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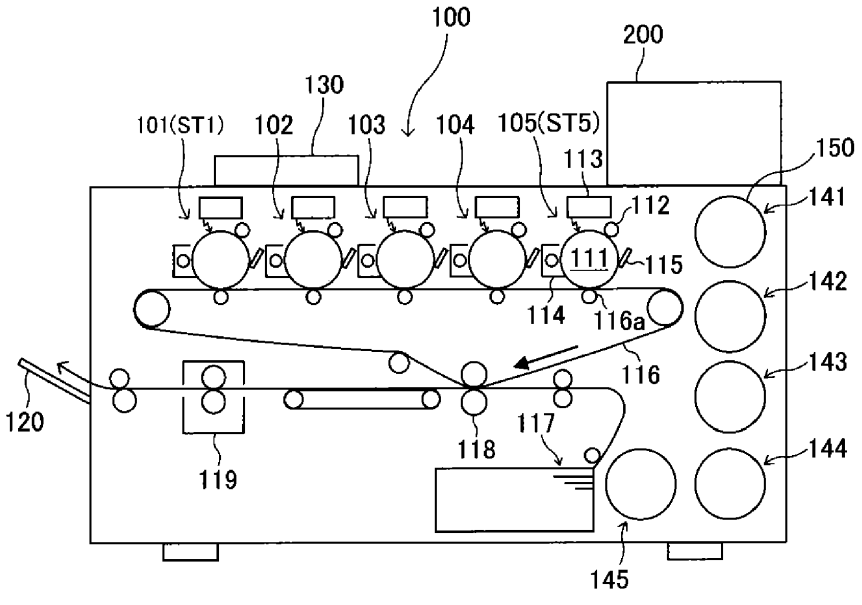
(54) IMAGE FORMING APPARATUS

(57) An image forming apparatus (100) includes image forming means (101 to 105, 150, and 160), reading means (101a, 101b, 105a, 105b, 141a, 142a), detection means (250), and determination means (300). The image forming means includes exchangeable units (114, 150, 160). Each exchangeable unit includes color data storing means (114a, 150a, 160a) storing data on color of each exchangeable unit. The reading means reads the data on color stored in the color data storing means. The detection means detects at least one of exchange of the exchangeable units, removal of each exchangeable unit from the image forming apparatus, and installation of each exchangeable unit into the image forming apparatus. The determination means determines whether the data on color are on a same color based on an output from the reading means when the detection means detects the at least one of the exchange, the removal, and the installation.

FIG. 1



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Description

BACKGROUND

Technical Field

[0001] Embodiments of the present disclosure relate to an image forming apparatus.

Description of the Related Art

[0002] Some conventional image forming apparatuses include two or more image forming means for forming two or more color images. Each image forming means includes a plurality of exchangeable units to form an image with a single color. The image forming apparatuses can also include selected image forming means.

[0003] For example, JP-2016-95375-A discloses an image forming apparatus including four image forming means that use color toner such as cyan toner, magenta toner, yellow toner, and black toner. In addition, the image forming apparatus includes one image forming means that uses special color toner selected from clear toner (i.e. transparent toner) and white toner. The image forming means in the image forming apparatus includes a plurality of exchangeable units (i.e. exchangeable parts) and a toner conveyance path including a toner bottle, a replenishment toner conveyance means, and a developing unit. When an exchange of the toner bottle and different toner types before and after the exchange are detected, JP-2016-095375-A discloses notifying needs of exchanging other parts included in the toner conveyance path in addition to the exchange of the toner bottle and requesting an input of completion of exchanging other units. JP-2016-095375-A notes that the above-described configuration can prevent color mixture in setting the toner bottle including a different type of toner from a type of toner before the exchange.

[0004] However, the above-described work to exchange units is troublesome. For example, the work includes inputting the completion of exchanging all units to prevent the color mixture. It is desired to further reduce such a troublesome work.

SUMMARY

[0005] In order to achieve the above-described object, there is provided an image forming apparatus according to claim 1. Advantageous embodiments are defined by the dependent claims.

[0006] Advantageously, the image forming apparatus includes two or more image forming means for forming an image with two or more colors, reading means, detection means, and determination means. At least one of the two or more image forming means includes a plurality of exchangeable units. Each of the exchangeable units includes color data storing means for storing data on color of each of the exchangeable units. The reading means reads the data on color of each of the exchangeable units stored in the color data storing means. The detection means detects at least one of exchange of the exchangeable units in the image forming apparatus, removal of each of the exchangeable units from the image forming apparatus, and installation of each of the exchangeable units into the image forming apparatus. The determination means determines whether the data on color of the exchangeable units are on a same color based on an output from the reading means when the detection means detects the at least one of the exchange, the removal, and the installation.

[0007] According to the present disclosure, the troublesome work to prevent the color mixture can be reduced as compared with the conventional case.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The aforementioned and other aspects, features, and advantages of the present disclosure would be better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. 1 is a schematic view illustrating a configuration of an image forming apparatus;
FIG. 2 is a schematic view illustrating a configuration of electrical components to prevent color mixture;
FIGS. 3A to 3C are schematic views each illustrating an exchange unit to which a radiofrequency identification (RFID) tag is fixed;
FIG. 4 is a schematic block diagram of a controller;
FIG. 5 is a flow chart of control according to a comparative embodiment;
FIG. 6 is a flowchart of control according to an embodiment of the present disclosure; and
FIG. 7 is a flow chart of control according to a variation.

[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.

DETAILED DESCRIPTION

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

[0011] Although the embodiments are described with technical limitations with reference to the attached drawings, such description is not intended to limit the scope of the disclosure and all of the components or elements described in the embodiments of this disclosure are not necessarily indispensable.

[0012] The following is a description of the present disclosure with reference to attached drawings. In the drawings for explaining the present disclosure, identical reference numerals are assigned to elements such as members and parts that have an identical function or an identical shape as long as differentiation is possible, and a description of those elements is omitted once the description is provided.

[0013] With reference to FIG. 1, a description is provided of an electrophotographic image forming apparatus according to an embodiment of the present disclosure. FIG. 1 is a schematic view illustrating a configuration of an image forming apparatus 100. The image forming apparatus 100 includes five image forming units 101 to 105. These five image-forming units are, for example, four image forming units to form color toner images each of which color is one of yellow, magenta, cyan, and black, and one image forming unit to form toner image using toner that has color other than the above-described colors (hereinafter referred to as spot color toner). The spot color toner is, for example, transparent toner, white toner, and gold toner. A user may have a plurality of image forming units including the above-described spot color toners that are different from each other and select one of the image forming unit to mount the one in the image forming apparatus 100.

[0014] The image forming units have a common mechanical configuration except that the toner used is different. The image forming unit 105 located at a right end portion in FIG. 1 includes a photoconductor 111 serving as a latent image bearer, a charging device 112, a writing device 113, a developing device 114, and a cleaning device 115. The image forming apparatus 100 includes toner supply devices to supply toner to the developing devices 114 and installed portions 141 to 145 into which five toner bottles 150 serving as toner containers to supply toner to the toner supply devices can be installed. The image forming means includes the image forming unit, the toner supply device, and the toner bottle. The image forming means includes three exchangeable units that are the developing device, toner supply device, and toner bottle. The developing device may be integrally formed as the image forming unit with other devices and exchanged. The toner bottle 150 and the toner supply device may be coupled to each other by a tube or the like.

