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

(11) EP 1 246 027 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.10.2002 Bulletin 2002/40

(51) Int Cl.[7]: **G03G 15/08**, G03G 21/16, G03G 15/00

(21) Application number: **02006647.8**

(22) Date of filing: **26.03.2002**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **26.03.2001 JP 2001086611**
11.06.2001 JP 2001175610
22.02.2002 JP 2002046268

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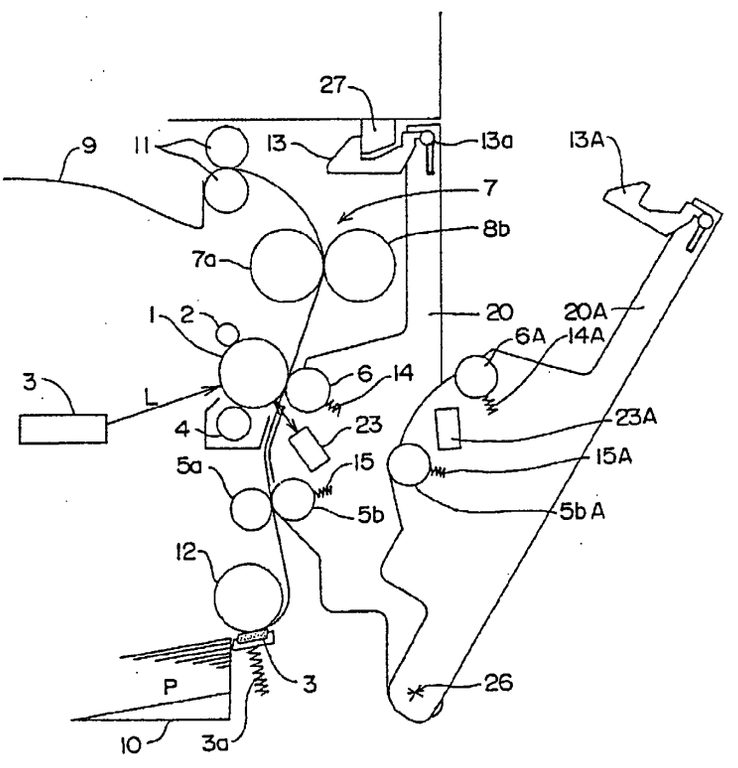
(54) Electrophotographic apparatus and method of detecting opening or closing of a cover of the apparatus

(57) A density detection value detected by the toner density detection sensor 23 before the door 20 is opened and a density detection value detected by the toner density detection sensor 23 after the door 20 is opened and closed are compared with each other, and determination is made on the basis of a difference between the detection values about whether or not the closed position of the door after the opening and closing operations of the door is in a regular closing position. Accordingly, since an incompletely closed state of the door is detected by the toner density detection sensor 23, various troubles due to the incompletely closed state of the door can be prevented from occurring.

FIG.1



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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an electrophotographic apparatus and a cover opening/closing detecting method thereof.

BACKGROUND OF THE INVENTION

[0002] In a conventional electrophotographic apparatus such as a reproducing machine, a printer, a facsimile machine, or the like, such a structure has been employed that a conveying path for a transfer paper extending in a horizontal direction is provided in a lower portion of an apparatus main body, a transfer paper is opposed to an image carrier comprising a photosensitive body at a transfer position while the transfer paper is being conveyed in a horizontal direction along the conveying path, so that a toner image formed on a surface of the image carrier is transferred to the transfer paper.

[0003] However, according to down-sizing of the apparatus, it is required to utilize a space in the apparatus main body effectively, the conveying path for a transfer paper must be devised according to such a requirement. Therefore, an electrophotographic apparatus has been also used having such a layout that a developing device is disposed on a lower side of an image carrier comprising a transfer paper conveying path, a transferring device is disposed at a position generally horizontal to the image carrier, the conveying path for a transfer paper is defined so as to extend in a vertical direction, and a toner image is transferred to the transfer paper conveyed in a vertical direction.

[0004] For this reason, for example, in an electrophotographic apparatus where a door is opened for a maintenance so that a transferring device and an idle roller for registration is separated from an image carrier, such a system is employed that a transfer paper conveying path is provided so as to extend in a vertical direction, and a transfer section is opposed to the image carrier in the conveying path extending in the vertical direction so that transferring of a toner image to a transfer paper is performed.

[0005] In such an apparatus, a developing device is provided upstream along a rotation direction of the image carrier, as viewed from a transfer section, and on a lower side of the image carrier, and a toner image formed on the image carrier in the developing device is transferred by the transfer section to a transfer paper which is fed in from a registration roller along a conveying path substantially in a vertical direction. A toner density detection sensor which detects a density of a toner image on the image carrier is disposed between the transfer section and the developing device so that the density of the toner image which has been developed on the image carrier by the developing device is detected. The toner density detection sensor is arranged on a side of a door so as not to block the transfer paper conveying path so that the toner density detection sensor along with the door is separated from the image carrier according to opening of the door. Since a photo sensor is used as the toner density detection sensor, it is necessary to position the photo sensor in a normal direction to a tangential direction of the image carrier in order for sensor light to be irradiated on a surface of the image carrier in a vertical direction thereto. Therefore, in an electrophotographic apparatus where the toner density detection sensor is mounted to the door side, it is necessary to provide a door positioning unit such that the door is closed to a regular position and it is further necessary to provide a confirming unit which confirms whether or not the door has been closed to the normal position.

[0006] Also, the electrophotographic apparatus is provided with a registration roller which positions a leading edge of a transfer paper and feeds out the transfer paper in synchronism with a toner image formed on the image carrier, to transfer the toner image on a predetermined portion of the transfer paper. A registration sensor which detects presence/absence of a transfer paper is arranged upstream of the registration roller, or on a side of a paper feeding roller, and a slack amount of a transfer paper upstream of the registration roller is determined by managing a time elapsed after a leading edge of the transfer paper has passed through the position of the registration roller. The registration sensor has a light emitting element and a light receiving element. The registration sensor and a reflecting plate are arranged so as to be opposed to each other on both sides of the conveying path for a transfer paper and the transfer paper blocks a light beam from the light emitting element so that passing-through of the leading edge of the transfer paper is detected on the basis of change of an output in the light receiving element.

[0007] As described above, the electrophotographic apparatus of the type where a toner image is transferred while a transfer paper is being conveyed approximately in the vertical direction is configured such that the reflecting plate combined with the registration sensor is disposed so as not to block the transfer paper conveying path and it is separated from the registration sensor simultaneously with the door opening. Since a photo sensor is used as the light receiving element in the registration sensor, the registration sensor must be positioned in a normal direction to the tangential line of the reflecting plate such that sensor light is irradiated on the reflecting plate vertically. Therefore, in the instance that the registration sensor determines that a closed position of a door is not positioned at a regular closing position when the door is closed, the door must be closed again so as to be positioned at a regular position.

[0008] As mentioned above, in an electrophotographic apparatus of such a type that a toner image is transferred to a transfer paper while the transfer paper is be-

ing conveyed generally in a vertical direction, the transfer device and the registration idle roller are mounted to the door side and they are respectively pressurized on the image carrier and the registration driving roller by compression springs. For this reason, when the door is closed, the door is resisted by a reaction force due to the pressurization just before the door is closed to the regular position. When the door is closed with a force by which a door locking unit rides beyond a projecting section provided on an apparatus main body, it is possible to close the door to the regular position. However, when the door is closed slowly, the door locking unit can not ride beyond the projecting section so that the door is not closed up to the regular position to be put in an incompletely closed state. When the door is put in the incompletely closed state, since the toner density detection sensor is not positioned at a regular position in the electrophotographic apparatus of the type where the toner density detection sensor is mounted to the door, light irradiated on the image carrier from the sensor is not returned back to the toner density detection sensor sufficiently, there is a problem that an erroneous detection occurs in the sensor and an image with a high quality having a regular toner density can not be obtained. Also, in the electrophotographic apparatus of the type that a reflecting plate to be combined with the registration sensor is mounted to the door, when the door is put in the incompletely closed state, an error occurs in detection of the leading edge of the transfer paper.

[0009] Also, in the above-mentioned electrophotographic apparatus where the transfer device and the registration idle roller are separated from the image carrier by opening the door for maintenance, when the door is not closed up to the regular position, since positioning of a transfer paper becomes inaccurate and transferring of a toner image on the surface of the image carrier to the transfer paper becomes incomplete, there is a problem that an image with a high quality can not be obtained.

[0010] Incidentally, in Japanese Patent Application Laid-Open No. 11-282223 (JP-A) publication, there is a description about a density detection sensor which irradiates light on an image carrier across a convey path for a transfer paper and detects the toner density by detecting the amount of reflected light from a standard image (test patch) formed on the image carrier. The density detection sensor has also a function serving as a jam detection sensor of a transfer paper jamming so as to detect whether or not a transfer paper has been conveyed through the conveying path. Also, in the above publication, there is a description about an embodiment where the density detection sensor is arranged on a manual insertion table where a transfer paper is manually inserted in the apparatus, which can be opened and closed to an apparatus main body.

[0011] However, in the invention described in the above publication, there is not ideal where the toner density detection sensor or the registration sensor is used to determine whether a closed position of a door has been positioned at a regular closing position.

