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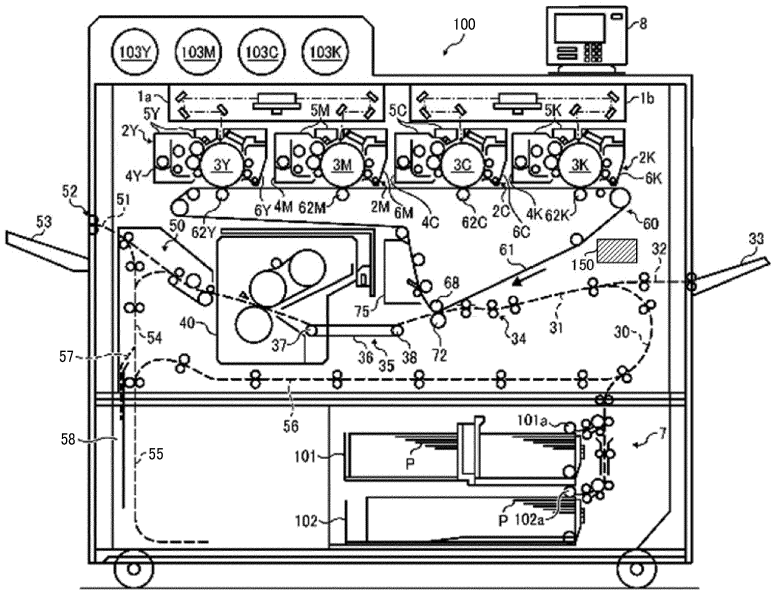
(54) IMAGE READING DEVICE AND IMAGE FORMING SYSTEM

(57) An image reading device (50) includes an image reading unit (80) to read an image formed on a sheet (P), a first conveyor (81) to convey the sheet (P), a second conveyor (82) to convey the sheet (P), and circuitry (150). The first conveyor (81) is disposed upstream from the image reading unit (80) in the conveyance direction of the sheet (P), and a second conveyor (82) is disposed downstream from the image reading unit (80) in the conveyance direction. The circuitry (150) controls conveyance speeds of the sheet (P) by the first conveyor (81) and the second conveyor (82) to change a difference between the conveyance speeds of the sheet (P) by the first conveyor (81) and the second conveyor (82) based on the image read by the image reading unit (80).

FIG. 1



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Description

BACKGROUND

Technical Field

[0001] Embodiments of the present disclosure relate to an image reading device and an image forming system.

Description of the Related Art

[0002] In an electrophotographic image forming apparatus, a desired result of image formation (printed matter) may not be obtained due to various causes. In order to deal with this situation, there is known a technique of indicating an abnormality in the result of image formation to a user.

[0003] As a general technique, there is already known a defect detection technique in which data detected from an image formed on a sheet-like recording medium is compared with data used at the time of image formation, and an abnormality is indicated to the user when the abnormality of the formed image is detected, thereby preventing an abnormal image from being output.

[0004] JP-2015-220471-A discloses an image forming apparatus including a rotator that contacts a recording medium being conveyed. The rotator is disposed above a conveyance path of the recording medium on a downstream side of an image reading unit and on an upstream side of a downstream conveyance roller pair. The image reading unit reads an image formed on the recording medium.

SUMMARY

[0005] The present disclosure has an object to prevent an image reading accuracy from deteriorating when an image formed on a recording medium is read.

[0006] Embodiments of the present disclosure describes an improved image reading device that includes an image reading unit to read an image formed on a sheet, a first conveyor to convey the sheet, a second conveyor to convey the sheet, and circuitry. The first conveyor is disposed upstream from the image reading unit in a conveyance direction of the sheet, and the second conveyor is disposed downstream from the image reading unit in the conveyance direction. The circuitry controls conveyance speeds of the sheet by the first conveyor and the second conveyor to change a difference between the conveyance speeds of the sheet by the first conveyor and the second conveyor based on the image read by the image reading unit.

[0007] According to the present disclosure, an image reading accuracy can be prevented from deteriorating when an image formed on a recording medium is read.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0008] A more complete appreciation of the disclosure and many of the attendant advantages thereof will be readily obtained as the same becomes 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 as an embodiment of an image forming system according the present disclosure;
FIG. 2 is a schematic view illustrating a conveyance switching device and the surrounding thereof included in the image forming apparatus in FIG. 1;
FIGS. 3A and 3B are flowcharts illustrating an operation example of speed change control according to a first embodiment of an image reading device according to the present disclosure;
FIGS. 4A and 4B are schematic views illustrating an example of a reference pattern chart according to the first embodiment;
FIG. 5 is a flowchart illustrating an operation example of speed change control according to a second embodiment of the present disclosure;
FIGS. 6A and 6B are flowcharts illustrating an operation example of speed change control according to a third embodiment of the present disclosure; and
FIGS. 7A and 7B are schematic views illustrating an example of an image used in the third embodiment.

[0009] 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. In addition, identical or similar reference numerals designate identical or similar components throughout the several views.

DETAILED DESCRIPTION

[0010] In describing embodiments illustrated in the drawings, specific terminology is employed for the sake of clarity. However, the disclosure of this patent specification 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 have the same function, operate in a similar manner, and achieve a similar result.

[0011] As used herein, the singular forms "a", "an", and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise.

[0012] It is to be noted that the suffixes Y, M, C, and K attached to each reference numeral indicate only that components indicated thereby are used for forming yellow, magenta, cyan, and black images, respectively, and

hereinafter may be omitted when color discrimination is not necessary or when the components are collectively referred to.

[0013] Embodiments of an image reading device and an image forming system according to the present disclosure is described with reference to the drawings. The image reading device according to the present embodiment determines whether or not a formed image has an abnormality based on a reading result of the formed image. The image reading device can control an image reading state so as to prevent an image reading accuracy from deteriorating when an image is read by an image reading unit.

[0014] In an apparatus employing the general technique to detect a defect in the image by reading the image (for example, an image forming apparatus), a mechanism for detecting the defect in the image is usually provided outside the apparatus. Alternatively, a mechanism for reading an image may be provides inside the apparatus to reduce the cost of the apparatus or downsize the apparatus.

[0015] Many general image forming apparatuses have a function of forming images on both surfaces of a sheet-like recording medium (hereinafter simply referred to as a "recording medium"). Accordingly, when the image reading unit is provided inside the image forming apparatus, the image reading unit is required to read the images on the front surface and the back surface of the recording medium. In this case, the image reading unit for reading the image is preferably disposed between a fixing device that fixes the image on the recording medium and a path switching unit that switches a conveyance path to reverse the recording medium between the front surface and the back surface in the conveyance direction. The image reading unit may be disposed immediately upstream from the path switching unit depending on the space to install the image reading unit inside the apparatus.

[0016] In the general path switching unit, a gate that is movable is used to switch the conveyance path. In this case, a space where the path switching unit (gate) moves is required around the gate. In the general path switching unit, generally, the conveyance path may be widened in the vertical direction (up-and-down direction) perpendicular to the conveyance direction. That is, a part of the conveyance path (conveyance space) of the recording medium includes a portion widened in the vertical direction. When the recording medium passes through the widened conveyance path, the slack of the recording medium may occur. When the slack occurs, the recording medium passing through the path switching unit may touch the gate. If the recording medium on which an image is formed touches the gate, the recording medium or the image formed on the recording medium may be damaged, and streak with uneven gloss may occur in the formed image.

[0017] In order to prevent the slack of the recording medium, the sheet being conveyed is preferably stretched in the conveyance direction to be in a "tensioned state". Therefore, preferably, a configuration is adopted in which conveyance roller pairs are disposed on the downstream side and the upstream side of the path switching unit, and the rotation speed of the downstream conveyance roller pair is higher than the rotation speed of the upstream conveyance roller pair. Thus, the downstream conveyance roller pair and the upstream conveyance roller pair apply tension to the recording medium.

[0018] However, in the case in which the recording medium is in the tensioned state by the two conveyance roller pairs, when the trailing end of the recording medium has passed through the upstream conveyance roller pair, the tension applied until then disappears, and thus the conveyance speed of the trailing end of the recording medium is accelerated. Accordingly, the conveyance speed of the entire recording medium is not steady. This variation in the conveyance speed may causes conveyance unevenness. When the conveyance unevenness occurs in the recording medium, the image reading accuracy of the image reading unit may deteriorate in the sub-scanning direction (conveyance direction).

[0019] In the general technique, the image reading accuracy at the time of image reading may not be improved in consideration of the conveyance unevenness as described above.

[0020] The image reading device according to the present disclosure prevents the conveyance unevenness during image reading, thereby improving the image reading accuracy for detecting the abnormality in an image formed on the recording medium. Specifically, a controller as circuitry controls the operation of conveyors disposed on the upstream side and the downstream side of the image reading unit that reads an image, thereby preventing the conveyance unevenness of the recording medium. This configuration sets the recording medium on which the image is formed in a proper posture for image reading, thereby improving the image reading accuracy. Hereinafter, an embodiment of the image forming apparatus (image forming system) including the image reading device according to the present disclosure is described, after which embodiments of the image reading device are described.

