(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 461 216 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.06.2012 Bulletin 2012/23

(51) Int Cl.:
G03G 15/00 *(2006.01)*

(21) Application number: **11192190.4**

(22) Date of filing: **06.12.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: **06.12.2010 JP 2010271430**
29.11.2011 JP 2011260596

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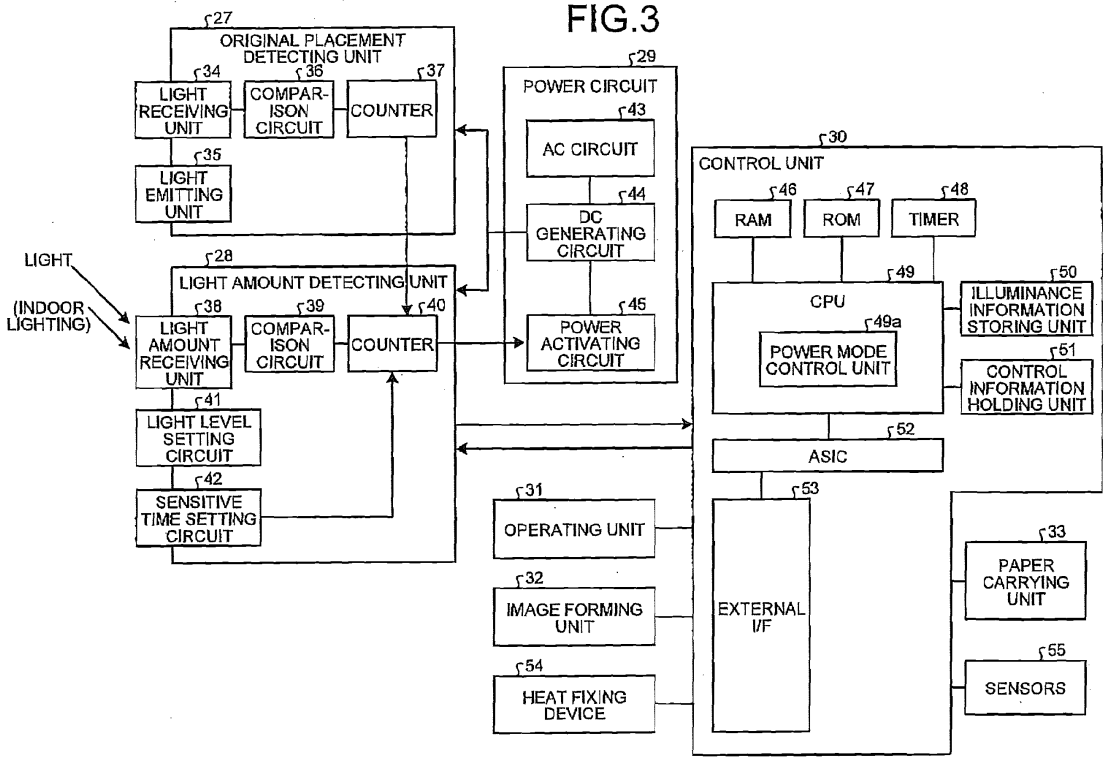
(54) Image Forming Apparatus, Image Forming Method, and Computer Program

(57) An image forming apparatus includes an illuminance detecting unit (28) that detects illuminance on the image forming apparatus in which the illuminance detecting unit (28) is installed; an original detecting unit (27) that detects whether or not a target original for image formation is placed in the image forming apparatus; and a power mode control unit (49a) that performs control regarding a normal power mode/a power saving mode based on an amount of change in the illuminance detected by the illuminance detecting unit (28), based on information detected by the original detecting unit (27) regarding whether or not an original is placed, and based on an operating condition of the image forming apparatus.

FIG.3



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Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to and incorporates by reference the entire contents of Japanese Patent Application No. 2010-271430 filed in Japan on December 6, 2010 and Japanese Patent Application No. 2011-260596 filed in Japan on November 29, 2011.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to an image forming apparatus, an image forming method, and a computer program.

2. Description of the Related Art

[0003] In an electrophotographic image forming apparatus, the power is supplied to a fixing heater even when the image forming apparatus is not in operation (is in an idle state). A technology is known for reducing the power consumption during such an idle state. According to that technology, an illuminance sensor detects the external illuminance and, when the external illuminance decreases, the apparatus automatically switches to a power saving mode in which the power supply to the fixing heater is stopped.

[0004] For example, Japanese Patent Application Laid-open No. 2005-088521 discloses an image forming apparatus that is aimed at saving on electricity that might be unnecessarily consumed. The image forming apparatus includes an image forming unit for forming images on a recording medium, a power circuit for supplying power to the image forming unit, and a light amount detecting unit that detects the external amount of light and accordingly sends a light reception signal to the power circuit. Based on the light reception signal output by the light amount detecting unit, the power circuit either supplies the power to the image forming unit, or disconnects the power supply to the image forming unit, or waits for a period before supplying the power to the image forming unit. Thus, the image forming apparatus disclosed in Japanese Patent Application Laid-open No. 2005-088521 is configured to perform control on supplying the power or disconnecting the power supply depending on the amount of light. Hence, power saving is expected to be achieved for certain, which in turn enables the user to save on the running cost.

[0005] However, in the image forming apparatus disclosed in Japanese Patent Application Laid-open No. 2DD5-088521, power saving control is performed only depending on the illuminance of the surrounding environment in which the image forming apparatus is installed. That is, in an image forming apparatus such as a multifunction peripheral, power saving control is performed not by taking into account whether or not an original is placed or by taking into account the operating conditions/performance of the image forming apparatus.

[0006] The present invention has been made in view of the above-mentioned issues and it is an object of the present invention to provide an image forming apparatus that is not only configured to perform power saving control depending on the external illuminance detected by an illuminance sensor but also configured to perform precise power saving control by taking into account various operating conditions of the image forming apparatus.

SUMMARY OF THE INVENTION

[0007] An image forming apparatus includes an illuminance detecting unit that detects illuminance on the image forming apparatus in which the illuminance detecting unit is installed; an original detecting unit that detects whether or not a target original for image formation is placed in the image forming apparatus; and a power mode control unit that performs control regarding a normal power mode/a power saving mode based on an amount of change in the illuminance detected by the illuminance detecting unit, based on information detected by the original detecting unit regarding whether or not an original is placed, and based on an operating condition of the image forming apparatus.

[0008] An image forming method is implemented in an image forming apparatus that includes an illuminance detecting unit that detects illuminance on the image forming apparatus in which the illuminance detecting unit is installed; and an original detecting unit that detects whether or not a target original for image formation is placed in the image forming apparatus. The image forming method includes performing control regarding a normal power mode/a power saving mode based on an amount of change in the illuminance detected by the illuminance detecting unit, based on information detected by the original detecting unit regarding whether or not an original is placed, and based on an operating condition of the image forming apparatus.

[0009] A computer program is implemented in a computer including an illuminance detecting unit that detects illuminance on the image forming apparatus in which the illuminance detecting unit is installed; and an original detecting unit that detects whether or not a target original for image formation is placed in the image forming apparatus. The computer program causes the computer to execute performing control regarding a normal power mode/a power saving mode based on an amount of change in the illuminance detected by the illuminance detecting unit (28), based on information detected by the original detecting unit (27) regarding whether or not an original is placed, and based on an operating condition of the image forming apparatus.

[0010] The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following

detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is an explanatory diagram for explaining an overall configuration of an image forming apparatus according to an embodiment of the present invention;

Fig. 2 is an explanatory diagram for explaining an internal configuration of a light exposing unit in the image forming apparatus according to the embodiment;

Fig. 3 is a block diagram of a functional configuration of the image forming apparatus according to the embodiment;

Fig. 4 is an explanatory diagram for explaining a configuration of an automatic document feeder (ADF) and an exemplary arrangement of an illuminance sensor according to the embodiment;

Fig. 5 is an explanatory diagram for explaining patterns of the detection level as detected by the illuminance sensor according to the embodiment;

Fig. 6 is an explanatory diagram for explaining the power ON/OFF control performed based on the detection level as detected by the illuminance sensor according to the embodiment;

Fig. 7 is a flowchart for explaining the control operation performed in the image forming apparatus according to the embodiment; and

Fig. 8 is a flowchart for explaining the control operation performed based on illuminance information detected by the illuminance sensor of the image forming apparatus according to the embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] An exemplary embodiment of an image forming apparatus, an image forming method, and a computer program according to the present invention is described in detail below with reference to the accompanying drawings.

