lubricant supply roller) as a second lubricant supply rotator, which will also be described in detail later.

[0053] As illustrated in FIG. 2, the lubricant supply device 15 includes a first lubricant supply roller 15a, a solid lubricant 15b, a compression spring 15c, and a leveling blade 15f. The first lubricant supply roller 15a (lubricant supply roller) serves as a first lubricant supply rotator around which brush bristles are disposed to slidingly contact the photoconductor drum 11 to supply a lubricant onto the photoconductor drum 11. The solid lubricant 15b slidingly contacts the first lubricant supply roller 15a (or brush bristles of the first lubricant supply roller 15a). The compression spring 15c serves as a biasing member to bias the solid lubricant 15b against the first lubricant supply roller 15a. The leveling blade 15f (thinning blade) contacts the photoconductor drum 11 to thin (level) the lubricant supplied onto the photoconductor drum 11.

[0054] The lubricant supply device 15 is disposed downstream from the cleaning device 14 (the cleaning blade 14a in particular) and upstream from the charging device 12 in the direction of rotation of the photoconductor drum 11. The leveling blade 15f is disposed downstream from the first lubricant supply roller 15a in the direction of rotation of the photoconductor drum 11.

[0055] Here, the first lubricant supply roller 15a is driven to rotate in the counterclockwise direction in FIG. 2 together with the photoconductor drum 11 by the drive motor in a state at which the brush bristles of the first lubricant supply roller 15a are in contact with the surface of the photoconductor drum 11. With this configuration, the lubricant is supplied from the solid lubricant 15b via the first lubricant supply roller 15a to the photoconductor drum 11.

[0056] The first lubricant supply roller 15a is driven to slidingly rotate against the direction of rotation of the photoconductor drum 11 that rotates counterclockwise in FIG. 2. That is, the first lubricant supply roller 15a rotates counterclockwise in FIG. 2. In other words, the direction of rotation of the first lubricant supply roller 15a is opposite to the direction of rotation (traveling) of the photoconductor drum 11 at a sliding contact position at which the first lubricant supply roller 15a and the photoconduc-

tor drum 11 contact each other.

[0057] The first lubricant supply roller 15a slidingly contacts both of the solid lubricant 15b and the photoconductor drum 11. While rotating, the first lubricant supply roller 15a scrapes lubricant from the solid lubricant 15b and applies the lubricant to the photoconductor drum 11.

[0058] On the back side of the solid lubricant 15b opposite the first lubricant supply roller 15a, the compression spring 15c serving as a biasing member is disposed to reduce uneven contact between the first lubricant supply roller 15a and the solid lubricant 15b. The compression spring 15c presses the solid lubricant 15b against the first lubricant supply roller 15a.

[0059] The solid lubricant 15b is produced by mixing inorganic lubricant in fatty acid metal salts. The fatty acid metal salts preferably include zinc stearate. It is also preferable that the inorganic lubricant include at least one of talc, mica, and boron nitride.

[0060] Zinc stearate is typical lamellar crystal powder. Lamellar crystals have a layer structure including self-organization of an amphiphilic molecule, and the crystal is broken easily along junctures between layers and becomes slippery receiving shearing force. Accordingly, the friction coefficient on the surface of the photoconductor drum 11 can be reduced. That is, the surface of the photoconductor drum 11 can be effectively covered with a small amount of lubricant by the lamellar crystals uniformly covering the surface of the photoconductor drum 11 by receiving the shearing force. Therefore, the surface of the photoconductor drum 11 can be covered relatively uniformly so as to be preferably protected from electrical stress in the charging process.

[0061] Further, by using inorganic lubricant having a planar structure such as talc, mica, and boron nitride, occurrence of slipping of toner and lubricant from (the cleaning blade 14a of) the cleaning device 14 is substantially decreased, and therefore the charging device 12 can be prevented from being contaminated.

[0062] The leveling blade 15f is a plate made of rubber, such as urethane rubber, disposed on the downstream side of the lubricant supply device 15 in the direction of rotation of the photoconductor drum 11 and contacts the surface of the photoconductor drum 11 at a predetermined angle and with a predetermined pressure. The leveling blade 15f levels off the lubricant on the photoconductor drum 11, which is supplied by the first lubricant supply roller 15a (and the second lubricant supply roller 14b), to a suitable amount uniformly on the photoconductor drum 11.

[0063] When the lubricant is applied from the solid lubricant 15b to the surface of the photoconductor drum 11 via the first lubricant supply roller 15a, a powdery lubricant is applied to the surface of the photoconductor drum 11. In this state, the lubricity may be insufficient. Therefore, the leveling blade 15f acts as a component to thin and level the lubricant. When the lubricant is leveled by the leveling blade 15f and becomes a coating on the photoconductor drum 11, the lubricant can fully exhibit lubricity.

[0064] In the present embodiment, the leveling blade 15f is in contact with the photoconductor drum 11 in the counter direction with respect to the traveling direction (rotation direction) of the photoconductor drum 11. Alternatively, for example, the leveling blade 15f may be in contact with the photoconductor drum 11 in a trading direction with respect to the traveling direction (rotation direction) of the photoconductor drum 11.

