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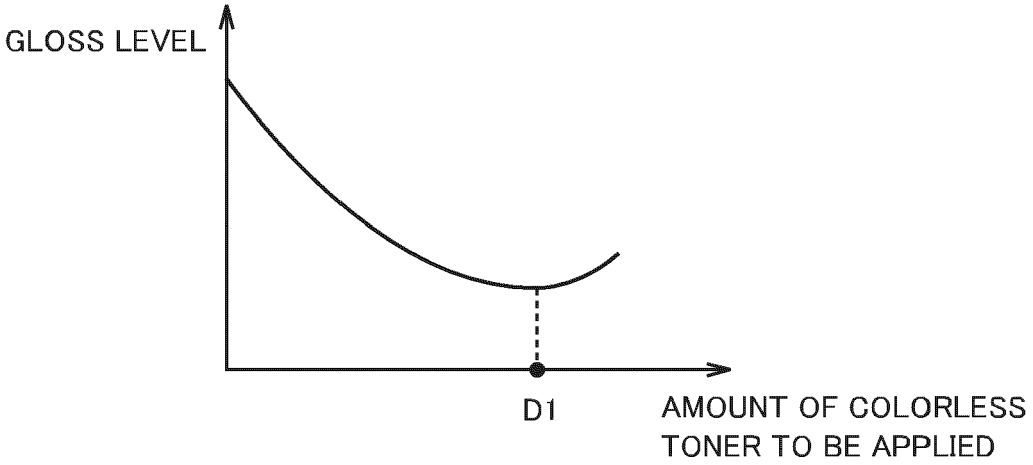
(54) GLOSS LEVEL ADJUSTMENT METHOD AND IMAGE FORMING APPARATUS

(57) Provided is an image forming apparatus (1) for forming an image by electrophotography. The image forming apparatus (1) includes a heating unit (60) configured to heat a recording medium formed with an image at a nip unit composed of a fixing rotator (60A) and a pressing rotator (60B). The image is formed by using a color toner containing a release agent. The image forming apparatus (1) further includes an adjustment toner applying unit (41CLR) configured to apply an adjustment toner containing the release agent less than the color toner to the surface of the image formed on the recording medium before it is conveyed into the nip unit, and a controller (100) configured to adjust an amount of the adjustment toner to be applied by the adjustment toner applying unit (41CLR) according to a predefined gloss level of the image.

FIG.3



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Description

[0001] The entire disclosure of Japanese Patent Application No. 2018-117709 filed on June 21, 2018 is incorporated herein by reference in its entirety.

Background

Technological Field

[0002] The present disclosure relates to a method for adjusting a gloss level in an image which is formed by an electrophotographic image forming apparatus.

Description of the Related Art

[0003] In an electrophotographic image forming apparatus, a toner image formed on a recording medium is fixed on the recording medium by heating and pressing. Since the toner is made of a developing material containing resin as the main ingredient, the surface of the image formed by the toner is smooth after fixing. As a result, the formed image generally has a high gloss level.

[0004] However, when a recording medium with a low surface gloss level is formed with an image with a high gloss level, the user may feel uncomfortable. Accordingly, various techniques have been proposed to suppress the gloss level of an image to be formed by an electrophotographic image forming apparatus.

[0005] For example, Japanese Patent Laying-Open No. 2007-4034 discloses a technique to reduce the gloss level of an image by using a roller having an uneven pattern to press the image after fixing.

Summary

[0006] However, according to the technique disclosed in Japanese Patent Laying-Open No. 2007-4034, the gloss level of the formed image can only be adjusted in accordance with the uneven pattern of the roller. Sometimes a user may hope to adjust the gloss level freely.

[0007] To achieve at least one of the abovementioned objects, according to an aspect of the present invention, there is provided a gloss level adjustment method for adjusting a gloss level of an image which is formed by an electrophotographic image forming apparatus. The gloss level adjustment method reflecting one aspect of the present invention comprises: forming an image on a recording medium by using a color toner containing a release agent; applying an adjustment toner containing the release agent less than the color toner to the surface of the image on the recording medium; and heating the image applied with the adjustment toner at a nip unit composed of a fixing rotator and a pressing rotator.

[0008] To achieve at least one of the abovementioned objects, according to an aspect of the present invention, there is provided a image forming apparatus configured to form an image by electrophotography. The image forming apparatus reflecting one aspect of the present invention comprises: a heating unit configured to heat the recording medium formed with an image at a nip unit composed of a fixing rotator and a pressing rotator, the image is formed by using a color toner containing a release agent; an adjustment toner applying unit configured to apply an adjustment toner containing the release agent less than the color toner to the surface of the image formed on the recording medium before it is conveyed into the nip unit; and a controller configured to adjust the amount of the adjustment toner to be applied by the adjustment toner applying unit according to a predefined gloss level of the image.

Brief Description of the Drawings

[0009] The advantages and features provided by one or more embodiments of the invention will become more fully understood from the detailed description given hereinafter and the appended drawings which are given by way of illustration only, and thus are not intended as a definition of the limits of the present invention.

Fig. 1 is a diagram representatively illustrating the surface of a sheet after it passes through a nip unit;
Fig. 2 is a diagram representatively illustrating the surface of another sheet after it passes through the nip unit;
Fig. 3 is a diagram schematically illustrating the relationship between an amount of colorless toner to be applied and the gloss level of an image to be formed;
Fig. 4 is a diagram schematically illustrating the entire configuration of an image forming apparatus;
Fig. 5 is a block diagram illustrating main components in the control system of the image forming apparatus;
Fig. 6 is a diagram representatively illustrating a preference table for defining an amount of colorless toner to be applied in accordance with a predefined gloss level;
Fig. 7 is a flowchart illustrating a process for applying the colorless toner to a sheet according to the predefined gloss level;
Fig. 8 is a diagram illustrating main components in an image forming device according to a modified example;
Fig. 9 is a diagram illustrating a preference table created in a control example (1);
Fig. 10 is a diagram illustrating a preference table created in a control example (2);
Fig. 11 is a diagram illustrating the amount of colorless toner to be applied, the measured gloss level and the number of jammed sheets in the control example (1);
Fig. 12 is a diagram illustrating the results of the control example (1) where no color toner is used;
Fig. 13 is a diagram illustrating an output image ap-

plied with no colorless toner; and
Fig. 14 is a diagram illustrating an output image applied with colorless toner.

Detailed Description of Embodiments

[0010] Hereinafter, one or more embodiments of the present invention will be described with reference to the drawings. However, the scope of the invention is not limited to the disclosed embodiments.

[0011] Hereinafter, an embodiment of an image forming apparatus 1 will be described with reference to the drawings. In the following description, the same parts or components are denoted by the same reference numerals, and the names and functions thereof are the same. Therefore, the description thereof will not be repeated.

[Adjust Gloss Level of Image with Colorless Toner]

[0012] Fig. 1 is a diagram representatively illustrating the surface of a sheet after it passes through a nip unit.

[0013] Typically, the toner used in the image formation contains a sufficient amount of a release agent. The image forming apparatus 1 heats a recording medium, on which an image is formed by using such toner, at a nip unit composed of a fixing rotator and a pressing rotator. When the recording medium is heated, the release agent contained in the toner oozes out and forms a layer between the toner and the surface of the fixing rotator. As a result, the recording medium is easy to be peeled off from the fixing rotator at the exit of the nip unit. In other words, the release agent functions to facilitate the separation of the recording medium from the fixing rotator. Fig. 1 illustrates that a release agent PA has oozed out to the surface of a toner TN applied to a sheet P. The sheet P is given as an example of the recording medium.

[0014] Generally, the layer formed by the release agent between the toner and the surface of the fixing rotator is uniform. Thus, the surface of the toner TN is smooth. Thereby, the image formed on the sheet P has a high gloss level. On the other hand, the user may hope to form an image with a low gloss level. Thus, the image forming apparatus 1 of the present embodiment is configured to adjust the gloss level of an image to be formed.

[0015] Fig. 2 is a diagram representatively illustrating the surface of another sheet after it passes through the nip unit.

[0016] The image forming apparatus 1 is configured to form an image on the sheet P by using a toner (referred to as toner A which may be composed of plural types of toners) containing a sufficient amount of a release agent, then apply a toner (referred to as toner B) containing the release agent less than the toner A to the image, and thereafter convey the sheet P to the nip unit.

[0017] In the nip unit, a sufficient amount of the release agent will ooze out from the toner A, but only a small amount of the release agent will ooze out from the toner B. After the toner B is melted, the toner B is in intimate contact with the surface of the fixing rotator, which makes it difficult for the release agent to enter into the intimate contact portions. Accordingly, the release agent can not form a complete layer between the toner and the surface of the fixing rotator. In other word, the release agent is present in some portions but not present in the other portions. When the sheet P is discharged out of the nip unit, the portions where the release agent is present are easy to be peeled off from the fixing rotator, but the portions where the release agent is not present are difficult to be peeled off from the fixing rotator. In other words, different portions on the surface of the sheet P will be peeled off from the fixing rotation member with different force. At the portions where the peeling is difficult, the toner will be drawn to the surface of the fixing rotary body so as to form pimples. As illustrated in Fig. 2, after passing through the nip unit, the surface of the image the sheet P will become uneven. In other words, the gloss level of the image is reduced.

