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(54) Electrophotographic copying machine and method for detecting density of original image thereof.

(57) An electrophotographic copying machine includes a detecting device (12) for detecting an original image density by scanning an original before a copy is taken, an inputting device (6,7) for specifying a desired region where the original image density is detected by the detecting device, an exposing device (9) for exposing the original with an amount of light corresponding to the detected original image density at the time of copying, a converting device (10) for converting light from the exposed original to image light, a photoconductor (13) receiving the image light and forming an electrostatic latent image, a developer (15) for developing the electrostatic latent image of the photoconductor using toner, and a transcriber (14) for transferring the developed image to paper.

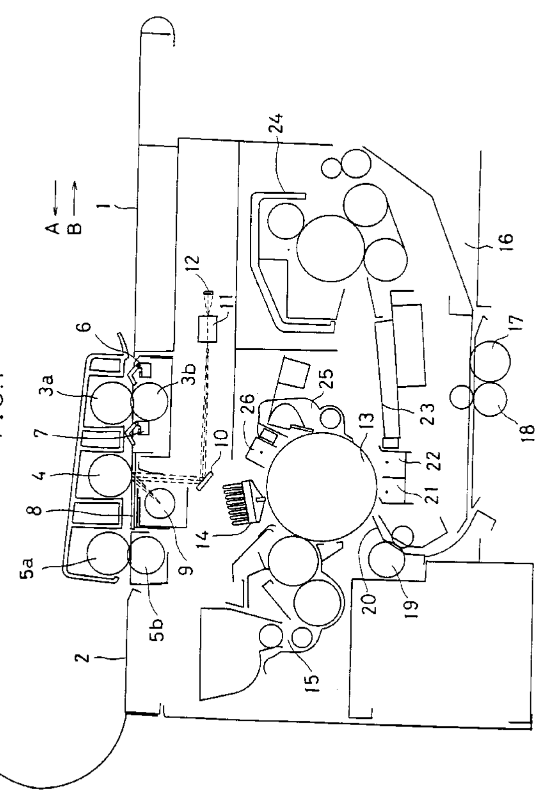

FIG.1

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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an electrophotographic copying machine which automatically exposes an original and a method for automatically detecting density of an original image.

2. Description of the Prior Art

Conventionally, in such an electrophotographic copying machine, data obtained by scanning a region having a constant width and a predetermined length from an end of an original by a density detector is regarded as density of an original image.

However, in the conventional copying machine, even if there is a region having an extremely high or low density in the original image, the density in that region is detected as density of the whole original. Therefore, when a copy is taken on the basis of the detected data, a copy image has density which is not desired by the user.

SUMMARY OF THE INVENTION

According to the invention, there is provided an electrophotographic copying machine comprising detecting means for detecting an original image density by scanning an original before a copy is taken, inputting means for specifying a desired region where the original image density is detected by the detecting means; exposing means for exposing the original with an amount of light corresponding to the detected original image density at the time of copying, converting means for converting light from the exposed original to image light, a photoconductor receiving the image light and forming an electrostatic latent image, a developer for developing the electrostatic latent image of the photoconductor using toner, and a transcriber for transferring the developed image to paper.

The detecting means may further read image data from the original and the converting means may comprise means for converting the image data to the image light.

The inputting means may comprise selecting means for selecting a desired region from among a plurality of previously set regions.

The inputting means is preferably means for specifying a length and width of a desired region.

The exposing means preferably exposes the original with a light amount corresponding to an average value of the original image density detected by the detecting means.

The detecting means may comprise a light receiving element array or a single light receiving element.

Further, according to the present invention, there is provided a method for detecting density of an original image in an electrophotographic copying machine in which a copy is taken by exposing the original with an amount of light corresponding to the original image density, the method comprising the steps of specifying a desired region where the original image density is detected, detecting the original image density in the specified region by scanning the original before copying operation and exposing the original with a light amount corresponding to the detected original image density at the time of copying.

The step of specifying the region may further comprise the step of selecting a desired region from among a plurality of previously set regions.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a view showing a structure in accordance with a first embodiment of the present invention.

Fig. 2 is a view showing a main part of the structure shown in Fig. 1.

Fig. 3 is a block diagram showing a control circuit in accordance with the first embodiment of the present invention.

Figs. 4(A) and 4(B) are flowcharts for describing operation in accordance with the first embodiment of the present invention.

Fig. 5 is a view showing a main part of a structure in accordance with a second embodiment of the present invention, which corresponds to Fig. 2.