[0013] The present invention relates to an image forming apparatus that is configured to switch to a power saving mode depending on the external illuminance detected by an illuminance sensor. The image forming apparatus has the following features. The illuminance sensor doubles as a power ON/OFF switch of the image forming apparatus. Depending on the amount of light detected by the illuminance sensor, the image forming apparatus determines whether the user has performed a power ON/OFF operation, or whether the surrounding illuminance has changed, or whether an original has been set. According to each case, the image forming apparatus performs power ON/OFF switching and switches to the power saving mode. The exemplary embodiment according to the present invention is described below with reference to the accompanying drawings.

[0014] Fig. 1 is an explanatory diagram for explaining an overall configuration of an image forming apparatus according to the present embodiment. As illustrated in Fig. 1, the image forming apparatus according to the present embodiment is what is called a tandem-type image forming apparatus in which image forming units of all four colors are arranged along a carrying belt, which is an endless moving member. More particularly, a carrying belt 4 carries paper sheets 3 (recording paper sheets) that are fed from a paper feeding tray 1 by a paper feeding roller 2. A plurality of image forming units (electrophotographic processing units) 5BK, 5M, 5C, and 5Y are arranged along the carrying belt 4 and arranged in that order from the upstream side of the direction of movement of the carrying belt 4. The image forming units 5BK, 5M, 5C, and 5Y have a common internal structure, except the fact that each forming unit forms toner images of a different color. The image forming unit 5BK forms black toner images, the image forming unit 5M forms magenta toner images, the image forming unit 5C forms cyan toner images, and the image forming unit 5Y forms yellow toner images.

[0015] Given below is the explanation in concrete terms about the image forming unit 5BK. Herein, since the image forming units 5M, 5C, and 5Y have an identical configuration to the configuration of the image forming unit 5BK, the explanation is not repeated regarding the image forming units 5M, 5C, and 5Y. Instead, regarding the image forming units 5M, 5C, and 5Y, reference numerals differentiated by M, C, and Y, respectively, are illustrated in the drawings in place of the reference numerals assigned to the constituent elements of the image forming unit 5BK.

[0016] The carrying belt 4 is an endless belt stretched around a driving roller 7 that is rotary-driven and around a driven roller 8. The driving roller 7 is rotary-driven by a driving motor (not illustrated). Herein, the driving motor, the driving roller 7, and the driven roller 8 function as a driving unit for moving the carrying belt 4 serving as an endless moving member.

[0017] At the time of performing an image forming operation, the paper sheets 3 that are stacked in the paper feeding tray 1 are fed one by one starting from the topmost paper sheet 3. The paper sheet 3 that has been fed gets adsorbed to the carrying belt 4 by means of electrostatic adsorption. Then, as the carrying belt 4 is rotary-driven, the paper sheet 3 is carried to the image forming unit 5BK. Thereat, a black toner image is transferred onto the paper sheet 3.

[0018] The image forming unit 5BK is configured with a photosensitive drum 9BK functioning as a photosensitive member, and is configured with a charger 10BK, a light exposing unit 11, a developer 12BK, a photosensitive member cleaner (not illustrated) and a static elimi-

nator 13BK that are disposed around the photosensitive drum 9BK. The light exposing unit 11 is configured to emit laser beams 14BK, 14M, 14C, and 14Y as light exposing beams corresponding to the image colors formed in the image forming units 5BK, 5M, 5C, and 5Y, respectively.

[0019] Fig. 2 is an explanatory diagram for explaining an internal configuration of the light exposing unit 11. Herein, laser diodes 24BK, 24M, 24C, and 24Y respectively emit the laser beams 14BK, 14M, 14C, and 14Y that serve as the light exposing beams corresponding to the image colors. The emitted laser beams 14BK, 14M, 14C, and 14Y fall upon a reflecting mirror 23 and are reflected to optical systems 25BK, 25M, 25C, and 25Y, respectively, for optical path adjustment. Then, the laser beams 14BK, 14M, 14C, and 14Y are scanned on the surfaces of photosensitive drums 9BK, 9M, 9C, and 9Y, respectively. The reflecting mirror 23 is a hexahedral polygon mirror. When the reflecting mirror 23 rotates, a light exposing beam corresponding to a single line in the main scanning direction can be scanned per polygon mirror face. For four laser diodes serving as light sources, a single polygon mirror is used for scanning. From among the laser beams 14BK, 14M, 14C, and 14Y; the light exposing beams of two colors are scanned on a single reflecting face of the polygon mirror, while the light exposing beams of the remaining two colors are scanned on the opposite reflecting face of the polygon mirror. As a result, the four photosensitive drums can be exposed to light at the same time. Each optical system 25 includes an f-θ lens and a deflecting mirror for deflecting the laser light.

[0020] A synchronization detecting sensor 26 is disposed outside the image area in the main scanning direction. After each line is scanned, the synchronization detecting sensor 26 detects the laser beams 14BK and 14Y, and adjusts the exposure start timing during image formation. Since the synchronization detecting sensor 26 is disposed on the side of the optical system 25BK, the laser beam 14Y falls on the synchronization detecting sensor 26 via folding mirrors 25Y_1, 25Y_D2, and 25Y_D3. The laser beams 14M and 14C cannot be subjected to write timing adjustment by the synchronization detecting sensor. Hence, the exposure start timing for the magenta color is matched to the exposure start timing for the black color; while the exposure start timing for the cyan color is matched to the exposure start timing for the yellow color. In this way, the image positions corresponding to all colors are aligned.

[0021] During an image forming operation, the outer surface of the photosensitive drum 9BK zs uniformly charged in the dark by the charger 10BK and is then exposed to light by the laser beam 14BK that is emitted corresponding to black images by the light exposing unit 11. As a result, an electrostatic latent image is formed on the surface of the photosensitive drum 9BK. Subsequently, the developer 12BK develops that electrostatic latent image into a visible image using the black toner. Thus, a black toner image is formed on the surface of the photosensitive drum 9BK.

[0022] At the position where the photosensitive drum 9BK abuts against the paper sheet 3 carried by the carrying belt 4 (i.e., at a transfer position), a transfer member 15BK transfers the black toner image onto the paper sheet 3. Consequently, an image in the black toner is formed on the paper sheet 3. Once the toner image is transferred, the photosensitive member cleaner (not illustrated) cleans the unnecessary residual toner from the outer surface of the photosensitive drum 9BK and the static eliminator 13BK removes electricity from the photosensitive drum 9BK. With that, the photosensitive drum 9BK becomes ready for the subsequent image forming operation.

[0023] With the black toner image transferred thereon at the image forming unit 5BK, the paper sheet 3 is carried by the carrying belt 4 to the next image forming unit 5M. Then, in an identical manner to the image forming process performed at the image forming unit 5BK, a magenta toner image is formed on the photosensitive drum 9M in the image forming unit 5M. The magenta toner image is transferred onto the paper sheet 3 and is superimposed on the black toner image that has already been transferred.

[0024] The paper sheet 3 is then carried to the image forming units 5C and 5Y in that order. In an identical manner as described above, a cyan toner image formed on the photosensitive drum 9C and a yellow toner image formed on the photosensitive drum 9Y are sequentially transferred onto the paper sheet 3 and are superimposed on the toner images that have already been transferred. As a result, a full-color toner image is formed on the paper sheet 3. Subsequently, the paper sheet 3 having the full-color superimposed image formed thereon is separated from the carrying belt 4. Then, the full-color image is fixed by a fixing unit 16 and the paper sheet 3 is discharged to the outside of the image forming apparatus. A discharging sensor 6 is disposed to check whether the paper sheet 3 is discharge normally to the outside.