[0015] The image forming apparatus 100 includes an intermediate transfer belt 116 serving as an intermediate transferor below the five image forming units 101 to 105. In the loop of the intermediate transfer belt 116, primary transfer devices 116a are arranged at positions corresponding to the image forming units 101 to 105. A secondary transfer device 118 facing the outer surface of the intermediate transfer belt 116 is also provided. The secondary transfer device 118 transfers a toner image on the intermediate transfer belt 116 to a sheet. The image forming apparatus 100 includes a sheet feeder 117 to feed the sheet between the intermediate transfer belt 116 and the secondary transfer device 118, a fixing device 119 to fix a toner image to the sheet, and an output tray 120 to receive the sheet, on which the toner image is fixed, ejected toward outside the image forming apparatus 100. The image forming apparatus 100 includes a document reading device 130 and a control panel 200 serving as notification means on the top of the image forming apparatus 100.

[0016] With reference to FIG. 1, the image forming unit for the spot color toner is set at a most upstream station ST1 or a most downstream station ST5 in a traveling direction of the intermediate transfer belt 116 in the image forming apparatus 100. The most upstream station ST1 is a setting portion for the image forming unit 101 in which the toner image is firstly transferred to the intermediate transfer belt 116. The most downstream station ST5 is a setting portion for the image forming unit 105 in which a toner image is lastly transferred to the intermediate transfer belt 116. For example, since the transparent toner is used to increase the glossiness of the image, the image forming unit to form a transparent toner layer is preferably set to the most upstream station ST1 that forms the transparent toner layer as the lowest layer on the intermediate transfer belt 116 and positions the transparent toner layer at the top of the toner layers on the sheet. Since the white toner is used to compensate for the whiteness of the sheet, the image forming unit to form the white toner layer is preferably set at the most downstream station ST5 that forms the white toner layer at the top of the toner layers on the intermediate transfer belt 116 and positions the white toner layer at the lowest position of the toner layers on the sheet.

[0017] To make a gold toner image stand out, the image forming unit to form the gold toner image is preferably set to the most upstream station ST1 that forms the gold toner image at the lowest position of the toner layers on the intermediate

transfer belt 116 and positions the gold toner image at the top of the toner layers on the sheet. When replacing the image forming unit that uses the spot color toner and another image forming unit involves changing the setting portions of the image forming units, the setting portion of the image forming unit that uses the black toner is preferably changed to the most upstream station ST1 or the most downstream station ST5.

[0018] Replacing the image forming unit that uses the spot color toner and another image forming unit and changing the setting portions of the image forming units as described above needs to prevent the color mixture. The configuration in the present embodiment includes three exchangeable parts, that is, the toner bottle, the toner supply device, and the developing device 114. These three parts use the same color toner.

[0019] FIG. 2 is a schematic view illustrating a configuration of electrical components to prevent color mixture. The developing device 114 and the toner supply device 160 include radiofrequency identification (RFID) tags each serving as color data storing means. In the most upstream station ST1 and the most downstream station ST5, access terminals 101a, 101b, 105a, and 105b are disposed to communicate with the RFID tags. The access terminal serving as reading means includes a central processing unit (CPU) and an analog front end (AFE) including an antenna and one channel modulation and demodulation integrated circuit (IC) and communicates with the RFID tag to detect and read color data stored in the RFID tag.

[0020] Access terminals 141a and 142a to communicate with RFID tags are provided at the installed portion into which the toner bottle for the most upstream station ST1 is installed and the installed portion into which the toner bottle for the most downstream station ST5 is installed, respectively. The above access terminals are coupled to a controller 300 serving as control means. The controller 300 is also coupled to an open and close detection sensor 250 to detect opening and closing a cover of the image forming apparatus that is opened and closed when at least one of the toner bottle 150, the toner supply device 160, and the developing device 114 is replaced.

[0021] FIGS. 3A to 3C each illustrate an exchange unit to which a radiofrequency identification (RFID) tag is fixed. FIG. 3A illustrates the toner bottle 150 including an RFID tag 150a, FIG. 3B illustrates the toner supply device 160 including an RFID tag 160a, and FIG. 3C illustrates the developing device 114 including an RFID tag 114a.

[0022] FIG. 4 is a schematic block diagram of the controller 300. The controller 300 includes a central processing unit (CPU) 301,a random-access memory (RAM) 302, a read only memory (ROM) 303 serving as memories, and a determination circuit 304, controls driving of each device of the image forming apparatus, and performs various arithmetic processing. Although the controller 300 is connected to various devices and sensors in addition to the control panel 200, FIG. 4 illustrates electrical components relating to preventing the color mixture, such as the sensor.

[0023] FIG. 5 is a flow chart of control according to a comparative embodiment to avoid the color mixture using the above-described electrical components. In step S501, based on a user operation such as pressing a button of the control panel 200, the controller 300 controls the control panel 200 to display an exchange operation screen for the spot color toner on the screen of the control panel 200. The exchange operation screen displays the currently installed spot color toner. A user operates the control panel 200 to specify the spot color toner to be exchanged. For example, the user specifies that the white toner is exchanged for the transparent toner. In step S502, the controller 300 rewrites and changes data on color of toner (set in each station) stored, for example, in a storage area 302a in the RAM 302 based on the specified exchange of colors. In step S503, the controller 300 rewrites and changes parameters about image forming conditions about the color exchanged and used. The parameters are stored in the storage area 302b. The parameters include, for example, a fixing temperature and a transfer voltage.

[0024] Subsequently, the controller 300 detects a unit exchange in S504. The controller 300 determines that a unit is exchanged when the open and close detection sensor 250 detects opening and closing the cover. In step S505, the controller 300 determines whether the data on color in the three parts that are the toner bottle 150, the toner supply device 160, and the developing device 114 are the data of the same color in each of the most upstream station ST1 and the most downstream station ST5.

[0025] When the controller 300 determines that the data about color in the three parts in each of the stations are the data of the same color (YES in step S505), the controller 300 determines whether the station in which the parts for the spot color toner are set is the station for the use of the spot color toner, that is, a right station for the spot color toner in step S506. This setting is performed by another user's setting operation using the control panel, which is different from the control in FIG. 5. When the controller 300 determines that the station in which the parts for the spot color toner are set is the right station for the spot color toner (YES in step S506), the controller 300 performs an adjustment of image forming conditions in step S507.

[0026] The adjustment of image forming conditions are operations called a process control. That is, the image forming unit in at least the station in which color in the parts is changed forms a test pattern, an optical sensor detects an image density of the test pattern, and the controller 300 adjusts image forming conditions including conditions of the charging device 112, the writing device 113, the developing device 114, the primary transfer device 116a, and the secondary transfer device 118 so that the detected image density is in a target range. Completing the adjustment of image forming conditions, the controller 300 controls the control panel 200 to display "ready for image formation" in step S508, maintains the image forming conditions to form the image, and ends the control according to the comparative embodiment.

[0027] When the controller 300 determines that the data on color in the three parts in each of the stations are not the data of the same color (NO in step S505), the controller 300 controls the control panel 200 to display "unit set failure" in step S509, which is an example of notification of an error, and ends the control according to the comparative embodiment. When the controller 300 determines that the station in which the parts for the spot color toner are set is not the right station for the spot color toner (NO in step S506), the controller 300 controls the control panel 200 to display "unit set failure" in step S509 and ends the control according to the comparative embodiment.

[0028] The above-described control in the comparative embodiment is different from the control in the image forming apparatus disclosed in JP-2016-95375-Ain the following point. In the comparative embodiment, when one of the exchange units is exchanged, the controller 300 does not request the user exchanging other exchange unit that is the above-described part, and the user does not need to input that the user exchange the requested exchange unit. However, the comparative embodiment does not sufficiently reduce the troublesome works to exchange units because the user needs to press the button on the control panel 200 and specify color at the start of exchanging the units.

