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IMAGE READING DEVICE, IMAGE FORMING APPARATUS, AND IMAGE READING METHOD

Abstract

An image reading device includes: a first reading portion configured to read an image of a sheet; a second reading portion disposed below a contact glass; a first white reference plate disposed in a conveying portion to face the first reading portion; a second white reference plate disposed in the conveying portion at a reference position that can face the second reading portion; and a control portion configured to light a first light source and generate first white reference data by using reflected light reflected from the first white reference plate, and light a second light source and generate second white reference data by using reflected light reflected from the second white reference plate. The control portion controls the first light source and the second light source such that a lighting time of the first light source does not overlap with a lighting time of the second light source.

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Background/Summary

INCORPORATION BY REFERENCE

[0001] This application is based upon and claims the benefit of priority from the corresponding Japanese Patent Application No. 2024-020835 filed on Feb. 15, 2024, the entire contents of which are incorporated herein by reference.

BACKGROUND

[0002] The present disclosure relates to an image reading device, an image forming apparatus, and an image reading method for reading images of both surfaces of a conveyed document sheet.

[0003] There is known an image processing apparatus including a sheet conveying device for conveying a document sheet that is a reading object. In addition, there is known an image reading device including a plurality of reading portions for reading images of both surfaces (a front surface and a back surface) of a document sheet. For example, the image reading device, with a configuration of including, in a conveyance path of an ADF, a CIS sensor (back surface CIS sensor) for reading a back surface image and a CIS sensor (front surface CIS sensor) for reading a front surface image, reads images of both surfaces of the document sheet in one path.

SUMMARY

[0004] An image reading device according to an aspect of the present disclosure includes: a conveying portion configured to convey a sheet; a first reading portion disposed in the conveying portion and configured to read an image of a first surface of the sheet conveyed by the conveying portion; a second reading portion disposed below a contact glass in such a way as to be reciprocally movable along a scanning direction and configured to read an image of a second surface of the sheet; a first white reference plate disposed in the conveying portion to face the first reading portion; a second white reference plate disposed in the conveying portion at a reference position that can face the second reading portion; and a control portion configured to light a first light source included in the first reading portion and generate first white reference data by using reflected light reflected from the first white reference plate, and light a second light source included in the second reading portion and generate second white reference data by using reflected light reflected from the second white reference plate. The control portion controls the first light source and the second light source such that a lighting time of the first light source does not overlap with a lighting time of the second light source.

[0005] An image forming apparatus according to another aspect of the present disclosure includes the image reading device and an image forming portion configured to form an image on the sheet.

[0006] An image reading method according to a further aspect of the present disclosure is for, in an image reading device including: a conveying portion configured to convey a sheet; a first reading portion disposed in the conveying portion and configured to read an image of a first surface of the sheet conveyed by the conveying portion; a second reading portion disposed below a contact glass in such a way as to be reciprocally movable along a scanning direction and configured to read an image of a second surface of the sheet; a first white reference plate disposed in the conveying portion to face the first reading portion; and a second white reference plate disposed in the conveying portion at a reference position that can face the second reading portion, reading the image, the image reading method including a control step of lighting a first light source included in the first reading portion and generating first white reference data by using reflected light reflected from the first white reference plate, and lighting a second light source included in the second reading portion and generating second white reference data by using reflected light reflected from

the second white reference plate, wherein in the control step, the first light source and the second light source are controlled such that a lighting time of the first light source does not overlap with a lighting time of the second light source.

[0007] According to the present disclosure, it is possible to provide an image reading device, an image forming apparatus, and an image reading method that can reduce the image reading time required for the initial document sheet and prevent low-quality images from being formed.

[0008] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description with reference where appropriate to the accompanying drawings. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter. Furthermore, the claimed subject matter is not limited to implementations that solve any or all disadvantages noted in any part of this disclosure.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a block diagram showing a system configuration of an image forming apparatus according to an embodiment of the present disclosure.

[0010] FIG. **2** is a diagram showing a configuration of an ADF and an image reading portion of the image forming apparatus according to the embodiment of the present disclosure.

[0011] FIG. **3** is a diagram schematically showing positional relationship among CIS sensors and a white reference plate and relationship with control time of a light source.

[0012] FIG. **4** is a flowchart showing an example of an image reading process executed by an image forming apparatus according to a practical example 1 of the present disclosure.

[0013] FIG. **5** is a flowchart showing an example of an image reading process executed by an image forming apparatus according to a practical example 2 of the present disclosure.

DETAILED DESCRIPTION

[0014] The following describes an embodiment of the present disclosure with reference to the accompanying drawings. It should be noted that the following embodiment is an example of a specific embodiment of the present disclosure and should not limit the technical scope of the present disclosure.

Configuration of Image Forming Apparatus **100**

[0015] First, a configuration of an image forming apparatus **100** according to an embodiment of the present disclosure is described with reference to FIG. **1**.

[0016] The image forming apparatus **100** is a multifunction peripheral having a plurality of functions such as a scan function for reading an image from a document sheet, a print function for forming an image based on image data, a facsimile function, and a copy function. The image forming apparatus **100** is an example of an image forming apparatus of the present disclosure. It is noted that the image forming apparatus of the present disclosure may be a scanner, a facsimile device, a copier, or the like.