[0065] The image forming processes are described in further detail below with continued reference to FIG. 2.

[0066] The developing roller 13a rotates clockwise in FIG. 2. In the developing device 13, as the first conveying screw 13b and the second conveying screw 13c, arranged via the partition, rotate as illustrated in FIG. 2, the developer G is circulated in the longitudinal direction of the developing device 13, being stirred with fresh toner T supplied from a toner supply device 30. The longitudinal direction of the developing device 13 is perpendicular to the plane on which FIG. 2 is drawn.

[0067] Thus, the toner T is triboelectrically charged and attracted to the carrier CR. Then, the toner T is borne on the developing roller 13a together with the carrier CR. The developer G borne on the developing roller 13a reaches the doctor blade 13d. The amount of the developer G on the developing roller 13a is regulated to a suitable amount by the doctor blade 13d, after which the developer G is carried to the development range opposite the photoconductor drum 11.

[0068] In the development range, the toner T in the developer G adheres to the electrostatic latent image on the photoconductor drum 11. Specifically, the toner T adheres to the electrostatic latent image by a development electric field formed by a potential difference (i.e., a developing potential) between a latent image potential (i.e., an exposure potential) of an image area irradiated with the laser beam L and a development bias (of approximately -500 V) applied to the developing roller 13a.

[0069] Subsequently, most of the toner T that adheres to the photoconductor drum 11 in the developing process is transferred to the intermediate transfer belt 17. The untransferred toner T adhering to (remaining on) the surface of the photoconductor drum 11 is collected in the cleaning device 14 by the cleaning blade 14a. Subsequently, the surface of the photoconductor drum 11 passes through the lubricant supply device 15 and the charge neutralizer sequentially to complete a series of image forming processes.

[0070] The toner supply device 30 of the apparatus body 1A includes the replaceable toner bottle 31 and the toner hopper 32. The toner hopper 32 holds and drives the toner bottle 31 and supplies fresh toner T to the developing device 13. Each toner bottle 31 contains fresh toner T (yellow toner in FIG. 2). On an inner surface of the toner bottle 31, a helical projection is disposed.

[0071] The fresh toner T in the toner bottle 31 is supplied through the toner supply inlet to the developing device 13 as the toner T existing in the developing device

13 is consumed. The consumption of the toner T in the developing device 13 is detected either directly or indirectly using a magnetic sensor disposed below the second conveying screw 13c in the developing device 13.

[0072] The configuration and operation of the lubricant supply device 15 according to the present embodiment is described below.

[0073] As described above with reference to FIG. 2 and the like, the lubricant supply device 15 is disposed in the process cartridge 10Y (of the image forming apparatus 1) according to the present embodiment. The lubricant supply device 15 is configured to supply the lubricant to a downstream surface of the photoconductor drum 11 in the rotation direction of the photoconductor drum 11 (serving as an image bearer) with respect to the cleaning blade 14a that is a plate in contact with the photoconductor drum 11 on which the toner image is borne.

[0074] The lubricant supply device 15 includes, e.g., the first lubricant supply roller 15a, the solid lubricant 15b, and the compression spring 15c. The first lubricant supply roller 15a serves as a first lubricant supply rotator that slidingly contact the downstream surface of the photoconductor drum 11 in the rotation direction with respect to the cleaning blade 14a. The solid lubricant 15b slidingly contacts the first lubricant supply roller 15a. The compression spring 15c serves as a biasing member to bias the solid lubricant 15b against the first lubricant supply roller 15a.

[0075] Here, the lubricant supply device 15 according to the present embodiment is configured to feed the lubricant from the inside of the lubricant supply device 15 toward the inside of the cleaning device 14 in which the cleaning blade 14a is installed, without passing through the photoconductor drum 11 (image bearer), and to supply the lubricant to a surface of the photoconductor drum 11 upstream from the cleaning blade 14a in the rotation direction of the photoconductor drum 11. In other words, the lubricant flows as indicated by an arrow in FIG. 3.

[0076] In other words, the lubricant supply device 15 according to the present embodiment can apply (supply) the lubricant to the surface of the photoconductor drum 11 on both the downstream side and the upstream side across the cleaning blade 14a in the rotation direction of the photoconductor drum 11.

[0077] Specifically, the lubricant that is not supplied to the surface of the photoconductor drum 11 by the first lubricant supply roller 15a (serving as the first lubricant supply rotator) but is detached from the first lubricant supply rollers 15a is fed toward the inside of the cleaning device 14 without passing through the photoconductor drum 11.

[0078] To be more specific, as illustrated in FIGS. 2 and 3, the cleaning device 14 includes the second lubricant supply roller 14b as a second lubricant supply rotator that slidingly contacts the surface of the photoconductor drum 11 at a position upstream from the cleaning blade 14a in the rotation direction of the photoconductor drum 11.