[0029] FIG. 6 is a flowchart of control to prevent the color mixture according to the present embodiment. As long as the power of the image forming apparatus is turned on, the controller 300 starts the control in step S601 after exchanging the unit is detected even if the user does not operate the control panel 200. The controller 300 determines whether the unit is exchanged when the open and close detection sensor 250 detects opening and closing the cover. After the cover is opened and closed, the controller 300 controls the access terminals to read color data in the units that are the toner bottle 150, the toner supply device 160, and the developing device 114 and send the color data to the controller 300. The controller 300 compares the sent color data and the color data stored in the storage area 302a in the RAM 302 and determines that the unit is exchanged when the sent color data does not match the color data stored in the storage area 302a. That is, the open and close detection sensor 250 is an example of detection means configured to detect at least one of exchange of the units, removal of the unit from the image forming apparatus, and installation of the unit into the image forming apparatus. The control according to the present embodiment is executed in the image forming apparatus, and the user does not need to execute an operation such as inputting color data. After determining that the unit is exchanged, the controller 300 determines whether the data on color in the three parts that are the toner bottle 150, the toner supply device 160, and the developing device 114 are the data of the same color in each of the most upstream station ST1 and the most downstream station ST5 in step S602, which is similar to the determination in step S505 in the comparative embodiment. In step S602, the controller 300 works as determination means.

[0030] When he controller 300 determines that the data on color in the three parts are the data of the same color in each of the stations (YES in step S602), the controller 300 rewrites and changes data on color of toner (set in each station) stored, for example, in the storage area 302a in the RAM 302 and corresponding to color set in each station in step S603. In step S604, the controller 300 rewrites and changes parameters about image forming conditions about color exchanged and used. The parameters are stored in the storage area 302b. The operations in steps S603 and step S604 are the same as the operations in steps S502 and S503 in the comparative embodiment. Subsequently, the controller 300 performs the adjustment of image forming conditions in step S605. The operation in step S605 is the same as the operation in step S507 in the comparative example. Completing the adjustment of image forming conditions, the controller 300 controls the control panel 200 to display "ready for image formation" in step S606, maintains the image forming conditions to form the image, and ends the control according to the present embodiment.

[0031] When the controller 300 determines that the data on color in the three parts in each of the stations are not the data of the same color (NO in step S602), the controller 300 controls the control panel 200 to display "unit set failure" in step S607 and ends the control according to the present embodiment.

[0032] Table 1 illustrates notifications displayed on the control panel when the three parts using the spot color toner are sequentially exchanged. As illustrated in the column labeled "before exchange" , the three parts of the spot color toner A is set in the most upstream station ST1, and the three parts of toner K (that is preferably black) of color other than the spot color is set in the most downstream station ST5 before exchange of the spot color toner and the toner other than the spot color toner. From the above-described state, only the toner bottles are exchanged, then the toner supply devices are also exchanged, and finally the developing devices are also exchanged. Exchange of all units are performed.

[Table 1]

Station	Units / state	Before exchange	→ Exchange of toner bottle	→ Exchange of toner supply device	→ Exchange of developing device
Station ST1	Toner Bottle	A	K	K	K
	Toner Supply	A	A	K	K

(continued)

Station	Units / state	Before exchange	→ Exchange of toner bottle	→ Exchange of toner supply device	→ Exchange of developing device
	Device				
	Developing Device	A	A	A	K
	Color data stored in RAM	A	A	A	K
Station ST5	Toner Bottle	K	A	A	A
	Toner Supply Device	K	K	A	A
	Developing Device	K	K	K	A
	Color data stored in RAM	K	K	K	A
Notification displayed in control panel			Toner bottle mismatch in each of ST1 and ST5	Toner bottle mismatch and Toner supply device mismatch in each of ST1 and ST5	

[0033] If the open and close detection sensor 250 detects opening and closing the cover after only the toner bottles are exchanged, the controller 300 determines that the data on color in the toner bottles in both of the most upstream station ST1 and the most downstream station ST5 do not match the data on color stored in the storage area 302a in the RAM 302. Therefore, as illustrated in the row labeled "Notification displayed in control panel" at the bottom of Table 1, the controller 300 controls the control panel 200 to display an warning, for example, "Toner bottle mismatch in each of the most upstream station ST1 and the most downstream station ST5".

[0034] Similarly, if the open and close detection sensor 250 detects opening and closing the cover when only the toner bottles and the toner supply devices are exchanged but the developing devices are not exchanged, as illustrated in the row labeled "Notification displayed in control panel" at the bottom of Table 1, the controller 300 controls the control panel 200 to display an warning, for example, "Toner bottle mismatch and Toner supply device mismatch in each of ST1 and ST5 in the most upstream station ST1 and the most downstream station ST5". Unlike the above descriptions, when the open and close detection sensor 250 detects opening and closing the cover after all the three parts including the developing devices are correctly exchanged, the controller 300 does not control the control panel 200 to display the warning.

[0035] The user who receives the above-described warning opens the cover again, correctly exchanges all the three parts including the developing devices and closes the cover. Then the controller 300 performs the above-described control. In step S601, the controller reads data of all exchanged units that are the toner bottle 150, the toner supply device 160, and the developing device 114 and determines that color of the units are exchanged because the data on color in the at least one of the three units does not match the data about color stored in the storage area 302a in the RAM 302. Subsequently, the controller 300 determines that the data on color in the three parts are the data of the same color in each of the stations (YES in step S602) and performs steps S603 to S606. As described above, the user only has to exchange the necessary unit based on the warning that notifies other unit (part) exchange when at least one of the exchange units is exchanged. The user does not need to input that all exchange units are exchanged.

[0036] The table 1 illustrates unit exchanges in both stations ST1 and ST5 that are similarly performed. However, when the unit set failure occurs in only one of the stations, the controller 300 identifies the station in which the data on color of the three parts are not the same color and informs the warning. When the user changes only positions for the image forming unit that uses the spot color toner and does not exchange color of units, the controller 300 may automatically determine whether the data on color in the three parts are the data on the same color and change the following data. That is, when the data on color in the three parts are the data on the same color, the controller 300 may automatically change the data on color stored in the storage area 302a in the RAM 302 and data on a set position. When the data on

color in the three parts are not the data on the same color, the controller 300 may inform the warning.

[0037] FIG. 7 is a flowchart of control to prevent the color mixture according to the variation. The difference between the control illustrated in FIG. 7 and the control illustrated in FIG. 6 is that the controller 300 performs step S602A that is the same step S 506 in the control according to the comparative embodiment illustrated in FIG. 5 after step S602. That is, the controller 300 determines whether the station in which the units for the spot color toner are set is the station for the use of the spot color toner, that is, the right station for the spot color toner in step S602A. As a precondition, setting of the station including the spot color toner is performed by another user's setting operation using the control panel, which is different from the control in FIG. 7. When the controller 300 determines that the station in which the units for the spot color toner are set is the right station for the spot color toner (YES in step S602A), the controller 300 performs steps S603 to S606 and ends the control according to the variation. When the controller 300 determines that the station in which the units for the spot color toner are set is not the right station for the spot color toner (NO in step S602A), the controller 300 controls the control panel 200 to display "unit set failure" in step S607 and ends the control according to the variation.

[0038] For example, the station for the use of the spot color toner is set as follows. Among the white toner, the transparent toner, and the gold toner, for example, the stations for the use of the white toner and the transparent toner are set the above-mentioned preferable stations. If the image forming unit using the white toner or the transparent toner is set to any one of the other stations, the controller 300 controls the control panel 200 to display "unit set failure". That is, this example of the above-described control limits a station to which each of the image forming units using the white toner and the transparent toner is set. In contrast, this example of the above-described control dose not limit a station to set the image forming unit using the gold toner. The controller 300 may be designed so that the user can set the station for the use of the spot color toner.