[0012] Also, in Japanese Patent No. 2661941 publication, there is a description about a density detection sensor which detects the density of a toner image on a transfer belt in an electrophotographic apparatus where the toner image formed on an image carrier is once transferred to the transfer belt and the transferred image is further transferred to a transfer paper. The density detection sensor serves as a sensor which detects the fact that the transfer belt has been moved for maintenance. Furthermore, the electrophotographic apparatus is provided with a door switch which detects whether a door is in an opened state or in a closed state, so that an image forming operation is performed only when it is detected that the door is in the closed state and the transfer belt is positioned at a regular position.

[0013] In the invention described in the above publication, however, there is not any idea where the toner sensor or the registration sensor is used to determine whether or not the closed position of the door is in a regular closing position.

SUMMARY OF THE INVENTION

[0014] It is an object of this invention to provide an electrophotographic apparatus which can obtain an image with a high quality by preventing an erroneous detection of a toner density detection sensor due to an incomplete closing of a door after door opening and closing operations, an error in detection of a leading edge of a transfer paper or an error in positioning of a transfer paper and incompleteness in transfer of a toner image to a transfer paper from occurring, and a method of detecting opening/closing of a cover for the electrophotographic apparatus.

[0015] According to a first aspect of the invention, there is provided an electrophotographic apparatus comprising a developing device arranged in the vicinity of an image carrier, a transferring device which transfers a toner image formed on the image carrier to a transfer paper, and a toner density sensor which detects a density of the toner image formed on the image carrier, where the toner density sensor is disposed on a door which is opened and closed in the vicinity of the image carrier and the toner density sensor can detect the density of the toner image on the image carrier in a state where the door has been closed, wherein the apparatus further comprises door position determining unit which compares a density detection value of a surface of the image carrier which has been detected by the toner density sensor before an operation for opening the door is performed and another density detection value of the surface of the image carrier which has been detected by the toner density sensor after the door has been opened and closed with each other to determine on the basis of a difference between the detection values whether the closed position of the door after opening

and closing operations is in a regular closing position.

[0016] According to a second aspect of the invention, there is provided a cover opening/closing detecting method of an electrophotographic apparatus, comprising a developing device arranged in the vicinity of an image carrier, a transferring device which transfers a toner image formed on the image carrier to a transfer paper, and a toner density sensor which detects a density of the toner image formed on the image carrier, where the toner density sensor is disposed on a door which is opened and closed in the vicinity of the image carrier and the toner density sensor can detect the density of the toner image on the image carrier in a state where the door has been closed, the method comprising the steps of, detecting a toner density of a surface of the image carrier by the toner density sensor before an operation for opening the door is performed and detecting a toner density of the surface of the image carrier by the toner density sensor after the door is opened and closed, comparing the detection value of the toner density before the door is opened and the detection value of the toner density after the door is opened and closed with each other, and determining whether the closed position of the door after the opening and closing operations of the door is in a regular closing position on the basis of a difference between the detection values.

[0017] A toner density detection value of a skin portion of the image carrier obtained by the toner density detection sensor after the last image forming operation, or of a portion of the image carrier where any toner has not adhered and another density detection value of the skin of the image carrier obtained by the toner density detection sensor after the door has been opened and closed are compared with each other, so that a determination can be made on the basis of a difference between these detection values about whether or not the position of the toner density detection sensor when the door has been closed is in a regular position. As a result, it can be determined whether or not the position of the door is in a regular closing position.

[0018] A determination about whether or not the closed position of the door is in the regular closing position can be made by first storing the detection value of the skin portion of the image carrier detected in the preceding image forming operation by the toner density detection sensor, detecting the skin portion of the image carrier again after the door is opened and closed, and comparing both the detection values with each other. When the closed position of the door is not in the regular closing position and it is in the incompletely closed position, since the toner density detection sensor is positioned out of the regular closing position, reflected light of a light beam emitted from the toner density detection sensor is not returned back to the sufficiently due to the curvature of the surface of the image carrier, which results in lowering of the detection value. Accordingly, the door position determining unit can determine on the basis of a difference between the toner density detection values whether or not the door is in the completely closed state. When the incompletely closed state is determined, for example, such a fact is displayed on an operation section or a display panel that the door is in the incompletely closed state and it is prompted to close the door up to the regular closing position securely.

[0019] According to a third aspect of the invention, in the first or second aspect, the toner density detection sensor detects the density of the skin portion of the surface of the image carrier.

[0020] According to a fourth aspect of the invention, in the first aspect, the door has a transfer roller, and the transfer roller is arranged so as to be positioned above the developing device to come into pressure-contact with a photosensitive body and come into pressure-contact with a portion of the image carrier positioned downstream of a detection portion of the image carrier which is detected by the toner density detection sensor regarding a rotation direction of the image carrier.

[0021] According to a fifth aspect of the invention, in the first aspect, the door has one of registration rollers paired, and the one of the registration rollers is brought into pressure-contact with the other of the registration rollers.

[0022] According to a sixth aspect of the invention, in the first aspect, the door has a transfer roller and one of registration rollers paired, and has the toner density detection sensor between the transfer roller and the one of the registration rollers.

[0023] According to a seventh aspect of the invention, there is provided an image forming apparatus which has a reflecting plate which is arranged on a door portion opposed to a registration sensor and is caused to approach to and separate from the registration sensor according to opening and closing operations, wherein the apparatus comprises door position determining unit which compares a detection value of reflection light from the reflecting plate, which has been detected by the toner density sensor before an operation for opening the door is performed and another detection value of reflection light from the reflecting plate, which has been detected by the toner density sensor after the door has been opened and closed with each other to determine on the basis of a difference between the detection values whether the closed position of the door after opening and closing operations is in a regular closing position.

[0024] According to an eighth aspect of the invention, there is provided a cover opening/closing detecting method of an electrophotographic apparatus which has a reflecting plate which is arranged on a door portion opposed to a registration sensor and is caused to approach to and separate from the registration sensor according to opening and closing operations, comprising the steps of, detecting reflected light from the reflecting plate by the registration sensor before an operation for opening the door and detecting reflected light from the reflecting plate by the registration sensor after the door

is closed, comparing the detection value before the door is opened and the detection value after the door is opened and closed with each other, and determining whether the closed position of the door after the opening and closing operations of the door is in a regular closing position on the basis of a difference between the detection values.

[0025] When a determination is made about whether or not the closed position of the door is in the regular closing position, the detection value of the reflected light on the reflecting plate, which has been detected the last time by the registration sensor is held or stored. Then, reflected light on the reflecting plate is detected again after the door has been opened and closed. Unless the closed position of the door is in the regular closing position, the registration sensor is positioned out of the regular position.

[0026] Light emitted from an light emitting element of the registration sensor and reflected by the reflecting plate is not returned back to the registration sensor sufficiently, and the detection value by a light receiving element of the registration sensor is lowered. The determination about whether or not the closed position of the door is in the regular position is made on the basis of this detection value . In this case, such a configuration can be employed that the effect of a door set (closing) failure is displayed on an operation portion thereby prompting the door to be closed securely.

[0027] Other objects and features of this invention will become understood from the following description with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Fig. 1 is a front sectional view that shows an embodiment of an electrophotographic apparatus and a method of detecting a cover of the apparatus according to the present invention;

Fig. 2 is a front sectional view that shows another operation mode of the embodiment in conformity with Fig. 1;

Fig. 3 is a circuit diagram that shows a control circuit example which is applicable to the present invention;

Fig. 4 is a graph that shows a difference in voltage level between a skin section and a developed image section on an image carrier in the electrophotographic apparatus;

Fig. 5 is a graph that shows a difference in output of a toner density detection sensor between an instance that a door is opened and an instance that the door is closed in the embodiment;

Fig. 6 is a flowchart that shows an operation of a control device performed when door opening and closing operations are performed in the embodiment;

Fig. 7 is a block diagram that shows an example of the control device which is applicable to the present invention;

Fig. 8 is a flowchart that shows a control operation of checking an incomplete door-closing in the embodiment;

Fig. 9 is a perspective view that shows an example of opened state and closed state of respective doors of a reproducing apparatus;

Fig. 10 is a front sectional view that shows another embodiment of an electrophotographic apparatus and a method of detecting opening and closing of a cover of the apparatus according to the present invention;

Fig. 11 is a circuit diagram that shows a control circuit example which is applicable to the embodiment;

Fig. 12 is a graph that shows a difference in voltage level between an instance that reflected light is received from a transfer paper and an instance that reflected light is received from a reflecting plate; and

Fig. 13 is a flowchart that shows operation of a control device performed when door opening and closing operations are performed in the embodiment.

DETAILED DESCRIPTIONS

[0029] The present invention relates to an electrophotographic apparatus. More particularly, this invention relates to an electrophotographic apparatus which can prevent transfer inferiority of an toner image or conveying failure of a transfer paper from occurring due to incompleteness of a door closing after a door is opened and closed for maintenance or the like and which can prevent a toner density abnormality from occurring due to an erroneous detection of a toner density detection sensor in advance, and a cover opening/closing detecting method thereof.

[0030] Embodiments of an electrophotographic apparatus and a method of detecting opening and closing of a door of the apparatus will be explained below with reference to the drawings.

[0031] Fig. 1 is a longitudinal sectional view that shows a door closed state and a door opened state of the entire configuration of an embodiment of the present invention, Fig. 2 is a longitudinal sectional view that shows the door closed state of the embodiment, and Fig. 9 is an appearance perspective view that shows one example of an electrophotographic apparatus where a door opening/closing detection device according to the present invention is employed. The electrophotographic apparatus shown here is constituted as an reproducing machine. Incidentally, the electrophotographic apparatus in this invention may be considered to be an image formation apparatus using an electrophotographic process.