[0021] First, a description is given of a basic configuration of an image forming apparatus 100 as an embodiment of the image forming system according to the present disclosure. The image forming apparatus 100 includes an image reading unit 80 (see FIG. 2) as an embodiment of the image reading device according to the present disclosure, and also includes an image forming unit that forms an image on a sheet-shaped recording medium (sheet P). As described later, various types of recording media can be used, but in the present embodiment, the recording medium is regarded as paper in the description. As illustrated in FIG. 1, the image forming apparatus 100 includes two optical writing units 1 (1a and 1b) and four process units 2 (2Y, 2M, 2C, and 2K) for

forming yellow (Y), magenta (M), cyan (C), and black (K) toner images. The image forming apparatus 100 further includes a sheet feeding path 30, a pre-transfer conveyance path 31, a bypass sheet feeding path 32, a bypass sheet feeding tray 33, a registration roller pair 34, a conveyance belt unit 35, a fixing device 40, a conveyance switching device 50, a sheet ejection path 51, an output roller pair 52, an output tray 53, a sheet feeding device 7, and a re-feeder.

[0022] The sheet feeding device 7 includes two recording medium storage units, that is, an upper sheet feeding tray 101 and a lower sheet feeding tray 102. Each of the upper sheet feeding tray 101 and the lower sheet feeding tray 102 accommodates a bundle of sheets P as sheet-shaped recording media therein. As an upper sheet feeding roller 101a (or a lower sheet feeding roller 102a) rotates, the top sheet P of the bundle of sheets P in the upper sheet feeding tray 101 (or the lower sheet feeding tray 102) is fed toward the sheet feeding path 30. The sheet feeding path 30 is connected to the pre-transfer conveyance path 31 for conveying the sheet P immediately upstream a secondary transfer nip described later. The sheet P fed from the upper sheet feeding tray 101 or the lower sheet feeding tray 102 enters the pre-transfer conveyance path 31 via the sheet feeding path 30. The sheet P includes a paper medium, a coated paper, a label paper, an overhead projector (OHP) transparency, a film, and the like.

[0023] The bypass sheet feeding tray 33 is disposed on the side surface of the housing of the image forming apparatus 100. The bypass sheet feeding tray 33 is closably openable with respect to the housing, and a bundle of sheets P is stacked on the upper surface of the bypass sheet feeding tray 33 in the open state. The top sheet P of the bundle of sheets P stacked on the bypass sheet feeding tray 33 is fed toward the pre-transfer conveyance path 31 by a feed roller of the bypass sheet feeding tray 33.

[0024] The image forming apparatus 100 illustrated in FIG. 1 has a so-called tandem configuration in which four process units 2Y, 2M, 2C, and 2K are arranged along the rotation direction of an intermediate transfer belt 61 described later. The process units 2 (2Y, 2M, 2C, and 2K) include drum-shaped photoconductors 3 (3Y, 3M, 3C, and 3K) as latent image bearers, respectively. In each of the process units 2 (2Y, 2M, 2C, and 2K), various components disposed around the photoconductor 3 are supported by a common support, and each process unit 2 is removably installable in the image forming apparatus 100. The photoconductor 3 has a drum shape in which a photoconductive layer is formed by coating a base pipe made of, e.g., aluminum with an inorganic photoconductive material having photosensitivity. Alternatively, the photoconductor 3 may have an endless belt shape.

[0025] The process units 2 have the same configuration except that colors of toners to be used are different. For example, the process unit 2Y for yellow includes, in addition to the photoconductor 3Y, a developing device 4Y for developing an electrostatic latent image formed on the surface of the photoconductor 3Y into a yellow toner image. The process unit 2Y further includes a charging device 5Y and a drum cleaning device 6Y. The charging device 5Y uniformly charges the surface of the photoconductor 3Y. The drum cleaning device 6Y removes transfer residual toner adhering to the surface of the photoconductor 3Y having passed through a primary transfer nip for yellow described later.

[0026] Each of the two optical writing units 1 (1a and 1b) includes a laser diode, a polygon mirror, and various lenses. The optical writing units 1 operate the laser diode and optically scan the photoconductors 3 (3Y, 3M, 3C, and 3K) of the process units 2 (2Y, 2M, 2C, and 2K) based on image data read by a scanner outside the apparatus or image data transmitted from a personal computer.

[0027] Each of the photoconductors 3 of the process units 2 is rotated counterclockwise in FIG. 1 by a driving unit. The optical writing unit 1a irradiates the photoconductor 3Y and the photoconductor 3M with laser beams while deflecting the laser beams in the axial direction of rotation of each photoconductor 3, thereby performing optical scanning. As a result, electrostatic latent images based on the image data for yellow and magenta are formed on the photoconductors 3Y and 3M, respectively. The optical writing unit 1b irradiates the photoconductor 3C and the photoconductor 3K with laser beams while deflecting the laser beams in the axial direction of rotation of each photoconductor 3, thereby performing optical scanning. As a result, electrostatic latent images based on the image data for cyan and black are formed on the photoconductors 3C and 3K, respectively.

[0028] The developing device 4Y develops latent images with a two-component developer (hereinafter simply referred to as a "developer") containing magnetic carriers and nonmagnetic yellow toner. Instead of the two-component developer, the developing device 4Y may use a one-component developer that does not contain magnetic carriers. The yellow toner in a toner bottle 103Y for yellow is appropriately supplied to the developing device 4Y by a toner supply device for yellow.

[0029] The drum cleaning device 6Y includes a cleaning blade made of, for example, polyurethane rubber that is pressed against the photoconductor 3Y, but another type of cleaning device may be used. To enhance the cleaning performance, the image forming apparatus 100 includes the drum cleaning device 6Y including a rotatable fur brush that contacts the photoconductor 3Y. The fur brush also scrapes lubricant from solid lubricant to form fine powder, and applies the fine powder onto the surface of the photoconductor 3Y.

[0030] A discharge lamp as a part of the process unit 2Y is disposed above the photoconductor 3Y. The discharge lamp irradiates the surface of the photoconductor 3Y having passed through the drum cleaning device 6Y with light to remove residual electric charges on the photoconductor 3Y. The discharged surface of the photocon-

ductor 3Y is uniformly charged by the charging device 5Y and optically scanned by the optical writing unit 1a. The charging device 5Y is rotated while being supplied with a charging bias from a power source. Instead of this method, a scorotron charger method may be adopted to charge the photoconductor 3Y in a non-contact manner.

[0031] Although the above description concerns the process unit 2Y for yellow, the process units 2M, 2C, and 2K for magenta, cyan, and black have the same configuration as that of the process unit 2Y, and the descriptions thereof are omitted.

[0032] A transfer unit 60 is disposed below the four process units 2 (2Y, 2M, 2C, and 2K). In the transfer unit 60, the intermediate transfer belt 61 is an endless belt stretched around multiple support rollers. As one of the support rollers rotates, the intermediate transfer belt 61 moves clockwise in FIG. 1 while contacting the photoconductors 3 (3Y, 3M, 3C, and 3K). Thus, primary transfer nips for yellow, magenta, cyan, and black are formed at the contact portions between the photoconductors 3 (3Y, 3M, 3C, and 3K) and the intermediate transfer belt 61.

[0033] In the vicinity of the primary transfer nips for yellow, magenta, cyan, and black, primary transfer rollers 62 (62Y, 62M, 62C, and 62K) are disposed in a space surrounded by the inner circumferential surface of the intermediate transfer belt 61, that is, inside the loop of intermediate transfer belt 61. The primary transfer rollers 62 (62Y, 62M, 62C, and 62K) press the intermediate transfer belt 61 toward the photoconductors 3 (3Y, 3M, 3C, and 3K), respectively. A primary transfer bias is applied to each of the primary transfer rollers 62 (62Y, 62M, 62C, and 62K) by a power source. As a result, primary transfer electric fields are formed in the primary transfer nips for yellow, magenta, cyan, and black to electrostatically move toner images on the photoconductors 3 (3Y, 3M, 3C, and 3K) toward the intermediate transfer belt 61.

[0034] As the intermediate transfer belt 61 rotates clockwise in FIG. 1 and sequentially passes through the primary transfer nips for yellow, magenta, cyan, and black, the toner images are primarily transferred to and sequentially superimposed on the outer circumferential surface of the intermediate transfer belt 61 in the primary transfer nips. In this primary transfer process, the superimposed toner images of four colors (hereinafter referred to as a "four-color toner image") are formed on the outer circumferential surface of the intermediate transfer belt 61.

[0035] A secondary transfer roller 72 is disposed below the intermediate transfer belt 61 in FIG. 1. The secondary transfer roller 72 contacts a portion of the outer circumferential surface of the intermediate transfer belt 61 wound around a secondary transfer backup roller 68 to form the secondary transfer nip. Thus, the secondary transfer nip where the secondary transfer roller 72 and the outer circumferential surface of the intermediate transfer belt 61 contact each other is formed.

[0036] A secondary transfer bias is applied to the secondary transfer roller 72 by a power source. On the other hand, the secondary transfer backup roller 68 inside the loop of the intermediate transfer belt 61 is electrically grounded. Thus, a secondary transfer electric field is generated in the secondary transfer nip.

[0037] The registration roller pair 34 is disposed on the right side of the secondary transfer nip in FIG. 1, and feeds the sheet P nipped therebetween to the secondary transfer nip in synchronization with the arrival of the four-color toner image on the intermediate transfer belt 61. In the secondary transfer nip, the four-color toner image on the intermediate transfer belt 61 is collectively transferred onto the sheet P by the secondary transfer electric field and the nip pressure, thereby forming a full-color image together with the white color of the sheet P.

[0038] Transfer residual toner, which has not been transferred to the sheet P in the secondary transfer nip, adheres to the outer circumferential surface of the intermediate transfer belt 61 having passed through the secondary transfer nip. A belt cleaning device 75 that contacts the intermediate transfer belt 61 removes the transfer residual toner.