[0039] The present disclosure may be applied to the image forming apparatus that limits the station for the use of the spot color toner to one station. Table 2 illustrates notifications displayed on the control panel of the image forming apparatus according to the present embodiment when the three parts using the spot color toner are sequentially exchanged. For example, the image forming apparatus may have an electrical circuit or a control system to limit the station for the use of the spot color toner to the most upstream station ST1. Alternatively, the image forming apparatus may have a mechanical structure to limit the station for the use of the spot color toner to the most upstream station ST1. The mechanical structure may be designed by changing an entire shape of the image forming unit or a part of the shape of the image forming unit. The electrical circuit, the control system, or the mechanical structure limits the station to set the image forming unit using the spot color toner. When the electrical circuit or the control system limits the station for the use of the spot color toner, the image forming apparatus may be designed to display the notification informing the warning of the unit set failure.

[0040] The following is an example of warning of mismatch in color of the three parts that is displayed by the control system. Table 2 illustrates notifications displayed on the control panel when the three parts using the transparent toner (i.e. clear toner) A are sequentially exchanged to the three parts using the gold toner B in the station to set the spot color toner. As illustrated in the column labeled "before exchange", the three parts of the transparent toner (i.e. clear toner) A as the spot color toner is set in the station to set the spot color toner before exchange of the transparent toner A and the gold toner B. From the above-described state, only the toner bottle of the transparent toner A is exchanged to the toner bottle of the gold toner B, then the toner supply device of the transparent toner A is also exchanged to the toner supply device of the gold toner B, and finally the developing device of the transparent toner A is also exchanged to the developing device of the gold toner B. Exchange of all units are performed.

[Table 2]

State	Before exchange	→ Exchange of toner bottle	→Exchange of toner supply device	→Exchange of developing device
Toner Bottle	A	K	K	K
Toner Supply Device	A	A	K	K
Developing Device	A	A	A	K
Color data stored in RAM	A	A	A	K
Notification displayed in control panel		Toner bottle mismatch	Toner bottle mismatch and Toner supply device mismatch	

[0041] If the open and close detection sensor 250 detects opening and closing the cover after only the toner bottles are exchanged, the controller 300 determines that the data on color of the toner bottle does not match the data on color stored in the storage area 302a in the RAM 302. Therefore, as illustrated in the row labeled "Notification displayed in control panel" at the bottom of Table 2, the controller 300 controls the control panel 200 to display a warning, for example, "Toner bottle mismatch".

[0042] Similarly, if the open and close detection sensor 250 detects opening and closing the cover when only the toner bottles and the toner supply devices are exchanged but the developing devices are not exchanged, as illustrated in the row labeled "Notification displayed in control panel" at the bottom of Table 2, the controller 300 controls the control panel 200 to display an warning, for example, "Toner bottle mismatch and Toner supply device mismatch". Unlike the above descriptions, when the open and close detection sensor 250 detects opening and closing the cover after all the three parts including the developing devices are correctly exchanged, the controller 300 does not control the control panel 200 to display the warning.

[0043] As described above, the control according to the present embodiment to prevent the color mixture does not need the operation of the control panel 200 at the start of the exchange of the exchange units. The user does not need to input that all exchange units are exchanged after the warning that informs other necessary unit (part) exchange when at least one of the exchange units is exchanged. Accordingly, the present embodiments can reduce the troublesome works to exchange units.

[0044] In the above embodiments, the units of the image forming unit using the spot color toner are exchanged, and the station for the use of the spot color toner is changed. The present disclosure may be applied to exchanging units of the image forming units using general color such as yellow, magenta, cyan, and black and changing the stations for the general color toners. In the above embodiments, the number of the exchange units is 3, but it may be 2 or 4 or more.

[0045] RFID serving as the color data storing means and access terminals serving as the reading means are examples, and various other storage means and reading means may be used. For example, A DIP switch may be used as the color data storing means, or storage means that can optically read the data such as bar code may be used. In this case, the determination circuit 304 in FIG. 4 may process signals from the reading device to determine color.

[0046] In the above embodiments, the present disclosure is applied to a copier. The present disclosure may be applied to a printer. In the above embodiments, a ready state for the image formation means the state in which the control panel of the copier or the printer displays "ready for image formation" or the like, the state in which the printer sends a signal informing that printer can print images to a host device such as a computer coupled to the printer, or the state in which the printer can receive a print instruction.

[0047] The present disclosure has been described as above on the basis of preferred embodiments. The present disclosure is not limited to the description in the above embodiments, and various modifications may be made without departing from the scope and spirit of the present disclosure.

[0048] The following is one of aspects of the present disclosure. The image forming apparatus can simultaneously or selectively include image forming means. The image forming means forms one color image of two or more color images and includes a plurality of exchangeable units. The image forming apparatus includes color data storing means, reading means, detection means, and determination means. The color data storing means is disposed in each of the plurality of units in at least one of image forming means. The reading means reads data stored in the color data storing means. The detection means detects exchange of the plurality of units, removal of the unit from the image forming apparatus, or installation of the unit into the image forming apparatus. The determination means determines whether the data on color of the plurality of units are on a same color based on an output from the reading means when the detection means detects exchange of the plurality of units, removal of the unit from the image forming apparatus, or installation of the unit into the image forming apparatus.

[0049] The following is another aspect of the present disclosure. In addition to the one of aspects described above, the image forming apparatus includes storage means. The storage means stores the data on color of the exchangeable units and a setting portion of the at least one of the two or more image forming means including the exchangeable units before detection of the at least one of the exchange, the removal, and the installation, and image forming conditions on color used by the two or more image forming means. The reading means is disposed at a position corresponding to the setting portion of the at least one of the two or more image forming means including the exchangeable units. After a newly-installed exchangeable unit is installed to the setting portion in the image forming apparatus, the determination means determines whether data on color of the newly-installed exchangeable unit read by the reading means at the position corresponding to the setting portion match the data on color of the exchangeable units and the setting portion stored in the storage means. When the determination means determines that the data on color of the newly-installed exchangeable unit are on the same color and that the data on color of the newly-installed exchangeable unit read by the reading means at the position corresponding to the setting portion do not match the data on color of the exchangeable units and the setting portion stored in the storage means, the determination means changes the image forming conditions stored in the storage means to the image forming conditions corresponding to the data on color of the newly-installed exchangeable unit read by the reading means after the newly-installed exchangeable unit is installed in the image forming

apparatus.

[0050] The following is still another aspect of the present disclosure. In addition to the one of aspects described above, the image forming apparatus includes storage means and control means. The storage means stores the data on color of the exchangeable units and a setting portion of the at least one of the two or more image forming means including the exchangeable units before detection of the at least one of the exchange, the removal, and the installation, and image forming conditions on color used by the two or more image forming means. The control means performs a process control to adjust the image forming conditions. The reading means is disposed at a position corresponding to the setting portion of the at least one of the two or more image forming means including the exchangeable units. After a newly-installed exchangeable unit is installed to the setting portion in the image forming apparatus, the determination means determines whether data on color of the newly-installed exchangeable unit read by the reading means at the position corresponding to the setting portion match the data on color of one of the exchangeable units and the setting portion stored in the storage means. The control means performs the process control when the determination means determines that the data on color of the newly-installed exchangeable units are on the same color and that the data on color of the newly-installed exchangeable unit read by the reading means at the position corresponding to the setting portion do not match the data on color of one of the exchangeable units and the setting portion stored in the storage means.

[0051] The following is still another aspect of the present disclosure. In addition to the one of aspects described above, the image forming apparatus includes storage means. The storage means stores the data on color of the exchangeable units and a setting portion of the at least one of the two or more image forming means including the exchangeable units before detection of the at least one of the exchange, the removal, and the installation. The reading means is disposed at a position corresponding to the setting portion of the at least one of the two or more image forming means including the exchangeable units. After a newly-installed exchangeable unit is installed to the setting portion in the image forming apparatus, the determination means determines whether data on color of the newly-installed exchangeable unit read by the reading means at the position corresponding to the setting portion match the data on color of one of the exchangeable units and the setting portion stored in the storage means. When the determination means determines that the data on color of the newly-installed exchangeable units are on the same color and that the data on color of the newly-installed exchangeable unit read by the reading means at the position corresponding to the setting portion do not match the data on color of one of the exchangeable units and the setting portion stored in the storage means, the determination means stores the data on color of the newly-installed exchangeable unit read by the reading means after the newly-installed exchangeable unit is installed in the image forming apparatus.