[0079] The second lubricant supply roller 14b (serving as the second lubricant supply rotator) is provided with brush bristles around the outer surface of the second lubricant supply roller 14b. While slidingly contacting the brush bristles against the photoconductor drum 11, the second lubricant supply roller 14b supplies the lubricant onto the photoconductor drum 11. The second lubricant supply roller 14b is a roller member (brush roller) in which straight or looped brush bristles are wound around the outer periphery of a core metal. As the brush bristles, for example, resin fibers such as polyester, nylon, rayon, acrylic, vinylon, and vinyl chloride can be used, and conductive fibers mixed with a conductivity-imparting agent such as carbon can be used as needed. For example, the bristles have a bristle length of about 0.2 mm to 20 mm and a bristle density of about 20,000 filaments per square inch (F / in^2) to 100,000 F /in^2.

[0080] The second lubricant supply roller 14b is disposed upstream from the cleaning blade 14a in the rotation direction of the photoconductor drum 11 and downstream from the primary transfer nip (primary transfer roller 9) in the rotation direction of the photoconductor drum 11. The second lubricant supply roller 14b is rotationally driven together with the first lubricant supply roller 15a in the counterclockwise direction in FIG. 2 by a drive motor in a state where the brush bristles are in contact with the surface of the photoconductor drum 11. Accordingly, as indicated by the arrow in FIG. 3, the lubricant transferred from the inside of the lubricant supply device 15 to the inside of the cleaning device 14 is applied (supplied) onto the photoconductor drum 11 via the second lubricant supply roller 14b.

[0081] Since the second lubricant supply roller 14b is located upstream from the cleaning blade 14a in the rotation direction of the photoconductor drum 11, the second lubricant supply roller 14b also acts as a cleaning roller to clean the untransferred toner adhering to the photoconductor drum 11.

[0082] Here, the cleaning device 14 is configured such that the lubricant fed from the lubricant supply device 15 falls onto and is supplied to the surface of the second lubricant supply roller 14b (serving as the second lubricant supply member).

[0083] Specifically, the lubricant supply device 15 includes lubricant conveying screws 15d and 14d as conveyors that convey the lubricant in the width direction from the inside of the lubricant supply device 15 toward the inside of the cleaning device 14.

[0084] The lubricant conveying screw 15d that conveys the lubricant in the width direction from the inside of the lubricant supply device 15 toward a relay conveying path 15g, which is a conveying path extending in a substantially vertical direction at one end in the width direction, is installed inside the lubricant supply device 15. The cleaning device 14 includes the lubricant conveying screw 14d that conveys the lubricant supplied via the relay conveying path 15g from the one end in the width direction toward the other end in the width direction. A

plurality of openings that become larger from the upstream side toward the downstream side are formed in the conveying path in which the lubricant conveying screw 14d is installed. Thus, the lubricant is supplied onto the second lubricant supply roller 14b substantially uniformly in the width direction. The lubricant borne on the second lubricant supply roller 14b is applied onto the photoconductor drum 11 by the rotation of the second lubricant supply roller 14b.

[0085] The conveying path for conveying the lubricant from the inside of the lubricant supply device 15 to the inside of the cleaning device 14 is not limited to the above-described conveying path. Different forms of conveying path can be used as long as the lubricant is conveyed without passing through the photoconductor drum 11.

[0086] As described above, in the present embodiment, the lubricant is supplied to the surface of the photoconductor drum 11 both on the downstream side and the upstream side across the cleaning blade 14a by one lubricant supply device 15 (solid lubricant 15b) without using two lubricant supply devices (solid lubricants). Accordingly, the lubricant can be efficiently supplied to the surface of the photoconductor drum 11 without increasing the size and cost of the apparatus as compared with the configuration in which two lubricant supply devices are provided.

[0087] Specifically, the first lubricant supply roller 15a is disposed downstream from the cleaning blade 14a in the rotation direction of the photoconductor drum 11. Accordingly, the lubricant is supplied to the surface of the photoconductor drum 11 from which the untransferred toner has been removed by the cleaning blade 14a, and supply unevenness (application unevenness) on the photoconductor drum 11 is less likely to occur. Further, since the first lubricant supply roller 15a is disposed in the vicinity of the upstream side of the charging device 12, the lubricant can be efficiently supplied to the charged region of the photoconductor drum 11. Accordingly, the effect of preventing deterioration of the photoconductor drum 11 due to electric discharge by the charging device 12 can be sufficiently exhibited.

[0088] However, the lubricant on the photoconductor drum 11 supplied by the first lubricant supply roller 15a reaches the position of the cleaning blade 14a after passing through the charging process, the developing process, the primary transfer process, and the like. Accordingly, when the lubricant on the photoconductor drum 11 supplied by the first lubricant supply roller 15a reaches the position of the cleaning blade 14a, the amount of the lubricant on the photoconductor drum 11 decreases, thus reducing the contribution rate to the durability and the cleaning performance of the cleaning blade 14a as compared with the lubricant supply by the second lubricant supply roller 14b.

[0089] In order to reduce such a disadvantage, a measure may be considered in which the amount of lubricant supplied by the first lubricant supply roller 15a is set to be large from the beginning. However, in such a case, the charging device 12 may be easily contaminated with the lubricant, or the amount of the lubricant consumed may increase.