[0039] After passing through the secondary transfer nip, the sheet P is separated from the intermediate transfer belt 61 and delivered to the conveyance belt unit 35. In the conveyance belt unit 35, an endless conveyance belt 36 is stretched around a drive roller 37 and a driven roller 38. As the drive roller 37 rotates, the conveyance belt 36 moves counterclockwise in FIG. 1. As the conveyance belt 36 moves, the sheet P delivered from the secondary transfer nip is conveyed while being held on the stretched surface of the outer circumferential surface of the conveyance belt 36, and delivered to the fixing device 40.

[0040] In the image forming apparatus 100 according to the present embodiment, a reverse conveyance unit includes the conveyance switching device 50, a re-feeding path 54, a switchback path 55, a post-switchback conveyance path 56, and the like. Specifically, the conveyance switching device 50 includes a conveyance path switcher 85 (see FIG. 2) that switches the destination of the sheet P delivered from the fixing device 40 between the sheet ejection path 51 and the re-feeding path 54. In the case of a print job in a single-sided print mode for forming an image only on the first side of the sheet P, the conveyance path switcher 85 sets the destination of the sheet P to the sheet ejection path 51. Accordingly, the sheet P on which an image has been formed only on the first side thereof is sent to the output roller pair 52 via the sheet ejection path 51, and is ejected onto the output tray 53 outside the image forming apparatus 100. In the case of a print job in a double-sided print mode for also forming an image on the second side of the sheet P, when the conveyance switching device 50 receives the sheet P on which images has been fixed on both sides thereof from the fixing device 40, the conveyance path switcher 85 also sets the destination of the sheet P to the sheet ejection path 51. Accordingly, the sheet P on

which the images has been formed on both sides thereof is ejected onto the output tray 53 outside the image forming apparatus 100. On the other hand, when the conveyance switching device 50 receives the sheet P on which an image has been fixed only on the first side thereof from the fixing device 40 in the case of the print job in the double-sided print mode, the conveyance path switcher 85 sets the destination of the sheet P to the re-feeding path 54.

[0041] The switchback path 55 is connected to the re-feeding path 54, and the sheet P conveyed to the re-feeding path 54 enters the switchback path 55. When the entire sheet P in the conveyance direction has entered the switchback path 55, the conveyance direction of the sheet P is reversed, and the sheet P is conveyed in the reverse direction in switchback manner. In addition to the re-feeding path 54, the post-switchback conveyance path 56 is connected to the switchback path 55, and the reversed sheet P enters the post-switchback conveyance path 56. At this time, the sheet P is reversed (turned upside down). Then, the reversed sheet P is conveyed again to the secondary transfer nip via the post-switchback conveyance path 56 and the sheet feeding path 30. After the toner image is transferred onto the second side of the sheet P in the secondary transfer nip, the fixing device 40 fixes the toner image on the second side. Then, the sheet P is ejected onto the output tray 53 via the conveyance switching device 50, the sheet ejection path 51, and the output roller pair 52.

[0042] In the image forming apparatus 100, a purge tray 58 to which an unnecessary sheet P is ejected is disposed at a lower portion on the left side of the apparatus in FIG. 1. For example, when the image forming apparatus 100 is stopped due to sheet jam or the like, a sheet P in the apparatus is conveyed to the purge tray 58. Specifically, a purge-tray conveyance path 57 for conveying the sheet P to the purge tray 58 is connected to the re-feeding path 54. When the sheet P is conveyed to the purge tray 58, the destination of the sheet P is set to the purge-tray conveyance path 57. Thus, the sheet P conveyed to the re-feeding path 54 is conveyed to the purge-tray conveyance path 57 at the position upstream from the post-switchback conveyance path 56 and ejected to the purge tray 58.

[0043] The image forming apparatus 100 further includes a control panel 8 that receives a job command from a user and displays a state of the image forming apparatus 100. Furthermore, the image forming apparatus 100 includes a controller 150 as circuitry that comprehensively controls each hardware to perform the operations described above and described below. The controller 150 has a configuration similar to that of a general computer, and includes, for example, an arithmetic processing device such as a central processing unit (CPU) and a storage device such as a read only memory (ROM), a random access memory (RAM), and a flash memory. In the controller 150, the arithmetic processing device executes a program stored in the storage device to implement a functional configuration that performs the operations described above and below. With such a functional configuration, the conveyance state of the sheet P can be controlled as described below.

[0044] In the above-described configuration, a configuration including the optical writing unit 1 (1a, 1b), the process unit 2 (2Y, 2M, 2C, and 2K), the conveyance belt unit 35, the fixing device 40, and the transfer unit 60 corresponds to the image forming unit that forms an image on the sheet P.

[0045] Next, the configuration of the conveyance switching device 50 and components disposed near the conveyance switching device 50 are described with reference to FIG. 2. In the image forming apparatus 100, the sheet P on which the image has been fixed by the fixing device 40 passes through a sheet cooling device 84 illustrated in FIG. 2. After that, when the sheet P passes through the image reading unit 80 disposed downstream from the sheet cooling device 84 in the conveyance direction, the image reading unit 80 reads the image formed on the sheet P. The controller 150 detects a defect in the read image to determine whether the image has an abnormality. The image reading unit 80 is disposed upstream from the conveyance path switcher 85.

[0046] The conveyance path switcher 85 is a gate that switches the conveyance path. The sheet P is conveyed to the sheet ejection path 51 or the re-feeding path 54 according to the switching of the conveyance path by the conveyance path switcher 85. When the sheet P is conveyed to the re-feeding path 54, the conveyance path switcher 85 rotates in the direction indicated by arrow 85b to switch the conveyance path.

[0047] Since the image reading unit 80 is disposed upstream from the conveyance path switcher 85, in the single-sided print mode for forming an image on only one side of the sheet P, the image reading unit 80 can read the image formed on the first side of the sheet P, and the controller 150 can detect a defect in the read image read by the image reading unit 80. In the double-sided print mode for forming images on both sides of the sheet P, the image reading unit 80 can read the image formed on the first side of the sheet P and the image formed on the second side of the sheet P, which is reversed in the switchback path 55 and conveyed via the post-switchback conveyance path 56, and the controller 150 can detect a defect in the read images on both sides read by the image reading unit 80.

[0048] In the conveyance switching device 50, an upstream conveyance roller pair 81 as a first conveyor is disposed upstream from the conveyance path switcher 85 and the image reading unit 80 in the conveyance direction of the sheet P. A downstream conveyance roller pair 82 as a second conveyor is disposed downstream from the conveyance path switcher 85 and the image reading unit 80 in the conveyance direction of the sheet P.

[0049] Here, the general technique as a comparative example is described again with reference to the configuration of the conveyance switching device 50. As illus-

trated in FIG. 2, since the conveyance path switcher 85 rotates in the direction indicated by arrow 85b in FIG. 2, the conveyance path is required to being widened in the direction perpendicular to the conveyance direction at the position to secure a space where the conveyance path switcher 85 moves. With reference to FIG. 2, the space in the conveyance path in which the conveyance path switcher 85 is disposed is wider than the spaces in the sheet ejection path 51 and the re-feeding path 54. When the sheet P passes through the conveyance path widened in the direction perpendicular to the conveyance direction, the posture of the sheet P being conveyed is not regulated by the conveyance path, and therefore, the sheet P may be slacked.

[0050] Therefore, in the conveyance switching device 50 included in the image forming apparatus 100, the controller 150 causes the downstream conveyance roller pair 82 disposed on the downstream side of the widened conveyance path to rotate faster than the upstream conveyance roller pair 81 disposed on the upstream side of the widened conveyance path to prevent the sheet P from being slacked. By setting the rotation speed of the downstream conveyance roller pair 82 to be higher than the rotation speed of the upstream conveyance roller pair 81, tension is applied to the sheet P. Thus, the sheet P is in the tensioned state, thereby preventing the sheet P from being slacked.

[0051] In the general technique of detecting a defect in an image, the rotation speed of each of conveyance roller pairs disposed on the upstream side and the downstream side of the image reading unit is generally set to a constant speed, and each conveyance roller pair rotates steadily (i.e., steady rotation). In the case of such conveyance roller pairs that rotate steadily, when the trailing end of the sheet P in the conveyance direction has passed through the upstream conveyance roller pair 81 and the tensioned state is released, the sheet P that has been stretched by the tension is about to return to the original state. As a result, force applied to the sheet P changes, thereby generating resilience. This resilience accelerates the conveyance speed of the trailing end of the sheet P in the conveyance direction. Therefore, in the general technique, the conveyance speed of the trailing end of the sheet P temporarily increases with respect to the image reading unit 80. That is, when the sheet P is conveyed by the conveyance roller pairs that rotate steadily, the conveyance speed of the trailing end of the sheet P temporarily increases, causing conveyance unevenness. Since the sheet P passes through the image reading unit 80 with the conveyance unevenness, the image reading accuracy may deteriorate in the sub-scanning direction (conveyance direction) when the image reading unit 80 reads the image formed on the sheet P.

[0052] A description is given below of the image reading device according to an embodiment of the present disclosure. The conveyance switching device 50 including the image reading unit 80, the conveyance path switcher 85, the upstream conveyance roller pair 81, and the downstream conveyance roller pair 82 described above is used as an embodiment of the image reading device. The conveyance switching device 50 includes the image reading unit 80, the controller 150, the upstream conveyance roller pair 81, and the downstream conveyance roller pair 82. The controller 150 changes operating conditions of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 to control the conveyance speed of the sheet P.