[0017] As shown in FIG. **1**, the image forming apparatus **100** includes an ADF (Auto Document Feeder) **1**, an image reading portion **2**, an image forming portion **3**, a sheet feed portion **4**, an operation/display portion **5**, a storage portion **6**, and a control portion **7**.

[0018] The ADF **1** is a sheet conveying device for conveying a document sheet (an example of a sheet of the present disclosure) that is a reading object. The ADF **1** executes a document sheet conveyance process in accordance with a control instruction from the control portion **7**.

[0019] The image reading portion **2** reads an image from a document sheet conveyed by the ADF **1**. In addition, the image reading portion **2** reads an image from a document sheet placed on a document sheet table **41** (see FIG. **2**).

[0020] The image forming portion **3** forms an image by an electrophotographic method on a sheet supplied from the sheet feed portion **4**. For example, the image forming portion **3** includes a photoconductor drum, a charging roller, a laser scanning unit, a developing device, a transfer roller, a cleaning device, a fixing device, and a sheet discharge tray.
[0021] The sheet feed portion **4** supplies a sheet to the image forming portion **3**. For example, the sheet feed portion **4** includes a sheet feed cassette, a manual feed tray, a sheet conveyance path, and a plurality of conveyance rollers.
[0022] The operation/display portion **5** is a user interface of the image forming apparatus **100**. For example, the operation/display portion **5** includes a display portion and an operation portion, wherein the display portion, such as a liquid crystal display, is configured to display a variety of information in response to control instructions from the control portion **7**, and the operation portion, such as operation keys or a touch panel, is configured to input a variety of information to the control portion **7** in response to user operations.
[0023] The storage portion **6** is a nonvolatile storage device. For example, the storage portion **6** is a storage device such as: a nonvolatile memory such as a flash memory or an EEPROM (registered trademark); an SSD (Solid State Drive); or an HDD (Hard Disk Drive).
[0024] The control portion **7** comprehensively controls the image forming apparatus **100**. As shown in FIG. **1**, the control portion **7** includes a CPU **11**, a ROM **12**, and a RAM **13**. The CPU **11** is a processor that executes various types of calculation processes. The ROM **12** is a nonvolatile storage device in which are preliminarily stored various types of information such as control programs for causing the CPU **11** to execute various processes. The RAM **13** is a volatile or nonvolatile storage device that is used as a temporary storage memory (working area) for the various types of processes executed by the CPU **11**. In the control portion **7**, the CPU **11** executes the various types of control programs preliminarily stored in the ROM **12**. This allows the control portion **7** to comprehensively control the image forming apparatus **100**.

Configuration of ADF **1** and Image Reading Portion **2**

[0025] Next, with reference to FIG. **1** and FIG. **2**, a configuration of the ADF **1** and the image reading portion **2** is described. Here, FIG. **2** is a cross section diagram showing the configuration of the ADF **1** and the image reading portion **2**. The ADF **1** and the image reading portion **2** are an example of an image reading device of the present disclosure.
[0026] As shown in FIG. **2**, the ADF **1** includes a document sheet placement portion **21**, a housing **22**, a pickup roller **23**, a separation roller **25**, a first conveyance roller **30**, a second conveyance roller **31**, a discharge roller **32**, and a discharge portion **33**.
[0027] A document sheet that is a conveyance object is placed on the document sheet placement portion **21**. In the ADF **1**, the document sheet placed on the document sheet placement portion **21** is conveyed in a conveyance direction D**1** shown in FIG. **2**.
[0028] The document sheet placement portion **21** is provided with a detection portion (not shown). The detection portion detects presence or absence of a document sheet on the document sheet placement portion **21**. For example, the detection portion is a reflection-type optical sensor provided on a document sheet placement surface of the document sheet placement portion **21**.
[0029] In addition, the document sheet placement portion **21** is provided with a lift plate (not shown). The lift plate lifts a bunch of document sheets placed on the document sheet placement portion **21** up to a position of contacting with the pickup roller **23**.
[0030] The housing **22** stores rollers and the like used to convey the document sheet. As shown in FIG. **2**, a first conveyance path **22**A and a second conveyance path **22**C for guiding the document sheet are formed inside the housing **22**. The second conveyance path **22**C, including a curved portion **22**B curved from the first conveyance path **22**A, reaches the discharge portion **33**. The curved portion **22**B is curved with a curvature with which the document sheet can make a U-turn in the housing **22**.
[0031] In the ADF **1**, the document sheet placed on the document sheet placement portion **21** is

conveyed along a conveyance route that travels the first conveyance path **22**A, the curved portion **22**B, and the second conveyance path **22**C to reach the discharge portion **33**.

[0032] The pickup roller **23** is provided above the document sheet placement portion **21**. The pickup roller **23** contacts with a surface (an upper surface) of a document sheet at the top of the bunch of document sheets lifted by the lift plate, and conveys the document sheet in the conveyance direction D**1**. The sheet feed belt (not shown) is provided in the first conveyance path **22**A, contacts with a surface of the document sheet conveyed in the conveyance direction D**1** by the pickup roller **23**, and conveys the document sheet toward the downstream in the conveyance direction D**1**.

[0033] The first conveyance roller **30** is provided at the curved portion **22**B. Upon contacting with a document sheet, the first conveyance roller **30** conveys the document sheet toward the downstream in the conveyance direction D**1**.