[0090] On the other hand, since the second lubricant supply roller 14b is disposed in the vicinity of the upstream side from the cleaning blade 14a, the lubricant can be efficiently supplied to an edge portion of the cleaning blade 14a. Accordingly, the lubricant supply by the second lubricant supply roller 14b has a higher contribution rate to the durability and cleaning performance of the cleaning blade 14a than the lubricant supply by the first lubricant supply roller 15a.

[0091] However, since a part of the untransferred toner (transfer residual toner) adhering to the surface of the photoconductor drum 11 is directly input to the second lubricant supply roller 14b, the supply amount of the lubricant is less likely to be stable.

[0092] Further, since the lubricant supply by the second lubricant supply roller 14b supplies the lubricant to the surface of the photoconductor drum 11 to which the untransferred toner adheres, uneven supply (uneven application) on the photoconductor drum 11 is more likely to occur than in the case of the lubricant supply by the first lubricant supply roller 15a. Accordingly, forming a protective layer made of a lubricant on the surface of the photoconductor drum 11 is less likely to exert the sufficient effect of preventing deterioration of the photoconductor drum 11 due to electric discharge by the charging device 12 (in particular, abnormal discharge called a charging hazard).

[0093] As described above, the lubricant supply by the first lubricant supply roller 15a and the lubricant supply by the second lubricant supply roller 14b have different advantages and disadvantages. A disadvantage of one thereof can be compensated for by an advantage of the other thereof.

[0094] Thus, the lubricant can be supplied to the surface of the photoconductor drum 11 by utilizing the characteristics of the lubricant supply by the two lubricant supply rollers 15a and 14b. Specifically, the durability of the cleaning blade 14a is enhanced, the cleaning performance by the cleaning blade 14a is good, the lubricant can be uniformly supplied to the surface of the photoconductor drum 11, and the deterioration of the photoconductor drum 11 due to electric discharge by the charging device 12 can be reduced.

[0095] As illustrated in FIGS. 2 and 3, in the present embodiment, the lubricant supply device 15 is disposed above the cleaning device 14.

[0096] Accordingly, at least a part of the lubricant can be conveyed from the inside of the lubricant supply device 15 toward the inside of the cleaning device 14 by causing the lubricant to fall by its own weight (including sliding on an inclined surface). Thus, the lubricant can be smoothly conveyed from the inside of the lubricant supply device 15 toward the inside of the cleaning device 14.

First Variation

[0097] As illustrated in FIG. 4, in a lubricant supply device 15 according to a first variation, a communication port 15h is formed to communicate the inside of the lubricant supply device 15 with the inside of a cleaning device 14.

[0098] The lubricant supply device 15 is formed such that the bottom surface of the lubricant supply device 15 is inclined downward toward the communication port 15h. Further, the cleaning device 14 includes an inclined conveying path 14f (inclined surface) inclined downward from the communication port 15h toward an upper portion of a second lubricant supply roller 14b.

[0099] With this configuration, the lubricant in the lubricant supply device 15 flows into the cleaning device 14 while sliding down on the inclined surface as indicated by an arrow in FIG. 4. Such a configuration can obviate the necessity of providing a lubricant conveying screw that conveys the lubricant.

[0100] Here, the communication port 15h is configured such that an opening range in a width direction of the communication port 15h (a direction perpendicular to a plane on which FIG. 4 is drawn) is a range including a width-direction range (substantially a range of a first lubricant supply roller 15a or a solid lubricant 15b in the width direction) in which the lubricant is supplied to the surface of the photoconductor drum 11 at a position downstream from a cleaning blade 14a in the rotation direction of the photoconductor drum 11. That is, the opening range in the width direction of the communication port 15h is equal to or larger than the lubricant supply range in the width direction by the first lubricant supply roller 15a, and has such a length as to include the lubricant supply range.

[0101] With such a configuration, the lubricant detached from the first lubricant supply roller 15a can be made to flow toward the inclined conveying path 14f without waste and without staying at the edge portion of the communication port 15h. In addition, the lubricant supply range in the width direction by the second lubricant supply roller 14b is equal to or more than the lubricant supply range in the width direction by the first lubricant supply roller 15a, and a sufficient amount of lubricant can be supplied to the surface of the photoconductor drum 11 in the width direction on the upstream side from the cleaning blade 14a.

Second Variation

[0102] As illustrated in FIG. 5, a lubricant supply device 15 according to the second variation includes scrapers 15r and 14g as scraping members to scrape the lubricant borne on at least one of the surfaces of a first lubricant supply roller 15a (serving as a first lubricant supply rotator) and a second lubricant supply roller 14b (serving as a second lubricant supply rotator).

[0103] In the second variation, the scraper 15r that scrapes off the lubricant borne on the surface of the first lubricant supply roller 15a and the scraper 14g that scrapes off the lubricant borne on the surface of the second lubricant supply roller 14b are provided.

[0104] Specifically, the scraper 15r provided inside the lubricant supply device 15 is held by a housing so as to slidingly contact the first lubricant supply roller 15a downstream from a contact position with the photoconductor drum 11 in the rotation direction of the photoconductor drum 11 and upstream from a contact position with the solid lubricant 15b in the rotation direction. The lubricant remaining on the first lubricant supply roller 15a after passing through the contact position with the photoconductor drum 11 is actively scraped off by the scraper 15r, and a sufficient amount of lubricant is fed toward the cleaning device 14.