[0032] In Figs. 1 and 2, the image formation apparatus is provided with an image carrier 1 comprising a drum-

like photosensitive body. The image carrier 1 is rotated in a counterclockwise direction on the figures. A charging roller 2 positioned above and on the left side of the image carrier 1, a light writing device 3 positioned generally on the left side of the image carrier 1, a developing unit 4 positioned approximately just below the image carrier 1 and a transfer roller 6 positioned generally on the right side of the image carrier 1 are respectively arranged around the image carrier 1. Roller pair 7a and 7b constituting a fusing device 7 are arranged above the image carrier 1, more specifically, obliquely above and on the right side of the image carrier 1. Furthermore, registration roller pairs 5a and 5b positioned below the image carrier 1 and further below the developing unit 4, a paper feeding roller 12 positioned further below the registration roller pair 5a and 5b, and a paper feeding cassette 10 positioned further obliquely below the paper feeding roller 12 are arranged. Transfer papers (sheets) P are drawn out from the paper feeding cassette 10 one by one, each transfer paper is conveyed to a transfer section via the registration roller pair 5a, 5b to be transferred with an toner image on the image carrier 1 by the transfer roller 6, the transfer paper transferred with the toner image is then conveyed to the fusing device 7 where the toner image is fused on the transfer paper, and the transfer paper is discharged to a discharged paper tray 9 via discharging roller pair 11. As understood from the above, a conveying path for a transfer paper P from the paper feeding roller 12 to the fusing device 7 is a conveying path extending generally in a vertical direction.

[0033] On the right side in Figs. 1 and 2 showing the image formation apparatus, a door 20 is mounted so as to rotate about a shaft 26 positioned at a lower end portion thereof to extend in a horizontal direction within a vertical plane to allow opening/closing of a right side wall section of the apparatus or the door in order to remove jammed paper when a jamming occurs or perform other maintenance. A hook 13 is mounted at an upper portion of the door 20 rotatably about a shaft 13a within a vertical plane. When the door 20 has been closed, the hook 13 is rotationally urged so as to engage a protrusion 27 on a side of an apparatus main body, and when the door 20 is closed, the hook 13 rides beyond the protrusion 27. Furthermore, the hook 13 is rotated against its urging force according to an external operation and it is disengaged from the protrusion 27 so that the door 20 can be opened.

[0034] The door 20 is rotatably mounted with the transfer roller 6 and it is rotatably mounted with one roller 5b of registration rollers paired. The transfer roller 6 and the registration roller 5b are respectively biased by springs 14, 15 so as to be brought into pressure-contact with the image carrier 1 and the other registration roller 5a. A toner density detection sensor 23 is mounted to the door 20 between the transfer roller 6 and the registration roller 5b. The transfer roller 6 is smaller than the developing unit 4 and a space occurs between the transfer roller 6 and the registration roller 5b, so that the toner density detection sensor 23 is disposed in the space. The toner density detection sensor 23 has a light emitting element and a light receiving element. When the door 20 is closed to a regular position, the toner density detection sensor 23 is opposed to the image carrier 23 from an obliquely left lower position in an obliquely and upwardly right direction, where the light emitting element emits light beam from a normal direction to a tangential line on a surface of the image carrier 1 and the light receiving element receives reflected light from the surface of the image carrier 1. Incidentally, in Fig. 1, reference numerals denoting the door and members attached to the door in the state where the door 20 has been closed are attached at their ends with a letter "A".

[0035] Next, a cover opening/closing detection method together with an operation of the above embodiment will be explained.

[0036] In Figs. 1 and 2, each of the transfer papers P which are fed from the paper feeding cassette 10 by the paper feeding roller 12 one by one forms a predetermined loop by its leading edge abutting on a nip between the registration roller pair 5 (5a, 5b) and it is once stopped. A skewed state of the paper P is corrected by the formation of the loop. On the other hand, the image carrier 1 comprising the drum-like photosensitive body supported rotatably is rotationally driven in a counterclockwise direction on Fig. 1. The surface of the image carrier 1 is uniformly charged to a predetermined polarity by the charging roller 2, laser beam L emitted from the light writing device 3 and optically modulated is irradiated on the charged surface so that a predetermined latent image is formed on the surface of the image carrier 1. This latent image is visualized by toner when it passes through the position of the developing unit 4.

[0037] The registration roller pair 5 (5a, 5b) starts rotation in a timing synchronized with a leading edge of the latent image on the image carrier 1 rotating in the counterclockwise direction to convey the transfer paper P whose skew has been corrected into the transfer section (nip section) between the image carrier 1 and the transfer roller 6. The transfer papers P conveyed into the transfer section are sequentially transferred with toner images on the image carrier 1 by the transfer roller 6. The transfer papers P transferred with toner images are fed to the nip section between a fusing roller 7a and a pressurizing roller 8b of the fusing device 7, where the toner images are fused on the transfer papers P. After fusing the toner images, the transfer papers P are discharged to the outside of the apparatus by the discharging roller pair 11 and they are stacked on the discharged paper tray 9.

[0038] In the embodiment shown, before an operation of opening the door 20 is performed, the density of a skin section of the image carrier 1 is detected by the toner density detection sensor and it is stored or held in a memory. For example, when jam of a transfer paper occurs and the door is closed after a work to remove the

jammed paper is terminated, or when the door is opened and closed for maintenance, the toner density detection sensor 23 is operated to perform detection of the density of the skin section of the image carrier 1. A door position determining unit which determines whether or not the closed position of the door is in the regular closing position is provided and a control unit which displays the effect that the door is in an incompletely closed state when the closed position of the door is not in the regular closing position and stops the image forming operation is provided.

[0039] That is, the embodiment shown is configured such that the toner density of a standard image (test patch image) formed on the image carrier 1 and the incompletely closed state of the door is detected utilizing the toner density detection sensor of a toner replenishment control device which controls toner replenishment.

[0040] Fig. 3 shows a driving circuit example of the toner density detection sensor, and Figs. 4 and 5 show an example of detection operation of the toner density detection sensor.

[0041] In Fig. 3, reference numeral 23 denotes the toner density detection sensor, 24 denotes a constant current circuit, 26 denotes a CPU including the door position determining unit, 27 denotes a resistor, 30 denotes a D/A converter, and 31 denotes an A/D converter, respectively. As shown in Fig. 3, the CPU 26 is connected with the D/A converter 30 and a control signal from the CPU 26 is inputted into the D/A converter 30, where the signal is converted into an analog signal. The D/A converter 30 is connected with the constant current circuit 24 comprising an operational amplifier 24a, a transistor 24b and resistors, and a LED 23a on the light emission side of the toner density detection sensor 23 is driven with a constant current by the constant current circuit 24.

[0042] Light beam from the LED 23a is irradiated on the image carrier 1, the reflected light from the image carrier 1 is incident on a phototransistor 23b of the toner density detection sensor 23, and current corresponding to the light amount of the reflected light from image carrier 1 flows in the resistor 27 connected to the phototransistor 23b. Accordingly, a voltage proportional to the above current is inputted into the A/D converter 31 connected to the resistor 27. The voltage is A/D-converted in the A/D converter 31 and inputted into the CPU 26 connected to the A/D converter 31.

[0043] As shown in Fig. 4, the amount of light from the LED 23a is controlled such that the voltage of the skin section of the image carrier 1 becomes 2.5V. The control performed such that the voltage of the skin section of the image carrier 1 becomes 2.5V and the control of the toner density performed by detecting the toner density of the standard image are performed just after a main switch is turned ON and at a time of image forming operation termination for every 500 papers.

[0044] However, in an instance that the door is opened and closed to solve a jam of a transfer paper when the jam occurs during an image forming operation, for maintenance or the like, the toner density detection sensor 23 is driven by the control unit to detect the toner density. More specifically, after the door switch is turned from OFF to ON, namely after the opened door is closed, the toner density detection sensor 23 is driven by the control unit and the voltage of the skin section of the image carrier 1 is detected as shown in Fig. 5. The detected value is compared with the voltage of the skin section of the image carrier 1 of 2.5V. As a result, when there is a difference ΔV in detection level, it is determined in the determining section that the door is in an incomplete closed state, so that the effect that the door is in the incomplete closed state is displayed on the operation section of the display section to stop the image forming operation.

[0045] As mentioned above, such a control that the voltage of the skin section of the image carrier 1 becomes 4V and such a toner density control that the toner density of the standard image or test patch image becomes constant are performed just after the main switch of the apparatus is turned ON and for each time of image forming operation of 500 papers by the CPU 26 shown in Fig. 3.

[0046] Fig. 6 is a flowchart that shows an operation of the control unit when door opening and closing operations are performed. In instance that the door is opened at a time t1 shown in Fig. 5, the voltage of the skin section of the image carrier 1 is detected by the toner density detection sensor (P sensor) 23 and a detection value V1 is stored in a memory (not shown) at Step S1. At Step S2 at a time t2 in Fig. 5, when the door is closed by an operator, the control proceeds to Step S3 where the voltage of the skin section of the photosensitive body 1 is detected by the toner density detection sensor 23 again and a detection value V2 can be obtained. Next, the control proceeds to Step S4 where the detection value V1 stored in the memory at Step S1 is compared with the detection value V2 detected at Step S3. At Step S4, when $V1 - V2 > 0.5$ is met, it is determined that the door is in the incompletely closed state, and the control proceeds to Step S5 where an warning about the incompletely closed state of the door is displayed on the operation section so that an image forming operation of the apparatus can not start. When the determination at Step S4 is $V1 = V2$, a normal image forming operation is made possible.