[0053] To solve the situation in the description of the general technique of detecting a defect in an image, in a first embodiment of the image reading device according to the present disclosure, the rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 are changed at the timing when a conveyance timing sensor 83 detects the trailing end of the sheet P. The conveyance timing sensor 83 is disposed at a predetermined position. The controller 150 changes the set values of the rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 to change the rotation speeds. Thus, among a plurality of conveyance roller pairs that determine the conveyance speed of the sheet P, the difference in the rotation speed of the conveyance roller pairs arranged at positions sandwiching the image reading unit 80, which reads the image formed on the sheet P, is variable. The control of the difference in the rotation speed prevents the image reading accuracy of reading an image formed on a recording medium from deteriorating. The speed change control of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 is described below with reference to FIGS. 3A to 4B.

[0054] FIGS. 3A and 3B are flowcharts illustrating the first embodiment of the speed change control that is executable in the conveyance switching device 50. In the first embodiment, the change values of rotation speeds is calculated using a reference pattern chart for speed adjustment.

[0055] First, a system administrator or a person in charge of maintenance sets the sheets P in the upper sheet feeding tray 101 or the lower sheet feeding tray 102, and switches the operation mode of the image forming apparatus 100 from an actual print mode, in which an image designated by a user is formed on the sheet P, to a mode in which a reference pattern for speed adjustment is formed via the control panel 8. When the system administrator or the like presses a start button in the control panel 8, an arbitrary number of sheets P are supplied from the upper sheet feeding tray 101 or the lower sheet feeding tray 102, and the image forming unit transfers the reference pattern chart onto the sheet P to form the reference pattern (S301).

[0056] FIG. 4A is an example of the reference pattern chart which is a chart image used in the first embodiment. FIG. 4A illustrates a reference pattern chart that is ideally formed. Therefore, a plurality of marks is formed at constant intervals in the conveyance direction of the sheet

P indicated by arrow D in FIGS 4A and 4B, which is referred to as the "reference pattern". The reference pattern includes a plurality of lines perpendicular to the conveyance direction and in parallel to each other. The interval between the lines of the reference pattern is referred to as a real interval Lr. That is, the interval of the reference pattern ideally formed on the sheet P is the real interval Lr. FIG. 4A merely illustrates an example, and the reference pattern is not limited to such an example if a plurality of reference marks is arranged at intervals based on a certain rule in the conveyance direction. The sheet P on which the reference pattern chart is formed is conveyed to the image reading unit 80, and the image reading unit 80 detects (images) the reference pattern chart and outputs the detection result (imaging result) to the controller 150 (S302).

[0057] The difference between the reference pattern chart formed on the sheet P and the image detected by the image reading unit 80 is described with reference to FIG. 4B. In the reference pattern chart, the lines of the reference pattern are disposed at the constant real intervals Lr in the conveyance direction. When the real interval Lr of the reference pattern is compared with the interval (i.e., a detected interval Ll illustrated by broken lines in FIG. 4B) of the reference pattern extracted from the reference pattern chart detected by the image reading unit 80, the real interval Lr of the reference pattern does not coincide with the detected interval L1 at the trailing end portion of the sheet P, thereby generating the difference. For example, when the tension is applied to the sheet P by the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82, the detected interval L1 is detected longer than the real interval Lr particularly at the trailing end portion of the sheet P. When the trailing end of the sheet P has passed through the upstream conveyance roller pair 81, the tension applied until then is eliminated, and the conveyance speed of the trailing end of the sheet P is increased by the resilience of the sheet P. As a result, the detected interval Ll is detected shorter than the real interval Lr.

[0058] The controller 150 calculates a change value of upstream rotation speed Vc1 suitable for the upstream conveyance roller pair 81 and a change value of downstream rotation speed Vc2 suitable for the downstream conveyance roller pair 82 based on the difference between the real interval Lr and the detected interval L1 (S303). The change value of upstream rotation speed Vc1 and the change value of downstream rotation speed Vc2 are rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 for reducing the difference between the real interval Lr and the detected interval Ll. With the change value of upstream rotation speed Vc1 and the change value of downstream rotation speed Vc2, the difference between the rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 becomes smaller than that during steady rotation. The controller 150 switches the conveyance speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 from the previous speeds (the rotation speed during steady rotation) to the change value of upstream rotation speed Vc1 and the change value of downstream rotation speed Vc2, respectively, at the timing when the conveyance timing sensor 83 detects the trailing end of the sheet P. The timing when the controller 150 changes the rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 also depends on the relative position between the image reading unit 80 and the conveyance timing sensor 83. Therefore, the parameters for calculating the change value of upstream rotation speed Vc1 and the change value of downstream rotation speed Vc2 include the conveyance distance from the conveyance timing sensor 83 to the upstream conveyance roller pair 81, the distance between the upstream conveyance roller pair 81 and the image reading unit 80, and the distance between the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82. The controller 150 stores the change value of upstream rotation speed Vc1 and the change value of downstream rotation speed Vc2 as calculation results in the storage device, and ends the processing in FIG. 3A.

[0059] Next, the speed change control in the actual print mode after the controller 150 calculates the change value of upstream rotation speed Vc1 and the change value of downstream rotation speed Vc2 is described with reference to a flowchart in FIG. 3B.

[0060] When the sheet P is supplied from the upper sheet feeding tray 101 or the lower sheet feeding tray 102, the image forming unit forms an image designated by a user on the sheet P (S310). Subsequently, at the timing when the conveyance timing sensor 83 detects the trailing end of the sheet P (S311), the controller 150 changes the rotation speed of the upstream conveyance roller pair 81 to the change value of upstream rotation speed Vc1, and changes the rotation speed of the downstream conveyance roller pair 82 to the change value of downstream rotation speed Vc2 (S312). By this speed change control, the conveyance unevenness of the sheet P can be prevented, and the image reading accuracy in the sub-scanning direction (conveyance direction) in the image reading unit 80 can be prevented from deteriorating.

[0061] Next, a second embodiment of the speed change control that can be executed in the conveyance switching device 50 is described. At the position where the conveyance path switcher 85 is disposed, that is, at the position where the conveyance path is widened, how much the sheet P is slacked also depends on the thickness of the sheet P (the stiffness of the sheet P). In the second embodiment, the controller 150 changes the rotation speed of the upstream conveyance roller pair 81 and the rotation speed of the downstream conveyance roller pair 82 in consideration of the thickness of the sheet P (referred to as a "sheet thickness"). FIG. 5 is a flowchart illustrating the speed change control according to the

second embodiment.

[0062] In the second embodiment, a table in which the sheet thickness and the rotation speed of the downstream conveyance roller pair 82 are associated with each other is stored in advance in the storage device included in the controller 150. The rotation speed of the downstream conveyance roller pair 82 changed in consideration of the sheet thickness is referred to as a second change value of downstream rotation speed Vc3.

[0063] The controller 150 according to the second embodiment acquires and sets the sheet thickness of the sheet P as an image formation target (S501). The data of the sheet thickness is based on, for example, a value designated by a user via the control panel 8 when a print job is executed. For example, when the type of the sheet P as the image formation target is designated, if the sheet thickness identified by the type of the sheet P is stored in the storage device included in the controller 150, the sheet thickness is determined based on the type of the sheet P. Alternatively, the data may be determined based on the size of the sheet P or may be set as an initial value in advance. Alternatively, the conveyance switching device 50 may be provided with a detector for detecting the sheet thickness, and the sheet thickness may be acquired by the detector.

[0064] As the sheet thickness is acquired, the controller 150 starts a print job (S502). When the conveyance timing sensor 83 detects the trailing end of the sheet P (S503), the controller 150 refers to the table stored in the storage device based on the sheet thickness acquired in step S501, and acquires the second change value of downstream rotation speed Vc3. Alternatively, the controller 150 may acquire the second change value of downstream rotation speed Vc3 before step S503. Then, the controller 150 changes the rotation speed of the downstream conveyance roller pair 82 based on the second change value of downstream rotation speed Vc3 (S504). With the second change value of downstream rotation speed Vc3, the difference between the rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 is reduced.

[0065] According to the second embodiment, the conveyance unevenness of the sheet P can be prevented based on the sheet thickness, and the image reading accuracy in the sub-scanning direction (conveyance direction) in the image reading unit 80 can be prevented from deteriorating. Although the speed change control is executed in consideration of the sheet thickness in the second embodiment, the amount of slack of the sheet P also depends on the type and material of the sheet such as paper, coated paper, label paper, an OHP transparency, or a film. Therefore, a table in which an identifier for uniquely identifying the type and material of the sheet P and the second change value of downstream rotation speed Vc3 are associated with each other may be stored in advance in the storage device included in the controller 150, and the controller 150 may perform the same operation as the above-described processing according to the type and material of the sheet P as the image formation target to change the rotation speed of the downstream conveyance roller pair 82.

[0066] Further, according to the second embodiment, unlike the first embodiment, the speed change control can be executed without forming and reading the reference pattern chart on the sheet P. Therefore, consumption of paper and toner for forming the reference pattern chart can be reduced, and time required for reading the reference pattern chart can be saved.

[0067] In the first embodiment, the image reading unit 80 reads an image (reference pattern chart) in which predetermined marks (reference pattern) are formed at constant real intervals Lr in the conveyance direction, and the controller 150 changes the conveyance speed based on the detected intervals Ll of the marks extracted from the read image of the reference pattern chart. In the third embodiment, a certain image formed at irregular intervals is used as an image to be read by the image reading unit 80 instead of the image formed at regular intervals, such as the reference pattern chart illustrated in FIG. 4A to control the change of the conveyance speed.