[0025] Fig. 3 is a block diagram of a functional configuration of the image forming apparatus according to the present embodiment. As illustrated in Fig. 3, the image forming apparatus according to the present embodiment includes an operating unit 31; a power circuit 29; a control unit 30; an image forming unit 32; a paper carrying unit 33; a light amount detecting unit 28; an original placement detecting unit 27; a heat fixing device 54 that has, for example, fixing roller with a built-in heater; and sensors 55, such as a carrying sensor, that are necessary in controlling the image forming apparatus.

[0026] The operating unit 31 includes various display modules for notifying the user of various functions of the image forming apparatus and includes functional switches for enabling the user to execute those functions.

[0027] The power circuit 29 includes an alternating-current (AC) circuit 43 that receives input of AC power; a direct-current (DC) generating circuit 44 that generates DC power from the AC input; and a power activating cir-

cuit 45, that supplies the power to the control unit 30 or disconnects the power supply to the control unit 30 in response to a trigger signal received from an external circuit. Besides, the power activating circuit 45 also inputs a power saving mode trigger signal to the control unit 30.

[0028] The control unit 30 includes a read only memory (ROM) 47 that is used to store various computer programs; a central processing unit (CPU) 49 that executes the computer programs stored in the ROM 47; a random access memory (RAM) 46 that is used to store data on a temporary basis; an application specific integrated circuit (ASIC) 52 that generates signals required by a timer 48, the operating unit 31, the image forming unit 32, the paper carrying unit 33, the heat fixing device 54, the sensors 55, and the CPU 49; and an external interface (I/F) 53 that serves as an input-output unit among the operating unit 31, the image forming unit 32, the paper carrying unit 33, the sensors 55, and the CPU 49. Besides, the control unit 30 has the function of outputting an image-forming-apparatus condition signal to the light amount detecting unit 28. The image-forming-apparatus condition signal indicates the condition, such as the idle state or the printing state, of the image forming apparatus at that point of time. In the control unit 30, the ROM 47 stores therein a computer program that implements the functions of a power mode control unit 49a, which performs power saving mode control in response to receiving the power saving mode trigger signal from the power circuit 29. For example, power saving mode control points to a reduction in the fixing temperature of the heat fixing device 54 to a temperature lower than in the idle state. Meanwhile, it is the CPU 49 that has the functions of the power mode control unit 49a. The control unit 30 also includes an illuminance information storing unit 50 and a control information holding unit 51 in a memory. The illuminance information storing unit 50 is used to store, at predetermined intervals, the illuminance detected by the light amount detecting unit 28 (detected by an illuminance sensor 20). The control information holding unit 51 holds control information in which the patterns of a change in the illuminance are specified in a corresponding manner to the power saving control methods. Meanwhile, the control unit 30 has an interval setting function for setting an arbitrary interval at which the illuminance detected by the light amount detecting unit 28 (detected by the illuminance sensor 20) is stored in the illuminance information storing unit 50.

[0029] The image forming unit 32 includes electrophotographic-process-based units and has a means for forming images. The paper carrying unit 33 has a means for feeding paper sheets from a tray and carrying those paper sheets to the outside of the image forming apparatus.

[0030] The light amount detecting unit 28 includes a light amount receiving unit 38 that detects the illuminance on the outside of the image forming apparatus; includes a comparison circuit 39 that performs an output to a counter 40; includes the counter 40 that outputs a trigger signal for turning ON or turning OFF the power circuit 29 based on the output from the comparison circuit 39, from a sensitive time setting circuit 42, and from an external circuit; includes a light level setting circuit 41 that sets a threshold value of the comparison circuit 39; and includes the sensitive time setting circuit 42 that sets the timing of outputting the trigger signal for turning ON or turning OFF the power circuit 29. The light amount detecting unit 28 corresponds to the illuminance sensor 20 (see Fig. 4) described later. The counter 40 holds a different counter value depending on whether or not a signal is received from the original placement detecting unit 27. When a signal is received from the original placement detecting unit 27, it is desirable to have a small counter value; and when no signal is received from the original placement detecting unit 27, it is desirable to have a large counter value. In other words, a signal is received from the original placement detecting unit 27 when the user performs power ON/OFF switching or switches the image forming apparatus to the power saving mode. Thus, it is desirable to have the counter value of about one to two seconds. On the other hand, no signal is received from the original placement detecting unit 27 when the image forming apparatus automatically performs power ON/OFF switching or automatically switches to the power saving mode according to the external illuminance changes. Thus, it is desirable to have the counter value of about one minute so that the image forming apparatus is prevented from switching the status thereof when the external illuminance changes in a short time. Meanwhile, the counter 40 can be configured to have a switch or a dial to allow the user to change the counter value.

[0031] The original placement detecting unit 27 includes a light emitting unit 35 that emits an infrared light to detect whether or not an original has been placed on a platen 18 of an automatic document feeder (ADF) 17 (see Fig. 4); includes a light receiving unit 34 that receives the light emitted by the light emitting unit 35; and a comparison circuit 36 that performs output to a counter 37. When an original is placed, the light emitted by the light emitting unit 35 is blocked by the original and a detection signal indicating "original placed" is output. On the other hand, when no original is placed, the light emitted by the light emitting unit 35 falls on the light receiving unit 34 and "original not placed" is detected. Meanwhile, in the present embodiment, although an optical scheme is implemented to detect whether or not an original is placed, such detection can also be performed using, for example, a mechanical switch using filler.

[0032] Fig. 4 is an explanatory diagram for explaining a configuration of the ADF 17 and an exemplary arrangement of the illuminance sensor 20 according to the present embodiment. The illuminance sensor 20 according to the present embodiment is disposed inside the ADF 17, which includes the platen 18, feeding rollers 19, a feeding belt 21, and discharging rollers 22. On the platen 18, a set of originals is placed with the image forming faces of the originals facing upward. When a start key on the operating unit 31 is pressed, the feeding rollers 19

and the feeding belt 21 feed the originals one by one, starting from the topmost original, to a predetermined position on a contact glass. Then, upon being read on the contact glass, each original is discharged via the feeding belt 21 and the discharging rollers 22. Herein, the feeding rollers 19, the feeding belt 21, and the discharging rollers 22 are driven by a carrying motor (not illustrated). In this way, in the ADF 17, the originals placed on the platen 18 are carried one by one on the contact glass and are subjected to optical image reading before being discharged via the feeding roller 21 and the discharging rollers 22. Meanwhile, the ADF 17 includes a mechanism (not illustrated) that enables opening of the ADF 17 from the contact glass. With that, the user becomes able to place an original on the contact glass (manual operation) for reading.

[0033] In the image forming apparatus, the outer packaging of the illuminance sensor 20 in the vicinity of the light receiving portion is made of a transparent material that allows transmission of light. Because of that, the illuminance sensor 20 can measure the amount of light on the outside of the image forming apparatus. The illuminance sensor 20 is installed at the position of setting the originals (i.e., installed at the position of placing the originals on the platen 18 (and can be installed on the side of the original placing face or on the side of the rear face)) and is configured to detect whether or not an original is placed and to detect the illuminance surrounding the image forming apparatus. Moreover, the illuminance sensor 20 doubles as a power ON/OFF switch. Thus, when the user presses a button provided on the illuminance sensor 20, the power of the image forming apparatus is turned ON or turned OFF.

[0034] Fig. 5 is an explanatory diagram for explaining patterns of the detection level as detected by the illuminance sensor 20 according to the present embodiment. In Fig. 5, (a) and (b) illustrate a change in the detection level after an original is placed and after an original is removed, respectively. When an original is placed, the illuminance sensor 20 detects the minimum level of illuminance (darkness); while when the original is removed and no other original is placed, the illuminance sensor 20 detects the indoor illuminance. In Fig. 5, (c) illustrates a change in the detection level when the power is turned ON or turned OFF. In the case when the power is turned ON or turned OFF, due to the action of the button, there exists a period when the minimum level of illuminance (darkness) is detected. That is, when the user presses the button provided on the illuminance sensor 20, the light is blocked by the user's finger thereby leading to the detection of the minimum level of illuminance. Once the user moves the finger away from the button on the illuminance sensor 20, the surrounding illuminance is detected. In Fig. 5, (d) and (e) illustrate changes in the detection level of the surrounding illuminance of the image forming apparatus (when no original is placed). The detection level of the surrounding illuminance of the image forming apparatus undergoes a modest change.