Fig. 6 is a block diagram showing a control circuit in accordance with the second embodiment of the present invention.

Figs. 7(A) and 7(B) are flowcharts for describing operation in accordance with the second embodiment of the present invention.

Fig. 8 is a view showing a structure in accordance with a third embodiment of the present invention.

Fig. 9 is a block diagram showing a control circuit in accordance with the third embodiment of the present invention.

Figs. 10(A) and 10(B) are flowcharts for describing operation in accordance with the third embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First to third embodiments of the present invention will be described in reference to the drawings hereinafter. However, the present invention is not limited to these embodiments. In addition, the same reference is allotted to common components in the first to third embodiments of the present invention.

[First embodiment]

Fig. 1 is a view showing a structure of a digital electrophotographic copying machine in accordance with a first embodiment of the present invention. In Fig. 1, reference numerals 1 and 2 designate original platens, reference numerals 3a and 3b designate front feed-rollers, reference numeral 4 designates a middle feed-roller, reference numerals 5a and 5b designate rear feed-rollers, reference numeral 6 designates a switch for detecting the front end of an original, reference numeral 7 designates a switch for detecting the rear end of the original, reference numeral 8 designates a contact glass for supporting the original, reference numeral 9 designates an exposure lamp for exposing the original, reference numeral 10 designates a mirror for guiding reflected light from the original irradiated by the exposure lamp 9 to an imaging lens 11, and reference numeral 12 designates a light receiving sensor which receives image light from the lens 11. In addition, this light receiving sensor 12 is a light receiving element array comprising a multiple of light receiving elements, which is, for example a CCD sensor.

In addition, reference numeral 13 designates a photosensitive drum, reference numeral 14 designates an LED head for writing image data detected by the light receiving sensor 12 on the photosensitive drum 13 as an electrostatic latent image and reference numeral 15 designates a developing device for developing the electrostatic latent image written in the photosensitive drum 13. Further, reference numeral 16 designates a paper inlet, reference numeral 17 designates an insertion roller for paper, reference numeral 18 designates a resist roller which determines feeding timing of the paper inserted by the insertion roller 17 and then feeds the paper, reference numeral 19 designates front transfer-roller, reference numeral 20 designates a front transfer-guide part, reference numeral 21 designates a transfer charger, reference numeral 22 designates a separating charger, reference numeral 23 designates a carrying guide plate, reference numeral 24 designates a fixing device, reference numeral 25 designates a cleaning part for cleaning the photosensitive drum 13, and reference numeral 26 designates a charger for uniformly charging the photosensitive drum 13. Fig. 2 is a view showing a main part of the copying machine shown in Fig. 1. As shown in Fig. 2, image light from the original is reflected by the mirror 10 and received by the light receiving sensor 12 through the imaging lens 11.

Fig. 3 is a block diagram showing a control circuit of the copying machine shown in Fig. 1. In Fig. 3, reference numeral R1 designates a control part housing a microcomputer therein, reference numeral K1 designates a key through which either automatic exposure or manual exposure is selected, reference numerals K2a and K2b designate input keys for inputting a length and a width of a region of the original whose density is to be detected, respectively, reference character E designates a control circuit for controlling an amount of light from the exposure lump 9, reference character M designates a scanning motor for driving the front feed-rollers 3a and 3b, the middle feed-roller 4 and the rear feed-rollers 5a and 5b, reference character D designates a scanning motor control circuit for controlling the scanning motor M, reference character H designates a clutch for transmitting turning force of the scanning motor M to each feed-roller, which controls a copy operation part C, the light amount control circuit E, the scanning motor control circuit D and the original clutch H in response to outputs from the switches 6 and 7, the light receiving sensor 12 and the input keys K1, K2a and K2b.