[0034] The opening portion **22**D is formed downstream of the first conveyance roller **30** in the second conveyance path **22**C in the conveyance direction D**1**. At the opening portion **22**D, a front surface CIS sensor **42** (see FIG. **1** and FIG. **2**) of the image reading portion **2** reads an image of a front surface of the document sheet passing over the opening portion **22**D.

[0035] The second conveyance roller **31** is provided downstream of the opening portion **22**D in the second conveyance path **22**C in the conveyance direction D**1**. Upon contacting with the document sheet conveyed by the first conveyance roller **30**, the second conveyance roller **31** conveys the document sheet toward the downstream in the conveyance direction D**1**.

[0036] The discharge roller **32** is provided downstream of the second conveyance roller **31** in the second conveyance path **22**C in the conveyance direction D**1**. Upon contacting with the document sheet conveyed by the second conveyance roller **31**, the discharge roller **32** discharges the document sheet to the discharge portion **33**. The document sheet discharged by the discharge roller **32** is stacked on the discharge portion **33**.

[0037] As shown in FIG. **1** and FIG. **2**, the image reading portion **2** includes the document sheet table **41**, the front surface CIS sensor **42**, and a back surface CIS sensor **43**.

[0038] The front surface CIS sensor **42** is a reading unit of the contact image sensor type, and includes in its inside a light source (LED), a condenser lens composed of a plurality of lenses, and a CMOS sensor. In the front surface CIS sensor **42**, light emitted from the light source is passed through reading glass to be reflected on the document sheet, the reflected light (image light) is passed through the reading glass again to be condensed by the condenser lens, and an image is formed on the CMOS sensor. In the CMOS sensor, the image light formed as the image is broken into pixels, converted into electric signals corresponding to the density of each pixel, and image reading is performed. The back surface CIS sensor **43** has the same configuration as the front surface CIS sensor, and includes a light source (LED), a condenser lens, and a CMOS sensor.

[0039] A document sheet that is a reading object is placed on the document sheet table **41**. The document sheet table **41** is provided at an upper part of a housing of the image forming apparatus **100**. The ADF **1** is provided in an openable and closable manner with respect to the document sheet table **41**, and also serves as a document sheet cover that supports one surface of a document sheet placed on a first contact glass **411** of the document sheet table **41**.

[0040] As shown in FIG. **2**, the document sheet table **41** includes the first contact glass **411**, a second contact glass **412**, and a guide member **413**. A document sheet from which an image is to be read by the front surface CIS sensor **42** is placed on the first contact glass **411**. In a state where the ADF **1** is closed to the document sheet table **41**, the second contact glass **412** and the guide member **413** face the opening portion **22**D of the housing **22** and form a part of the second conveyance path **22**C. The second contact glass **412** transmits the light that has been emitted from the front surface CIS sensor **42** toward the opening portion **22**D, and transmits the light reflected from the document sheet. The guide member **413**, at a position downstream of the second contact glass **412** in the conveyance direction D**1**, guides the document sheet to the discharge roller **32**.

[0041] The front surface CIS sensor **42** is provided below the first contact glass **411** and the second contact glass **412**. The front surface CIS sensor **42** is elongated in the depth direction of FIG. **2**, and is provided reciprocally movable along the left/right direction of FIG. **2**. In a state of being disposed at a position (reading position DP) below the second contact glass **412**, the front surface CIS sensor **42** reads an image of a front surface of a document sheet conveyed by the ADF **1**. Specifically, the front surface CIS sensor **42** outputs an analog signal corresponding to the image read from the front surface of the document sheet. The analog signal output from the front surface CIS sensor **42** is converted into a digital signal (image data) by an analog front-end circuit (not shown) and is input to the control portion **7**.
[0042] In addition, a white reference plate **42**B (front surface shading plate) used for a shading correction by the front surface CIS sensor **42** is disposed at a position (reference position HP) under the guide member **413**. That is, the white reference plate **42**B is disposed at the reference position HP that can face the front surface CIS sensor **42** in the ADF **1**. In a state of being disposed at the reference position HP, the front surface CIS sensor **42** lights the light source and generates white reference data by using reflected light reflected from the white reference plate **42**B.
[0043] The back surface CIS sensor **43** is disposed in the ADF **1**, and reads an image of a back surface of a document sheet conveyed by the ADF **1**. The back surface CIS sensor **43** is provided at a position that faces the front surface CIS sensor **42** via the opening portion **22**D. Specifically, as shown in FIG. **2**, the back surface CIS sensor **43** is provided downstream of the curved portion **22**B and the first conveyance roller **30** and upstream of the second conveyance roller **31** in the conveyance direction D**1**. In addition, the back surface CIS sensor **43** is provided downstream of the reading position DP and upstream of the reference position HP. The back surface CIS sensor **43** outputs an analog signal corresponding to the image read from the back surface of the document sheet. The analog signal output from the back surface CIS sensor **43** is converted into a digital signal (image data) by an analog front-end circuit (not shown) and is input to the control portion **7**.
[0044] In addition, a white reference plate **43**B (back surface shading plate) used for a shading correction by the back surface CIS sensor **43** is disposed at a position facing the back surface CIS sensor **43**. The white reference plate **43**B is disposed between the first contact glass **411** and the back surface CIS sensor **43**. The back surface CIS sensor **43** lights the light source and generates white reference data by using reflected light reflected from the white reference plate **43**B.
[0045] As described above, the back surface CIS sensor **43** and the white reference plate **43**B are disposed downstream, in a document sheet conveyance direction, of the reading position DP at which the front surface CIS sensor **42** reads an image of a document sheet, and the white reference plate **42**B is disposed downstream of the back surface CIS sensor **43** and the white reference plate **43**B in the document sheet conveyance direction.
[0046] By adopting the above-described structure where the front surface CIS sensor **42** and the back surface CIS sensor **43** are disposed to face each other, it is possible to downsize the image reading device (the ADF **1** and the image reading portion **2**) and reduce the cost. Here, in the above-described structure, if, in order to reduce the image reading time required for the initial document sheet (First Scan Operating Time: FSOT), a setting such as generating the white reference data for the front surface CIS sensor and a setting such as generating the white reference data for the back surface CIS sensor are performed at approximately the same timing, light-emitting times of the light sources (LED) of the two CIS sensors overlap with each other, thereby failing to generate appropriate white reference data, causing a problem of forming low-quality images. On the other hand, in the image forming apparatus **100** according to the embodiment of the present disclosure, as described below, it is possible to reduce the image reading time required for the initial document sheet and prevent low-quality images from being formed.