[0052] The following is still another aspect of the present disclosure. In addition to the one of aspects described above, the image forming apparatus includes storage means. The storage means stores the data on color of the exchangeable units and a setting portion of the at least one of the two or more image forming means including the exchangeable units before detection of the at least one of the exchange, the removal, and the installation. The reading means is disposed at a position corresponding to the setting portion of at least one of the two or more image forming means including the exchangeable units. After a newly-installed exchangeable unit is installed to the setting portion in the image forming apparatus, the determination means determines whether data on color of the newly-installed exchangeable unit read by the reading means at the position corresponding to the setting portion match the data on color of one of the exchangeable units and the setting portion stored in the storage means. When the determination means determines that the data on color of the newly-installed exchangeable units are on the same color and that the data on color of the newly-installed exchangeable unit read by the reading means at the position corresponding to the setting portion do not match the data on color of the exchangeable units and the setting portion stored in the storage means, the determination means stores the data on color of the newly-installed exchangeable unit read by the reading means in the storage means in association with the setting portion.

[0053] Numerous additional modifications and variations are possible in light of the above teachings. It is therefore to be understood that, within the scope of the above teachings, the present disclosure may be practiced otherwise than as specifically described herein. With some embodiments having thus been described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the scope of the present disclosure and appended claims, and all such modifications are intended to be included within the scope of the present disclosure and appended claims.

Claims

1. An image forming apparatus (100) comprising:

two or more image forming means (101 to 105, 150, and 160) for forming an image with two or more colors;
at least one of the two or more image forming means (101 to 105, 150, and 160) including a plurality of exchangeable units (114, 150, 160), each of the exchangeable units (114, 150, 160) including color data storing

means (114a, 150a, 160a) for storing data on color of each of the exchangeable units (114, 150, 160);
reading means (101a, 101b, 105a, 105b, 141a, 142a) for reading the data on color of each of the exchangeable units (114, 150, 160) stored in the color data storing means (114a, 150a, 160a);
detection means (250) for detecting at least one of exchange of the exchangeable units (114, 150, 160) in the image forming apparatus (100), removal of each of the exchangeable units (114, 150, 160) from the image forming apparatus (100), and installation of each of the exchangeable units (114, 150, 160) into the image forming apparatus (100); and
determination means (300) for determining whether the data on color of the exchangeable units (114, 150, 160) are on a same color based on an output from the reading means (101a, 101b, 105a, 105b, 141a, 142a) when the detection means (250) detects the at least one of the exchange, the removal, and the installation.

2. The image forming apparatus (100) according to claim 1, further comprising control means (300) for setting the image forming apparatus (100) into a ready state for image formation when the determination means (300) determines that the data on color of the exchangeable units (114, 150, 160) are on the same color..

3. The image forming apparatus (100) according to claim 1 or 2, further comprising notification means (200) for notifying an error when the determination means (300) determines that the data on color of the exchangeable units (114, 150, 160) are not on the same color.

4. The image forming apparatus (100) according to claim 2, further comprising notification means (200) for notifying an error when the determination means (300) determines that the data on color of the exchangeable units (114, 150, 160) are not on the same color,
wherein the control means (300) ends a notification of the error and sets the image forming apparatus (100) into the ready state for image formation, after the notification means (200) notifies the error, the detection means (250) detects the at least one of the exchange, the removal, and the installation, and the determination means (300) determines that the data on color of the exchangeable units (114, 150, 160) are on the same color.

5. The image forming apparatus (100) according to any one of claims 1 to 4,
wherein the two or more image forming means (101 to 105, 150, and 160) include first image forming means for forming an image with a first color and second image forming means for forming an image with a second color different from the first color, each of the first image forming means and the second image forming means including the exchangeable units, and
wherein the determination means (300) determines whether the data on color of the exchangeable units (114, 150, 160) of each of the first image forming means and the second image forming means are on the same color.

6. The image forming apparatus (100) according to claim 3,
wherein the two or more image forming means (101 to 105, 150, and 160) include first image forming means for forming an image with a first color and second image forming means for forming an image with a second color different from the first color, each of the first image forming means and the second image forming means including the exchangeable units,
wherein the determination means (300) determines whether the data on color of the exchangeable units (114, 150, 160) of each of the first image forming means and the second image forming means are on the same color, and
wherein the notification means (200) identifies and notifies the image forming means (101 to 105, 150, and 160) that is determined by the determination means (300) that the data on color of the exchangeable units (114, 150, 160) are not on the same color.

7. The image forming apparatus (100) according to any one of claims 1 to 6,
wherein, when the determination means that determines the data on color of the exchangeable units (114, 150, 160) are on a same color and when the same color is different from a color before the exchange in a setting portion of the image forming means (101 to 105, 150, and 160) subjected to the exchange, the removal, or the installation, an image forming condition is changed based on the data on color.

8. The image forming apparatus (100) according to claim 5,
wherein, when the determination means (300) determines that the data on color of the exchangeable units (114, 150, 160) of the at least one of the two or more image forming means (101 to 105, 150, and 160) are on the same color and when a setting portion of the at least one of the two or more image forming means (101 to 105, 150, and 160) is changed, the determination means (300) changes image forming conditions of the at least one of the two or more image forming means (101 to 105, 150, and 160) based on the changed setting portion.

9. The image forming apparatus (100) according to any one of claims 1 to 8,
wherein, in a case in which the determination means determines that the data on color of the exchangeable units (114, 150, 160) are on a same color, when the same color is different from a color before one of the exchange, the removal, and the installation in a setting portion of the image forming means (101 to 105, 150, and 160) subjected to the exchange or when the setting portion in the image forming apparatus (100) is changed, a test pattern is formed and detected and an adjustment of image forming conditions is performed.

10. The image forming apparatus (100) according to any one of claims 1 to 8,
wherein, when the determination means determines that the data on color of the exchangeable units (114, 150, 160) are on a same color and when the same color is different from a color before at least one of the exchange, the removal, and the installation in a setting portion of the image forming means (101 to 105, 150, and 160) subjected to the exchange, storage means (302) stores a newest color.

11. The image forming apparatus (100) according to any one of claims 1 to 8,
wherein, when the determination means determines that the data on color of the exchangeable units (114, 150, 160) are on a same color and when a setting portion of the image forming means (101 to 105, 150, and 160) subjected to the exchange is changed, storage means (302) stores a newest setting portion.