[0035] Fig. 6 is an explanatory diagram for explaining the power ON/OFF control performed based on the detection level as detected by the illuminance sensor 20 according to this embodiment. Herein, it is the original placement detecting unit 27 that detects whether or not an original is placed. When the image forming apparatus is in operation or when a panel of the operation unit 31 is operated, the power mode control unit 49a does not switch to the power saving mode or does not perform power ON/OFF switching even if there is a change in the detection level ("no change in power mode, original placed/original not placed" in (A) in Fig. 6). When the detection level decreases for a certain period of time, the power mode control unit 49a determines that the user has pressed a power button and then performs power ON/OFF switching according to the user operation ("power-ON by user intention/power-OFF by user intention, original placed/original not placed" in (B) and (C) in Fig. 6).

[0036] In contrast, when the image forming apparatus is not in operation for a certain period of time as well as when the panel of the operating unit 31 is not operated for that period of time, the power mode control unit 49a switches to the power saving mode and turns OFF the power ("power-OFF according to change in surrounding illuminance, original place/original not placed" in (D) in Fig. 6). Moreover, when the detection level detected by the illuminance sensor increases to or exceeds a certain level, the power mode control unit 49a switches back to the normal mode from the power saving mode and turns ON the power ("power-ON according to change in surrounding illuminance" in (E) in Fig. 6). Meanwhile, in (E) in Fig. 6, "x" is set corresponding to "power ON according to change in surrounding illuminance, original placed". That is because, when an original is placed on the platen 18, the detection level detected by the illuminance sensor 20 does not change even if the surrounding illuminance increases. Hence, the power cannot be turned ON based on that detection level. In this way, when the image forming apparatus is in operation or when a user operation of the panel is received, the power mode control unit 49a does not perform power saving mode control. On the other hand, when the image forming apparatus is not in operation and when a user operation of the panel is received, the power mode control unit 49a performs power saving mode control.

[0037] Fig. 7 is a flowchart for explaining the control operation performed in the image forming apparatus according to the present embodiment. Firstly, the power mode control unit 49a determines whether or not timer flow has occurred, that is, whether or not a certain period of time has elapsed (Step S11). If timer flow is determined to have occurred (YES at Step S11), then the power mode control unit 49a performs control based on the illuminance information detected by the illuminance sensor 20 (Step S12). Subsequently, the power mode control unit 49a performs other types of control (Step S13). When all types of control are executed, the power mode control

unit 49a resets the timer 48 (Step S14) and then counts up the timer 48 (Step S15). Meanwhile, if timer flow is not determined to have occurred (NO at Step S11), the power mode control unit 49a continues with counting up the timer 48 (Step S15). In the explanation of the flowchart given above, it is possible to shuffle the sequence of performing the control based on the illuminance information detected by the illuminance sensor 20 and performing the other types of control.

[0038] Fig. 8 is a flowchart for explaining the control operation performed based on the illuminance information detected by the illuminance sensor 20 of the image forming apparatus according to the present embodiment. Firstly, the power mode control unit 49a monitors the operating condition of the image forming apparatus and monitors the operating condition of the panel of the operating unit 31 (Step S21). If it is determined that the image forming apparatus is not in operation and that the panel of the operating unit 31 is not operated (NO at Step S21), the power mode control unit 49a continues with recording the detection level detected by the illuminance sensor 20 in the illuminance information storing unit 50 (Step S22). Herein, in the illuminance information storing unit 50 in a memory, the detection level detected by the illuminance sensor 20 is stored at predetermined intervals along with the history (of detection levels).

[0039] Then, the power mode control unit 49a checks whether or not the detection level, recorded in the illuminance' information storing unit 50, matches with the illuminance level patterns, held by the control information holding unit 51 (Step S23). Subsequently, if the recorded detection level is matching with any of the illuminance level patterns (YES at Step S23), the power mode control unit 49a performs power ON/OFF switching based on the specifications determined on a pattern-by-pattern basis (Step S24). In the control information holding unit 51, the patterns of a change in the illuminance are specified in a corresponding manner to the operations to be controlled (power ON/OFF operations). Thus, the power mode control unit 49a performs pattern matching by referring to the history information of detection levels recorded in the control information holding unit 51 and, if the corresponding pattern is found, performs the operation associated with that pattern.

[0040] On the other hand, if at least the image forming apparatus is in operation or at least the panel of the operating unit 31 is operated (YES at Step S21), then the power mode control unit 49a clears the record of detection levels detected by the illuminance sensor 20 (Step S25).

[0041] Hence, according to the present embodiment, in the image forming apparatus that performs power saving control on the basis of the illuminance detected by the illuminance sensor 20, precise power saving control can be performed by taking into account various operating conditions of the image forming apparatus. That is, precise power saving control can be performed by taking into account the information on whether or not an original is placed for image formation as detected by the original placement detecting unit 27, by taking into account the amount of change in illuminance as detected by the light amount detecting unit 28, and by taking into account the operating conditions of the image forming apparatus.

[0042] In the embodiment, the control flow of the illuminance sensor 20 illustrated in Fig. 8 is achieved using the hardware such as various circuits inside the light amount detecting unit 28. However, alternatively, the control flow can also be achieved using software. For example, the CPU 49 of the control unit 30 reads a computer program (containing description of the control flow of the illuminance sensor 20 illustrated in Fig. 8) stored in the ROM 47 and executes that computer program to achieve the control flow.

[0043] Herein, the computer program executed in the present embodiment is assumed to be stored in advance in the ROM 47. Alternatively, the computer program executed in the present embodiment can be provided in the form of an installable or executable file on a computer-readable recording medium such as a compact disk read only memory (CD-ROM), a flexible disk (FD), a compact disk readable (CD-R), or a digital versatile disk (DVD).

[0044] Still alternatively, the computer program executed in the present embodiment can be saved as a downloadable file on a computer connected to a network such as the Internet or can be made available for distribution through the network. Still alternatively, the computer program executed in the present embodiment can be distributed over a network such as the Internet.

[0045] Herein, the computer program executed in the present embodiment contains a module for implementing the functions of the power mode control unit 49a. Regarding the actual hardware, a CPU (processor) retrieves the computer program from the ROM and runs it so that the computer program is loaded in a main memory device. As a result, the functions of the power mode control unit 49a are implemented in the main memory device.

[0046] In this way, according to an aspect of the present invention, in an image forming apparatus configured to perform power saving control depending on the external illuminance detected by an illuminance sensor, precise power saving control can also be performed by taking into account various operating conditions of the image forming apparatus.

[0047] Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

Claims

1. An image forming apparatus comprising:

an illuminance detecting unit (28) that detects illuminance on the image forming apparatus in which the illuminance detecting unit (28) is installed;
an original detecting unit (27) that detects whether or not a target original for image formation is placed in the image forming apparatus; and
a power mode control unit (49a) that performs control regarding a normal power mode/a power saving mode based on an amount of change in the illuminance detected by the illuminance detecting unit (28), based on information detected by the original detecting unit (27) regarding whether or not an original is placed, and based on an operating condition of the image forming apparatus.

2. The image forming apparatus according to claim 1, wherein the illuminance detecting unit (28) has a power ON/OFF switch that enables turning ON or turning OFF of the power of the image forming apparatus.

3. The image forming apparatus according to claim 1, further comprising:

an illuminance recording unit (50) that records, at predetermined intervals, the illuminance detected by the illuminance detecting unit (28); and
a control information holding unit (51) that holds control information in which patterns of a change in the illuminance are specified in a corresponding manner with power saving control methods, wherein
based on the detected illuminance that is recorded in the illuminance recording unit (50) and based on the patterns held by the control information holding unit (51), the power mode control unit (49a) determines a power saving control method.

4. The image forming apparatus according to claim 3, wherein, based on a detection result of the original detecting unit (27), the illuminance recording unit (50) records, at predetermined intervals, the detected illuminance as detected by the illuminance detecting unit (28).

5. The image forming apparatus according to any one of claims 1 to 4, wherein, when the image forming apparatus is in operation or when a user operation of a panel is received, the power mode control unit (49a) does not perform control of the power saving mode.