Configuration of Control Portion **7**

[0047] Next, a configuration of the control portion **7** is described in more detail with reference to FIG. **1**. As shown in FIG. **1**, the control portion **7** includes a lighting processing portion **51**, a

movement processing portion **52**, and a setting processing portion **53**.
[0048] Specifically, an image reading program for causing the CPU **11** to execute an image reading process (see FIG. **4** and FIG. **5**) described below is preliminarily stored in the ROM **12**. The control portion **7** functions as the lighting processing portion **51**, the movement processing portion **52**, and the setting processing portion **53** by executing the image reading program stored in the ROM **12**. Here, a device including the ADF **1**, the image reading portion **2**, and the control portion **7** is an example of the image reading device of the present disclosure. It is noted that the present disclosure may be realized by a device including the image reading portion **2** and the control portion **7**.
[0049] It is noted that the image reading program may be recorded on a non-transitory computer-readable recording medium such as a CD, a DVD, or a flash memory, and may be read from the recording medium and stored in a storage device such as the storage portion **6**. In addition, the lighting processing portion **51**, the movement processing portion **52**, and the setting processing portion **53** may be composed of an electronic circuit such as an integrated circuit (ASIC).
[0050] Here, the control portion **7** performs a process (setting process) required for initial setting and adjustment of the front surface CIS sensor **42** and the back surface CIS sensor **43** at various timings such as when the image forming apparatus **100** is powered on, when it returns from a power saving state (sleep mode), when a predetermined change in temperature or humidity is observed, and when the image reading process is started. In addition, in the setting process, the control portion **7** lights the light sources of the front surface CIS sensor **42** and the back surface CIS sensor **43** and generates white reference data by using reflected lights reflected from the white reference plate **42**B and the white reference plate **43**B.
[0051] Specifically, the control portion **7** lights the light source of the front surface CIS sensor **42** and generates white reference data for the front surface CIS sensor **42** (white reference data for images read from the front surface) by using reflected light reflected from the white reference plate **42**B, and lights the light source of the back surface CIS sensor **43** and generates white reference data for the back surface CIS sensor **43** (white reference data for images read from the back surface) by using reflected light reflected from the white reference plate **43**B. In addition, the control portion **7** controls the light sources such that the lighting time of the light source of the front surface CIS sensor **42** does not overlap with the lighting time of the light source of the back surface CIS sensor **43**.
[0052] The lighting processing portion **51**, the movement processing portion **52**, and the setting processing portion **53** included in the control portion **7** respectively execute processes for generating the white reference data.
[0053] The lighting processing portion **51** controls lighting (ON) and extinguishing (OFF) of each of the light sources of the front surface CIS sensor **42** and the back surface CIS sensor **43**.
[0054] The movement processing portion **52** controls the movement of the front surface CIS sensor **42**. Specifically, in the setting process, the movement processing portion **52** moves the front surface CIS sensor **42** between the reference position HP and the reading position DP shown in FIG. **2** in a scanning direction (left/right direction in FIG. **2**).
[0055] The setting processing portion **53** performs the initial setting, adjustment and the like of each of the front surface CIS sensor **42** and the back surface CIS sensor **43**. In addition, the setting processing portion **53** generates reference data (white reference data, black reference data).
[0056] Having generated the white reference data, the control portion **7** performs the shading correction by using the white reference data during image reading. That is, the control portion **7** generates the white reference data before reading an image from a conveyed document sheet, and executes the shading correction of the read image by using the generated white reference data.
[0057] For example, the control portion **7** generates the white reference data and executes the image reading process by having configurations of practical examples 1 and 2 described below. The control portion **7** may have a configuration of either one of the practical example 1 and the practical example 2, or may have both configurations and switch between them as necessary.

Image Reading Process According to Practical Example 1

[0058] FIG. **3** and FIG. **4** show an example of the procedure of an image reading process executed by the control portion **7** in the image forming apparatus **100** according to the practical example 1.