[0018] In the present embodiment, in addition to a toner such as the toner A that contains more release agent as described above, another toner such as the toner B that contains less release agent is used to reduce the gloss level of an image to be formed on a sheet. Since the toner B is used to adjust the gloss level, it is preferable that the toner B does not contain any coloring material such as a dye or a pigment. In the present specification, the toner that contains less release agent and is used to adjust the gloss level is referred to as "colorless toner". The colorless toner is an example of adjustment toner. The "colorless toner" means that the toner used for gloss level adjustment contains less coloring material than any of the YMCK toners, and does not mean that it does not contain any coloring material.

[0019] Fig. 3 is a diagram schematically illustrating the relationship between an amount of colorless toner to be applied and a gloss level of an image to be formed. The amount of colorless toner to be applied is, for example, the amount to be applied to a sheet per unit area on which an image is formed.

[0020] As illustrated in Fig. 3, the gloss level of an image decreases as the amount of colorless toner to be applied increases to an amount D1, and after the amount D1, the gloss level of the image increases as the amount of colorless toner to be applied increases. In other words, the gloss level of the image at the amount D1 is minimum.

[Configuration of Image Forming Apparatus]

[0021] Fig. 4 is a diagram schematically illustrating the entire configuration of the image forming apparatus 1. Fig. 5 is a block diagram illustrating main components in the control system of the image forming apparatus 1. Hereinafter, the configuration of the image forming apparatus 1 will be described with reference to Figs. 4 and 5.

[0022] The image forming apparatus 1 is an intermediate transfer-type color image forming apparatus using electrophotography processing technology, and may be

implemented by, for example, a color copying machine or an MFP (Multi-Function Peripheral).

[0023] The image forming apparatus 1 transfers (primary transfer) a yellow (Y) toner image, a magenta (M) toner image, a cyan (C) toner image and a black (K) toner image formed on corresponding photoconductor drums 413 to an intermediate transfer belt (first transfer member) 421 and superimposes the toner images of the 4 colors on the intermediate transfer belt 421, and thereafter transfers (secondary transfer) the superimposed toner image to the sheet P so as to form an image. The image forming apparatus 1 is a tandem type image forming apparatus in which the photoconductor drums 413 corresponding to the 4 colors of Y, M, C and K are arranged in series in the traveling direction of the intermediate transfer belt 421, and the toner images of the 4 colors are sequentially transferred to the intermediate transfer belt 421 in one procedure. The image forming apparatus 1 further includes a unit configured to apply the colorless toner to the sheet P.

[0024] As mainly illustrated in Fig. 5, the image forming apparatus 1 includes an image reading device 10, an operation display device 20, an image processing device 30, an image forming device 40, a paper conveying device 50, a fixing device 60, a communication device 71, a storage device 72, and a controller 100.

[0025] The controller 100 includes a central processing unit (CPU) 101, a read-only memory (ROM) 102, a random access memory (RAM) 103 and the like. The CPU 101 is configured to read out a program from the ROM 102 according to a processing task, deploy the program in the RAM 103, and control the operation of each component in the image forming apparatus 1 together with the deployed program. During the control, various data stored in the storage device 72 is used. The storage device 72 may be any storage device such as a non-volatile semiconductor memory (so-called flash memory) or a hard disk drive.

[0026] The controller 100 is configured to exchange, via the communication device 71, various data with an external device (for example, a personal computer) that is connected to a communication network such as a local area network (LAN) or a wide area network (WAN). The communication device 71 may be implemented by, for example, a communication control card such as a network card. The controller 100 acquires data (input image data) of an image to be printed on the sheet P, and forms the image on the sheet P based on the acquired input image data. The controller 100 may acquire the input image data by, for example, receiving image data transmitted from an external device.

[0027] As mainly illustrated in Fig. 4, the image reading device 10 includes elements such as an automatic document feeding device 11 also called as an automatic document feeder (ADF) and a document image scanning device 12 (such as a scanner). The automatic document feeding device 11 is configured to convey a document D placed in a document tray via a conveying mechanism to the document image scanning device 12. When the automatic document feeding device 11 continuously conveys plural pieces of documents D placed in the document tray to the document image scanning device 12, the document image scanning device 12 may read the images (on both sides) of plural pieces of documents D continuously.

[0028] The document image scanning device 12 reads an image of a document by optically scanning the document that is conveyed onto a contact glass by the automatic document feeding device 11 or placed on the contact glass by a user, and forming an image on the light receiving surface of a CCD (Charge Coupled Device) sensor 12a based on the light rays reflected from the document. The image reading device 10 generates input image data based on the reading result of the document image scanning device 12. The image processing device 30 is configured to perform a predetermined process on the input image data.

[0029] The operation display device 20 is, for example, a liquid crystal display (LCD) with a touch panel, and functions as a display unit 21 and an operation unit 22. The display unit 21 displays the status of various operation screens and images, the operation status of each function, and the like in accordance with a display control signal from the controller 100. The operation unit 22 may be a software key, a hardware key, or a combination thereof. As an example, the operation unit 22 includes various operation keys such as numeric keys and a start key, and is configured to receive various inputs from the user and output an operation signal to the controller 100.

[0030] The image processing device 30 includes a circuit or the like configured to perform a digital image process on the input image data according to default preferences or user preferences. For example, the image processing device 30 is configured to perform a tone correction based on tone correction data (tone correction table) under the control of the controller 100. In addition to the tone correction, the image processing device 30 is configured to perform various correction processes such as color correction and shading correction or a compression process on the input image data. The image forming device 40 is controlled based on the processed input image data.

[0031] The image forming device 40 includes image forming units 41Y, 41M, 41C and 41K, an image forming unit 41CLR, and an intermediate transfer unit 42. Each of the image forming units 41Y, 41M, 41C and 41K is configured to form an image with Y color toner, M color toner, C color toner and K color toner, respectively, according to the input image data, and the image forming unit 41CLR is configured to apply the colorless toner to a sheet. In Fig. 4, for convenience of explanation, the common components are denoted by the same reference numerals, and when it is necessary to distinguish these components, Y, M, C, K or CLR is added to the reference numerals as a suffix. Further in Fig. 4, for simplicity and clarity, the reference numerals such as "412" are given

to the components corresponding to the image forming unit 41Y, and no reference numeral is given to those components corresponding to each of the image forming units 41M, 41C, 41K and 41CLR.

[0032] The image forming unit 41 includes an exposure device 411, a developing device 412, a photoconductor drum 413, a charging device 414, a drum cleaning device 415, and the like. The photoconductor drum 413 is, for example, a negatively charged organic photoconductor (OPC) including an undercoat layer (UCL), a charge generation layer (CGL) and a charge transport layer (CTL) sequentially laminated on the outer peripheral surface of a conductive aluminum cylinder (aluminum tube) having a diameter of 80 mm. The charge generation layer is made of an organic semiconductor obtained by dispersing a charge generation material (such as phthalocyanine pigment) in a resin binder (such as polycarbonate resin), and is configured to generate a pair of positive charge and negative charge when exposed to the exposure device 411. The charge transport layer is obtained by dispersing a hole transporting material (such as an electron-donating nitrogen-containing compound) in a resin binder (such as polycarbonate resin), and is configured to transport the positive charge generated in the charge generation layer to the surface of the charge transport layer.

[0033] The controller 100 is configured to control a drive current supplied to a drive motor (not shown) for rotating the photoconductor drum 413 so as to rotate the photoconductor drum 413 at a constant circumferential speed.

[0034] The charging device 414 is configured to negatively charge the surface of the photoconductor drum 413 uniformly. The exposure device 411 is provided with, for example, a semiconductor laser which is configured to irradiate the photoconductor drum 413 with a laser beam corresponding to the image of each color component. Accordingly, positive charges are generated in the charge generation layer of the photoconductor drum 413 and transported to the surface of the charge transport layer so as to neutralize the surface charges (negative charges) of the photoconductor drum 413. As a result, an electrostatic latent image of each color component is formed on the surface of the photoconductor drum 413 due to the potential difference with the surroundings.

[0035] The developing device 412 is, for example, a two-component developing device which is configured to visualize the electrostatic latent image by attaching the toner of each color component (oilless toner containing wax in toner particles) to the surface of the photoconductor drum 413 so as to form a toner image. The drum cleaning device 415 is provided with a drum cleaning blade or the like in sliding contact with the surface of the photoconductor drum 413 so as to remove the residual toner on the surface of the photoconductor drum 413 after the primary transfer.

[0036] The intermediate transfer unit 42 includes an intermediate transfer belt 421, a plurality of primary transfer rollers 422, a plurality of support rollers 423, a secondary transfer roller 424, a belt cleaning device 426, and the like. The intermediate transfer belt 421 is formed of an endless belt stretched over the plurality of support rollers 423 into a loop shape. At least one of the plurality of support rollers 423 is configured as a drive roller, and the others are configured as driven rollers. For example, it is preferable that a roller 423A disposed downstream to the primary transfer roller 422 for the component K in the belt traveling direction is a drive roller, which makes it easy to keep the traveling speed of the belt constant during the primary transfer. Due to the rotation of the roller (drive roller) 423A, the intermediate transfer belt 421 travels at a constant speed in the direction indicated by an arrow A.