[0047] Therefore, when it is determined by the control device or unit the door is in the incompletely closed state, the effect is displayed and the image forming operation of the apparatus is made impossible, so that the toner density is prevented from being detected erroneously due to that the toner density detection sensor 23 is not in the regular position and an image with a poor image quality is prevented from being formed due to the erroneous detection of the toner density.

[0048] Fig. 7 is a block diagram that shows one example of the control device of the reproducing machine

in this embodiment. Reference numeral 39 denotes a CPU, which is configured with a memory stored with a control program and the like, a microprocessor and the like. Reference numeral 23 denotes a toner density detection sensor, 40 denotes a door switch of a front door, I1 denotes an input terminal of the door switch 40, and I2 denotes an input terminal of the toner density detection sensor 23. As clearly understood from this configuration, only when the door switch 40 is opened and closed, detection of an incompletely closed state of the door by the toner density detection sensor 23 and the CPU 39 and a control based on the detection can be performed.

[0049] Fig. 8 is a flowchart of a control of checking an incompletely closed state of a door, and Fig. 9 is an appearance view that shows an opened state of a door of a reproducing machine . In Fig. 8, whether or not reproduction of 500 sheets of transfer papers have been completed is checked, and a measurement value of reflected light obtained by lighting of the LED 23a after completion of reproduction of 500 sheets of transfer papers is stored in the memory as DATA1 (Step S10). Next, whether or not a jam occurs is detected (Step S11). When occurrence of a jam is detected, a reproducing or copying operation is stopped (Step S12). Next, whether or not a right door 20 has been opened is determined (Step S13). In instance that the jam which has occurred at Step S11 can be handled by opening a door other than the right door 20, for example, in instance that a jam has occurred in an ADF, this jam can be handled by opening only an ADF door 21a. Therefore, the check about whether or not the door is in the incompletely closed state through Step S14 is terminated (Step S21).

[0050] At Step S13, when the opening of the right door 20 is detected, the right door 20 is not always closed lastly. Therefore, whether or not all the doors, i.e., the front door 21b, the ADF door 21a, and a paper feeding device door 21c have been closed is determined (Step S16). When all the doors have been closed, the toner density detection sensor 23 is once turned ON and its measurement value is stored in the memory as DATA2 (Step S17). Next, whether or not the value of DATA2 stored is 2.0V or less is confirmed (Step S18), and when the value is 2.0V or less, the value of DATA2 is subtracted from the value of DATA1 (Step S19). When the value obtained by the subtraction is 0.5V or more, it is determined that the door is in the incompletely closed state and an warning message is displayed on the operation section 32 of the reproducing machine, thereby notifying the message to a user. Also, for example, such a fact that the door is in the incompletely closed state can be notified to a maintenance operator for the reproducing machine by connecting the apparatus to a communication line (Step S20).

[0051] Next, with reference to Figs. 10 to 13, anther embodiment of the present invention will be explained. This embodiment is structured such that a reflecting plate combined with a registration sensor possessed by an electrophotographic apparatus is mounted to a door so that determination is made about whether the door is in a predetermined closed position, and the other structure of this embodiment is approximately equal to the above-mentioned structure. Therefore, constitution portions equal to those in the above-mentioned embodiment are denoted by the common reference numerals.

[0052] In Fig. 10, a charging roller 2, a light writing device 3, a developing unit 4, and a transfer roller 6 are arranged around an image carrier 1. A paper feeding cassette 10 accommodating transfer papers P is provided in a bottom portion of the apparatus. A paper feeding roller 12, a registration roller pair comprising a registration driving roller 5a and a registration idle roller 5b are arranged along a transfer paper conveying path. A registration sensor 23 and a reflecting plate 50 are provided upstream of the registration roller pair so as to be opposed to each other via the transfer paper conveying path . A fusing roller pair 7 is provided downstream of the transfer section and a paper discharging roller pair 11 is provided further downstream thereof. A discharged paper receiving tray 9 is formed in an upper section of the apparatus.

[0053] A right door 20 which opens and closes a right wall section of an apparatus main body is provided rotatably about a fulcrum 26 on a lower side of the door. A lock section 13 rotated about a fulcrum 13a is provided at an upper end of the right door 20, and a portion to be locked 27 which engages the lock section 13 is provided at the side of the apparatus main body.

[0054] The transfer roller 6, the registration idle roller 5a and the reflecting plate 50 are fixed to the right door 20, and they are moved according to opening and closing of the right door 20. The reflecting plate 50 has a function serving as a guide plate which guides conveyance of a transfer paper P. The reflecting plate 50 is formed in a curved face towards a transfer paper conveying direction so that the curved face is brought in point-contact or line-contact with a transfer paper conveyed.

[0055] A transfer paper P drawn out from the paper feeding cassette 10 by the paper feeding roller 12 to be fed passes through a registration sensor 23 and abuts on a nip section between respective rollers of the registration roller pair which is put in stopped state of rotation to form a predetermined loop and stop once. A skewed state of the transfer paper P is corrected by the loop formation.

[0056] On the other hand, while the image carrier 1 is rotationally driven in a counterclockwise direction on Fig. 10, a surface thereof is uniformly charged to a predetermined polarity by the charging roller 2. Photo-modulated Laser light L which is emitted from the light writing device 3 is irradiated on the charged surface and scanned so that a predetermined latent image is formed on the image carrier surface.

[0057] The latent image is visualized when it passes through the developing unit 4 by toner. The transfer pa-

per P whose skewed state has been corrected is conveyed in the transfer section having the nip section between the image carrier 1 and the transfer roller 6 by the registration roller pair which starts rotation with a timing coincident with the position of a leading edge of the latent image on the image carrier 1 which is rotating in the counterclockwise direction.

[0058] The toner image on the image carrier 1 is sequentially transferred on the transfer paper P fed to the transfer section by the transfer roller 6. The transfer paper P transferred with the toner image is fed to a nip section of the fusing roller pair 7, in which the toner image is fused on the transfer paper P. After the toner image fusing, the transfer paper P is discharged outside of the apparatus by the discharging roller pair 11 to be stacked on the discharged paper tray 9.

[0059] The registration sensor 23 comprising a photosensor is to detect passing-through of the transfer paper P, and it irradiates sensor light towards the reflecting plate 50 and receives reflected light from the reflecting plate 50. Therefore, since there is a difference in received light output level between an instance that a transfer paper P exists in the conveying path and an instance that a transfer paper P does not exist in the conveying path, presence/absence of a transfer paper, namely passing of a transfer paper through the conveying path can be detected.

[0060] Fig. 11 shows a diagram of a driving circuit of the registration sensor. In Fig. 11, the CPU 26 includes a door position determining unit which determines whether or not the closed position of the door after the door has been opened and closed is in a regular closing position. A control signal from the CPU 26 is inputted into the D/A converter 30, where it is converted to an analog signal. The output of the D/A converter 30 is inputted into an operational amplifier 24a and the output of the operational amplifier 24a is inputted into a constant current circuit 24 comprising a transistor 24b and resistors. The LED 23a which is a light emitting element of the registration sensor 23 is driven with a constant current by the constant current circuit 24 to emit a constant amount of light.

[0061] Light of the LED 23a is irradiated on the reflecting plate 50, the reflected light from the reflecting plate 50 is incident on the phototransistor 23b which is a light receiving element of the registration sensor 23, and current corresponding to the amount of the reflected light from the reflecting plate 50 flows into a resistor 27 connected to thephototransistor23b. Therefore, a voltage proportional to the above current is inputted into an A/D converter 31 connected to the resistor 27. The voltage is A/D-converted in the A/D converter 31, and the A/D-converted voltage is inputted into the CPU 26.

[0062] Figs. 12 and 13 are explanatory diagram that explains detection operation of a registration sensor. As shown in Fig. 12, the amount of light emitted from the LED 23a is controlled such that the voltage outputted from the phototransistor 23b by receiving reflected light from the reflecting plate 50 becomes 2.5V. Such a control that the output voltage of the phototransistor 23b due to the reflected light from the reflecting plate 50 becomes 2.5V is performed just after a main switch (not shown) is turned ON or each time when image forming operation on N sheets of transfer papers has been completed.

[0063] However, at a time point when the right door 20 is opened at a time of jam of a transfer paper P during an image forming operation or at a time of maintenance and it is further closed, the registration sensor 23 is driven by the control of the CPU 26 and the voltage value of the phototransistor 23b due to the reflected light from the reflecting plate 50 is measured. As explained regarding Fig. 5, such a configuration is employed that, when a difference ΔV in detection level between a measurement value V1 (2.5V) before the door is opened and a value V2 measured after the door is opened and closed is a predetermined value or more, the effect that the door is not closed up to the regular closed position is displayed on the operation section or the display and the image forming operation is stopped.

[0064] During a normal copying or reproducing operation, when a transfer paper P passes through a position of the registration sensor 23, light emitted from the LED 23a is reflected from the transfer paper P, and such a control that the output voltage of the phototransistor 23b becomes 4V is performed by the CPU 26 shown in Fig. 11.

[0065] Fig. 13 is a flowchart of a control operation in an instance that a door opening and closing operation occurs. In Fig. 13, when an operator opens the right door 20 at the time t1 shown in Fig. 5, the value of the voltage outputted by the light receiving element of the registration sensor 23 receiving light emitted form the light emitting element of the registration sensor 23 and reflected from the reflecting plate 50 is stored in the memory as a detection value V1 at Step S21.