[0059] It is noted that the present disclosure can be recognized as an image reading method (the image reading method of the present disclosure) that executes one or more steps included in the image reading process. In addition, one or more steps included in the image reading process described here may be omitted as necessary. In addition, steps of the image reading process may be executed in different orders as far as the same action effect is obtained. Furthermore, although in this description the control portion **7** executes the steps of the image reading process, in other embodiments, one or more processors may execute the steps of the image reading process dispersedly. The image reading process is executed at the start of image forming process.

[0060] FIG. **3** schematically shows positional relationship among the front surface CIS sensor **42**, the back surface CIS sensor **43**, and the white reference plate **42**B and shows relationship with control time of the light source. It is noted that in FIG. **3**, the state shown in FIG. **2** is shown reversely left and right. That is, the direction in which the front surface CIS sensor **42** moves from the reference position HP to the reading position DP is shown as rightward.

[0061] As shown in FIG. **3**, the white reference plate **42**B is disposed such that its front edge (SHD plate front edge) is separated from the reference position HP by 2 mm, and its rear edge (SHD plate rear edge) is separated from the reference position HP by 7.6 mm. The back surface CIS sensor **43** is disposed at a position separated from the rear edge of the white reference plate **42**B by 17.9 mm and separated from the reading position DP by 10 mm.

Step S**11**

[0062] First, in step S**11**, the control portion **7** acquires a request (read request) for reading images of both surfaces of the document sheet. For example, when the user performs an operation to start image formation of images of both surfaces, the control portion **7** acquires the read request. It is noted that at this point in time, the front surface CIS sensor **42** is disposed at the reference position HP, and the light source is in the extinguished (OFF) state.

Step S**12**

[0063] In step S**12**, the control portion **7** (the setting processing portion **53**) performs the setting process of the front surface CIS sensor **42**. Specifically, the setting processing portion **53** performs the initial setting, adjustment, mode setting and the like of the front surface CIS sensor **42**. In addition, the setting processing portion **53** generates black reference data for the front surface CIS sensor **42** by extinguishing the light source in a state where the front surface CIS sensor **42** is disposed at the reference position HP. In step S**12**, the control portion **7** executes the setting process by a well-known method.

Step S**13**

[0064] In step S**13**, the control portion **7** (the lighting processing portion **51**) lights the light source of the front surface CIS sensor **42** (ON).

Step S**14**

[0065] In step S**14**, the control portion **7** (the movement processing portion **52**) moves the front surface CIS sensor **42** from the reference position HP to the rear edge of the white reference plate **42**B (SHD plate rear edge). While the front surface CIS sensor **42** is moving, the light source maintains the lighting state, and the white reference data for the front surface CIS sensor **42** is generated.

Step S**15**

[0066] In step S**15**, the control portion **7** (the lighting processing portion **51**) extinguishes the light source of the front surface CIS sensor **42** (OFF). The lighting processing portion **51** extinguishes the light source at the timing when the front surface CIS sensor **42** reaches the edge portion of the white reference plate **42**B. In this way, the control portion **7** generates the white reference data by lighting the light source while moving the front surface CIS sensor **42** from the reference position

HP to a position at the rear edge of the white reference plate **42**B.

Step S**16**

[0067] In step S**16**, the control portion **7** (the movement processing portion **52**) moves the front surface CIS sensor **42** from the position at the rear edge of the white reference plate **42**B (SHD plate rear edge) to the reading position DP. That is, after generating the white reference data while disposing the front surface CIS sensor **42** at the reference position HP, the movement processing portion **52** extinguishes the light source and moves the front surface CIS sensor **42** from the reference position HP to the reading position DP. While the front surface CIS sensor **42** is moving, the light source maintains the extinguished state (see FIG. **3**).

Step S**17**

[0068] In step S**17**, the control portion **7** (the lighting processing portion **51**) lights the light source of the front surface CIS sensor **42**. In this way, while the front surface CIS sensor **42** is in a section in which it is moving from the white reference plate **42**B to the reading position DP, the control portion **7** extinguishes the light source, and at the timing when the front surface CIS sensor **42** reaches the reading position DP, the control portion **7** lights the light source. After step S**17**, the control portion **7** moves the process to step S**18**.

[0069] Here, the control portion **7** executes the setting process of the front surface CIS sensor **42** and the setting process of the back surface CIS sensor **43** at the same time (step S**21**).

Step S**21**

[0070] In step S**21**, the control portion **7** (the setting processing portion **53**) performs the setting process of the back surface CIS sensor **43**. Specifically, the setting processing portion **53** performs the initial setting, adjustment, mode setting and the like of the back surface CIS sensor **43**. In addition, the setting processing portion **53** generates black reference data and white reference data for the back surface CIS sensor **43** by lighting the light source of the back surface CIS sensor **43**. In step S**21**, the control portion **7** executes the setting process by a well-known method.

[0071] It is noted that in step S**21**, the control portion **7** may extinguish the light source of the back surface CIS sensor **43** while generating the white reference data by lighting the light source of the front surface CIS sensor **42**. That is, the control portion **7** may generate the white reference data for the back surface CIS sensor **43** after generating the white reference data for the front surface CIS sensor **42**.

[0072] In addition, the control portion **7** may generate the white reference data for the back surface CIS sensor **43** while the front surface CIS sensor **42** is moved from the reference position HP to the reading position DP.