[0037] Each primary transfer roller 422 is disposed inside the inner peripheral surface of the intermediate transfer belt 421, facing the photoconductor drum 413 of each color component. The primary transfer roller 422 is pressed against the photoconductor drum 413 through the intermediary of the intermediate transfer belt 421, forming a primary transfer nip for transferring the toner image from the photoconductor drum 413 to the intermediate transfer belt 421.

[0038] The secondary transfer roller 424 is disposed outside the outer peripheral surface of the intermediate transfer belt 421, facing a backup roller 423B disposed downstream to the drive roller 423A in the belt traveling direction. The secondary transfer roller 424 is pressed against the backup roller 423B through the intermediary of the intermediate transfer belt 421, forming a secondary transfer nip for transferring the toner image from the intermediate transfer belt 421 to the sheet P.

[0039] When the intermediate transfer belt 421 passes through the primary transfer nip, the toner images on the photoconductor drum 413 are primarily transferred and sequentially superimposed on the intermediate transfer belt 421. Specifically, a primary transfer bias is applied to the primary transfer roller 422 so as to generate charges having an opposite polarity to the toner on the back surface (the surface that contacts the primary transfer roller 422) of the intermediate transfer belt 421, and thereby each toner image is electrostatically transferred to the intermediate transfer belt 421.

[0040] After the toner images are transferred to the intermediate transfer belt 421, when the sheet P is conveyed to pass through the secondary transfer nip, the toner image on the intermediate transfer belt 421 is secondarily transferred to the sheet P. Specifically, a secondary transfer bias is applied to the secondary transfer roller 424 so as to generate charges having an opposite polarity to the toner on the back surface (the surface that contacts the secondary transfer roller 424) of the sheet P, and thereby, the toner image on the intermediate transfer belt 421 is electrostatically transferred to the sheet P. The sheet P transferred with the toner image is conveyed toward the fixing device 60.

[0041] In the image forming apparatus 1 of the present

embodiment, the image forming unit 41CLR for the colorless toner is disposed upstream of the image forming units 41Y, 41M, 41C and 41K for the color toners. Thus, the colorless toner is disposed closer to the intermediate transfer belt 421 than each of the color toners. Thereby, in the image on the sheet P after the secondary transfer, the colorless toner is disposed on the surface of the color toners.

[0042] The belt cleaning device 426 is provided with a belt cleaning blade or the like in sliding contact with the surface of the intermediate transfer belt 421 so as to remove the residual toner on the surface of the intermediate transfer belt 421 after the secondary transfer. Alternatively, a structure in which a secondary transfer belt is stretched over a plurality of support rollers including the secondary transfer roller into a loop shape (i.e., a belt-type secondary transfer unit) may be adopted to replace the secondary transfer roller 424.

[0043] The fixing device 60 includes an upper fixing unit 60A having a fixing member disposed on the side of a surface (the fixing surface) of the sheet P on which the toner image is formed, a lower fixing unit 60B having a support member disposed on the side of the back surface (opposite to the fixing surface) of the sheet P, a heating source (not shown), and the like. The support member disposed on the side of the back surface is pressed against the fixing member disposed on the side of the fixing surface so as to sandwich (nip) the sheep P. The portion which nips the sheet P in this manner is appropriately referred to as a "nip unit". The fixing device 60 fixes the toner image on the sheet P by heating and pressing the sheet P on which the toner image has been secondarily transferred at the nip unit. The fixing device 60 is disposed as a unit in the fixing device F.

[0044] The upper fixing unit 60A includes a fixing belt 61, a heating roller 62, an upper pressing roller 63, and a stretching member 64 (so as to constitute a belt heating system). The fixing belt 61 is an endless belt which serves as a fixing member and is stretched over the heating roller 62, the upper pressing roller 63 and the stretching member 64 (tension roller) at a predetermined belt tension (for example, 400 N). The fixing belt 61 and a lower pressing roller 65 constitute a nip unit. The fixing belt 61 is an example of a fixing rotator, and the lower pressing roller 65 is an example of a pressing rotator.

[0045] The fixing belt 61 is configured to contact the sheet P on which the toner image is formed and heat the sheet P at a fixing temperature (for example, 160 to 200°C) so as to fix the toner image on the sheet P. The fixing temperature is a temperature which may provide necessary heat so as to melt the toner on the sheet P, and may vary depending on the type of a sheet P used to form an image or the like.

[0046] The fixing belt 61 includes, for example, a base which is formed from polyimide (PI) having a thickness of 50 μm into a cylinder having an outer diameter of 110 mm, an elastic layer laminated on the surface (the outer peripheral surface) of the base, and a release layer laminated on the surface (the outer peripheral surface) of the elastic layer. The fixing belt 61 is wound around the heating roller 62 and the upper pressing roller 63 with a predetermined tension, forming an oval along the horizontal direction. The elastic layer of the fixing belt 61 is formed from silicone rubber having a thickness of 200 μm, and the releasing layer is formed from PFA (tetrafluoroethylene-perfluoroalkyl vinyl ether copolymer) having a thickness of 30 μm into a tube. Thus, the heat capacity of the fixing belt is relatively small.

[0047] The heating roller 62 is configured to heat the fixing belt 61. The heating roller 62 is internally built with a heating source (a halogen heater) for heating the fixing belt 61. The temperature of the heating source is controlled by the controller 100. The heating roller 62 is heated by the heating source, and as a result, the fixing belt 61 is heated.

[0048] The heating roller 62 is obtained by laminating, for example, a PTFE (polytetrafluoroethylene) coat on the surface (the outer peripheral surface) of a cylindrical mandrel. The heating roller 62 has an outer diameter of 60 mm. The mandrel is formed from an aluminum plate having a thickness of 1 mm. Thus, the heat capacity of the heating roller 62 is relatively small.

[0049] A plurality of heating lamps configured to heat the heating roller 62 with heat converted from electrical power are disposed inside the heating roller 62. When the heating roller 62 is heated by one or more of the heating lamps, the fixing belt 61 traveling around the heating roller 62 is heated, and thus, when a sheet P passes through the fixing nip (nip unit), it is heated by the fixing belt 61. The heating lamp may be, for example, a halogen lamp. The plurality of heating lamps are disposed in a circle with a predefined radius from the center of the heating roller 62 and equally spaced in the circumferential direction. The rated power for the heating lamps in total is, for example, 1500 W.

[0050] With the supply of electric power, the heating lamps are turned on (and thereby generate heat) so as to heat the heating roller 62 with an amount of heat substantially proportional to the supplied electric power. The plurality of heating lamps have the same length of 290 mm, for example. In order to ensure the fixing quality at both side portions of the fixing belt 61 in the width direction (orthogonal to the sheet conveying direction), each of the plurality of heating lamps is configured in such a manner that the light distribution (corresponding to the light intensity and the heating intensity) at both side portions in the longitudinal direction is larger than the light distribution at the central portion in the longitudinal direction. In the present embodiment, if the light distribution of each heating lamp at the central portion which has a length of 250 mm is set to 100%, the light distribution at each side portion which has a length of 20 mm is 115%.

[0051] A temperature sensor (not shown) configured to detect the surface temperature of the fixing belt 61 is provided in the vicinity of the heating roller 62. The temperature sensor is disposed to face an upstream portion

of the fixing belt 61 in the traveling direction. The temperature sensor may be, for example, a non-contact thermistor.

[0052] The upper pressing roller 63 is pressed against the lower pressing roller 65 through the intermediary of the fixing belt 61. The lower pressing roller 65 is driven to rotate by a main drive source (not shown) disposed in the fixing device 60. The lower fixing unit 60B includes, for example, a lower pressing roller 65 which is a support member at the back surface side (so as to constitute a roller pressing system). The controller 100 controls the main drive source (drive motor) to rotate the lower pressing roller 65 in the counterclockwise direction. The control (for example, the rotation on/off and the circumferential speed) of the drive motor is performed by the controller 100. The lower pressing roller 65 is internally built with a heating source (not shown) such as a halogen heater. The lower pressing roller 65 is heated by the heating source. The controller 100 controls the electric power supplied to the heating source so as to maintain the lower pressing roller 65 at a predetermined temperature (for example, 80 to 120°C).

[0053] The upper pressing roller 63 includes, for example, an aluminum mandrel (having a diameter of 30 mm) and an elastic layer laminated on the surface (the outer peripheral surface) of the mandrel to have a thickness of 15 mm. The elastic layer is formed from, for example, silicone rubber having a JIS A hardness of 10. Due to the soft elastic layer provided in the upper pressing roller 63, when the upper pressing roller 63 is pressed against the lower pressing roller 65, it may largely deform at the nip unit so as to provide a sufficient fixing area for the nip unit.

[0054] The lower pressing roller 65 is pressed against the upper pressing roller 63 with a predetermined fixing load (for example, 2650 N) through the intermediary of the fixing belt 61. Thereby, a fixing nip is formed between the fixing belt 61 and the lower pressing roller 65 for nipping and conveying the sheet P. When the lower pressing roller 65 is driven to rotate, the fixing belt 61 is driven to rotate clockwise. Accordingly, the upper pressing roller 63 is driven to rotate clockwise. The stretching member 64 is driven to rotate clockwise.