[0066] At Step S22, when it is detected that the right door 20 has been closed by the operator, the control proceeds to Step S23, where the value of the voltage outputted by the light receiving element of the registration sensor 23 receiving light emitted from the light emitting element of the registration sensor 23 and reflected from the reflecting plate 50 at the time t2 shown in Fig. 5 is detected and this value is defined as a detection value V2. Next, the control proceeds to Step S24 where the detection value V1 stored in the memory at Step S21 is compared with the detection value V2 obtained at Step S23.

[0067] When the determination at Step S24 is V1 - V2 > 0.5, by CPU 26, the control proceeds to Step S25, where the warning indicating the effect that the closing of the door is incomplete is displayed on the operation section, and start of an image forming operation is inhibited and a service man calling is prompted. When the determination at Step S24 is not V1 - V2 > 0.5, for example, V1 = V2, an ordinary image forming operation is

made possible.

[0068] Thus, in instance that the closing of the door is incomplete, since set inferiority of the right door 20 is displayed by control of the CPU 26 and the image forming operation of the apparatus is made impossible, transfer inferiority or conveying failure of a transfer paper due to that the right door 20 is not in the regular position can be prevented.

[0069] The connection of the CPU, the door switch and the registration sensor is made in the same manner as the instance of the embodiment shown in Fig. 7 and explanation thereof will be omitted. The detection control about whether the door is in the regular closed position is performed by the registration sensor 23 and the CPU 26 only at an opening and closing time of the door switch.

[0070] Since the operation of the detection control about whether or not the door is in the regular closed position is also the same as the operation of the detection control of the above-mentioned embodiment shown in Fig. 8, explanation thereof will be omitted.

[0071] According to the embodiments described above, since a determination can be made about whether or not the closed position of the door 20 is in the regular closing position by the registration sensor 23, an operator can be prevented from performing an image forming operation in a state where he/she overlooks transfer inferiority or conveying failure due to an incomplete closing of the door without adding any device or part which detects an incompletely closed state of the door 20.

[0072] Also, since the function serving as the guide plate for a transfer paper in the transfer paper conveying path is given to the reflecting plate 50 combined with the registration sensor 23, the number of guide plates can be reduced, which results in cost reduction. Further, since the surface of the reflecting plate 50 comes in contact with transfer papers, toner particles or paper powder are prevented from being deposited on the surface of the reflecting plate 50 so that the light irradiated from the registration sensor can always be returned back to the registration sensor at a constant reflectance. In addition, since the reflecting plate 50 has the function serving as the guide plate for a transfer paper and it is curved, guiding of transfer papers can be performed smoothly.

[0073] According to the present invention, since the detection value of the skin section on the image carrier detected by the toner density detection sensor at the time of the last image forming operation and the detection value of the skin section on the image carrier detected by the toner density detection sensor at a time of door opening and closing are compared with each other and determination is made on the basis of a difference between these detection values about whether or not the closed position of the door after the opening and closing of the door is in the regular closing position, an operator can be prevented from performing an image forming operation in a state where he/she overlooks transfer inferiority or conveying failure due to an incomplete closing of the door without adding any device or part which detects an incompletely closed state of the door.

[0074] Also, an image forming operation can be prevented from being performed while an operator overlooks a toner density control abnormality due to an erroneous detection of the toner density detection sensor.

[0075] The present document incorporates by reference the entire contents of Japanese priority documents, 2001-086611 filed in Japan on March 26, 2001, 2001-175610 filed in Japan on June 11, 2001 and 2002-46268 filed in Japan on February 22, 2002.

[0076] Although the invention has been described with respect to a specific embodiment 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 which fairly fall within the basic teaching herein set forth.

Claims

1. An electrophotographic apparatus comprising a developing device 4 arranged in the vicinity of an image carrier 1, a transferring device 6 which transfers a toner image formed on the image carrier 1 to a transfer paper, and a toner density detection sensor 23 which detects a density of the toner image formed on the image carrier 1, where the toner density detection sensor 23 is disposed on a door 20 which is opened and closed in the vicinity of the image carrier 1 and the toner density detection sensor 23 can detect the density of the toner image on the image carrier 1 in a state where the door 20 has been closed,

   wherein the apparatus further comprises a door position determining unit 26 which compares a density detection value of a surface of the image carrier 1 which has been detected by the toner density detection sensor 23 before an operation of opening the door 20 is performed and another density detection value of the surface of the image carrier which has been detected by the toner density detection sensor 23 after the door 20 has been opened and closed with each other to determine on the basis of a difference between the detection values whether the closed position of the door 20 after opening and closing operations is in a regular closing position.

2. The electrophotographic apparatus according to claim 1, wherein the toner density detection sensor 23 detects the density of the skin section of the surface of the image carrier 1.

3. The electrophotographic apparatus according to claim 1, wherein the door 20 has a transfer roller 6, and the transfer roller 6 is arranged so as to be positioned above the developing device 4 to come into pressure-contact with a image carrier 1 and come into pressure-contact with a portion of the image carrier 1 positioned downstream of a detection section of the image carrier which is detected by the toner density detection sensor 23 regarding a rotation direction of the image carrier 1, when the door 20 is closed.

4. The electrophotographic apparatus according to claim 1, wherein the door 20 has one of registration rollers 5 paired, and the one of the registration rollers 5 is brought into pressure-contact with the other of the registration rollers 5, when the door 20 is closed.

5. The electrophotographic apparatus according to claim 1, wherein the door 20 has a transfer roller 6 and one of registration rollers 5 paired, and has the toner density detection sensor 23 between the transfer roller 6 and the one of the registration rollers 5.

6. An electrophotographic apparatus which has a reflecting plate 50 which is arranged on a door 20 section opposed to a registration sensor 23 and is caused to approach to and separate from the registration sensor 23 according to opening and closing operations,

wherein the apparatus comprises a door position determining unit 26 which compares a detection value of reflection light from the reflecting plate 50, which has been detected by the toner density detection sensor 23 before an operation of opening the door 20 is performed and another detection value of reflection light from the reflecting plate 50, which has been detected by the toner density detection sensor 23 after the door 20 has been opened and closed with each other to determine on the basis of a difference between the detection values whether the closed position of the door 20 after opening and closing operations is in a regular closing position.

7. The electrophotographic apparatus according to claim 6, wherein the reflecting plate 50 has a function serving as a transfer paper guiding plate 50 in a conveying path for a transfer paper.

8. The electrophotographic apparatus according to claim 6, wherein the reflecting plate 50 is curved.

9. A cover opening/closing detecting method of an electrophotographic apparatus, comprising a developing device arranged in the vicinity of an image carrier, a transferring device which transfers a toner image formed on the image carrier to a transfer paper, and a toner density detection sensor which detects a density of the toner image formed on the image carrier, where the toner density detection sensor is disposed on a door which is opened and closed in the vicinity of the image carrier and the toner density detection sensor can detect the density of the toner image on the image carrier in a state where the door has been closed,

the method comprising the steps of: detecting a toner density of a surface of the image carrier by the toner density detection sensor before an operation of opening the door is performed and detecting a toner density of the surface of the image carrier by the toner density detection sensor after the door is opened and closed; comparing the detection value of the toner density before the door is opened and the detection value of the toner density after the door is opened and closed with each other; and determining whether the closed position of the door after the opening and closing operations of the door is in a regular closing position on the basis of a difference between the detection values.

10. A method of detecting opening and closing of a cover of an electrophotographic apparatus according to claim 9, wherein the toner density detection sensor detects the toner density of a skin section of the image carrier.

11. A cover opening/closing detecting method of an electrophotographic apparatus which has a reflecting plate which is arranged on a door section opposed to a registration sensor and is caused to approach to and separate from the registration sensor according to opening and closing operations, comprising the steps of:

detecting reflected light from the reflecting plate by the registration sensor before an operation of opening the door and detecting reflected light from the reflecting plate by the registration sensor after the door is closed; comparing the detection value before the door is opened and the detection value after the door is opened and closed with each other; and determining whether the closed position of the door after the opening and closing operations of the door is in a regular closing position on the basis of a difference between the detection values.

FIG.1

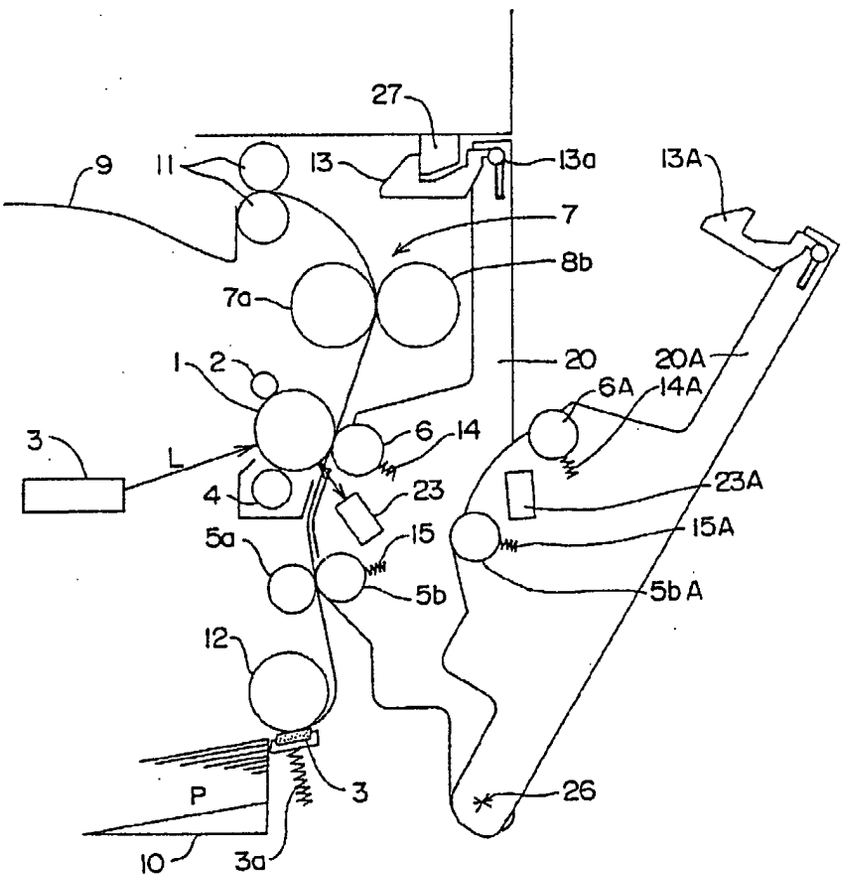

27
9
11
13
13a
13A
7
8b
7a
20
20A
1
2
6A
14A
3
L
6
14
4
23
23A
5a
15
15A
5b
5b A
12
P
3
26
10
3a