Step S**22**

[0073] In step S**22**, the control portion **7** executes the document sheet conveyance process. Specifically, the control portion **7** outputs an instruction to the ADF **1** to convey a document sheet that is the reading object. After step S**22**, the control portion **7** moves the process to step S**18**.

Step S**18**

[0074] In step S**18**, the control portion **7** starts the reading process of reading images of both surfaces of the conveyed document sheet. Specifically, the control portion **7** executes the shading correction of the image read from the front surface by using the white reference data for the front surface generated by the front surface CIS sensor **42**, and executes the shading correction of the image read from the back surface by using the white reference data for the back surface generated by the back surface CIS sensor **43**.

[0075] As described above, in the image reading method according to the practical example 1, the control portion **7** generates the white reference data for the front surface CIS sensor **42** and the white reference data for the back surface CIS sensor **43** by adjusting ON/OFF time of the light source of the front surface CIS sensor **42** (see FIG. **3**). Specifically, while the front surface CIS sensor **42** is in a section in which it is moving from the white reference plate **42**B to the reading position DP, the control portion **7** sets the light source to the OFF state. This prevents the light-

emitting time of the light source of the back surface CIS sensor **43** and the light-emitting time of the light source of the front surface CIS sensor **42** from overlapping with each other even when the setting process of the back surface CIS sensor **43** is performed while the front surface CIS sensor **42** is moving, thus making it possible to generate the white reference data for the back surface CIS sensor **43** appropriately.

[0076] In addition, with the above-described configuration, it is possible to execute the setting process (the process of generating the white reference data) of the front surface CIS sensor **42** and the setting process (the process of generating the white reference data) of the back surface CIS sensor **43** at the same timing, thus making it possible to reduce the image reading time required for the initial document sheet.

Image Reading Process According to Practical Example 2

[0077] FIG. **5** shows an example of the procedure of an image reading process executed by the control portion **7** in the image forming apparatus **100** according to a practical example 2. The positional relationship among the front surface CIS sensor **42**, the back surface CIS sensor **43**, and the white reference plate **42**B is the same as in the configuration shown in FIG. **3**.

Step S**31**

[0078] First, in step S**31**, the control portion **7** acquires a request (read request) for reading images of both surfaces of the document sheet. For example, when the user performs an operation to start image formation for images of both surfaces, the control portion **7** acquires the read request. It is noted that at this point in time, the front surface CIS sensor **42** is disposed at the reference position HP, and the light source is in the extinguished (OFF) state. Upon acquiring the read request, the control portion **7** executes the setting process of the front surface CIS sensor **42** (S**32** to S**37**) and the setting process of the back surface CIS sensor **43** (S**51** to S**56**).

Step S**32**

[0079] In step S**32**, the control portion **7** (the setting processing portion **53**) performs the initial setting of the front surface CIS sensor **42**.

Step S**33**

[0080] In step S**33**, the control portion **7** (the setting processing portion **53**) performs the adjustment of the front surface CIS sensor **42**.

Step S**34**

[0081] In step S**34**, the control portion **7** (the setting processing portion **53**) performs the mode setting of the front surface CIS sensor **42**.

Step S**35**

[0082] In step S**35**, the control portion **7** (the setting processing portion **53**) generates the black reference data for the front surface CIS sensor **42**. Upon generating the black reference data for the front surface CIS sensor **42**, the control portion **7** suspends the setting process of the front surface CIS sensor **42**.

[0083] The control portion **7** executes the setting process of the back surface CIS sensor **43** at the same timing as of the processes of the steps S**32** to S**35**.

Step S**51**

[0084] In step S**51**, the control portion **7** (the setting processing portion **53**) performs the initial setting of the back surface CIS sensor **43**.

Step S**52**

[0085] In step S**52**, the control portion **7** (the setting processing portion **53**) performs the adjustment of the back surface CIS sensor **43**.

Step S**53**

[0086] In step S**53**, the control portion **7** (the setting processing portion **53**) performs the mode setting of the back surface CIS sensor **43**.

Step S**54**

[0087] In step S**54**, the control portion **7** (the setting processing portion **53**) generates the black

reference data for the back surface CIS sensor **43**.

Step S**55**

[0088] In step S**55**, the control portion **7** (the lighting processing portion **51**) lights the light source of the back surface CIS sensor **43** (ON).

Step S**56**

[0089] In step S**56**, the control portion **7** (the setting processing portion **53**) generates the white reference data for the back surface CIS sensor **43**. Upon generating the white reference data for the back surface CIS sensor **43**, the control portion **7** moves the process to step S**36** and resumes the setting process of the front surface CIS sensor **42**.

Step S**57**

[0090] In step S**57**, the control portion **7** executes the document sheet conveyance process. Specifically, the control portion **7** outputs an instruction to the ADF **1** to convey a document sheet that is the reading object. After step S**57**, the control portion **7** moves the process to step S**40**.

Step S**36**

[0091] In step S**36**, the control portion **7** (the lighting processing portion **51**) lights the light source of the front surface CIS sensor **42** (ON). Upon lighting the light source of the front surface CIS sensor **42**, the control portion **7** executes the processes of steps S**37** and S**38**.