FIG. 1

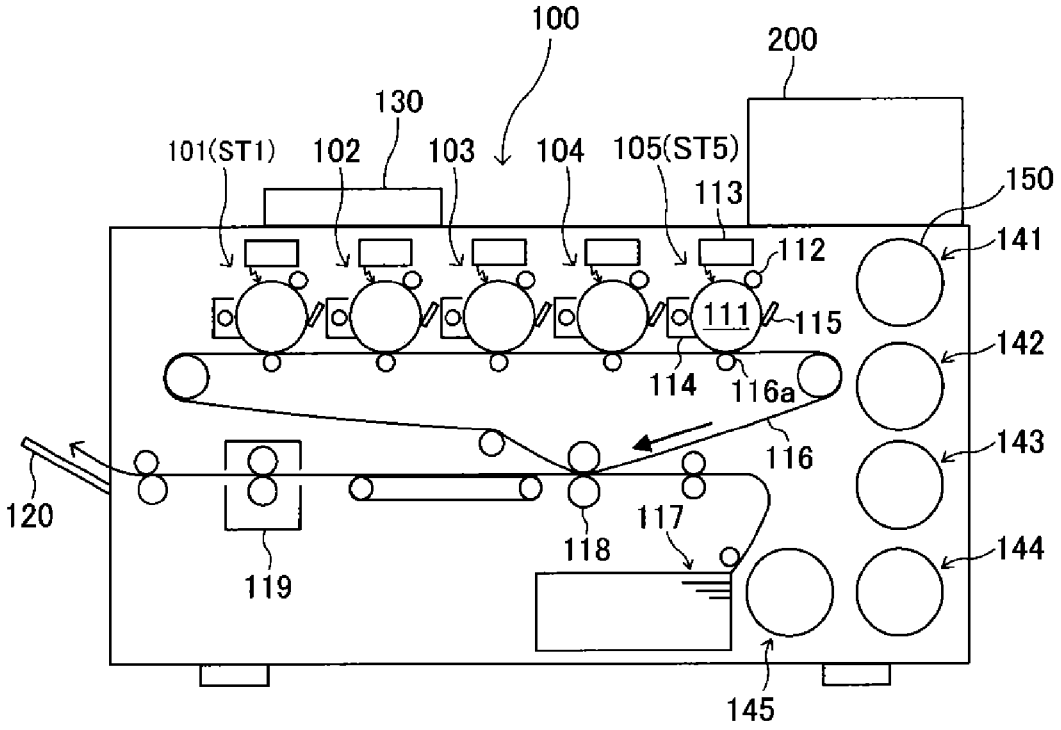

100
200
130
101(ST1)
102
103
104
105(ST5)
113
150
141
112
111
115
142
114
116a
116
143
120
117
118
144
119
145

FIG. 2

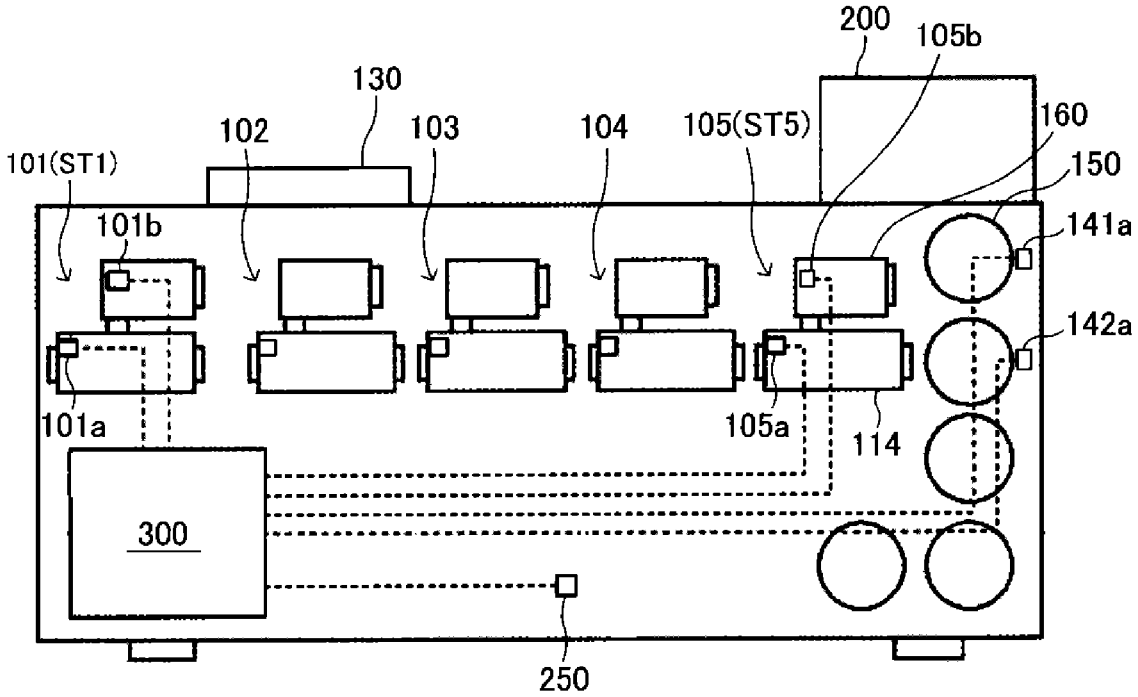

200
105b
130
160
102
103
104
105(ST5)
150
101(ST1)
101b
141a
142a
101a
105a
114
300
250

FIG. 3A

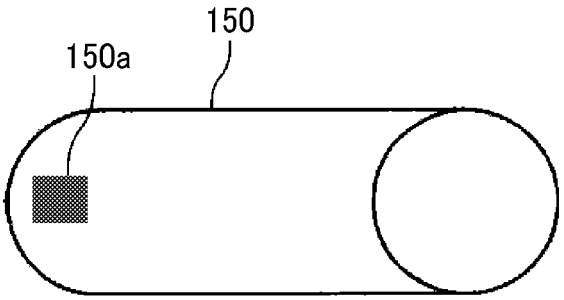


FIG. 3B

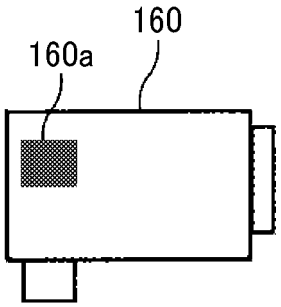


FIG. 3C

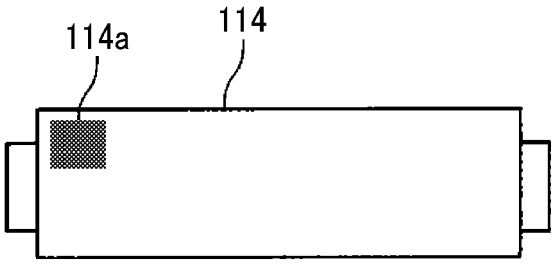
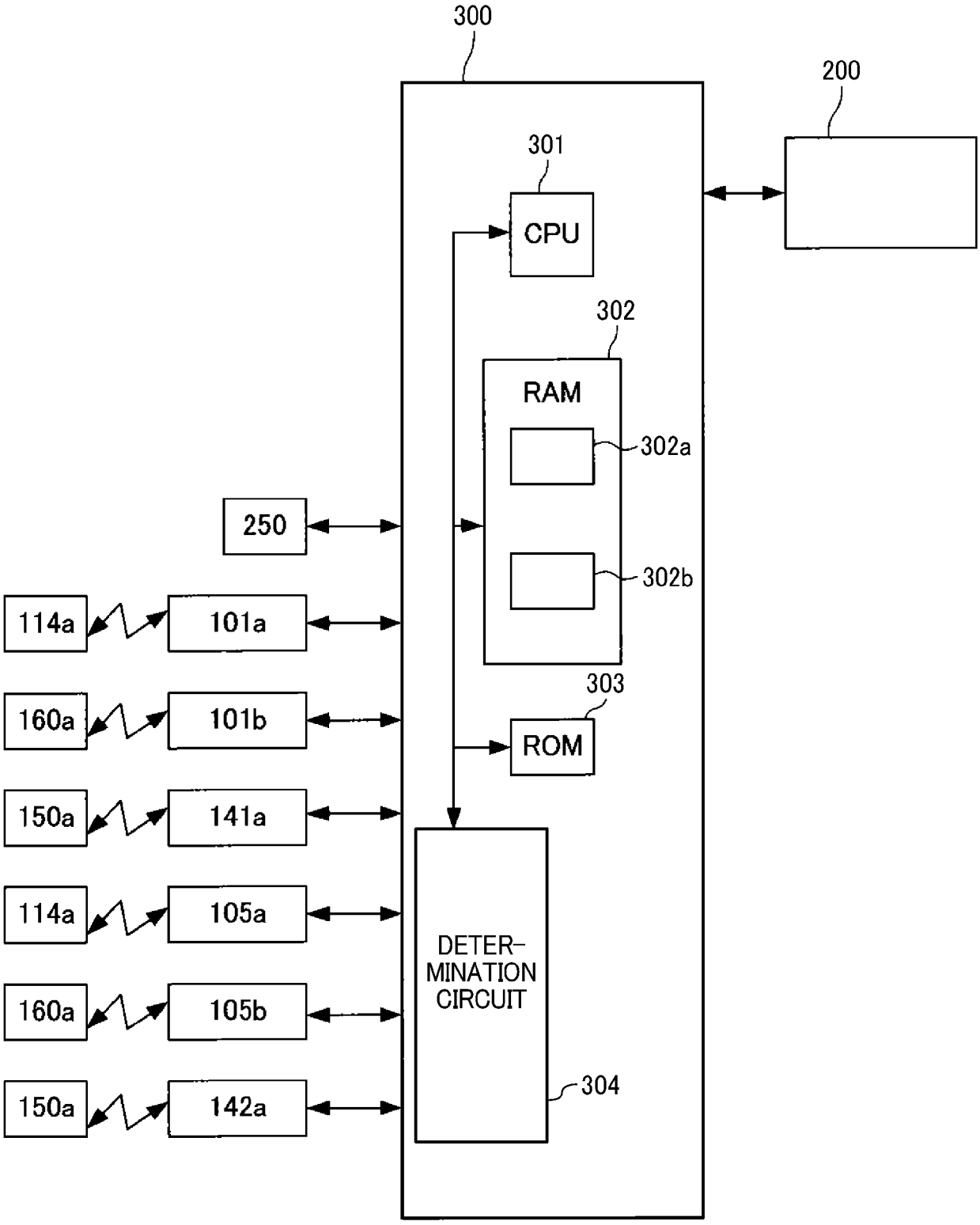