[0055] The lower pressing roller 65 includes, for example, an aluminum mandrel (having a thickness of 5 mm), an elastic layer laminated on the surface (the outer peripheral surface) of the mandrel, and a release layer (not shown) laminated on the surface (peripheral surface) of the elastic layer. The elastic layer is formed from silicone rubber. The release layer is formed from PFA having a thickness of 30 μm into a tube. Since the lower pressing roller 65 includes an aluminum mandrel having a thickness of 5 mm, it is highly rigid and has a heat capacity larger than that of the fixing belt. The lower pressing roller 65 has a so-called reverse crown shape in which the diameter decreases toward the central portion in the longitudinal direction. When the outer diameter of the end portion is denoted by D1 and the outer diameter of the central portion is denoted by D2, the difference between the two diameters is referred to as the reverse crown amount. The reverse crown amount is set to about 0.1 to 0.8 mm. The lower pressing roller 65 is rotated at a predetermined surface speed by a drive unit.

[0056] The fixing device 60 includes a drive source configured to rotate the upper pressing roller 63 and a drive source configured to rotate the lower pressing roller 65. As the drive source, for example, a common AC motor or a DC brushless motor may be used. The DC brushless motor is structurally similar to an AC permanent magnet synchronous motor which is provided with a permanent magnet as the rotor, and is configured to detect the rotational position of the rotor by using a Hall element or the like, generate a magnetic field based on the detected rotational position and control the same so as to control the torque or the speed of the rotor. A drive controller is connected to these drive sources, the speed or the like is controlled by the drive controller.

[0057] The paper conveying device 50 includes a paper feeding unit 51, a paper discharging unit 52, a conveying path unit 53, and the like. Three paper feeding tray units 51a to 51c constitute the paper feeding unit 51, and each tray unit is configured to house a specific type of sheets P (standard-sized sheets or special-sized sheets) that may be classified based on the basis weight, the size or the like. The conveying path unit 53 includes a plurality of conveying roller pairs such as registration roller pairs 53a.

[0058] The sheets P housed in the paper feeding tray units 51a to 51c are fed one by one from the top and conveyed by the conveying path unit 53 to the image forming device 40. At this time, the inclination of each sheet P to be fed is corrected and the timing for conveying each sheet P is adjusted by a registration roller unit composed of the registration roller pairs 53a. Then, in the image forming device 40, the toner images on the intermediate transfer belt 421 are secondarily transferred to one surface of the sheet P collectively, and in the fixing device 60, a fixing process is performed. The sheet P on which the image is formed is discharged to the outside of the apparatus by the paper discharging unit 52 provided with at least a pair of discharging rollers 52a. The sheet discharged to the outside of the apparatus is discharged into, for example, a paper discharge tray (not shown). In addition, at the time of continuous printing in which image formation is continuously performed on a plurality of sheets, the plurality of sheets discharged to the outside are stacked in the paper discharge tray.

[Preference table]

[0059] Fig. 6 is a diagram representatively illustrating a preference table for defining an amount of colorless toner to be applied in accordance with a predefined gloss level. The information for specifying the preference table is stored in a storage device (for example, the storage device 72) accessible to the CPU 101.

[0060] As illustrated in Fig. 6, the lower the predefined gloss level is, the larger the amount of colorless toner to be applied will be. As an example, the preference table includes predefined gloss levels down to the minimum gloss level illustrated in Fig. 3. Thus, the maximum amount of colorless toner to be applied according to the preference table is equal to or less than the amount corresponding to the minimum gloss level.

[Processing Flow]

[0061] Fig. 7 is a flowchart illustrating a process for applying the colorless toner to a sheet according to the predefined gloss level. The process of Fig. 7 is initiated when the image forming apparatus 1 receives an instruction to form an image on the sheet P, and is implemented by, for example, causing the CPU 101 to execute a predetermined program. The flow of the process will be described with reference to Fig. 7. Note that the process maybe configured as a part of a given process (for example, an image forming process).

[0062] In step S10, the CPU 101 acquires the predefined gloss level for an image to be formed on the sheet P. As an example, the predefined gloss level is included in the description of a print job, and the CPU 101 implements the control of step S10 by reading out the predefined gloss level from the print job.

[0063] In step S20, the CPU 101 acquires, from the preference table, the amount of colorless toner to be applied based on the gloss level acquired in step S10.

[0064] In step S30, the CPU 101 controls the image forming unit 41CLR to apply the colorless toner to the sheet P according to the amount of colorless toner acquired in step S20. As an example, the CPU 101 controls the amount of positive charges to be generated in the charge generation layer of the image forming unit 41CLR based on the amount of colorless toner to be applied.

[Modified Example]

[0065] The number of colors used by the image forming apparatus 1 to form an image is not limited to that illustrated in Fig. 4. Fig. 8 is a diagram illustrating main components in an image forming device 40 according to a modified example.

[0066] In the example of Fig. 8, the image forming device 40 includes 4 types of image forming units 41CLR, 41Y, 41M and 41C. In other words, in the example of Fig. 8, the image forming apparatus 1 can only output 3 types of colors (Y, M, C). Further, in such image forming apparatus 1, the image forming unit 41CLR for the colorless toner is disposed upstream of the 3 image forming units 41Y, 41M and 41C for the color toners. Thereby, the colorless toner may be applied to the surface of the 3 kinds of the color toners (Y, M, C).

[Examples]

(Production Examples of Toner)

<Production Example 1 of Resin Dispersion>

[0067] 85 parts by mass of terephthalic acid, 6 parts by mass of trimellitic acid and 250 parts by mass of bisphenol A propylene oxide adduct were added into a reaction vessel equipped with a stirrer, a thermometer, a condenser and a nitrogen gas introduction pipe, after flushing the reaction vessel with dry nitrogen gas, 0.1 parts by mass of titanium tetrabutoxide was added, and the reaction was carried out while stirring at about 180°C for 8 hours under nitrogen gas flow. Then, 0.2 parts by mass of titanium tetrabutoxide was added, the temperature was raised to about 220°C, and the reaction was carried out while stirring for 6 hours. Thereafter, the pressure in the reaction vessel was reduced to 10 mmHg, and the reaction was carried out under the reduced pressure to obtain a polyester resin (A1).

[0068] The glass transition point (Tg) of the polyester resin (A1) was 59°C, and the weight-average molecular weight (Mw) thereof was 9000.

[0069] 200 parts by mass of the amorphous polyester resin (A1) was dissolved in 200 parts by mass of ethyl acetate, and into the obtained solution, an aqueous solution obtained by dissolving sodium polyoxyethylene lauryl ether sulfate in 800 parts by mass of ion exchanged water so that its concentration is 1% by mass was slowly dropped while stirring. After removing ethyl acetate under the reduced pressure, the solution was adjusted to pH 8.5 with ammonia. Thereafter, the concentration of solid contents was adjusted to 20% by mass. Thus, a dispersion of polyester resin (A1) in which the fine particles of the amorphous polyester resin (A1) were dispersed in an aqueous medium was prepared.

<Production Example 2 of Resin Dispersion>

[0070] 315 parts by mass of dodecanedioic acid and 220 parts by mass of 1,6-hexanediol were added into a reaction vessel equipped with a stirrer, a thermometer, a condenser and a nitrogen gas introduction pipe, after flushing the reaction vessel with dry nitrogen gas, 0.1 parts by mass of titanium tetrabutoxide was added, and the reaction was carried out while stirring at about 180°C for 8 hours under nitrogen gas flow. Then, 0.2 parts by mass of titanium tetrabutoxide was added, the temperature was raised to about 220°C, and the reaction was carried out while stirring for 6 hours. Thereafter, the pressure in the reaction vessel was reduced to 10 mmHg, and the reaction was carried out under the reduced pressure to obtain a polyester resin (B1).

[0071] The melting point (Tm) of the polyester resin (B1) was 72°C, and the weight-average molecular weight (Mw) thereof was 14000.

[0072] The polyester resin (B1) was dissolved in a sol-

vent, aqueous ammonia was added, and then ion-exchanged water was dropped to obtain a polyester resin (B1) dispersion by phase inversion emulsification. The concentration of solid contents in the polyester resin solution (B1) was 20%.

<Preparation Example of Wax Dispersion>

[0073] 200 parts by mass of ester wax (melting point: 73°C) was melted by heating it to 95°C. To the melted ester wax, a surfactant aqueous solution obtained by dissolving sodium alkyldiphenyl etherdisulfonate in 800 parts by mass of ion-exchanged water so that its concentration is 3% by mass was added, and then an ultrasonic homogenizer was used to perform the dispersion treatment. The concentration of solid contents was adjusted to 20% by mass. Thus, a wax dispersion in which fine particles of wax were dispersed in an aqueous medium was prepared.

<Production Example of Colorant Dispersion>

[0074] 90 parts by weight of sodium dodecyl sulfate was dissolved while stirring in 1600 parts by weight of ion exchange water, and while the solution is being stirred, 420 parts by weight of copper phthalocyanine was gradually added as a cyan pigment. Thereafter, a stirrer was used to perform the dispersion treatment. Thus, a colorant dispersion C was prepared.

[0075] Similarly, a colorant dispersion M was prepared by changing the pigment in the colorant dispersion C to carmine 6B (PR 57: 1) which is a magenta pigment.