Step S**37**

[0092] In step S**37**, the control portion **7** (the setting processing portion **53**) generates the white reference data for the front surface CIS sensor **42**. Upon generating the white reference data for the front surface CIS sensor **42**, the control portion **7** moves the process to step S**39**. In this way, the setting processing portion **53** generates the white reference data for the back surface CIS sensor **43** in a state where the front surface CIS sensor **42** is disposed at the reference position HP, and then generates the white reference data for the front surface CIS sensor **42**.

Step S**38**

[0093] In step S**38**, the control portion **7** (the movement processing portion **52**) moves the front surface CIS sensor **42** from the reference position HP to the reading position DP. While the front surface CIS sensor **42** is moving, the light source maintains the lighting state. In this way, after generating the white reference data for the back surface CIS sensor **43**, the control portion **7** lights the light source of the front surface CIS sensor **42** and moves the front surface CIS sensor **42** from the reference position HP to the reading position DP.

Step S**39**

[0094] In step S**39**, the control portion **7** (the lighting processing portion **51**) extinguishes the light source of the front surface CIS sensor **42** (OFF). In this way, in the practical example 2, after the white reference data for the back surface CIS sensor **43** is generated, the front surface CIS sensor **42** is moved to the reading position DP. As a result, there is no need to extinguish the light source of the front surface CIS sensor **42** while the front surface CIS sensor **42** is moving.

Step S**40**

[0095] In step S**40**, the control portion **7** starts the reading process of reading images of both surfaces of the conveyed document sheet. Specifically, the control portion **7** executes the shading correction of the image read from the front surface by using the white reference data for the front surface generated by the front surface CIS sensor **42**, and executes the shading correction of the image read from the back surface by using the white reference data for the back surface generated by the back surface CIS sensor **43**.

[0096] As described above, in the image reading method according to the practical example 2, the control portion **7** generates the white reference data for the front surface CIS sensor **42** and the white reference data for the back surface CIS sensor **43** by generating the white reference data for the front surface CIS sensor **42** after completing the process of generating the white reference data for the back surface CIS sensor **43**. Specifically, the control portion **7** disposes the front surface CIS sensor **42** at the reference position HP and does not move it therefrom while the white reference

data for the back surface CIS sensor **43** is generated, and after the white reference data for the back surface CIS sensor **43** is generated, the control portion **7** generates the white reference data for the front surface CIS sensor **42** and moves the front surface CIS sensor **42** from the reference position HP to the reading position DP. This prevents the light-emitting time of the light source of the back surface CIS sensor **43** and the light-emitting time of the light source of the front surface CIS sensor **42** from overlapping with each other, thus making it possible to generate the white reference data for the back surface CIS sensor **43** appropriately.

[0097] In addition, with the above-described configuration, it is possible to execute the setting process (the initial setting, adjustment, mode setting, process of generating the black reference data) of the front surface CIS sensor **42** and the setting process (the initial setting, adjustment, mode setting, process of generating the black reference data) of the back surface CIS sensor **43** at the same timing, thus making it possible to reduce the image reading time required for the initial document sheet.

[0098] In the way described above, each time the power of the image forming apparatus **100** enters the ON state or it returns from the sleep mode, the control portion **7** executes the image reading process repeatedly. It is noted that the above-described image reading processes in the practical examples 1 and 2 are presented as an example, and the contents of the processes and the order thereof can be changed as necessary.

[0099] As described above, the image forming apparatus **100** includes: the ADF **1** configured to convey a document sheet; the back surface CIS sensor **43** (first reading portion) disposed in the ADF **1** and configured to read an image of the document sheet conveyed by the ADF **1**; the front surface CIS sensor **42** (second reading portion) disposed below the first contact glass **411** in such a way as to be reciprocally movable along a scanning direction; the white reference plate **43**B (first white reference plate) disposed in the ADF **1** to face the back surface CIS sensor **43**; the white reference plate **42**B (second white reference plate) disposed in the ADF **1** at the reference position HP that can face the front surface CIS sensor **42**; and the control portion **7** configured to light a first light source included in the back surface CIS sensor **43** and generate first white reference data for back surface by using reflected light reflected from the white reference plate **43**B, and light a second light source included in the front surface CIS sensor **42** and generate second white reference data for front surface by using reflected light reflected from the white reference plate **42**B. In addition, the control portion **7** controls the first light source and the second light source such that a lighting time of the first light source does not overlap with a lighting time of the second light source.

[0100] With the above-described configuration, since the lighting time of the light source for generating the white reference data for the front surface CIS sensor **42** does not overlap with the lighting time of the light source for generating the white reference data for the back surface CIS sensor **43**, it is possible to generate the white reference data for each of the front surface CIS sensor **42** and the back surface CIS sensor **43** appropriately. It is thus possible to prevent low-quality images from being formed. In addition, with the above-described configuration, it is possible to execute the setting process of the front surface CIS sensor **42** and the setting process of the back surface CIS sensor **43** at the same timing, thus making it possible to reduce the image reading time required for the initial document sheet.

Appended Notes on the Disclosure

[0101] The following notes are appended concerning a summary of the disclosure extracted from the above-described embodiment. It is noted that the configurations and processing functions explained in the following notes can be arbitrarily selected and combined.