[0105] On the other hand, the scraper 14g provided inside the cleaning device 14 is held by the housing so as to slidingly contact the second lubricant supply roller 14b at a position downstream from a contact position with the photoconductor drum 11 in the rotation direction of the photoconductor drum 11 and upstream from a supply position, to which the lubricant is supplied from the lubricant supply device 15, in the rotation direction. The lubricant remaining on the second lubricant supply roller 14b after passing through the contact position with the photoconductor drum 11 and the untransferred toner transferred from the photoconductor drum 11 to the second lubricant supply roller 14b are positively scraped off by the scraper 14g and discharged to the outside without being accumulated in the cleaning device 14 by the waste-toner conveying screw 14c.

Third Variation

[0106] As illustrated in FIG. 6, in the third variation, a cleaning device 14 includes a supply roller 14r as a supply rotator that supplies the lubricant fed from a lubricant supply device 15 to a second lubricant supply roller 14b (serving as a second lubricant supply member).

[0107] The lubricant fed from the lubricant supply device 15 into the cleaning device 14 is temporarily borne on the supply roller 14r (serving as the supply rotator). The lubricant is supplied onto the second lubricant supply roller 14b by the supply roller 14r rotating counterclockwise in FIG. 6.

[0108] Providing the supply roller 14r in this manner allows the lubricant to be evenly supplied onto the second lubricant supply roller 14b with less variation in supply amount.

[0109] The supply roller 14r is preferably a roller on which a surface layer made of a material that easily bears the lubricant and has a high lubricant supply performance to the second lubricant supply roller 14b is formed.

[0110] As described above, the lubricant supply device 15 according to the present embodiment supplies the lubricant to the surface of the photoconductor drum 11 at a position downstream in the rotation direction of the

photoconductor drum 11 from the cleaning blade 14a that contacts the photoconductor drum 11 (image bearer) on which a toner image is borne. The lubricant is fed from the inside of the lubricant supply device 15 toward the inside of the cleaning device 14, in which the cleaning blade 14a is installed, without passing through the photoconductor drum 11. The lubricant is also supplied to the surface of the photoconductor drum 11 at a position upstream from the cleaning blade 14a in the rotation direction.

[0111] Thus, the lubricant can be efficiently supplied to the surface of the photoconductor drum 11 without providing two lubricant supply devices.

[0112] In the present embodiment, the photoconductor drum 11, the charging device 12, the developing device 13, the cleaning device 14, and the lubricant supply device 15 are integrated to form the process cartridge 10Y, thereby making the image forming unit compact and enhancing the operability in maintenance.

[0113] Alternatively, the components of the image forming unit can be configured to be independently installed in the apparatus body 1A of the image forming apparatus 1 so as to be replaced separately. In particular, the lubricant supply device 15 and the cleaning device 14 may be configured as a single unit so as to be replaceably installed in the apparatus body 1A of the image forming apparatus 1. Alternatively, the lubricant supply device 15 may be configured to be detachable from the cleaning device 14 so as to be replaceably installed in the apparatus body 1A of the image forming apparatus 1 as a single unit.

[0114] In such a configuration, similar effects to those of the above-described embodiment and variations are also attained.

[0115] It is to be noted that the term "process cartridge" used in the present disclosure means a removable unit including an image bearer and at least one of a charging device to charge the image bearer, a developing device to develop latent images on the image bearer, and a cleaning device to clean the image bearer that are united together, and is designed to be removably installed as a united part in the image forming apparatus.

[0116] In the present embodiment, as the lubricant supply rollers 15a and 14b (lubricant supply rotators), those in which straight or looped brush bristles are wound around the outer periphery of a core metal are used. However, as the lubricant supply rollers 15a and 14b (serving as the lubricant supply rotators), those in which a foamed elastic layer is formed on the core metal can also be used. In such a case, foamed polyurethane (urethane foam) or the like can be used as the foamed elastic layer.

[0117] In the present embodiment, the compression spring 15c is used as a biasing member that biases the solid lubricant 15b against the first lubricant supply roller 15a. However, the configuration of the biasing member is not limited to the compression spring, and various forms of a biasing member may be used.

[0118] Further, in the present embodiment of the present disclosure, the image forming apparatus 1 includes the lubricant supply device 15 that supplies the lubricant to the surface of the photoconductor drum 11 as the image bearer. For example, according to an embodiment of the present disclosure, an image forming apparatus may include a lubricant supply device that supplies a lubricant to the surface of the intermediate transfer belt 17 as an image bearer.

[0119] Even in such a case, effects equivalent to the present embodiment can be obtained.

[0120] Note that embodiments of the present disclosure are not limited to the above-described embodiments and it is apparent that the above-described embodiments can be appropriately modified within the scope of the technical idea of the present disclosure in addition to what is suggested in the above-described embodiments. Further, features of components of the embodiments, such as the number, the position, and the shape are not limited the embodiments and thus may be preferably set.