[0068] FIGS. 6A and 6B are flowcharts illustrating the third embodiment of the speed change control that is executable in the conveyance switching device 50. In the third embodiment, as illustrated in FIG. 7A, the controller 150 calculates the change values of upstream and downstream rotation speeds of the upstream and downstream conveyance roller pairs 81 and 82 (also simply referred to as the "change values of rotation speeds") based on feature points specified from a target image (i.e., an image to be actually formed) instead of the reference pattern chart for speed adjustment.

[0069] In the third embodiment, since the reference pattern dedicated for calculating the change values of rotation speeds is not used, the operation mode of the image forming apparatus 100 is not switched unlike the first embodiment. Note that, when the calculated change values of rotation speeds are not stored in the storage device of the controller 150, the operation mode may be temporarily changed at the time of initial operation, and the change values of rotation speeds may be calculated while executing the image formation processing of the target image designated by a user. If the change values of rotation speeds have already been calculated, the processing according to the flowchart of FIG. 6A described below may not be executed.

[0070] First, the flow of processing when the change values of rotation speeds is calculated is described. As illustrated in FIG. 6A, a user or a system administrator executes a print job (S601). FIG. 7A illustrates an example of an image formed in the print job executed in step S601. The image illustrated in FIG. 7A includes a plurality of images. Among the plurality of portions, which is located at positions different from each other in the conveyance direction, included in the image, a portion of the image on the upstream side in the conveyance direction is suitable for calculating the change values of rotation

speeds. Therefore, the controller 150 designates, as a "determination region", a region in which a feature point is easily detected among the portion on the upstream side in the conveyance direction in the original data (image data) of the target image. Then, in the image included in the designated determination region, the controller 150 specifies a portion used for calculating the change values of rotation speeds as the feature point. The controller 150 calculates an interval between adjacent feature points of the plurality of feature points specified by the controller 150 (S602).

[0071] The controller 150 automatically extracts and specifies the feature points. In this automatic extraction processing, the controller 150 searches and extracts the portions in the image, for example, where the density or brightness significantly changes among pixels included in the original data (image data) of the target image. Here, the determination region and the feature point are described. As illustrated in FIG. 7A, three portions on the upstream side in the conveyance direction among the plurality of portions included in the target image formed on the sheet P are defined as determination regions. Then, a feature point is specified in the image included in each determination region. In the example of FIGS. 7A and 7B, the lower left edge of the character "A" in the first determination region, the lower left edge of the character "B" in the second determination region, and the lower right edge of the character "C" in the third determination region are defined as the feature points.

[0072] Then, the controller 150 executes the arithmetic processing of calculating the interval between the feature points adjacent to each other in the conveyance direction. The calculated intervals are referred to as a first real interval Lr' and a second real interval Lr" as illustrated in FIG. 7B. The sheet P on which the target image is actually formed is conveyed to the image reading unit 80, and the image reading unit 80 detects (images) the sheet P and outputs the detection result (imaging result) to the controller 150 (S603).

[0073] The difference between the target image formed on the sheet P and the image detected by the image reading unit 80 is described with reference to FIG. 7B. The target image includes predetermined intervals (i.e., the first real interval Lr' and the second real interval Lr") in the conveyance direction. When the interval of the same portion is extracted from the detected image detected by the image reading unit 80, the detected intervals (i.e., a first detected interval Ll' and a second detected interval L1") may be different from the real intervals (the first real interval Lr' and the second real interval Lr") specified from the original data. In particular, the detected interval does not coincide with the real interval in the trailing end portion (upstream side in the conveyance direction) of the sheet P, thereby generating the difference between the detected interval and the real interval.

[0074] This is because, when the state in which the tension is applied to the sheet P by the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 is shifted to the state in which the tension disappears, the conveyance speed of the trailing end of the sheet P increases, and the sheet P may be slacked. Therefore, immediately after the tension disappears, the first detected interval Ll' is longer than the first real interval Lr', and the second detected interval Ll" is longer than the second real interval Lr". The controller 150 specifies feature points included in the determination regions used for extracting the real intervals Lr' and Lr" (S604), and calculates the first detected interval Ll' and the second detected interval Ll" (S605).

[0075] Subsequently, the controller 150 calculates a change value of upstream rotation speed Vc4 suitable for the upstream conveyance roller pair 81 and a change value of downstream rotation speed Vc5 suitable for the downstream conveyance roller pair 82 (S606). The change value of upstream rotation speed Vc4 and the change value of downstream rotation speed Vc5 are rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 for reducing the difference between the first real interval Lr' and the first detected interval Ll' and the difference between the second real interval Lr" and the second detected interval Ll".

[0076] With the change value of upstream rotation speed Vc4 and the change value of downstream rotation speed Vc5, the difference between the rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 becomes smaller than that during steady rotation. The controller 150 switches the conveyance speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 from the previous speeds (the rotation speed during steady rotation) to the change value of upstream rotation speed Vc4 and the change value of downstream rotation speed Vc5, respectively, at the timing when the conveyance timing sensor 83 detects the trailing end of the sheet P. The timing when the controller 150 changes the rotation speeds of the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 also depends on the relative position between the image reading unit 80 and the conveyance timing sensor 83. Therefore, the parameters for calculating the change value of upstream rotation speed Vc4 and the change value of downstream rotation speed Vc5 include the conveyance distance from the conveyance timing sensor 83 to the upstream conveyance roller pair 81, the distance between the upstream conveyance roller pair 81 and the image reading unit 80, and the distance between the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82. The controller 150 stores the change value of upstream rotation speed Vc4 and the change value of downstream rotation speed Vc5 as calculation results in the storage device, and ends the processing in FIG. 6A.

[0077] Next, the speed change control in the actual print mode after the controller 150 calculates the change value of upstream rotation speed Vc4 and the change

value of downstream rotation speed Vc5 is described. As illustrated in FIG. 6B, this control (i.e., steps S610 to S630) is similar to the control in steps S310 to S312 illustrated in FIG. 3B in the first embodiment, and thus detailed description thereof is omitted.

[0078] By this speed change control, the conveyance unevenness of the sheet P can be prevented, and the image reading accuracy in the sub-scanning direction (conveyance direction) in the image reading unit 80 can be prevented from deteriorating.

[0079] The aspects of the first embodiment, the second embodiment, and the third embodiment may be combined with each other. For example, a user can select any one of aspects or the combination thereof to control the conveyance operation of each conveyance roller pair.

[0080] The image reading device includes the upstream conveyance roller pair 81, the downstream conveyance roller pair 82, the image reading unit 80, and the controller 150. In each of the embodiments described above, the image reading device is described as an apparatus for detecting a defect in an image, but the application of the image reading device is not limited thereto. For example, the image reading device according to the present embodiment can be applied to an apparatus for detecting the density or position of an image.

[0081] The image forming unit may employ an inkjet method, and a belt-shaped conveyance belt may be used instead of the conveyance roller.

[0082] To change the speed difference between the upstream and downstream roller pairs, a method of changing the rotation speeds of both the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82 as described in the first embodiment may be employed, or a method of changing only the rotation speed of the downstream conveyance roller pair 82 as described in the second embodiment may be employed. Alternatively, only the rotation speed of the upstream conveyance roller pair 81 may be changed. That is, the controller 150 controls the conveyance operation of each roller so as to change the difference in conveyance speed between the upstream conveyance roller pair 81 and the downstream conveyance roller pair 82.

[0083] According to the above-described embodiments, the image reading accuracy can be prevented from deteriorating when an image formed on a sheet is read.

[0084] Any one of the above-described operations may be performed in various other ways, for example, in an order different from the one described above.

[0085] Each of the functions of the described embodiments may be implemented by one or more processing circuits or circuitry. Processing circuitry includes a programmed processor, as a processor includes circuitry. A processing circuit also includes devices such as an application specific integrated circuit (ASIC), a digital signal processor (DSP), a field programmable gate array (FPGA), and conventional circuit components arranged to perform the recited functions.

Claims

1. An image reading device (50) comprising:

   an image reading unit (80) configured to read an image formed on a sheet (P);
   a first conveyor (81) disposed upstream from the image reading unit (80) in a conveyance direction of the sheet (P) to convey the sheet (P);
   a second conveyor (82) disposed downstream from the image reading unit (80) in the conveyance direction to convey the sheet (P); and
   circuitry (150) configured to control conveyance speeds of the sheet (P) by the first conveyor (81) and the second conveyor (82) to change a difference between the conveyance speeds of the sheet (P) by the first conveyor (81) and the second conveyor (82) based on the image read by the image reading unit (80).

2. The image reading device (50) according to claim 1, wherein the circuitry (150) is configured to change the difference based on reading results at a plurality of portions included in the image read by the image reading unit (80), the plurality of portions located at positions different from each other in the conveyance direction.

3. The image reading device (50) according to claim 2, wherein the image formed on the sheet (P) is a chart image in which marks are arranged in the conveyance direction, and
   wherein the circuitry (150) is configured to change the difference based on a reading result of the chart image by the image reading unit (80).

4. The image reading device (50) according to claim 3, wherein the marks are located at a constant interval in the conveyance direction, and
   wherein the circuitry (150) is configured to change the difference based on an interval between the marks read by the image reading unit (80).

5. The image reading device (50) according to claim 2, wherein the circuitry (150) is configured to change the difference based on reading results of feature points located at positions different from each other in the conveyance direction among the plurality of portions.