6. The image forming apparatus according to any one of claims 1 to 4, wherein, when the image forming apparatus is not in operation and when a user operation of a panel is received, the power mode control unit (49a) performs control of the power saving mode.

7. The image forming apparatus according to any one of claims 3 to 5, further comprising an interval setting unit (30) that sets an arbitrary interval at which the illuminance recording unit (50) records the detected illuminance as detected by the illuminance detecting unit (28).

8. The image forming apparatus according to any one of claims 3 to 6, further comprising an illuminance setting unit that sets arbitrary illuminance in the patterns held by the control information holding unit (51).

9. An image forming method implemented in an image forming apparatus that includes
an illuminance detecting unit (28) that detects illuminance on the image forming apparatus in which the illuminance detecting unit (28) is installed; and
an original detecting unit (27) that detects whether or not a target original for image formation is placed in the image forming apparatus,
the image forming method comprising:

performing control regarding a normal power mode/a power saving mode based on an amount of change in the illuminance detected by the illuminance detecting unit (28), based on information detected by the original detecting unit (27) regarding whether or not an original is placed, and based on an operating condition of the image forming apparatus.

10. A computer program that is implemented in a computer including
an illuminance detecting unit (28) that detects illuminance on the image forming apparatus in which the illuminance detecting unit (28) is installed; and
an original detecting unit (27) that detects whether or not a target original for image formation is placed in the image forming apparatus,
the computer program causing the computer to execute:

performing control regarding a normal power mode/a power saving mode based on an amount of change in the illuminance detected by the illuminance detecting unit (28), based on information detected by the original detecting unit (27) regarding whether or not an original is placed, and based on an operating condition of the image forming apparatus.

FIG.1

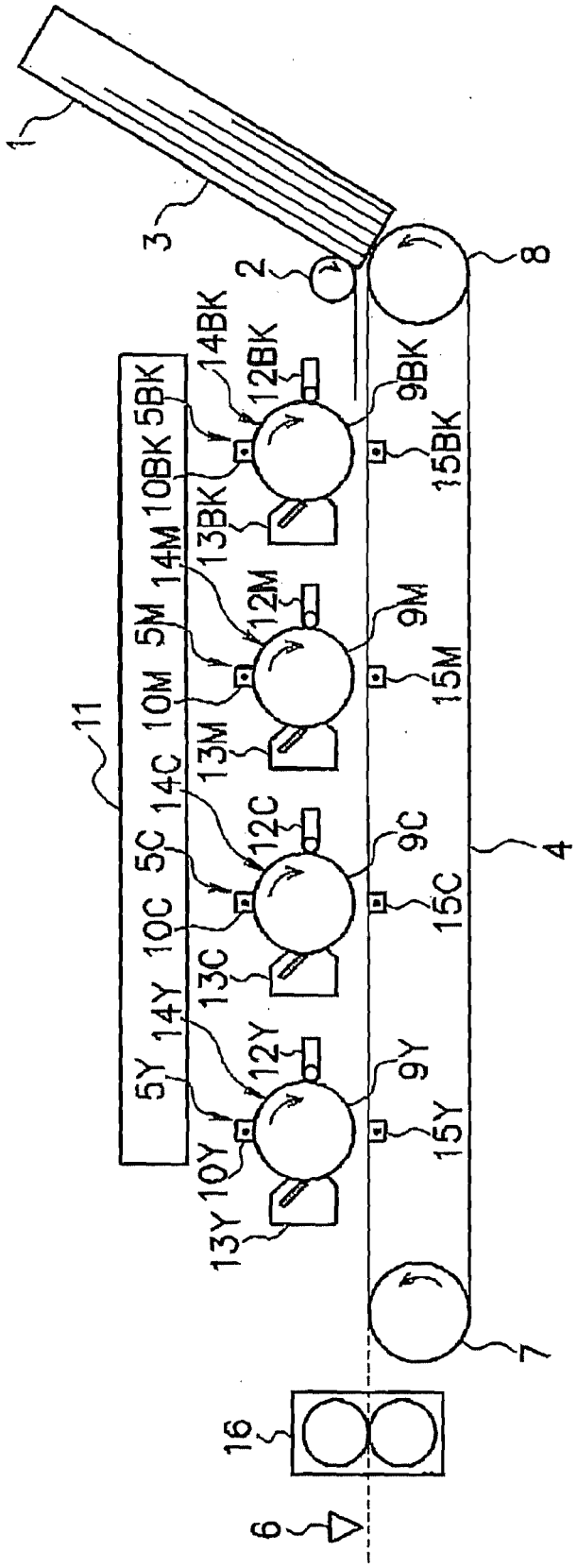

1
3
2
8
14BK
12BK
9BK
5BK
10BK
15BK
13BK
14M
12M
9M
5M
10M
15M
13M
11
14C
12C
9C
5C
10C
15C
13C
4
14Y
12Y
9Y
5Y
10Y
15Y
13Y
7
16
6