FIG.2

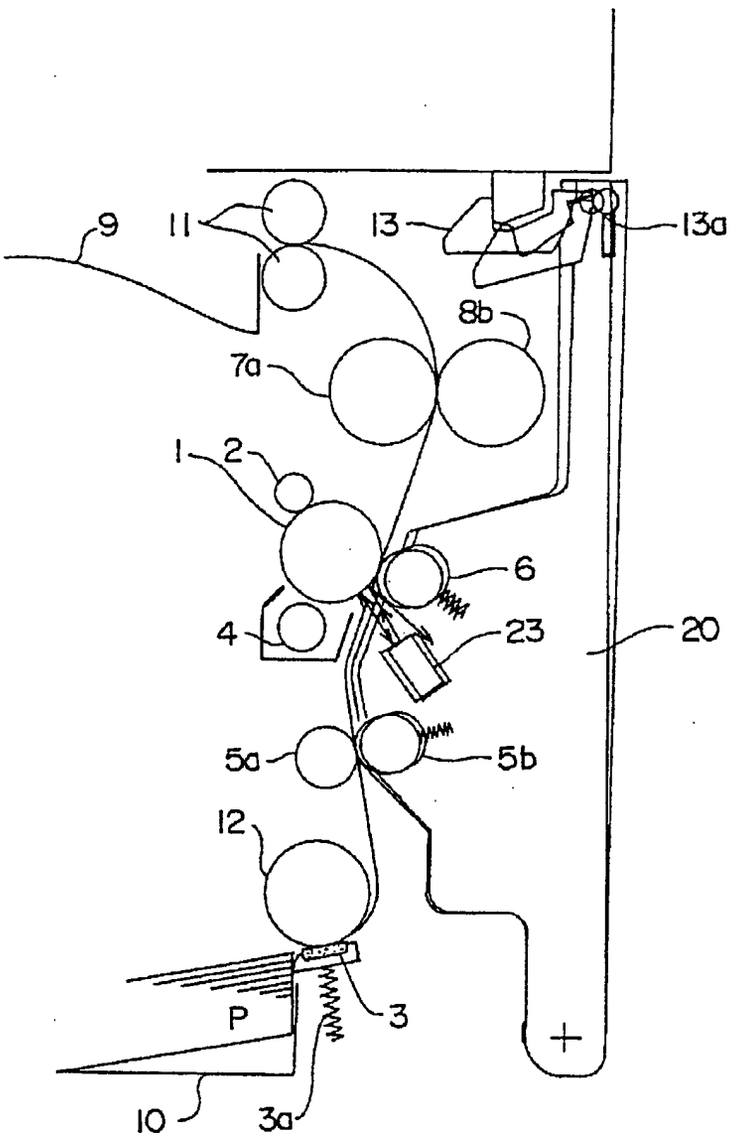


FIG.3

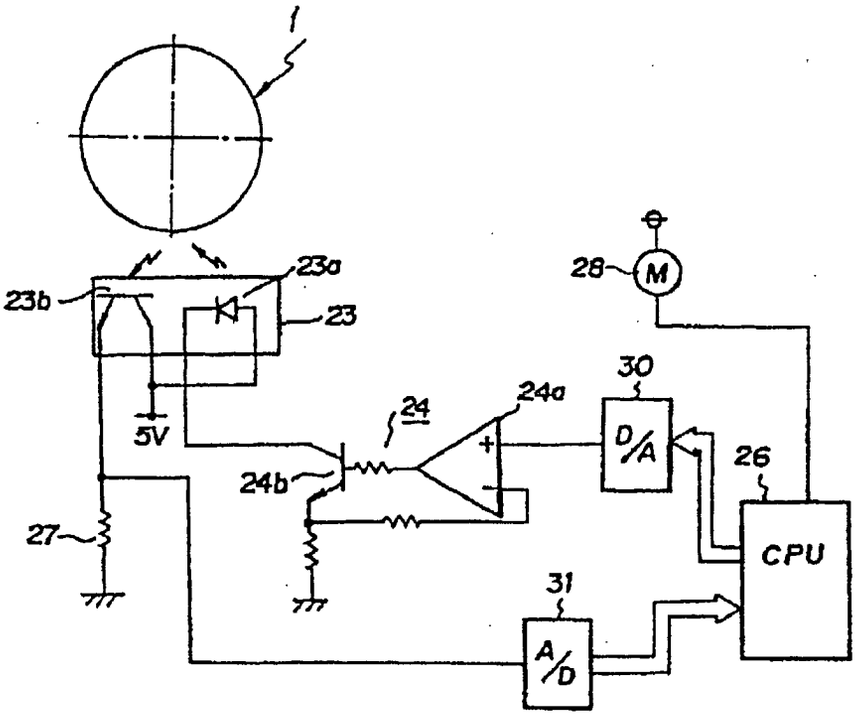

1
23a
23b
23
28
M
30
24
24a
5V
D/A
26
24b
27
CPU
31
A/D

FIG.4

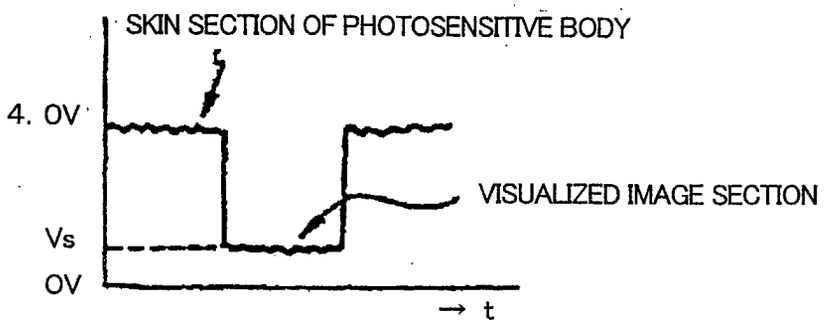

SKIN SECTION OF PHOTOSENSITIVE BODY
4. OV
VISUALIZED IMAGE SECTION
Vs
OV
t

FIG.5

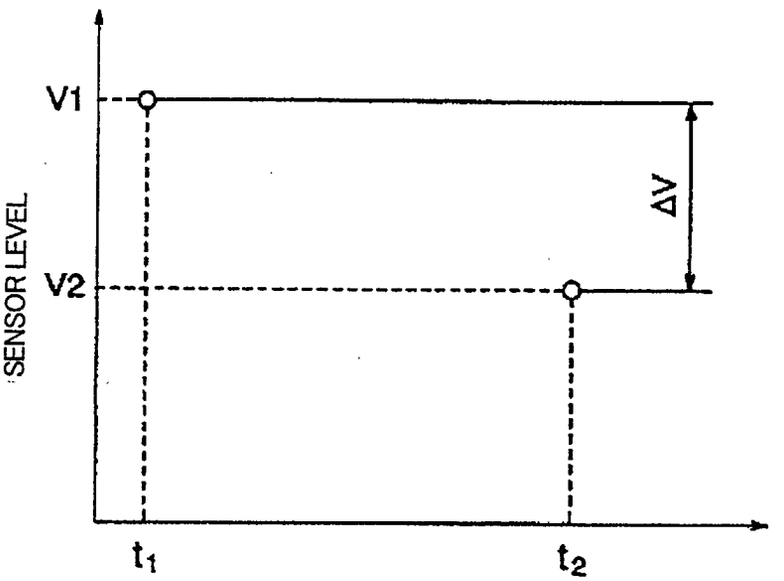


FIG.6

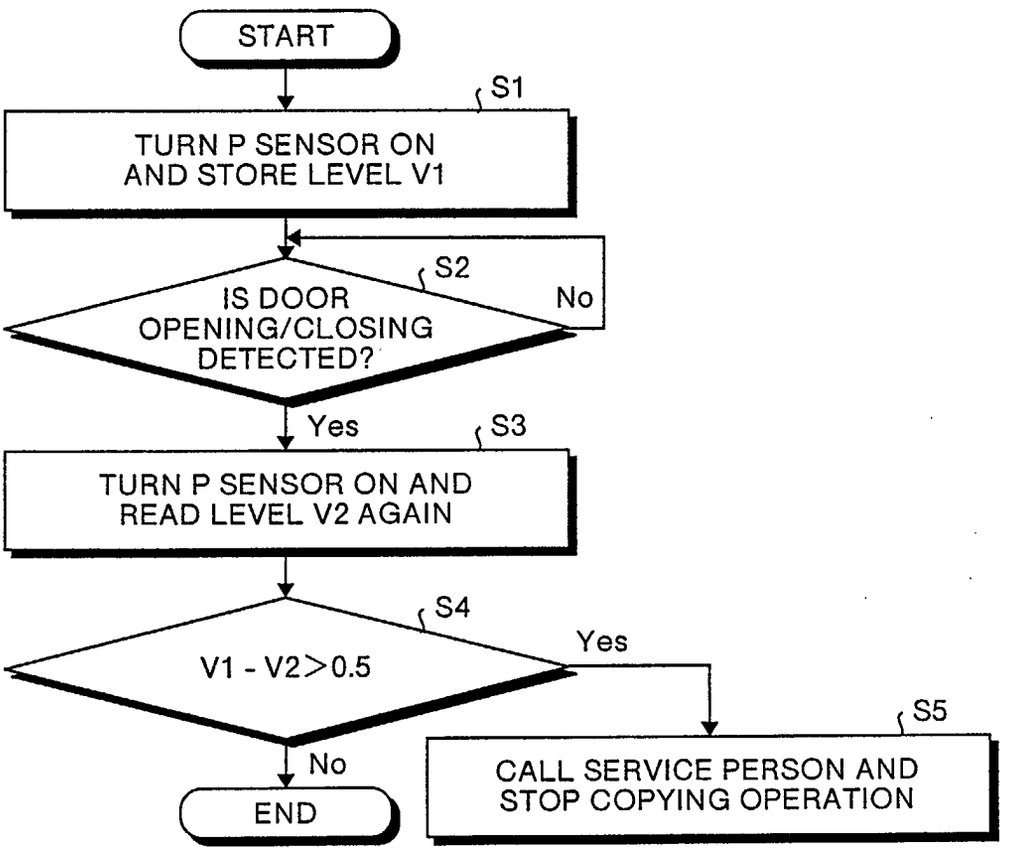
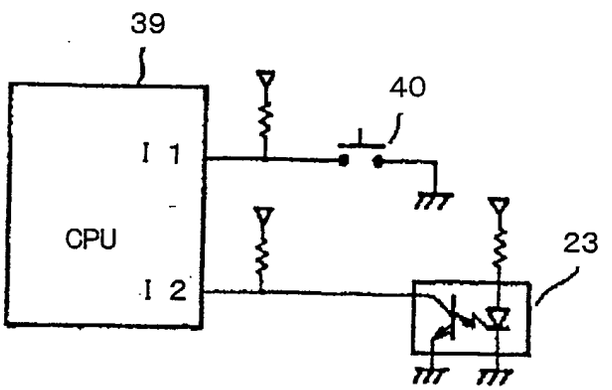

START
S1
TURN P SENSOR ON AND STORE LEVEL V1
S2
IS DOOR OPENING/CLOSING DETECTED?
No
Yes
S3
TURN P SENSOR ON AND READ LEVEL V2 AGAIN
S4