[0076] Similarly, a colorant dispersion Y was prepared by changing the pigment in the colorant dispersion C to PY-180 which is a yellow pigment.

<Cyan Toner>

[0077] 300 parts by mass of the polyester resin (A1) dispersion, 100 parts by mass of the polyester resin (B1) dispersion, 70 parts by mass of the wax dispersion, 41.3 parts by mass of the colorant dispersion C, 225 parts by mass of ion exchanged water, and 2.5 parts by mass of polyoxyethylenelauryl ether sodium sulfate was added into a reaction vessel equipped with a stirrer, a condenser and a thermometer, and 0.1 N of hydrochloric acid was added while stirring to adjust pH to 2.5.

[0078] Next, 0.3 parts by mass of poly-aluminum chloride aqueous solution (10% aqueous solution in terms of $AlCl_3$) was dropped over 10 minutes, and the internal temperature was raised to 60°C while stirring. Thereafter, the internal temperature was gradually raised to 75°C and maintained at 75°C to perform the measurements by using a Coulter counter, and when the average particle diameter was about 6 μm, 2 parts by mass of 3-Hydroxy-(2,2'-iminobissuccinic acid) tetrasodium salt aqueous solution (40% aqueous solution) was added to stop the particle size growth, and the internal temperature was raised to 85°C. When the shape factor measured by using "FPIA-2000" was 0.96, the reaction solution was cooled to room temperature at a rate of 10°C/min. The reaction solution was filtered, repeatedly washed, and dried to obtain toner particles.

[0079] To the obtained toner particles, 1% by mass of hydrophobic silica (the average primary particle diameter = 12 nm, hydrophobicity = 68) and 1% by mass of hydrophobic titanium oxide (the average primary particle diameter = 20 nm, hydrophobicity = 63) were added, and mixed by using a Henschel mixer (manufactured by Mitsui Miike Machinery), and then sieved by using a 45 μm mesh sieve so as to remove the coarse particles. Thereby, a cyan toner was produced.

[0080] The volume based median diameter of the cyan toner was 6.10 μm, and the average circularity was 0.965.

<Magenta Toner and Yellow Toner>

[0081] A magenta toner and a yellow toner were produced according to the method for producing the cyan toner as described in the above except that the colorant dispersion M and the colorant dispersion Y were used respectively instead of the colorant dispersion C.

<Colorless Toner (1)>

[0082] A colorless toner (1) was produced according to the method for producing the cyan toner as described in the above except that the wax dispersion and the colorant dispersion were not used.

<Colorless Toner (2)>

[0083] A colorless toner (2) was produced according to the method for producing the cyan toner as described in the above except that the amount of the wax dispersion was reduced to 15 parts (1/5 of the amount used in the production of cyan toner) and the colorant dispersion was not used.

(Control Example)

[0084] Hereinafter, a control example (1) and a control example (2) will be described as examples of modes specific control.

[0085] In the control example (1) and the control example (2), a bizhub PRESS C1070 (manufactured by Konica Minolta) was used. The image forming device 40 in the bizhub PRESS C1070 has, for example, a structure described with reference to Fig. 4. In other words, in the bizhub PRESS C1070, toners are applied to the sheet P in the order of the cyan toner, the magenta toner, the yellow toner and the colorless toner from the side closer to the sheet P. Thus, the colorless toner is applied to the sheet P at the farthest position.

[0086] In the control example (1), a toner which con-

tains no wax (the colorless toner (1)) was used as the colorless toner, and in the control example (2), a toner which contains wax at 1/5 of the amount of the color toner (the colorless toner (2)) was used as the colorless toner. As the sheet P, the KINBISHI paper (81.4 g/m^2) manufactured by Mitsubishi Paper Mills Limited was used.

[0087] In each of the control example (1) and the control example (2), the relationship between an amount of colorless toner to be applied and a gloss level of 60 (hereinafter simply referred to as "gloss level") was obtained by preliminary experiments, and based on that, a preference table was created to determine the amount of colorless toner from a desired gloss level. Fig. 9 is a diagram illustrating a preference table created in the control example (1), and Fig. 10 is a diagram illustrating a preference table created in the control example (2). In the present specification, the unit of the amount of colorless toner is g/m^2.

[0088] The temperature of the fixing belt 61 for the preference table in each of Figs. 9 and 10 is 190°C. If the temperature of the fixing belt 61 is different, a preference table may be created for each corresponding temperature of the fixing belt 61. When the fixing belt 61 such as the hardness of the elastic layer is changed, a preference table may be created correspondingly.

[0089] In the control example (1) and the control example (2), the amount of colorless toner to be applied is determined by referring to the preference table, but it is not limited thereto. As an example, the amount of colorless toner to be applied may be determined by referring to a function T = f(G), wherein T represents the amount of colorless toner and G represents the desired gloss level. f(G) may be, for example, a quadratic function of G.

[0090] Referring back to Figs. 9 and 10 again, the gloss level of an output image is further included in each table as the verification result. The gloss level of an output image illustrated in Fig. 9 or Fig. 10 is measured from a blue solid image of cyan and magenta after the amount of colorless toner is applied in accordance with the preference table and fixed thereafter.

[0091] In the example of either Fig. 9 or Fig. 10, the gloss level of the output image is the same as or close to the predefined gloss level. Thereby, it was confirmed that the desired gloss level is substantially realized in either the control example (1) or the control example (2).

[0092] By comparison, in the control example (1), the amount of colorless toner required to adjust the gloss level of an output image to 11 was 1 g/m^2, while in the control example (2), that amount was 2.5 g/m^2, which means that it is possible to change the gloss level greater with a smaller amount of colorless toner that contains no wax as described in the control example (1).

[0093] Therefore, in order to reduce the consumption of colorless toner, it is advantageous that the colorless toner contains less wax, and it is advantageous that the colorless toner contains no wax.

[0094] Fig. 11 is a diagram illustrating the amount of colorless toner to be applied, the measured gloss level and the number of jammed sheets in the control example (1). The jammed sheets means the occurrence of paper jam due to the reason that the sheet P is stuck to the fixing belt 61. Fig. 11 illustrates the number of jammed sheets when the image formation is performed on 10 sheets. In the example of Fig. 11, the amount of colorless toner (1) applied onto the blue solid image of cyan and magenta is increased irrespective of the above preference table. The measured gloss level represents the gloss level of an image successfully printed on a sheet P.

[0095] According to the results shown in Fig. 11, it is found that when the amount of the colorless toner (1) to be applied is increased to a certain amount, the gloss level does not decrease any more, and the jam of sheets tends to occur. Thereby, it is desirable that the maximum amount of colorless toner to be applied should be set equal to such an amount that corresponds to the minimum gloss level.

[0096] Fig. 12 is a diagram illustrating the results of the control example (1) where no color toner is used. In other words, in the example of Fig. 12, only the colorless toner is applied to the sheet P. The number of jammed sheets indicates the number of sheets jammed when the image formation is performed on 10 sheets at each amount of colorless toner. The measured gloss level represents the gloss level of an image successfully printed on a sheet P.

[0097] According to the results shown in Fig. 12, it is found that when the colorless toner is applied to an area other than the image area formed by the color toner, the gloss level slightly increases and the jam of sheets tends to occur. Thereby, it is desirable that the colorless toner should be applied only to the area (image area) to which the color toner is applied.

(Image Example)

[0098] Fig. 13 is a diagram illustrating an output image applied with no colorless toner. In an image 1300 illustrated in Fig. 13, the gloss level is the same in all portions of the image area.

[0099] Fig. 14 is a diagram illustrating an output image applied with colorless toner. In an image 1400 of Fig. 14, the gloss level of an element in the image area may be modified by using the colorless toner. The modification of the gloss level will be described in detail hereinafter.

[0100] The image 1400 includes a sun 1410, a mountain 1420, and a mountain 1430. The sun 1410 is output at a gloss level of 50. In the mountain 1420, a portion 1421 is output at a gloss level of 20, and another portion 1422 is output at a gloss level of 50. In the mountain 1430, a portion 1421 is output at a gloss level of 20, and another portion 1422 is output at a gloss level of 50.

[0101] As described above, in the example of Fig. 14, the same element may be printed with different gloss levels. In order to print an image in this manner, for example, the amount of colorless toner to be applied may be adjusted for each portion.

[0102] The method of applying the colorless toner is

not limited to the electrophotography as described in Fig. 4 or the like as long as the colorless toner may be applied before the sheet is heated and pressed at the nip unit. On the other hand, as illustrated in Fig. 14, in order to apply the colorless toner at the correct position in an element of the image, the colorless toner is preferably applied by the electrophotography.

[0103] Although embodiments of the present invention have been described and illustrated in detail, the disclosed embodiments are made for purposes of illustration and example only and not limitation. The scope of the present invention should be interpreted by terms of the appended claims.

Claims

1. A gloss level adjustment method for adjusting a gloss level of an image which is formed by an electrophotographic image forming apparatus, comprising:

   forming an image on a recording medium by using a color toner containing a release agent;
   applying an adjustment toner containing the release agent less than the color toner to the surface of the image on the recording medium; and
   heating the image applied with the adjustment toner at a nip unit composed of a fixing rotator and a pressing rotator.

2. The gloss level adjustment method according to claim 1, further comprising acquiring a predefined gloss level of the image,
   wherein applying the adjustment toner includes adjusting an amount of the adjustment toner to be applied according to the predefined gloss level.