6. The image reading device (50) according to any one of claims 1 to 5, further comprising a conveyance path switcher (85) between the first conveyor (81) and the second conveyor (82), configured to switch a conveyance path of the sheet (P),
   wherein the image reading unit (80) is disposed upstream from the conveyance path switcher (85) in the conveyance direction, and

wherein the circuitry (150) is configured to control the conveyance speeds of the sheet (P) by the first conveyor (81) and the second conveyor (82) such that the conveyance speed of the sheet (P) by the second conveyor (82) is higher than the conveyance speed of the sheet (P) by the first conveyor (81) when the sheet (P) is being conveyed by the first conveyor (81) and the second conveyor (82) and to reduce the difference when a trailing end of the sheet (P) has passed through a predetermined position.

7. The image reading device (50) comprising according to claim 1,
wherein the circuitry (150) is configured to change the difference based on a thickness of the sheet (P).

8. An image forming system (100) comprising:

an image forming unit (1; 2; 35; 40; 60) configured to form an image on a sheet (P); and
the image reading device (50) according to any one of claims 1 to 7, configured to read the image formed on the sheet (P) by the image forming unit (1; 2; 35; 40; 60).

FIG. 1

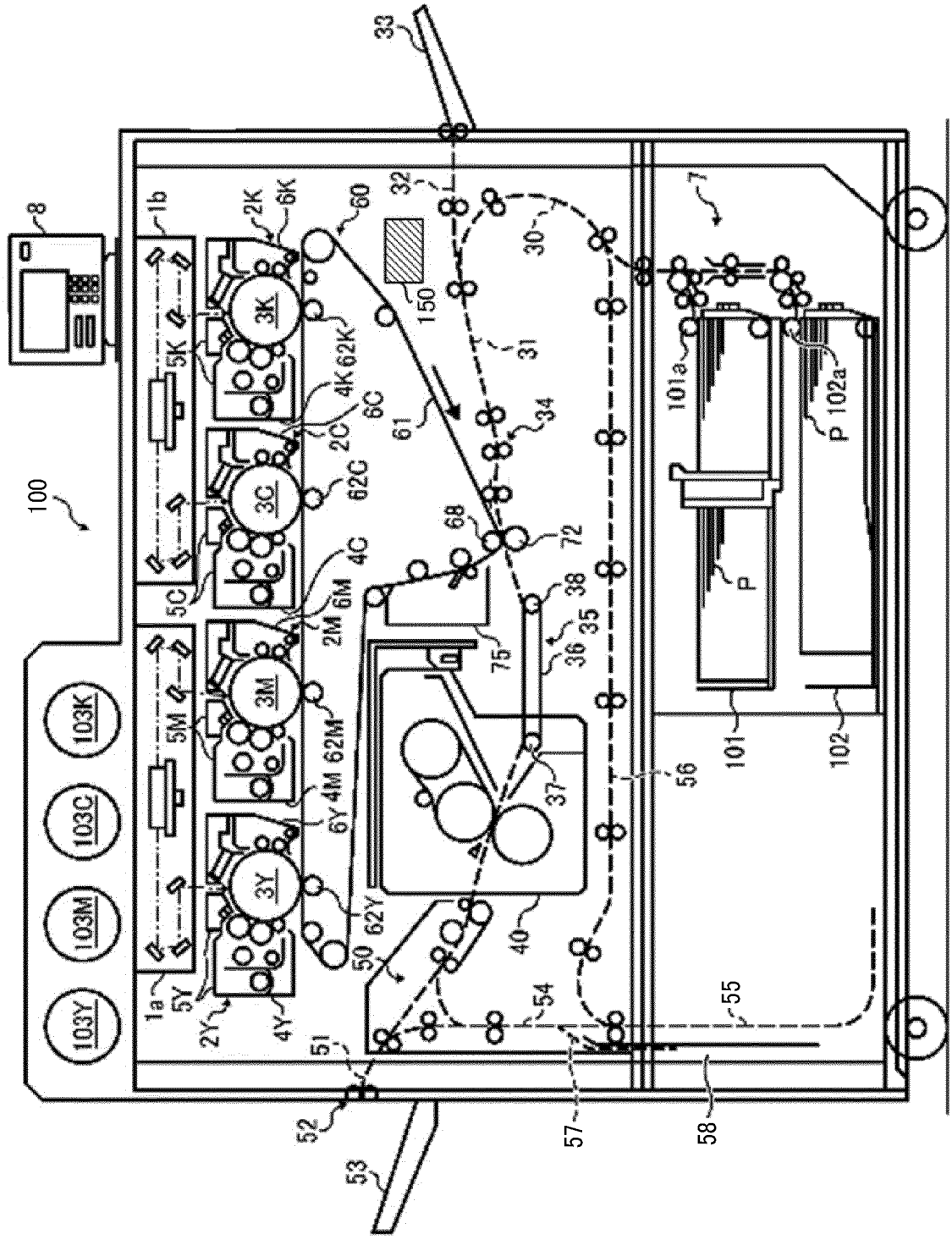

100
8
1b
1a
2K
3K
4K
5K
6K
62K
2C
3C
4C
5C
6C
62C
2M
3M
4M
5M
6M
62M
2Y
3Y
4Y
5Y
6Y
62Y
103K
103C
103M
103Y
60
61
32
150
33
30
31
34
68
72
38
35
36
75
37
40
50
51
52
53
54
55
56
57
58
7
101a
102a
P
101
102

FIG. 2

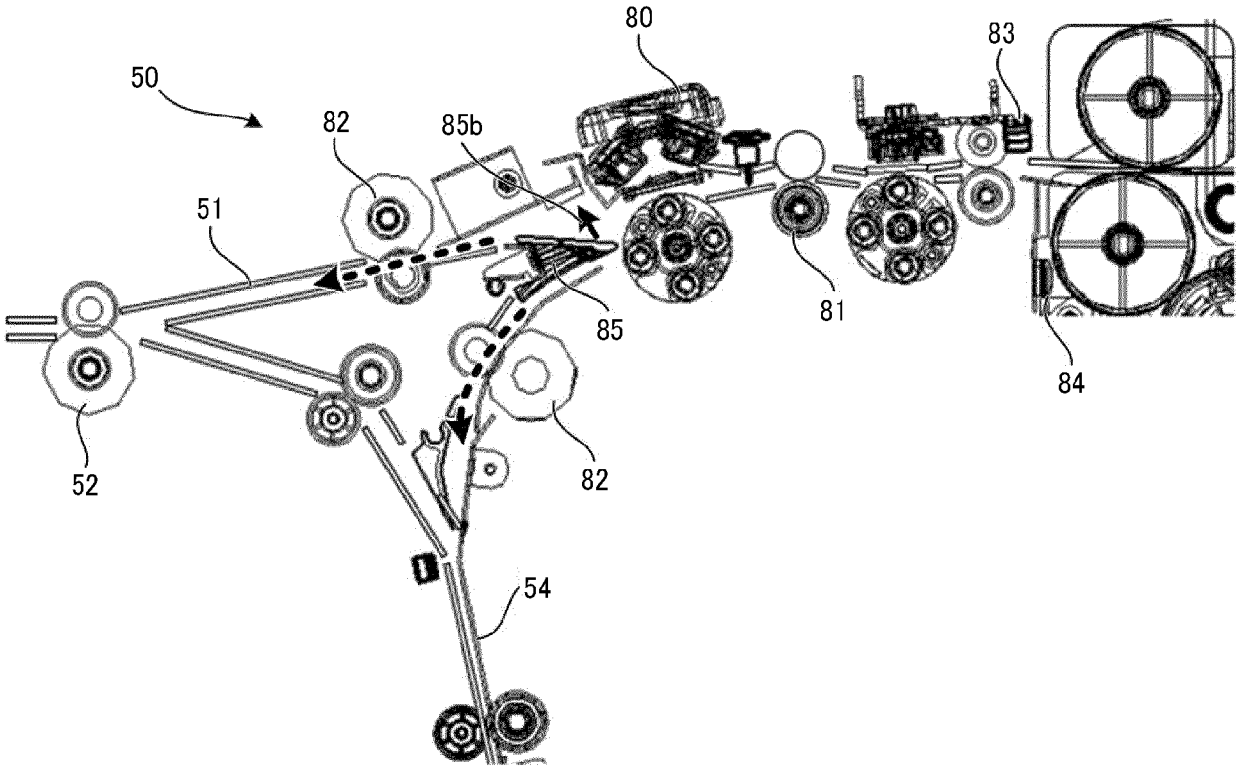


FIG. 3A

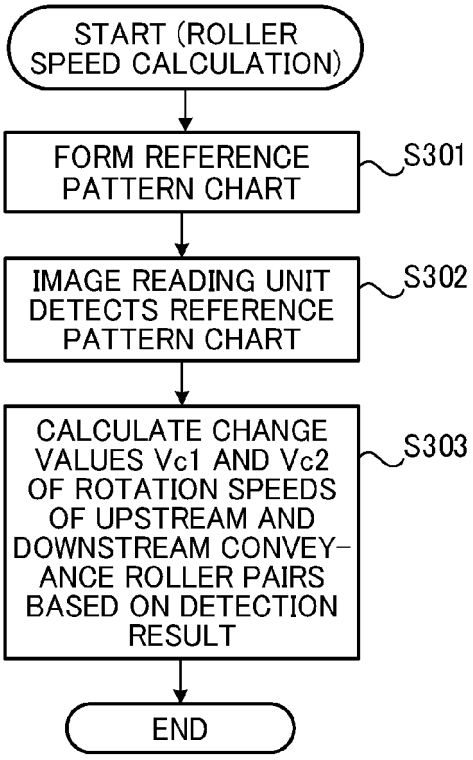

START (ROLLER SPEED CALCULATION)
FORM REFERENCE PATTERN CHART
S301
IMAGE READING UNIT DETECTS REFERENCE PATTERN CHART
S302
CALCULATE CHANGE VALUES Vc1 AND Vc2 OF ROTATION SPEEDS OF UPSTREAM AND DOWNSTREAM CONVEY-ANCE ROLLER PAIRS BASED ON DETECTION RESULT
S303
END