Claims

1. A lubricant supply device (15) configured to supply a lubricant to a surface of an image bearer (11) at a position downstream from a cleaning blade (14a) in a rotation direction of the image bearer (11),

   the lubricant supply device (15) comprising a conveying path (15g, 15h) configured to feed the lubricant from an inside of the lubricant supply device (15) to an inside of a cleaning device (14) in which the cleaning blade (14a) configured to contact the image bearer (11) is disposed, without passing through the image bearer configured to bear a toner image,
   the conveying path (15g, 15h) being configured to feed the lubricant to the surface of the image bearer (11) at a position upstream from the cleaning blade (14a) in the rotation direction of the image bearer (11).

2. The lubricant supply device according to claim 1, further comprising:

   a first lubricant supply rotator (15a) configured to slidingly contact the surface of the image bearer (11) at a position downstream from the cleaning blade (14a) in a rotation direction of the image bearer;
   a solid lubricant (15b) configured to slidingly contact the first lubricant supply rotator (15a);
   a biasing member (15c) configured to bias the solid lubricant (15b) against the first lubricant supply rotator (15a); and
   a second lubricant supply rotator (14b) disposed in the cleaning device (14) and configured to slidingly contact the surface of the image bearer

(11) at a position upstream from the cleaning blade (14a) in the rotation direction of the image bearer (11).

3. The lubricant supply device according to claim 2, wherein the lubricant detached from the first lubricant supply rotator without being supplied to the surface of the image bearer by the first lubricant supply rotator is fed toward the inside of the cleaning device without passing through the image bearer.

4. The lubricant supply device according to claim 2 or 3, wherein the lubricant fed from the lubricant supply device (15) falls onto a surface of the second lubricant supply rotator (14b) and is supplied to the cleaning device (14).

5. The lubricant supply device according to claim 2 or 3, wherein the cleaning device (14) includes a supply rotator (14r) configured to supply the lubricant fed from the lubricant supply device (15) to the second lubricant supply rotator (14b).

6. The lubricant supply device according to any one of claims 2 to 5, further comprising a scraping member (15r, 14g) configured to scrape off the lubricant borne on a surface of at least one of the first lubricant supply rotator (15a) and the second lubricant supply rotator (14b).

7. The lubricant supply device according to any one of claims 1 to 6, further comprising a conveyor (15d, 14d) configured to convey the lubricant from the inside of the lubricant supply device (15) toward the inside of the cleaning device (14).

8. The lubricant supply device according to any one of claims 1 to 6, further comprising a communication port (15h) communicating the inside of the lubricant supply device (15) with the inside of the cleaning device (14).

9. The lubricant supply device according to claim 8, wherein an opening range of the communication port (15) in a width direction of the communication port (15h) includes a range in the width direction in which the lubricant is supplied to the surface of the image bearer at the position downstream from the cleaning blade in the rotation direction of the image bearer.

10. The lubricant supply device according to any one of claims 1 to 9,
wherein the lubricant supply device (15) is disposed above the cleaning device (14).

11. A process cartridge (10) detachably attachable to a body (1A) of an image forming apparatus (1), the process cartridge comprising:

the lubricant supply device (15) according to claim 1;
the image bearer (11); and
the cleaning device (14).

12. An image forming apparatus (1) comprising:

the lubricant supply device (15) according to claim 1;
the image bearer (11); and
the cleaning device (14).