3. The gloss level adjustment method according to claim 1, wherein in applying the adjustment toner, the maximum amount of the adjustment toner to be applied corresponds to the amount of the adjustment toner at which the change in the gloss level of the image is minimum.

4. The gloss level adjustment method according to any one of claims 1 to 3, wherein applying the adjustment toner includes applying the adjustment toner only to a location where the color toner is applied.

5. The gloss level adjustment method according to any one of claims 1 to 4, wherein applying the adjustment toner includes applying the adjustment toner by electrophotography.

6. The gloss level adjustment method according to any one of claims 1 to 4, wherein the adjustment toner contains no release agent.

7. An image forming apparatus (1) configured to form an image by electrophotography, comprising:

   a heating unit (60) configured to heat a recording medium formed with an image at a nip unit composed of a fixing rotator (60A) and a pressing rotator (60B), the image being formed by using a color toner containing a release agent;
   an adjustment toner applying unit (41CLR) configured to apply an adjustment toner containing the release agent less than the color toner to the surface of the image formed on the recording medium before it is conveyed into the nip unit; and
   a controller (100) configured to adjust an amount of the adjustment toner to be applied by the adjustment toner applying unit (41CLR) according to a predefined gloss level of the image.

FIG.1

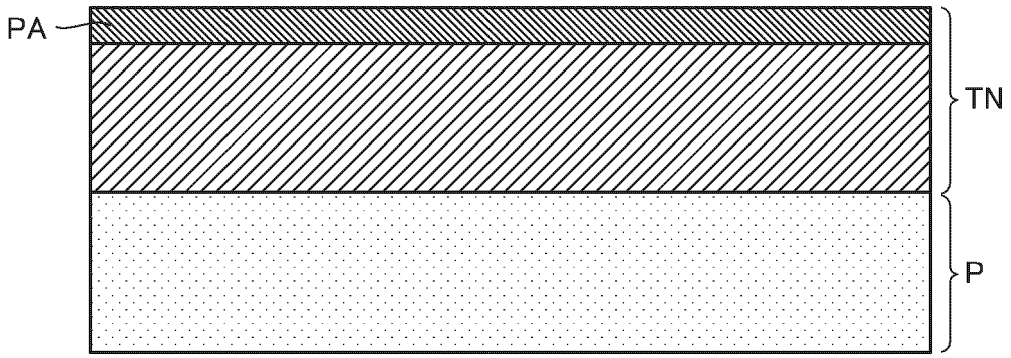


FIG.2

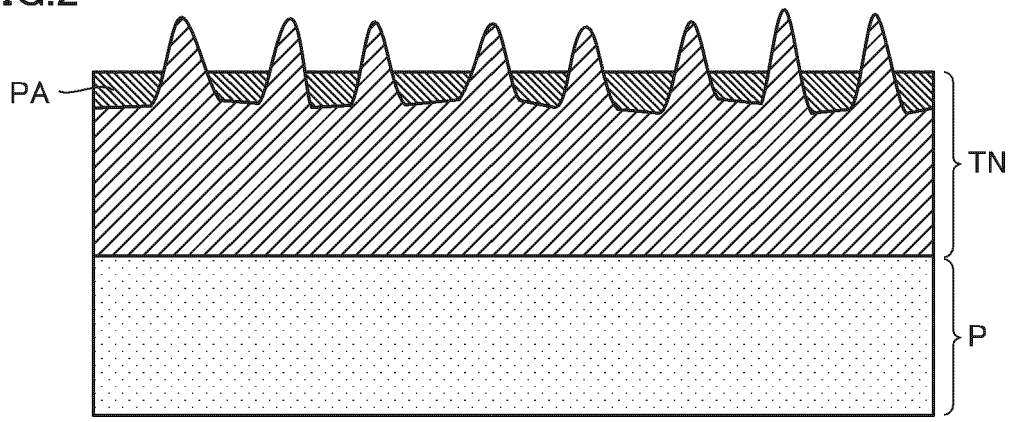


FIG.3

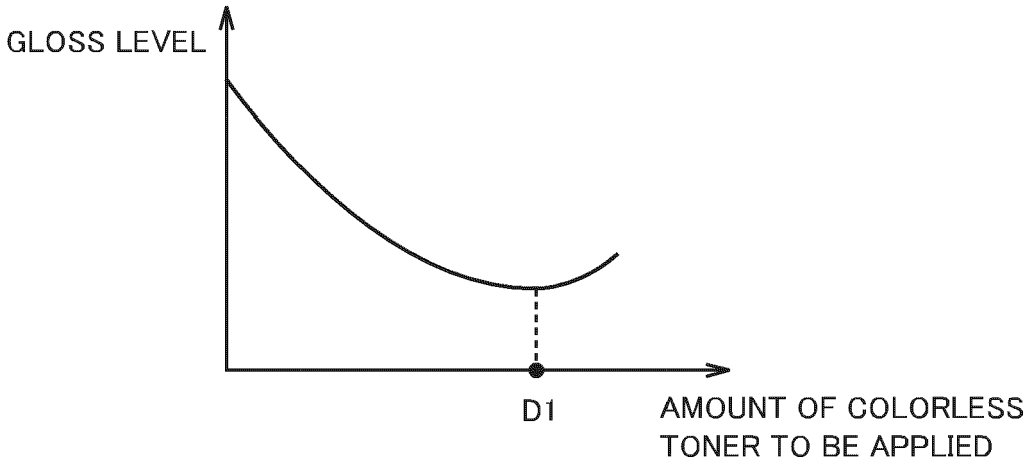
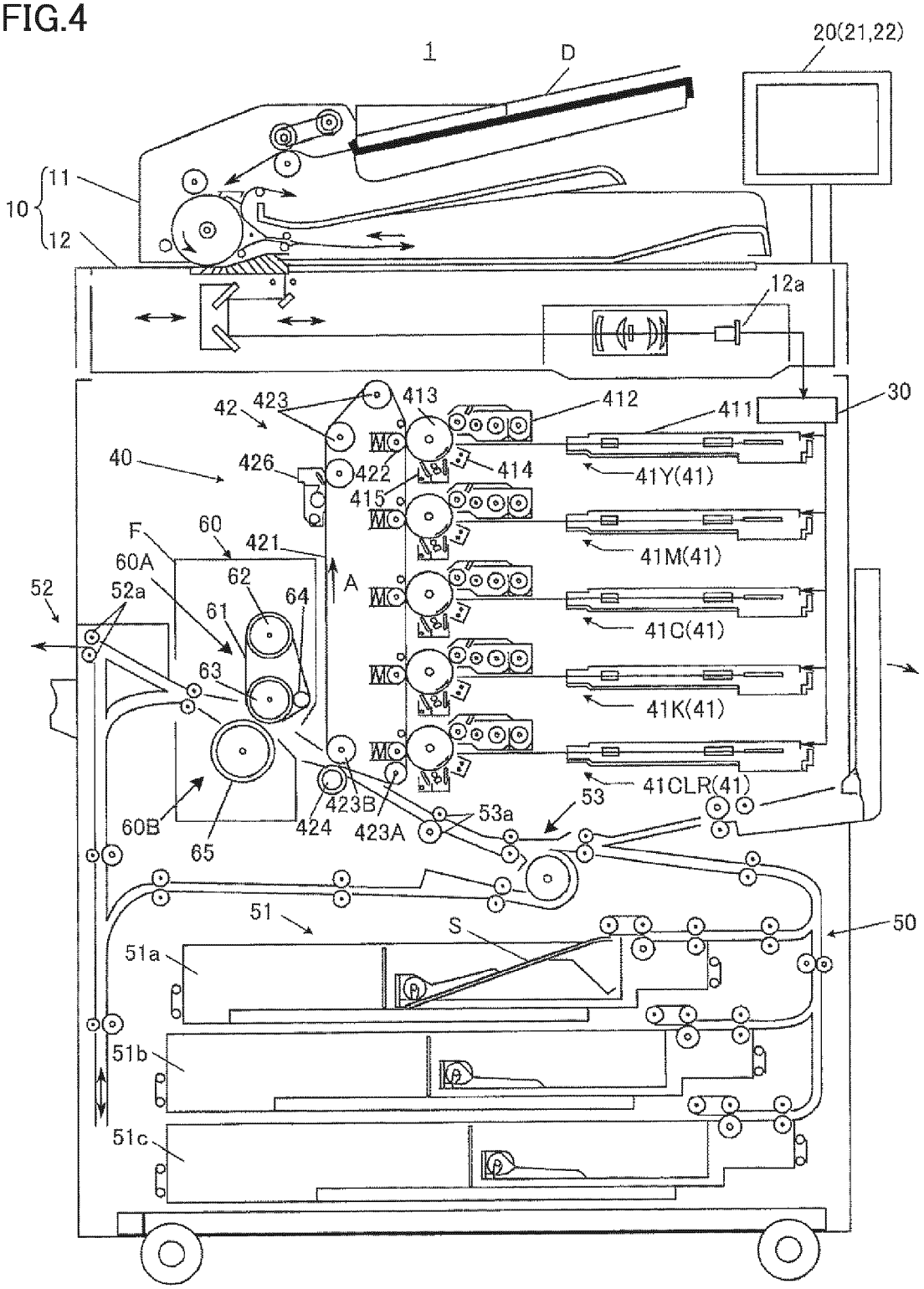