FIG.2

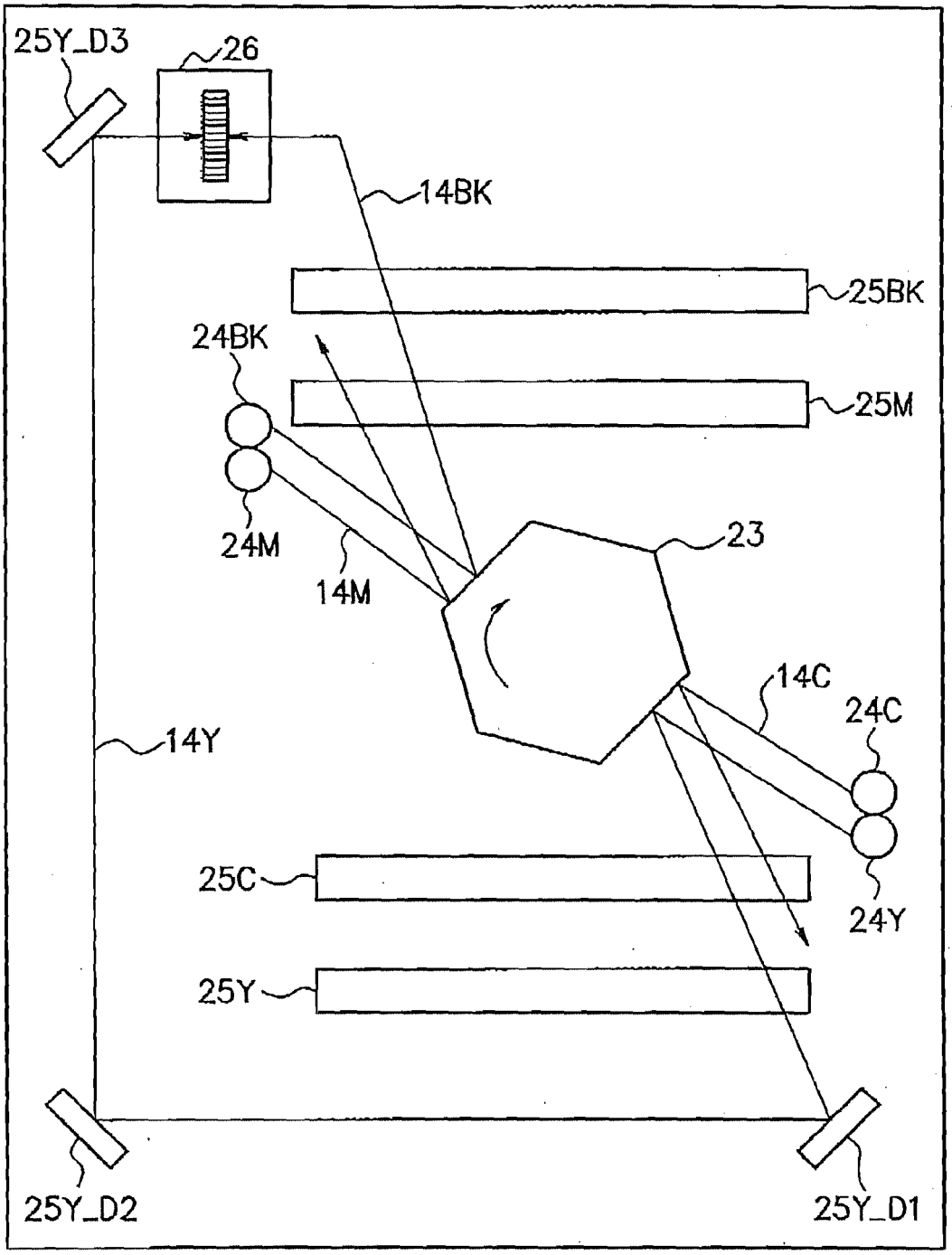

25Y_D3
26
14BK
25BK
24BK
25M
24M
14M
23
14C
24C
14Y
25C
24Y
25Y
25Y_D2
25Y_D1

FIG.3

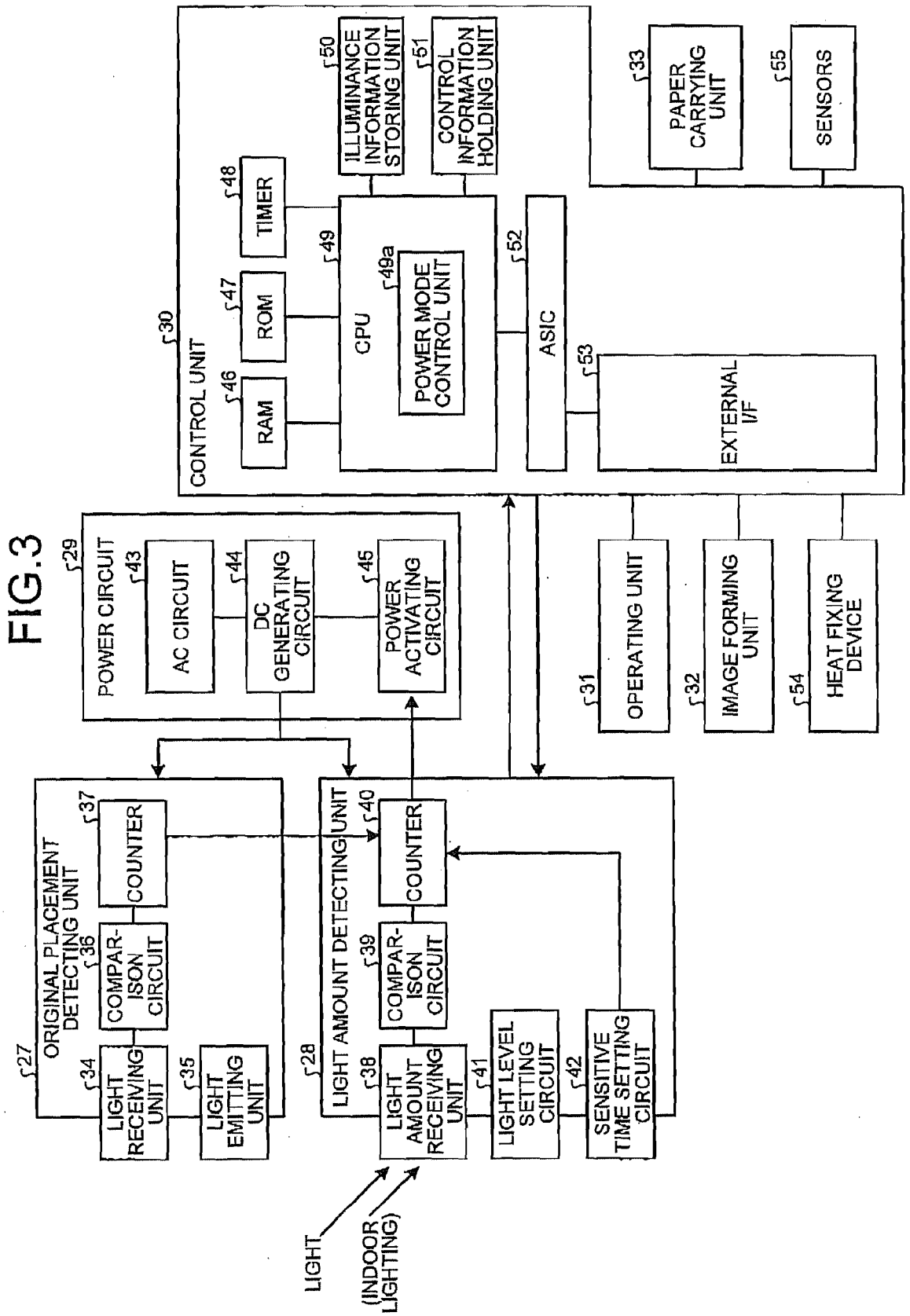

CONTROL UNIT
30
CPU
49
POWER MODE CONTROL UNIT
49a
RAM
46
ROM
47
TIMER
48
ASIC
52
EXTERNAL I/F
53
ILLUMINANCE INFORMATION STORING UNIT
50
CONTROL INFORMATION HOLDING UNIT
51
PAPER CARRYING UNIT
33
SENSORS
55
POWER CIRCUIT
29
AC CIRCUIT
43
DC GENERATING CIRCUIT
44
POWER ACTIVATING CIRCUIT
45
OPERATING UNIT
31
IMAGE FORMING UNIT
32
HEAT FIXING DEVICE
54
ORIGINAL PLACEMENT DETECTING UNIT
27
LIGHT RECEIVING UNIT
34
LIGHT EMITTING UNIT
35
COMPARISON CIRCUIT
36
COUNTER
37
LIGHT AMOUNT DETECTING UNIT
28
LIGHT AMOUNT RECEIVING UNIT
38
COMPARISON CIRCUIT
39
COUNTER
40
LIGHT LEVEL SETTING CIRCUIT
41
SENSITIVE TIME SETTING CIRCUIT
42
LIGHT
(INDOOR LIGHTING)