FIG. 3B

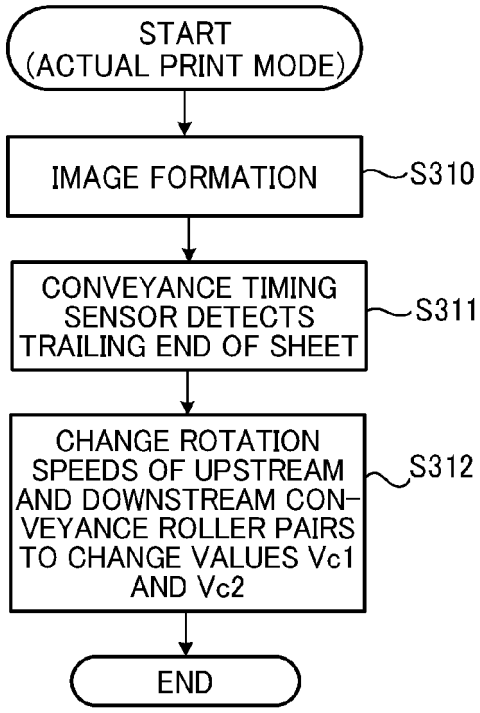

START (ACTUAL PRINT MODE)
IMAGE FORMATION
S310
CONVEYANCE TIMING SENSOR DETECTS TRAILING END OF SHEET
S311
CHANGE ROTATION SPEEDS OF UPSTREAM AND DOWNSTREAM CON-VEYANCE ROLLER PAIRS TO CHANGE VALUES Vc1 AND Vc2
S312
END

FIG. 4A

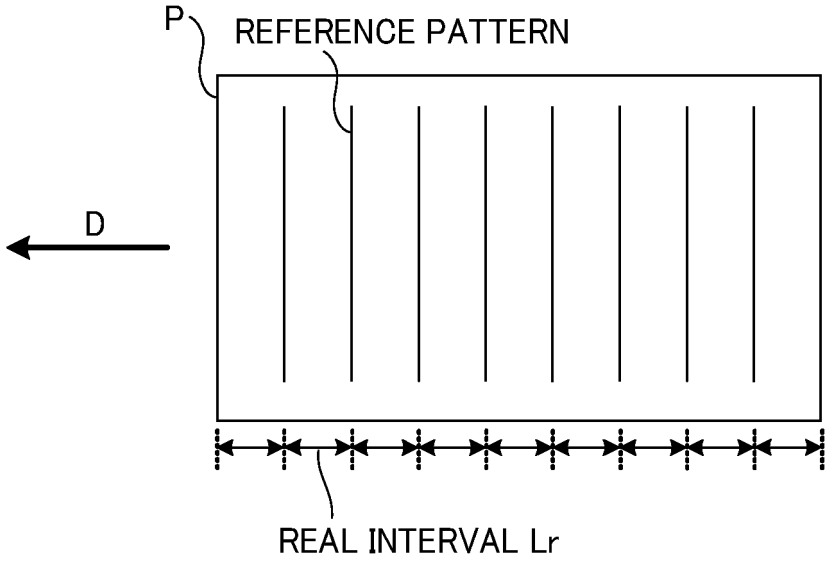

P
REFERENCE PATTERN
D
REAL INTERVAL Lr

FIG. 4B

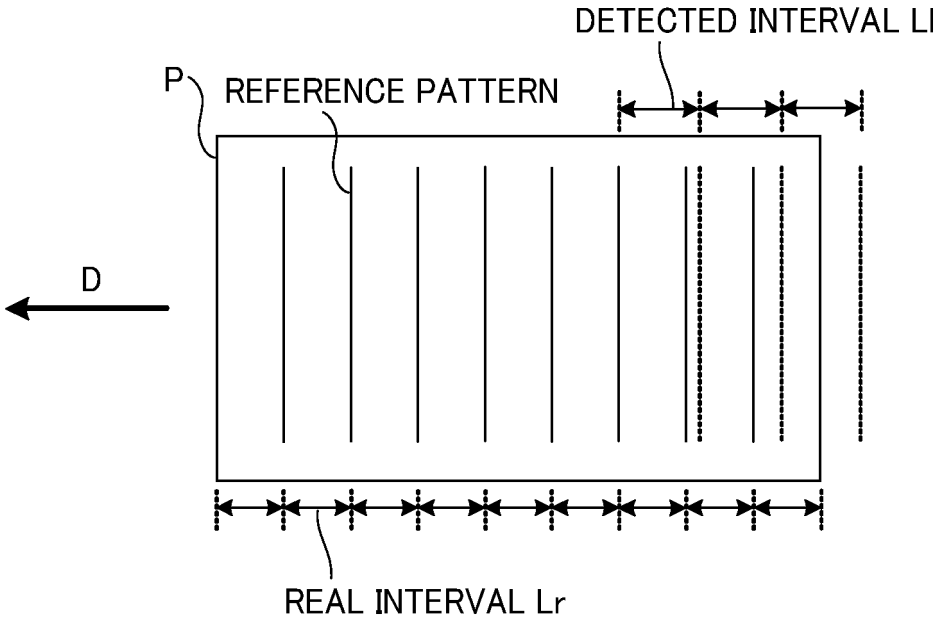

DETECTED INTERVAL LI
P
REFERENCE PATTERN
D
REAL INTERVAL Lr

FIG. 5

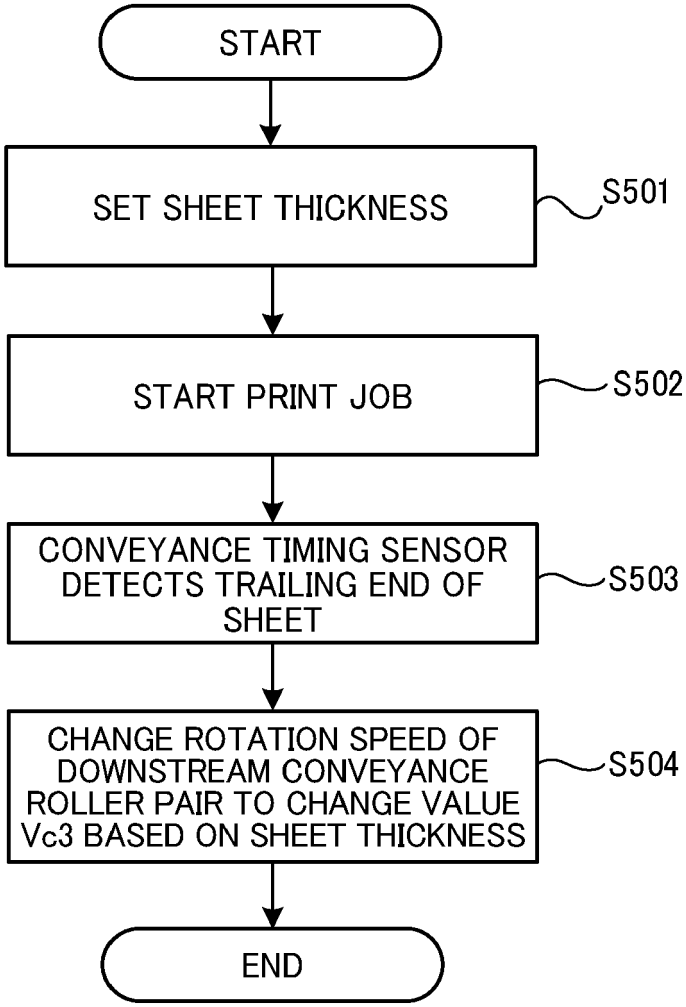

START
SET SHEET THICKNESS
S501
START PRINT JOB
S502
CONVEYANCE TIMING SENSOR DETECTS TRAILING END OF SHEET
S503
CHANGE ROTATION SPEED OF DOWNSTREAM CONVEYANCE ROLLER PAIR TO CHANGE VALUE Vc3 BASED ON SHEET THICKNESS
S504
END