FIG.4


1
D
20(21,22)
10
11
12
12a
30
42
423
413
412
411
40
426
422
414
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415
41M(41)
F
60
421
60A
62
A
41C(41)
52
52a
61
64
63
41K(41)
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423B
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53a
51
S
50
51a
51b
51c

FIG.5

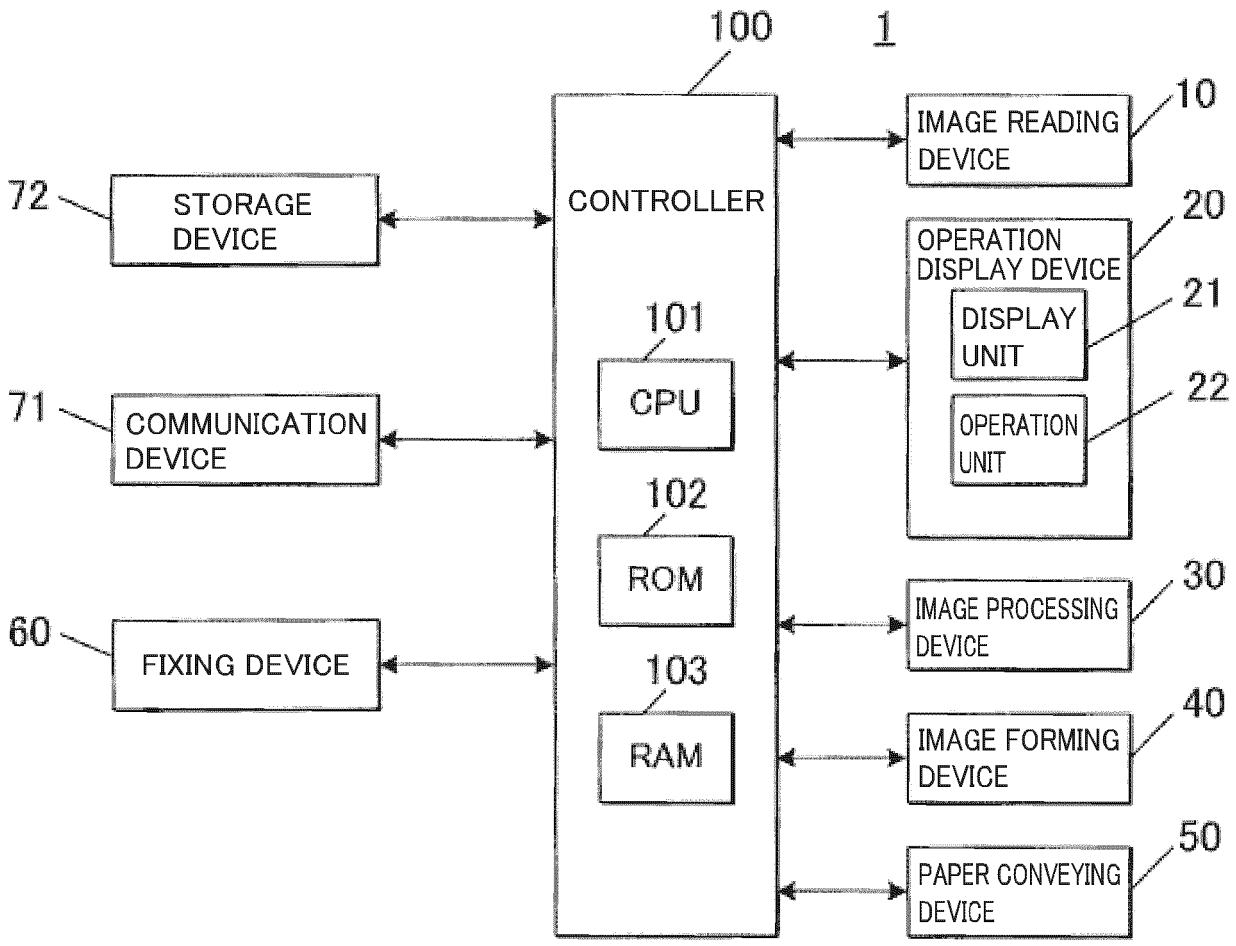

100
1
CONTROLLER
101
CPU
102
ROM
103
RAM
72
STORAGE DEVICE
71
COMMUNICATION DEVICE
60
FIXING DEVICE
IMAGE READING DEVICE
10
OPERATION DISPLAY DEVICE
20
DISPLAY UNIT
21
OPERATION UNIT
22
IMAGE PROCESSING DEVICE
30
IMAGE FORMING DEVICE
40
PAPER CONVEYING DEVICE
50

FIG.6

PREFERENCE TABLE	
PREDEFINED (DESIRED) GLOSS LEVEL	AMOUNT OF COLORLESS TONER TO BE APPLIED
45	0
40	0.1
35	0.2
30	0.3
25	0.4
20	0.6
15	0.8
10	1

FIG.7

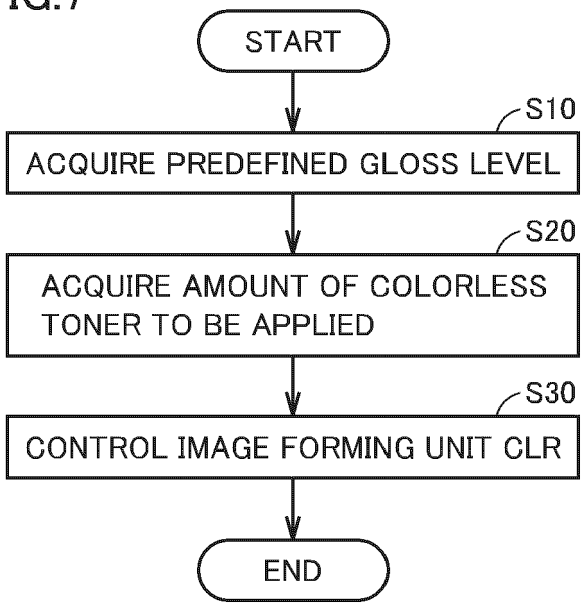

START
S10
ACQUIRE PREDEFINED GLOSS LEVEL
S20
ACQUIRE AMOUNT OF COLORLESS TONER TO BE APPLIED
S30
CONTROL IMAGE FORMING UNIT CLR
END

FIG.8

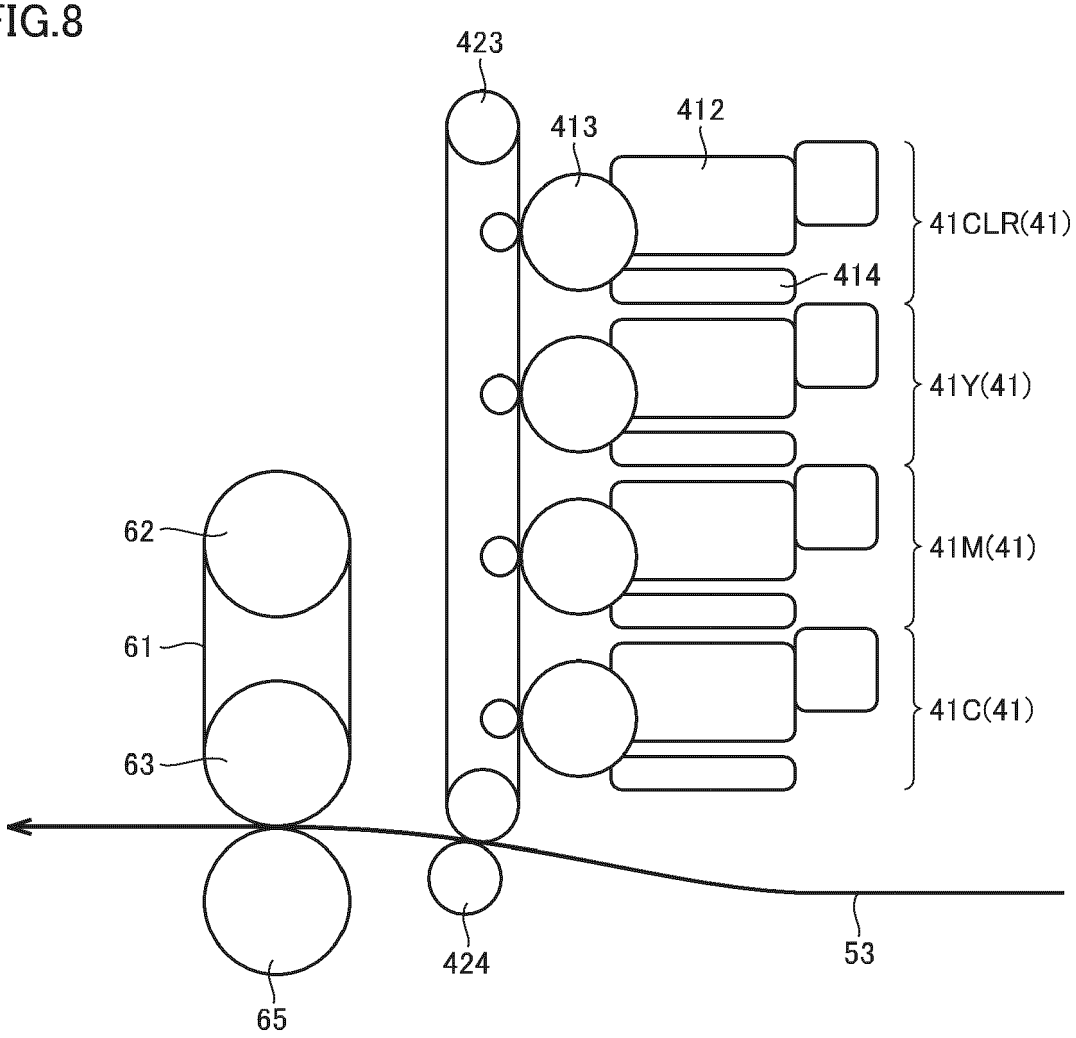


FIG.9

PREFERENCE TABLE		
PREDEFINED (DESIRED) GLOSS LEVEL	AMOUNT OF COLORLESS TONER TO BE APPLIED	GLOSS LEVEL OF OUTPUT IMAGE
45	0	45
40	0.1	40
35	0.2	35
30	0.3	31
25	0.4	26
20	0.6	19
15	0.8	14
10	1	11