FIG. 1

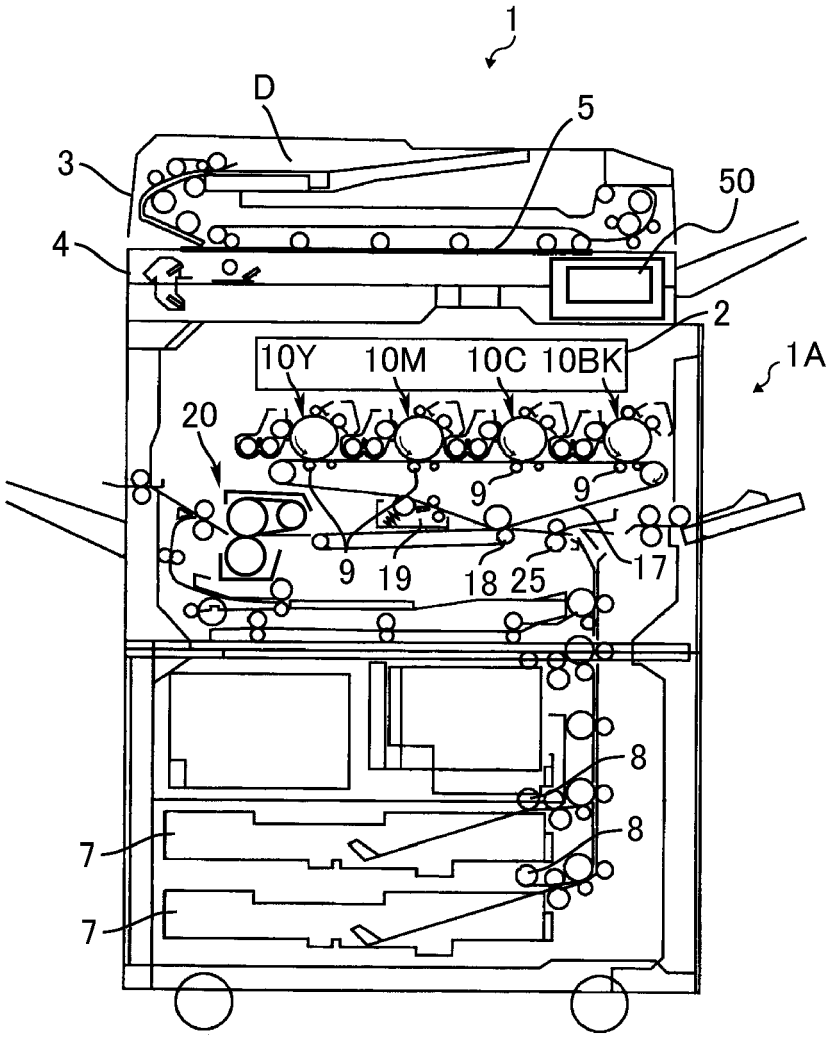
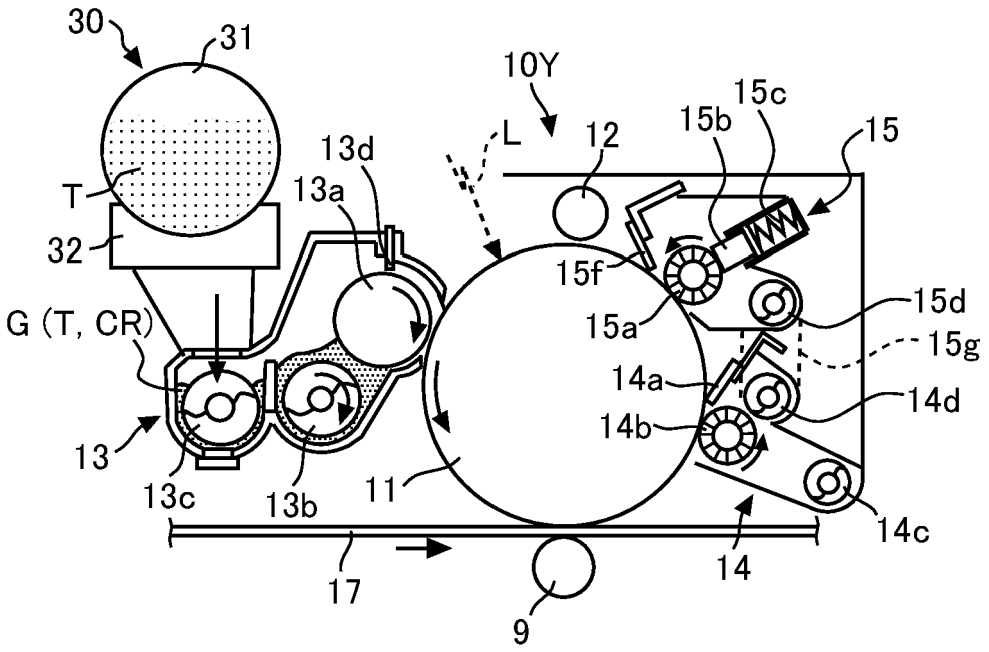


FIG. 2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31
10Y
L
12
15c
15b
15
13d
13a
T
32
15f
15d
G (T, CR)
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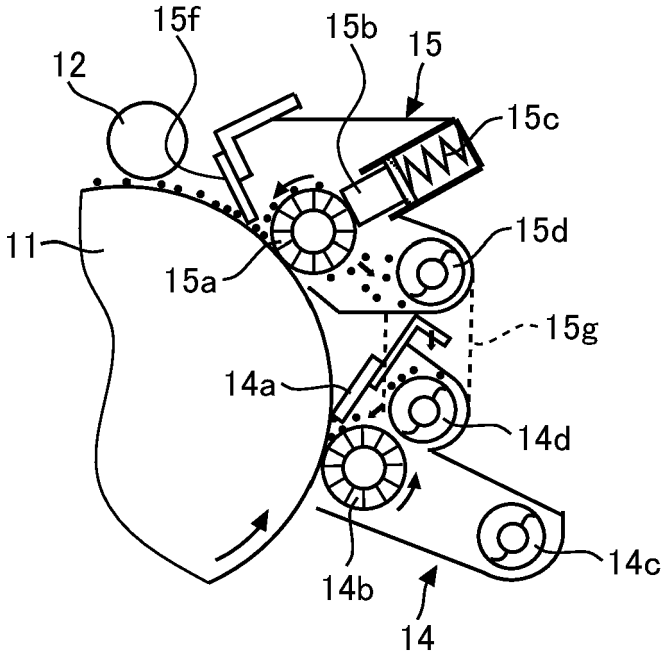
15g
14a
14d
13
14b
13c
13b
11
14c
17
14
9