FIG. 6A

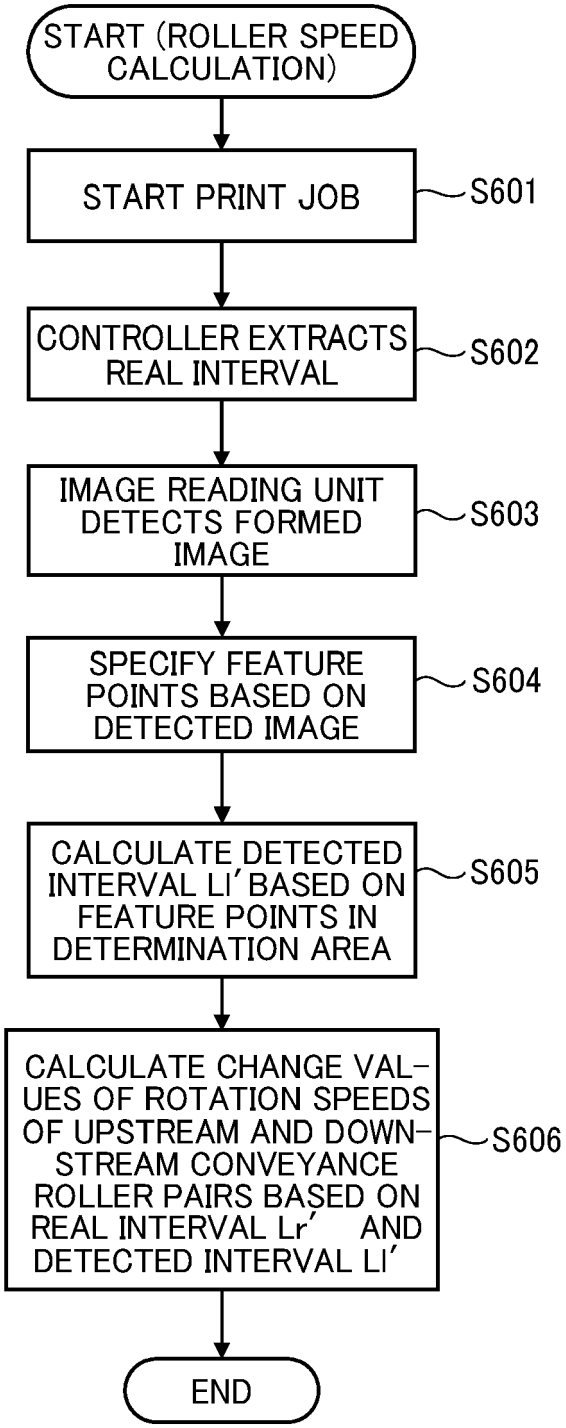

START (ROLLER SPEED CALCULATION)
START PRINT JOB
S601
CONTROLLER EXTRACTS REAL INTERVAL
S602
IMAGE READING UNIT DETECTS FORMED IMAGE
S603
SPECIFY FEATURE POINTS BASED ON DETECTED IMAGE
S604
CALCULATE DETECTED INTERVAL LI' BASED ON FEATURE POINTS IN DETERMINATION AREA
S605
CALCULATE CHANGE VALUES OF ROTATION SPEEDS OF UPSTREAM AND DOWNSTREAM CONVEYANCE ROLLER PAIRS BASED ON REAL INTERVAL Lr' AND DETECTED INTERVAL LI'
S606
END

FIG. 6B

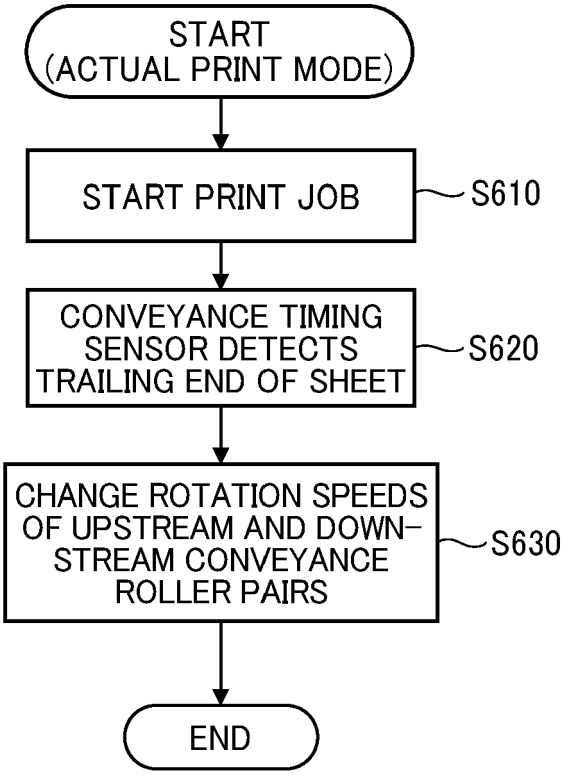

START (ACTUAL PRINT MODE)
START PRINT JOB
S610
CONVEYANCE TIMING SENSOR DETECTS TRAILING END OF SHEET
S620
CHANGE ROTATION SPEEDS OF UPSTREAM AND DOWNSTREAM CONVEYANCE ROLLER PAIRS
S630
END

FIG. 7A

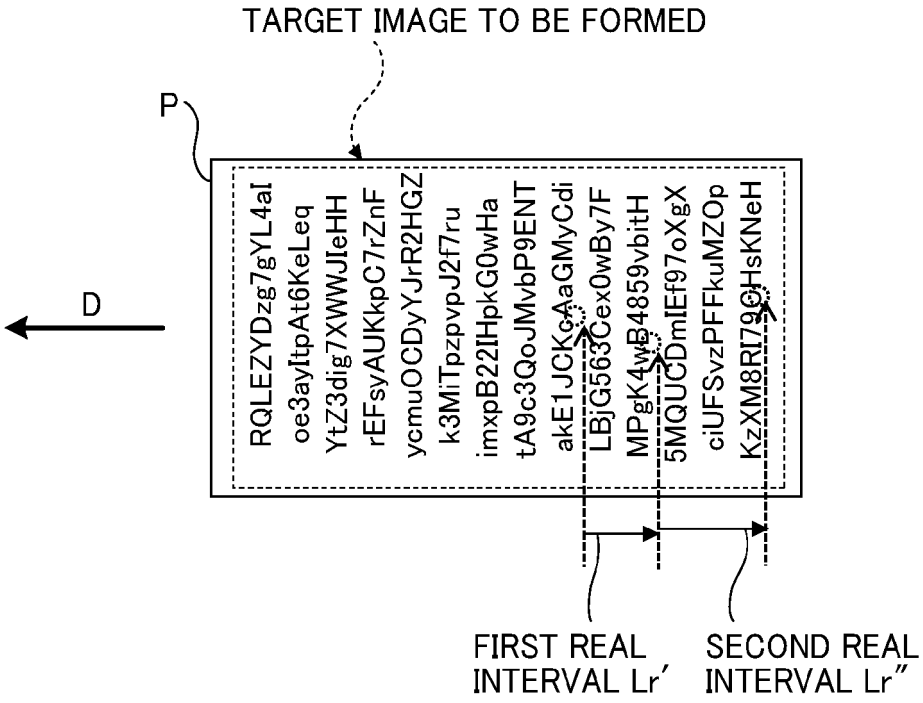
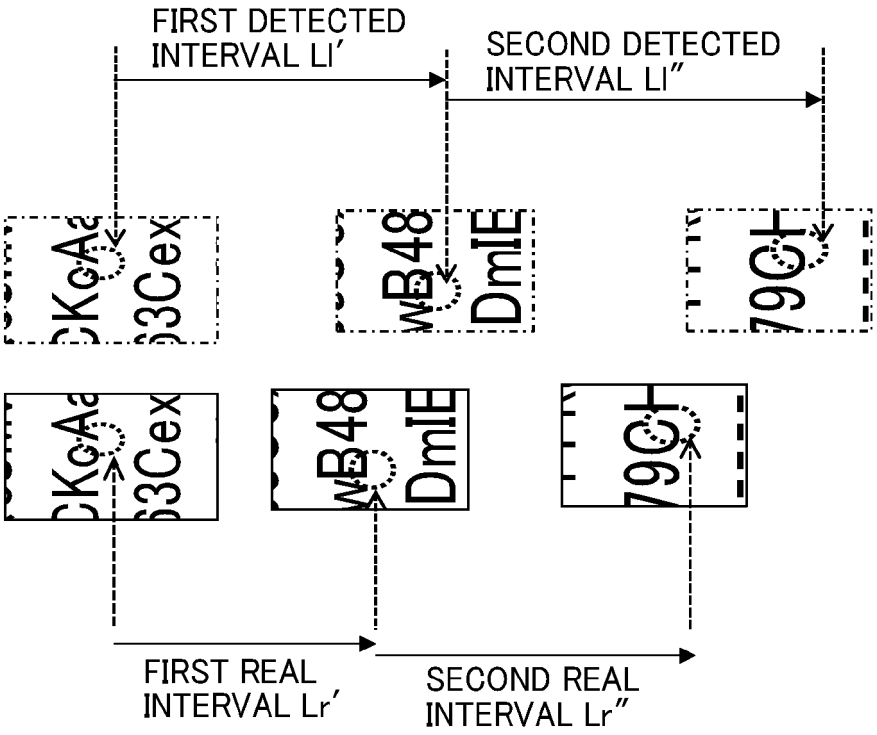

TARGET IMAGE TO BE FORMED
P
D
RQLEZYDzg7gYL4aI
oe3ayItpAt6KeLeq
YtZ3dig7XWWJIeHH
rEFsyAUKkpC7rZnF
ycmuOCDyYJrR2HGZ
k3MiTpzpvpJ2f7ru
imxpB22IHpkG0wHa
tA9c3QoJMvbP9ENT
akE1JCKgAaGMyCdi
LBjG563Cex0wBy7F
MPgK4wB4859vbitH
5MQUCDmIEf97oXgX
ciUFSvzPFFkuMZOp
KzXM8RI790HsKNeH
FIRST REAL INTERVAL Lr′
SECOND REAL INTERVAL Lr″

FIG. 7B


FIRST DETECTED INTERVAL LI′
SECOND DETECTED INTERVAL LI″
FIRST REAL INTERVAL Lr′
SECOND REAL INTERVAL Lr″

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 21 16 1482

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,P A,P	EP 3 769 969 A1 (RICOH CO LTD [JP]) 27 January 2021 (2021-01-27) * paragraph [0011] - paragraph [0084]; figures 1-13 *	1-5,7,8 6	INV. G03G15/00 G03G15/23
X	EP 3 425 456 A1 (KONICA MINOLTA INC [JP]) 9 January 2019 (2019-01-09) * paragraph [0012] - paragraph [0222]; figures 1-12 *	1-8	

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	19 July 2021	Rubio Sierra, F

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