V1 - V2>0.5
Yes
S5
CALL SERVICE PERSON AND STOP COPYING OPERATION
No
END

FIG.7



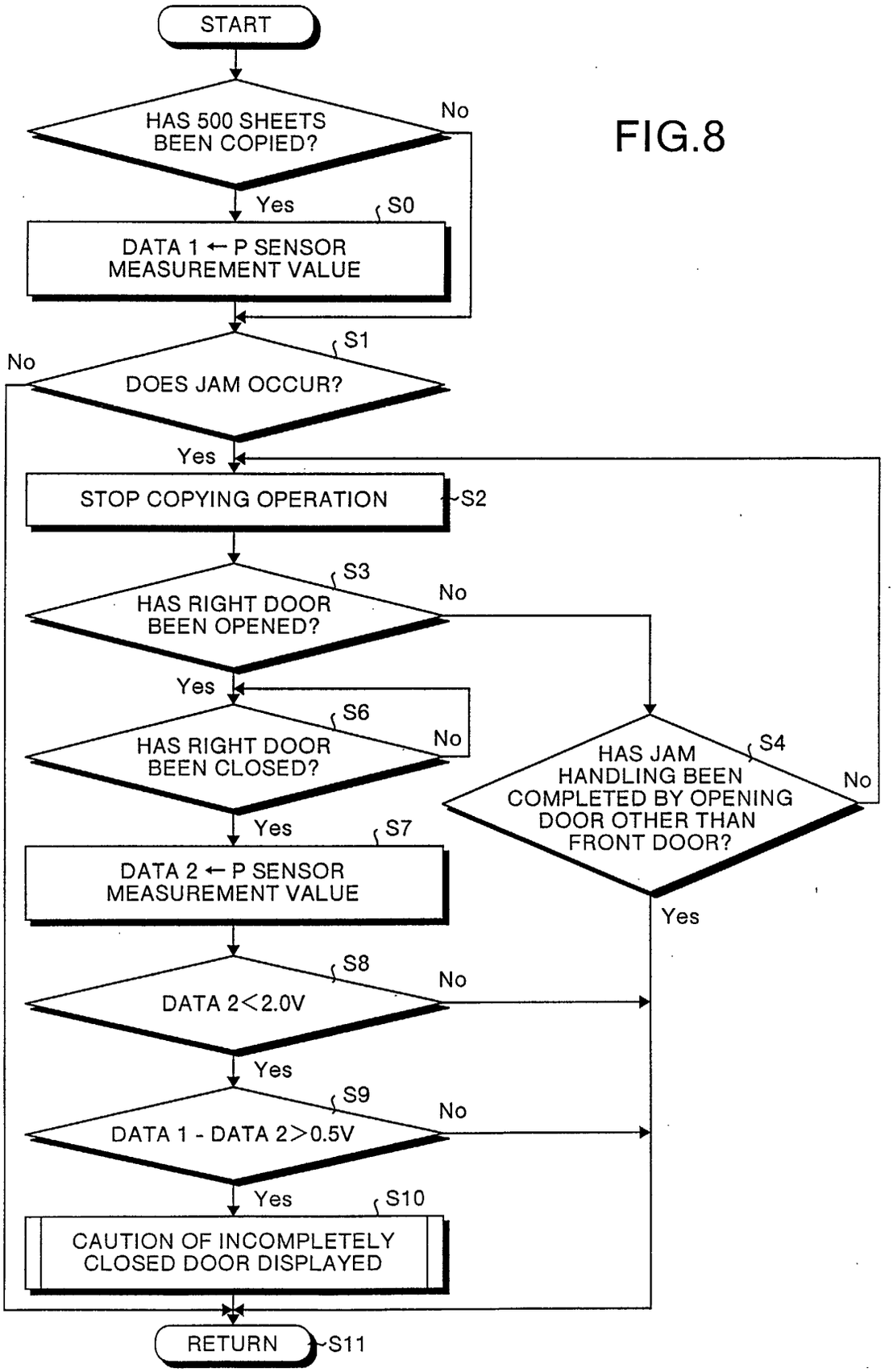

START
HAS 500 SHEETS BEEN COPIED?
No
Yes
S0
DATA 1 ← P SENSOR MEASUREMENT VALUE
S1
No
DOES JAM OCCUR?
Yes
STOP COPYING OPERATION
S2
S3
HAS RIGHT DOOR BEEN OPENED?
No
Yes
S6
HAS RIGHT DOOR BEEN CLOSED?
No
Yes
S7
DATA 2 ← P SENSOR MEASUREMENT VALUE
S4
HAS JAM HANDLING BEEN COMPLETED BY OPENING DOOR OTHER THAN FRONT DOOR?
No
Yes
S8
DATA 2<2.0V
No
Yes
S9
DATA 1 - DATA 2>0.5V
No
Yes
S10
CAUTION OF INCOMPLETELY CLOSED DOOR DISPLAYED
RETURN
S11