FIG. 3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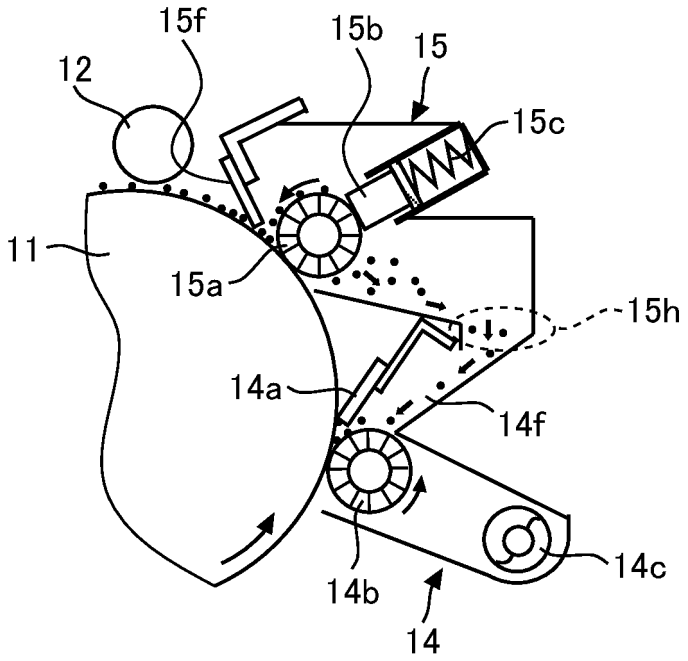
15g
14a
14d
14c
14b
14

FIG. 4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15c
11
15a
15h
14a
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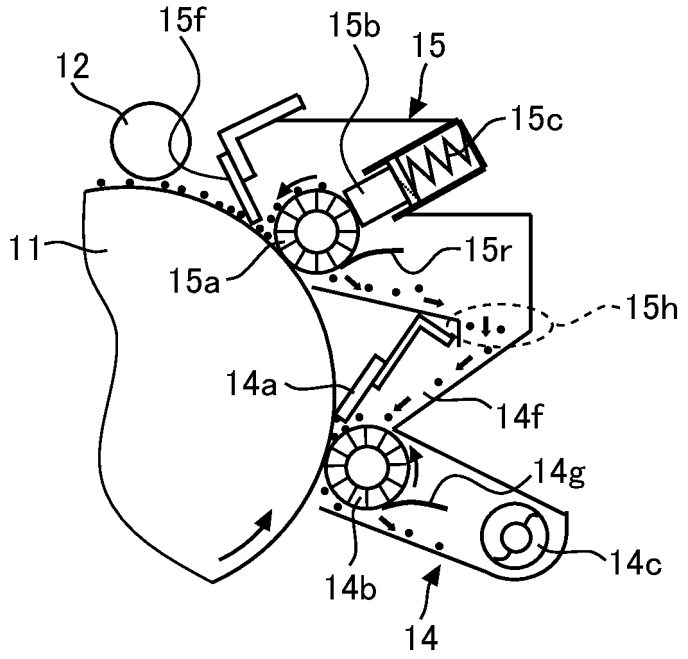
14b
14c
14

FIG. 5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15h
14a
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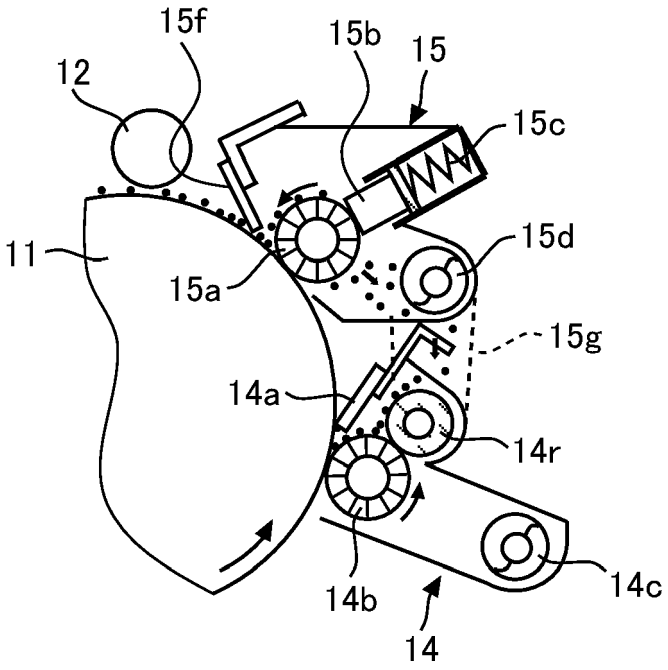
14

FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 21 18 9910

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP 2010 019982 A (RICOH KK) 28 January 2010 (2010-01-28) * abstract; figure 2 *	1-12	INV. G03G21/00
A	JP 2007 292920 A (RICOH KK) 8 November 2007 (2007-11-08) * abstract; figures 4-6 *	1-12	
A,D	JP 2008 046301 A (RICOH KK) 28 February 2008 (2008-02-28) * abstract; figure 2 *	1-12	

TECHNICAL FIELDS SEARCHED (IPC)

G03G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 December 2021	Urbaniec, Tomasz

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02-12-2021

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JP 2008046301 A	28-02-2008	NONE	

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- JP 2010019982 A **[0002] [0004]**