FIG. 4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200
301
CPU
302
RAM
302a
302b
303
ROM
250
114a
101a
160a
101b
150a
141a
114a
105a
160a
105b
150a
142a
DETER-
MINATION
CIRCUIT
304

FIG. 5

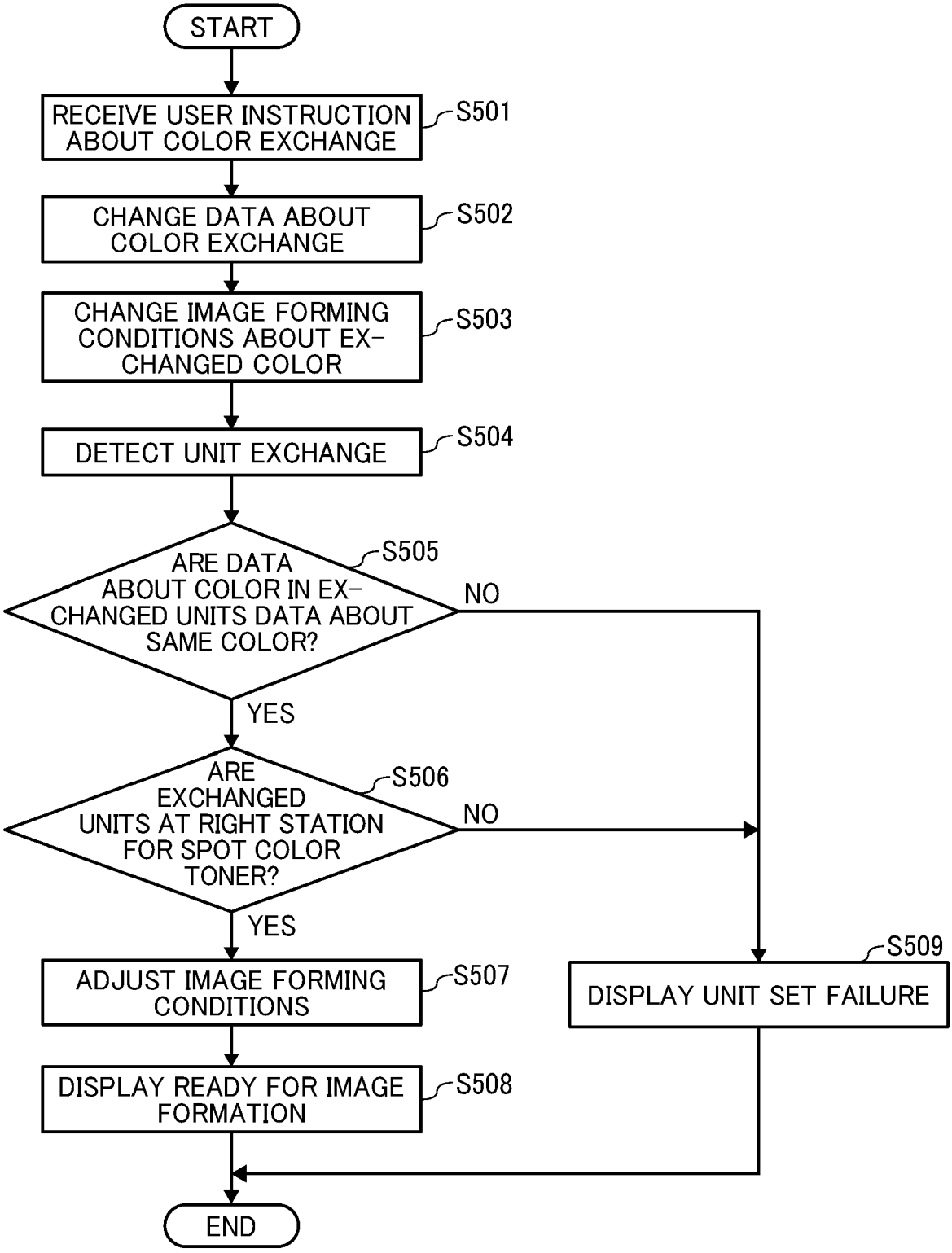

START
RECEIVE USER INSTRUCTION ABOUT COLOR EXCHANGE
S501
CHANGE DATA ABOUT COLOR EXCHANGE
S502
CHANGE IMAGE FORMING CONDITIONS ABOUT EX-CHANGED COLOR
S503
DETECT UNIT EXCHANGE
S504
ARE DATA ABOUT COLOR IN EX-CHANGED UNITS DATA ABOUT SAME COLOR?
S505
NO
YES
ARE EXCHANGED UNITS AT RIGHT STATION FOR SPOT COLOR TONER?
S506
NO
YES
ADJUST IMAGE FORMING CONDITIONS
S507
DISPLAY READY FOR IMAGE FORMATION
S508
DISPLAY UNIT SET FAILURE
S509
END