Note 1

[0102] An image reading device comprising: [0103] a conveying portion configured to convey a sheet; [0104] a first reading portion disposed in the conveying portion and configured to read an image of a first surface of the sheet conveyed by the conveying portion; [0105] a second reading

portion disposed below a contact glass in such a way as to be reciprocally movable along a scanning direction and configured to read an image of a second surface of the sheet; [0106] a first white reference plate disposed in the conveying portion to face the first reading portion; [0107] a second white reference plate disposed in the conveying portion at a reference position that can face the second reading portion; and [0108] a control portion configured to light a first light source included in the first reading portion and generate first white reference data by using reflected light reflected from the first white reference plate, and light a second light source included in the second reading portion and generate second white reference data by using reflected light reflected from the second white reference plate, wherein [0109] the control portion controls the first light source and the second light source such that a lighting time of the first light source does not overlap with a lighting time of the second light source.

Note 2

[0110] The image reading device according to Note 1, wherein [0111] the first reading portion and the first white reference plate are disposed downstream, in a conveyance direction in which the sheet is conveyed, of a reading position at which the second reading portion reads an image of the sheet, and the second white reference plate is disposed downstream of the first reading portion and the first white reference plate in the conveyance direction.

Note 3

[0112] The image reading device according to Note 1 or 2, wherein [0113] the first white reference plate is disposed between the first reading portion and the contact glass.

Note 4

[0114] The image reading device according to any one of Notes 1 to 3, wherein [0115] after generating the second white reference data while disposing the second reading portion at the reference position, the control portion extinguishes the second light source and moves the second reading portion from the reference position to the reading position.

Note 5

[0116] The image reading device according to Note 4, wherein [0117] the control portion extinguishes the second light source at a timing when the second reading portion reaches an edge portion of the second white reference plate.

Note 6

[0118] The image reading device according to Note 4 or 5, wherein [0119] the control portion further generates the first white reference data while moving the second reading portion from the reference position to the reading position.

Note 7

[0120] The image reading device according to any one of Notes 1 to 3, wherein [0121] after generating the first white reference data in a state where the second reading portion is disposed at the reference position, the control portion generates the second white reference data.

Note 8

[0122] The image reading device according to Note 7, wherein [0123] after generating the first white reference data, the control portion further lights the second light source and moves the second reading portion from the reference position to the reading position.

[0124] It is to be understood that the embodiments herein are illustrative and not restrictive, since the scope of the disclosure is defined by the appended claims rather than by the description preceding them, and all changes that fall within metes and bounds of the claims, or equivalence of such metes and bounds thereof are therefore intended to be embraced by the claims.

Claims

1. An image reading device comprising: a conveying portion configured to convey a sheet; a first reading portion disposed in the conveying portion and configured to read an image of a first surface

of the sheet conveyed by the conveying portion; a second reading portion disposed below a contact glass in such a way as to be reciprocally movable along a scanning direction and configured to read an image of a second surface of the sheet; a first white reference plate disposed in the conveying portion to face the first reading portion; a second white reference plate disposed in the conveying portion at a reference position that can face the second reading portion; and a control portion configured to light a first light source included in the first reading portion and generate first white reference data by using reflected light reflected from the first white reference plate, and light a second light source included in the second reading portion and generate second white reference data by using reflected light reflected from the second white reference plate, wherein the control portion controls the first light source and the second light source such that a lighting time of the first light source does not overlap with a lighting time of the second light source.

2. The image reading device according to claim 1, wherein the first reading portion and the first white reference plate are disposed downstream, in a conveyance direction in which the sheet is conveyed, of a reading position at which the second reading portion reads an image of the sheet, and the second white reference plate is disposed downstream of the first reading portion and the first white reference plate in the conveyance direction.

3. The image reading device according to claim 2, wherein the first white reference plate is disposed between the first reading portion and the contact glass.

4. The image reading device according to claim 2, wherein after generating the second white reference data while disposing the second reading portion at the reference position, the control portion extinguishes the second light source and moves the second reading portion from the reference position to the reading position.

5. The image reading device according to claim 4, wherein the control portion extinguishes the second light source at a timing when the second reading portion reaches an edge portion of the second white reference plate.

6. The image reading device according to claim 4, wherein the control portion further generates the first white reference data while moving the second reading portion from the reference position to the reading position.

7. The image reading device according to claim 2, wherein after generating the first white reference data in a state where the second reading portion is disposed at the reference position, the control portion generates the second white reference data.

8. The image reading device according to claim 7, wherein after generating the first white reference data, the control portion further lights the second light source and moves the second reading portion from the reference position to the reading position.

9. An image forming apparatus comprising: the image reading device according to claim 1; and an image forming portion configured to form an image on the sheet.

10. An image reading method for, in an image reading device including: a conveying portion configured to convey a sheet; a first reading portion disposed in the conveying portion and configured to read an image of a first surface of the sheet conveyed by the conveying portion; a second reading portion disposed below a contact glass in such a way as to be reciprocally movable along a scanning direction and configured to read an image of a second surface of the sheet; a first white reference plate disposed in the conveying portion to face the first reading portion; and a second white reference plate disposed in the conveying portion at a reference position that can face the second reading portion, reading the image, the image reading method comprising a control step of lighting a first light source included in the first reading portion and generating first white reference data by using reflected light reflected from the first white reference plate, and lighting a second light source included in the second reading portion and generating second white reference data by using reflected light reflected from the second white reference plate, wherein in the control step, the first light source and the second light source are controlled such that a lighting time of the first light source does not overlap with a lighting time of the second light source.