FIG.10

PREFERENCE TABLE		
PREDEFINED (DESIRED) GLOSS LEVEL	AMOUNT OF COLORLESS TONER TO BE APPLIED	GLOSS LEVEL OF OUTPUT IMAGE
45	0	45
40	0.2	41
35	0.5	35
30	0.8	29
25	1.1	25
20	1.5	20
15	1.9	15
10	2.5	11

FIG.11

AMOUNT OF COLORLESS TONER TO BE APPLIED	GLOSS LEVEL OF OUTPUT IMAGE	NUMBER OF JAMMED SHEETS/ TOTAL NUMBER OF SHEETS
0	45	0/10
0.2	35	0/10
0.4	26	0/10
0.6	19	0/10
0.8	14	0/10
1	11	0/10
1.2	11	1/10
1.4	12	2/10
1.6	12	2/10
1.8	14	3/10
2	15	4/10
2.2	17	6/10
2.4	20	8/10

FIG.12

AMOUNT OF COLORLESS TONER TO BE APPLIED	GLOSS LEVEL OF OUTPUT IMAGE	NUMBER OF JAMMED SHEETS/ TOTAL NUMBER OF SHEETS
0(BLANK PAPER)	5	0/10
0.2	7	0/10
0.4	10	0/10
0.6	13	0/10
0.8	18	2/10
1	25	6/10

FIG.13

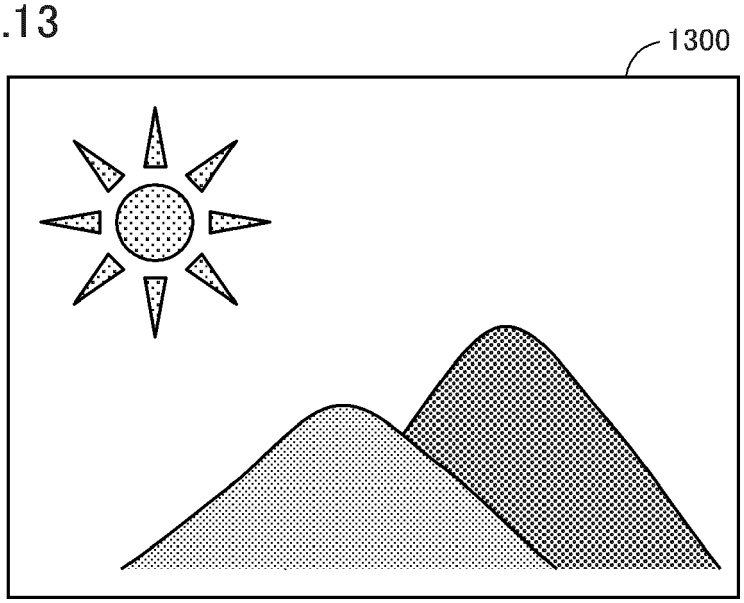
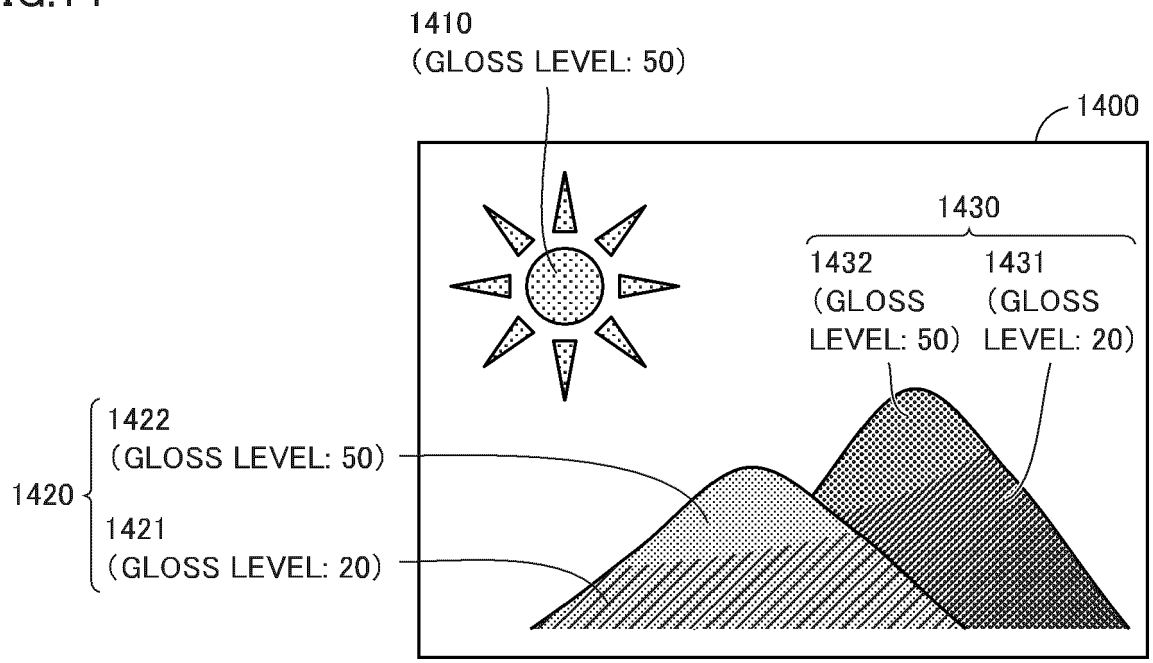


FIG.14


1410
(GLOSS LEVEL: 50)
1400
1430
1432
(GLOSS
LEVEL: 50)
1431
(GLOSS
LEVEL: 20)
1420
1422
(GLOSS LEVEL: 50)
1421
(GLOSS LEVEL: 20)

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EUROPEAN SEARCH REPORT

Application Number
EP 19 17 9029

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	EP 2 221 672 A1 (CANON KK [JP]) 25 August 2010 (2010-08-25) * paragraphs [0006], [0008], [0025] - [0031], [0035], [0041], [0120]; figures 2, 7, 9, 13 *	1-7	INV. G03G15/20 G03G15/00
Y	EP 3 173 868 A1 (KONICA MINOLTA INC [JP]) 31 May 2017 (2017-05-31) * paragraph [0034] *	1-7	
Y	US 2012/177427 A1 (FUJITA MICHIYO [JP] ET AL) 12 July 2012 (2012-07-12) * paragraphs [0036], [0043], [0046], [0059], [0063], [0065] *	1-7	
A	US 2012/177426 A1 (FUJITA MICHIYO [JP] ET AL) 12 July 2012 (2012-07-12) * the whole document *	1-7	
A	US 2012/014702 A1 (TAKEMURA TAICHI [JP]) 19 January 2012 (2012-01-19) * the whole document *	1-7	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	9 December 2019	Billmann, Frank

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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09-12-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2221672 A1	25-08-2010	CN 101794094 A	04-08-2010
		EP 2221672 A1	25-08-2010
		JP 5132594 B2	30-01-2013
		JP 2010175968 A	12-08-2010
		KR 20100088548 A	09-08-2010
		US 2010196035 A1	05-08-2010
EP 3173868 A1	31-05-2017	CN 106814566 A	09-06-2017
		EP 3173868 A1	31-05-2017
		JP 6567398 B2	28-08-2019
		JP 2017097277 A	01-06-2017
		US 2017153573 A1	01-06-2017
US 2012177427 A1	12-07-2012	JP 5948875 B2	06-07-2016
		JP 2012159835 A	23-08-2012
		US 2012177427 A1	12-07-2012
US 2012177426 A1	12-07-2012	JP 5938905 B2	22-06-2016
		JP 2012159834 A	23-08-2012
		US 2012177426 A1	12-07-2012
US 2012014702 A1	19-01-2012	CN 102338998 A	01-02-2012
		EP 2410383 A1	25-01-2012
		JP 5606193 B2	15-10-2014
		JP 2012022113 A	02-02-2012
		KR 20120007447 A	20-01-2012
		US 2012014702 A1	19-01-2012

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Patent documents cited in the description

- JP 2018117709 A **[0001]**
- JP 2007004034 A **[0005] [0006]**