FIG.4

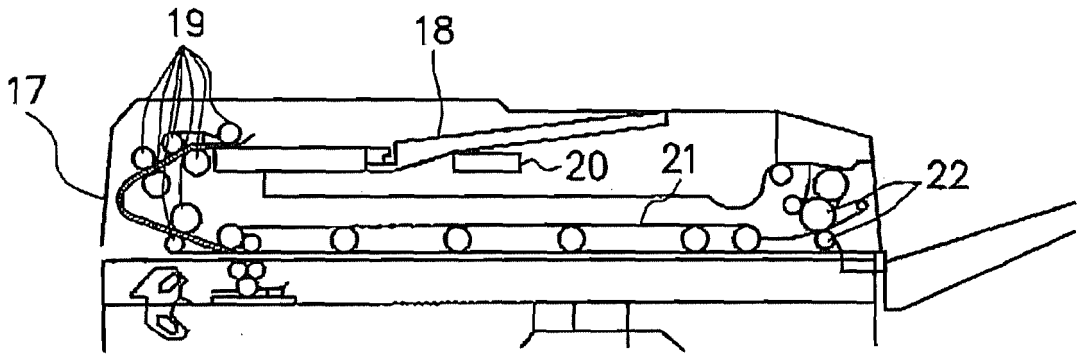


FIG.5

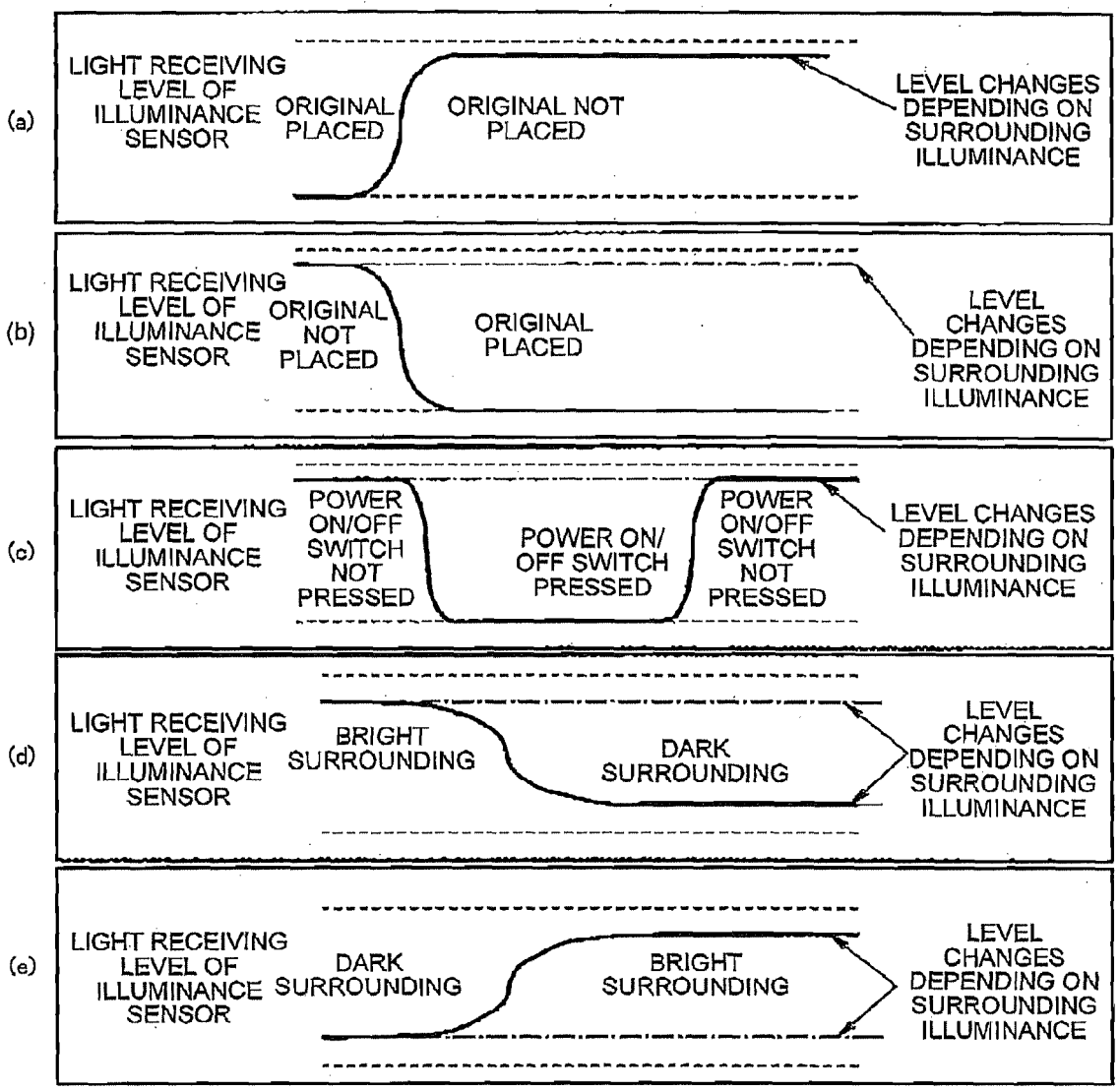

(a)
LIGHT RECEIVING LEVEL OF ILLUMINANCE SENSOR
ORIGINAL PLACED
ORIGINAL NOT PLACED
LEVEL CHANGES DEPENDING ON SURROUNDING ILLUMINANCE
(b)
LIGHT RECEIVING LEVEL OF ILLUMINANCE SENSOR
ORIGINAL NOT PLACED
ORIGINAL PLACED
LEVEL CHANGES DEPENDING ON SURROUNDING ILLUMINANCE
(c)
LIGHT RECEIVING LEVEL OF ILLUMINANCE SENSOR
POWER ON/OFF SWITCH NOT PRESSED
POWER ON/ OFF SWITCH PRESSED
POWER ON/OFF SWITCH NOT PRESSED
LEVEL CHANGES DEPENDING ON SURROUNDING ILLUMINANCE
(d)
LIGHT RECEIVING LEVEL OF ILLUMINANCE SENSOR
BRIGHT SURROUNDING
DARK SURROUNDING
LEVEL CHANGES DEPENDING ON SURROUNDING ILLUMINANCE
(e)
LIGHT RECEIVING LEVEL OF ILLUMINANCE SENSOR
DARK SURROUNDING
BRIGHT SURROUNDING
LEVEL CHANGES DEPENDING ON SURROUNDING ILLUMINANCE