FIG.8

FIG.9

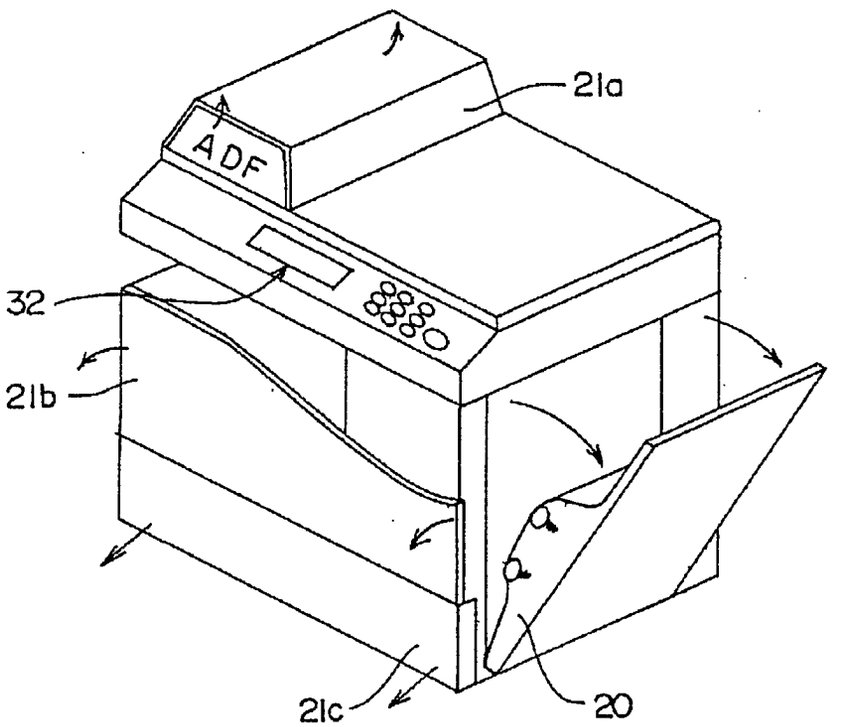


FIG.10

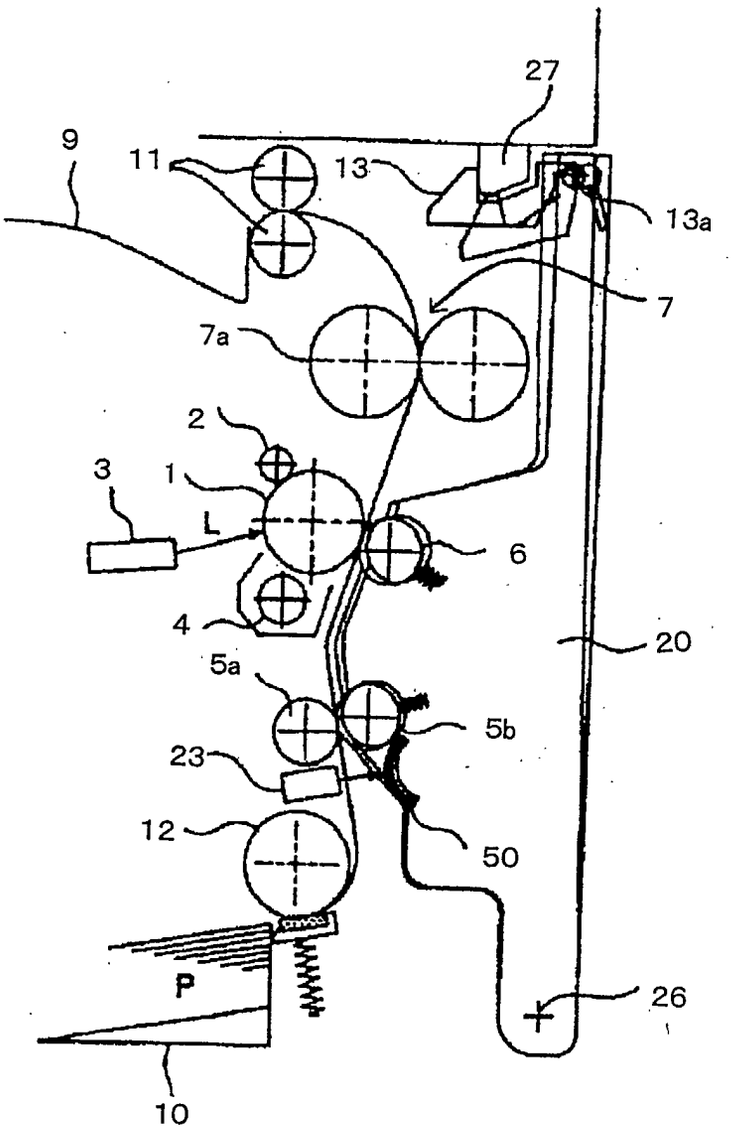


FIG.11

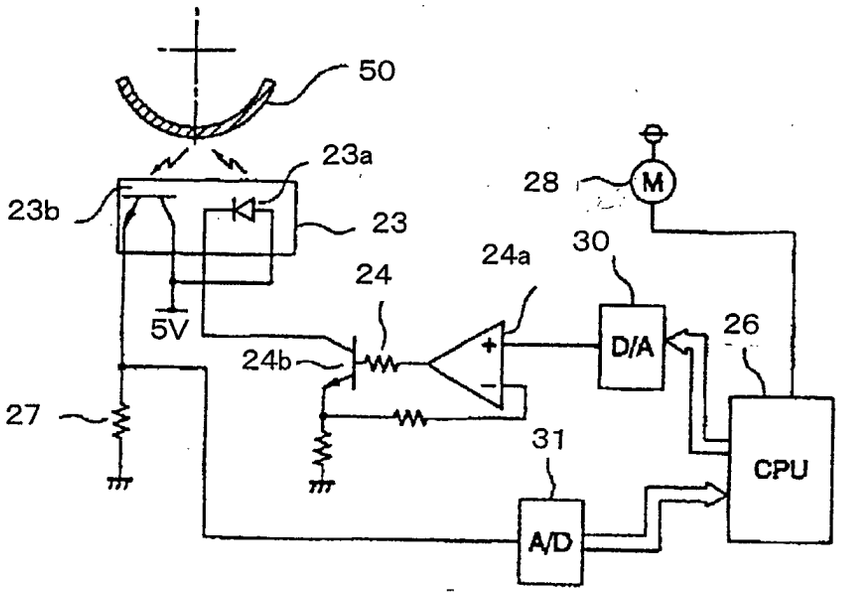

50
23a
23b
23
28
M
30
24a
24
5V
26
D/A
24b
27
31
CPU
A/D

FIG.12

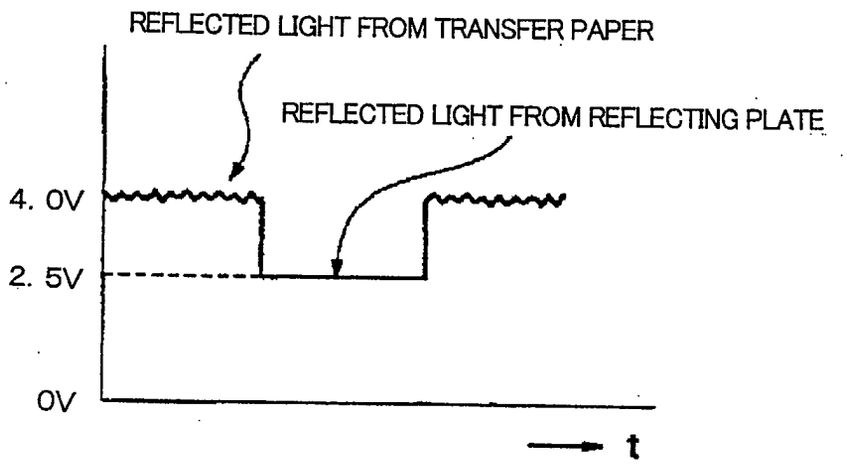
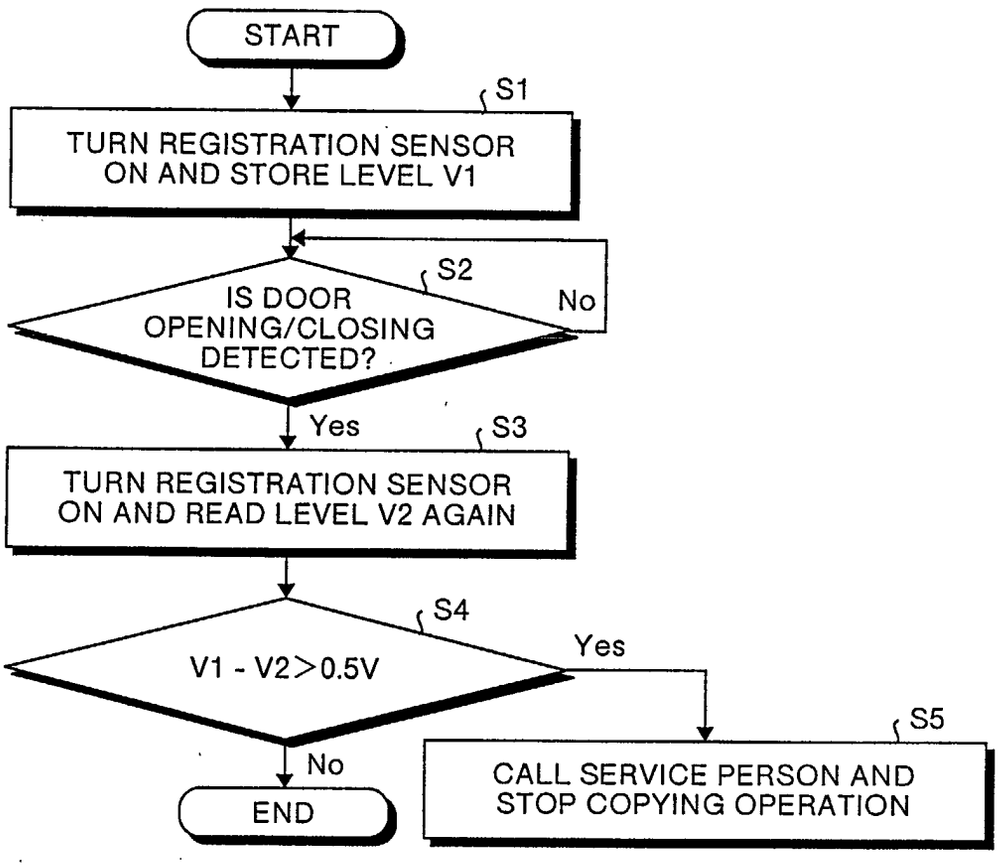

REFLECTED LIGHT FROM TRANSFER PAPER
REFLECTED LIGHT FROM REFLECTING PLATE
4. 0V
2. 5V
0V
t

FIG.13


START
S1
TURN REGISTRATION SENSOR ON AND STORE LEVEL V1
S2
IS DOOR OPENING/CLOSING DETECTED?
No
Yes
S3
TURN REGISTRATION SENSOR ON AND READ LEVEL V2 AGAIN
S4
V1 - V2>0.5V
Yes
No
S5
CALL SERVICE PERSON AND STOP COPYING OPERATION
END