FIG. 6

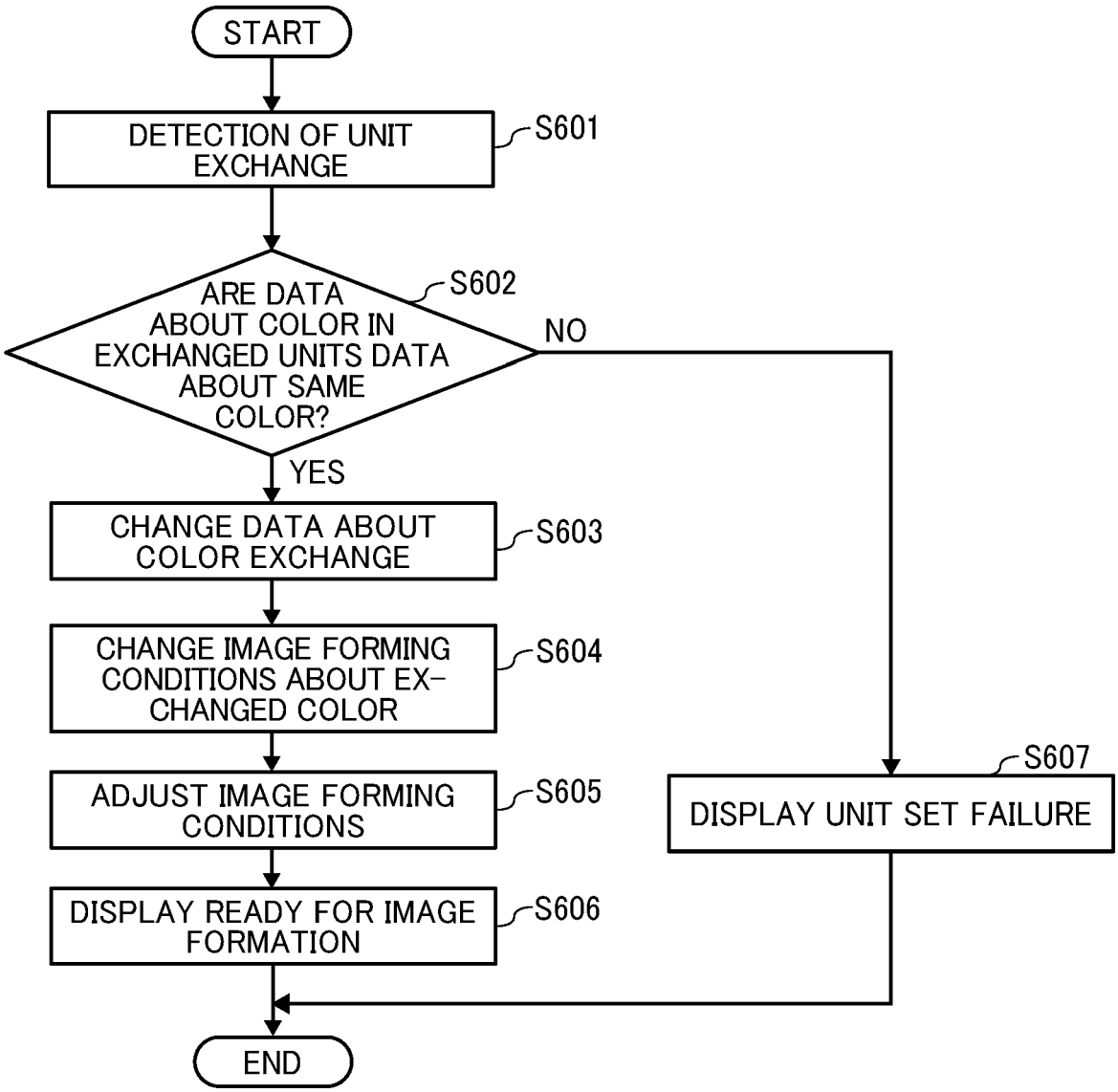
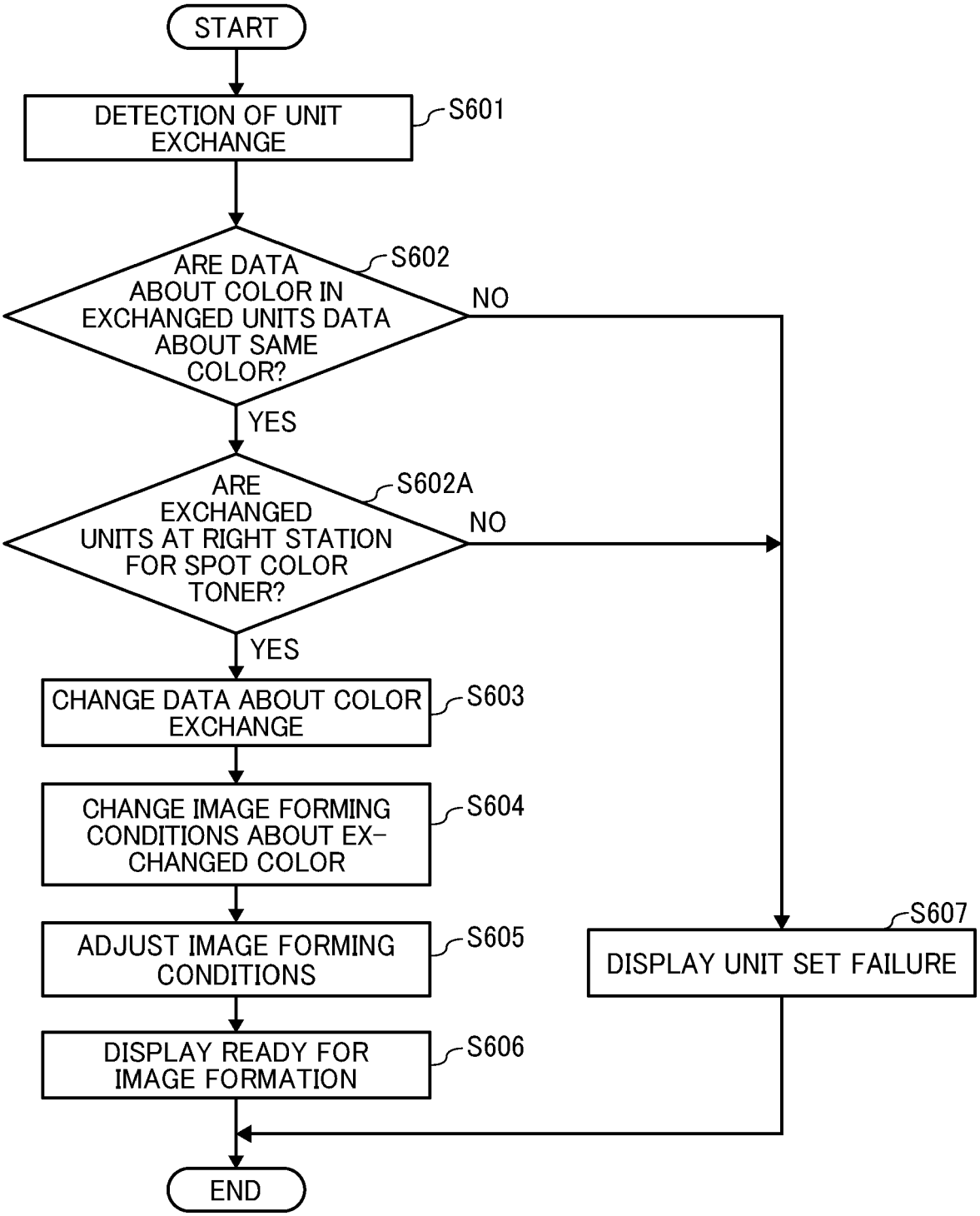

START
DETECTION OF UNIT EXCHANGE
S601
ARE DATA ABOUT COLOR IN EXCHANGED UNITS DATA ABOUT SAME COLOR?
S602
NO
YES
CHANGE DATA ABOUT COLOR EXCHANGE
S603
CHANGE IMAGE FORMING CONDITIONS ABOUT EX-CHANGED COLOR
S604
ADJUST IMAGE FORMING CONDITIONS
S605
DISPLAY READY FOR IMAGE FORMATION
S606
DISPLAY UNIT SET FAILURE
S607
END

FIG. 7


START
DETECTION OF UNIT EXCHANGE
S601
ARE DATA ABOUT COLOR IN EXCHANGED UNITS DATA ABOUT SAME COLOR?
S602
NO
YES
ARE EXCHANGED UNITS AT RIGHT STATION FOR SPOT COLOR TONER?
S602A
NO
YES
CHANGE DATA ABOUT COLOR EXCHANGE
S603
CHANGE IMAGE FORMING CONDITIONS ABOUT EXCHANGED COLOR
S604
ADJUST IMAGE FORMING CONDITIONS
S605
DISPLAY READY FOR IMAGE FORMATION
S606
DISPLAY UNIT SET FAILURE
S607
END

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EUROPEAN SEARCH REPORT

Application Number
EP 20 20 8869

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