FIG.6

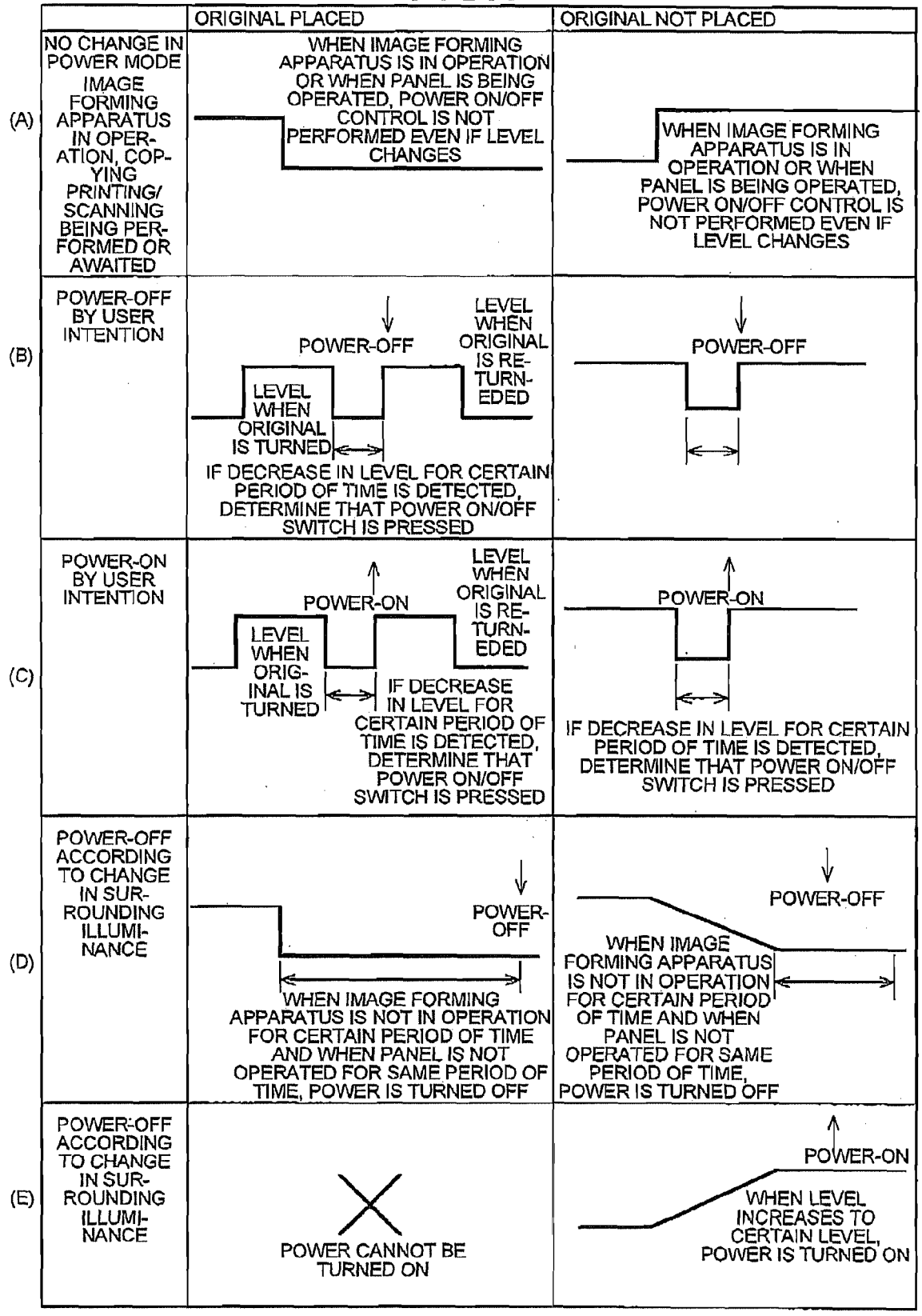

ORIGINAL PLACED
ORIGINAL NOT PLACED
(A)
NO CHANGE IN POWER MODE
IMAGE FORMING APPARATUS IN OPERATION, COPYING PRINTING/ SCANNING BEING PERFORMED OR AWAITED
WHEN IMAGE FORMING APPARATUS IS IN OPERATION OR WHEN PANEL IS BEING OPERATED, POWER ON/OFF CONTROL IS NOT PERFORMED EVEN IF LEVEL CHANGES
WHEN IMAGE FORMING APPARATUS IS IN OPERATION OR WHEN PANEL IS BEING OPERATED, POWER ON/OFF CONTROL IS NOT PERFORMED EVEN IF LEVEL CHANGES
(B)
POWER-OFF BY USER INTENTION
POWER-OFF
LEVEL WHEN ORIGINAL IS RE-TURN-EDED
LEVEL WHEN ORIGINAL IS TURNED
IF DECREASE IN LEVEL FOR CERTAIN PERIOD OF TIME IS DETECTED, DETERMINE THAT POWER ON/OFF SWITCH IS PRESSED
POWER-OFF
(C)
POWER-ON BY USER INTENTION
POWER-ON
LEVEL WHEN ORIGINAL IS RE-TURN-EDED
LEVEL WHEN ORIG-INAL IS TURNED
IF DECREASE IN LEVEL FOR CERTAIN PERIOD OF TIME IS DETECTED, DETERMINE THAT POWER ON/OFF SWITCH IS PRESSED
POWER-ON
IF DECREASE IN LEVEL FOR CERTAIN PERIOD OF TIME IS DETECTED, DETERMINE THAT POWER ON/OFF SWITCH IS PRESSED
(D)
POWER-OFF ACCORDING TO CHANGE IN SUR-ROUNDING ILLUMI-NANCE
POWER-OFF
WHEN IMAGE FORMING APPARATUS IS NOT IN OPERATION FOR CERTAIN PERIOD OF TIME AND WHEN PANEL IS NOT OPERATED FOR SAME PERIOD OF TIME, POWER IS TURNED OFF
POWER-OFF
WHEN IMAGE FORMING APPARATUS IS NOT IN OPERATION FOR CERTAIN PERIOD OF TIME AND WHEN PANEL IS NOT OPERATED FOR SAME PERIOD OF TIME, POWER IS TURNED OFF
(E)
POWER-OFF ACCORDING TO CHANGE IN SUR-ROUNDING ILLUMI-NANCE
POWER CANNOT BE TURNED ON
POWER-ON
WHEN LEVEL INCREASES TO CERTAIN LEVEL, POWER IS TURNED ON

FIG.7

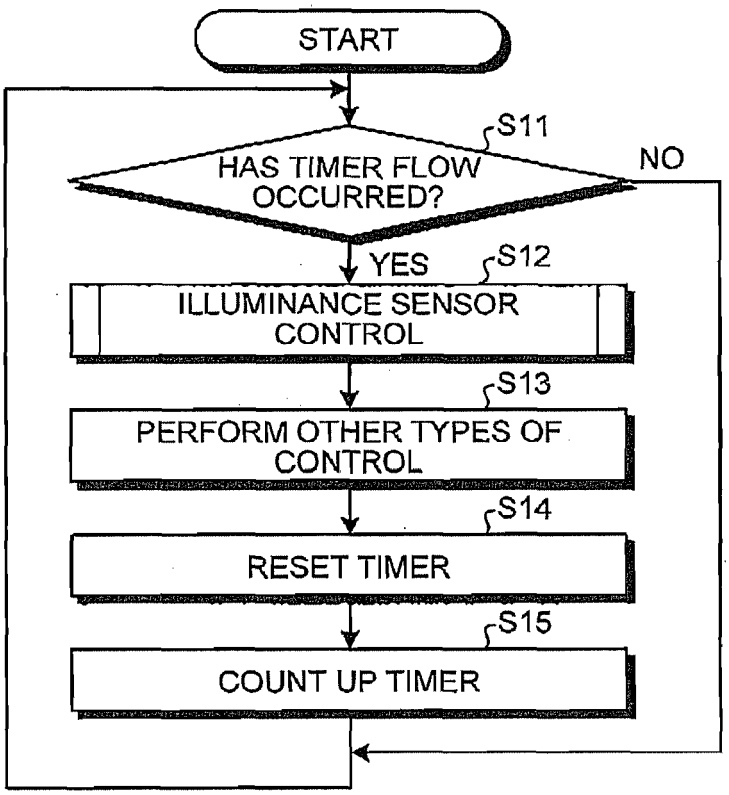
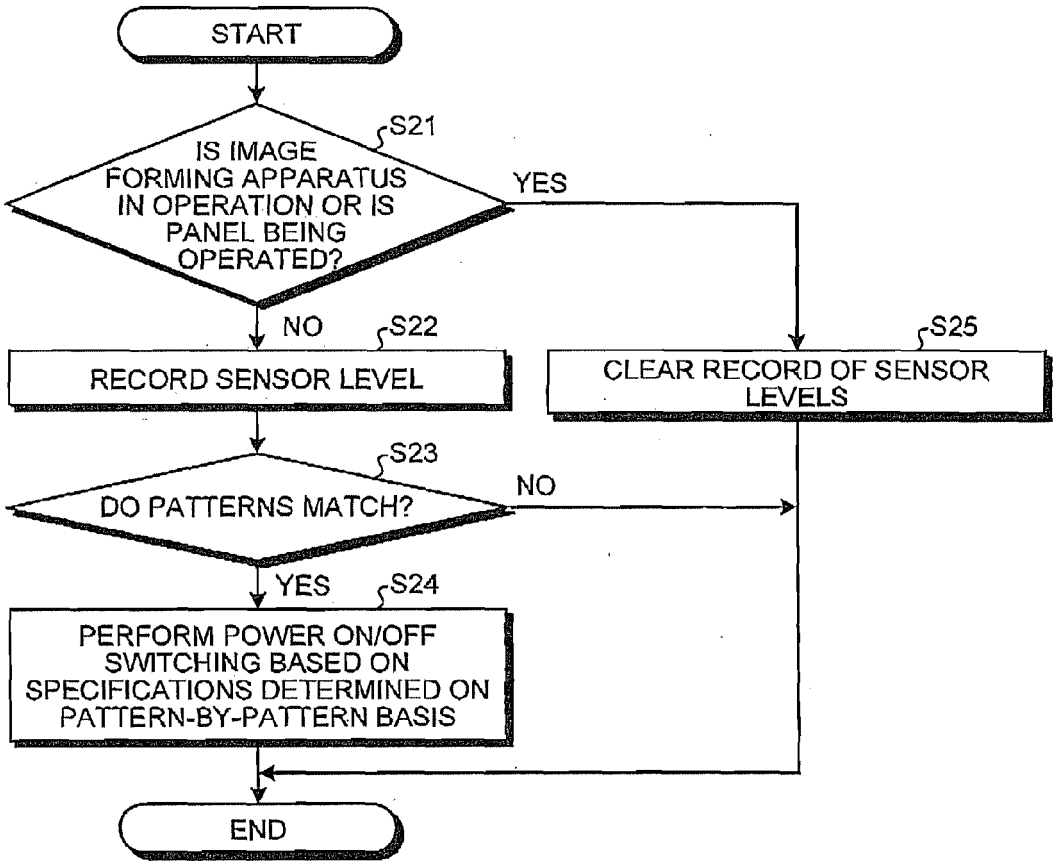

START
S11
HAS TIMER FLOW OCCURRED?
NO
YES
S12
ILLUMINANCE SENSOR CONTROL
S13
PERFORM OTHER TYPES OF CONTROL
S14
RESET TIMER
S15
COUNT UP TIMER

FIG.8


START
S21
IS IMAGE FORMING APPARATUS IN OPERATION OR IS PANEL BEING OPERATED?
YES
NO
S22
RECORD SENSOR LEVEL
S25
CLEAR RECORD OF SENSOR LEVELS
S23
DO PATTERNS MATCH?
NO
YES
S24
PERFORM POWER ON/OFF SWITCHING BASED ON SPECIFICATIONS DETERMINED ON PATTERN-BY-PATTERN BASIS
END

REFERENCES CITED IN THE DESCRIPTION

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- JP 2011260596 A **[0001]**
- JP 2005088521 A **[0004]**
- JP 2DD5088521 B **[0005]**