Figs. 4(A) and 4(B) show flowcharts for describing the operation of the above structure. First, "automatic exposure" is selected by the key K1 in step 101 and desired length and width of the density detecting region of the original are input by the keys Ka1 and Ka2 in steps 102 and 103. Then, operation for detecting density is started in step 104. More specifically, when the original is inserted from the original platen 1 and the switch 6 is turned on, the original clutch H, the scanning motor M and the exposure lamp 9 are turned on in step 106. Then, when the original is sent in a direction shown by an arrow A and the switch 7 is turned on in step 107, a timer (housed in the control part R) for measuring a moving distance of the original in the feeding direction starts counting in step 108. Then, when the front end of the specified region reaches the middle feed-roller 4, the control part R1 starts detecting the density of the original image by the light receiving sensor 12 in steps 109 and 110. Then, when the rear end of the specified region passes through the middle feed-roller 4 in step 111, the control part R1 completes image density detecting operation of the light receiving sensor 12 in step 112. Then, the control part R1 averages the density of the original image and decides the amount of light from the exposure lamp 9 in step 113. Next, the original clutch H, the scanning motor M and the exposure lamp 9 are turned off in step 114. Then, the original clutch H is turned on and the scanning motor M is reversed and then the original is sent in a direction shown by an arrow A in step 115. The original is sent in the direction shown by the arrow B until the switch 7 and the original select switch 6 are both turned off in steps 116 and 117. Then, the original clutch H and the scanning motor M are turned off. In this state, the original is returned to the original platen 1 and can be in a state capable of being copied in step 119. In addition, in the above operation, only a light receiving element of the light receiving sensor 12 in a range corresponding to the width of the original set by the key K2b detects the image density. According to the first embodiment of the present invention, the light receiving sensor 12 serves as both an image density detecting sensor and an original image data detecting sensor. In copying operation after the step 119, the original is irradiated by the exposure lamp 9 and then the light receiving sensor 12 receives the image light from the original and then converts it to image data. This image data is written in the photosensitive drum 13 as an electrostatic latent image by the LED head 14 and developed by the developer 15. The developed image is transferred to the paper by the transfer charger 21 and the transferred paper is separated from the photosensitive drum 13 by the separating charger 22, fixed at the fixing device 24 and then discharged. Thus, the original image density of the region which is manually set according to user's preference is automatically detected, whereby the amount of exposure of the exposure lamp 9 can be automatically controlled while copying operation is performed. As a result, it is possible to take a copy having image density which is desired by the user.

[Second embodiment]

Fig. 5 is a view showing a structure in accordance with a second embodiment of the present invention, which corresponds to Fig. 2. Referring to Fig. 5, the light receiving sensor 12 shown in Fig. 1 comprises three light receiving sensors (for example CCD sensors) 12a, 12b and 12c which separately receive image light reflected by the mirror 10 through imaging lenses 11a, 11b and 11c, respectively. Other structure is the same as that shown in Fig. 1.

Fig. 6 is a block diagram showing a control circuit in accordance with the second embodiment of the present invention. In Fig. 6, reference numeral R2 designates a control part housing a microcomputer therein, reference numeral K3 designates a select key for selecting the light receiving sensor for detecting the density of the original image from among three sensors 12a, 12b and 12c. Other respects are the same as those shown in Fig. 3.

Figs. 7(A) and 7(B) are flowcharts for describing operation of the structure in accordance with the second embodiment of the present invention. First, " automatic exposure " is selected by the key K1 in step 201 and then a range for detecting the original image density in the original feeding direction is input from the key A2 in step 202. Then, the sensor for detecting the original image density is selected from among the light receiving sensors 12a, 12b and 12c by the key K3 in step 203. Then, similar to the first embodiment of the present invention, the original is scanned in steps 204 to 207. When at least one light receiving sensor is selected in steps 208 and 209, the timer (housed in the control part R2) for detecting a position of the original in the feeding direction starts counting in step 211. When the original reaches the starting position of the image density detection, which was input by the key K2, in step 212, the original image density is detected by the selected light receiving sensor in step 213. Then, when the original image density in a range of the original in the feeding direction input by the key K2 is detected in step 214, the detecting operation of the original image density by the light receiving sensor is completed in step 215. The following operations in steps 217 to 222 are the same as those in steps 113 to 119 shown in Fig. 4(B). Then, in the copying operation, the original is irradiated with an amount of light of the exposure lamp 9 corresponding to the original image density detected by any one of light receiving sensors 12a to 12c as described above. Then, image data having density corresponding to an amount of irradiation of the exposure lamp 9 is detected by three light receiving sensors 12a to 12c. The image data detected by each light receiving sensor is composed in the control part R2 and output to the copy operation part C. More specifically, the image data is written in the photosensitive drum 13 by the LED head 14 and transferred to the paper in the same manner as in the first embodiment of the present invention.

As described above, according to this embodiment of the present invention, since a region in a longitudinal direction (feeding direction) of the original can be optionally set and the region in the width direction of the original can be selected corresponding to any one of the light receiving sensors 12a to 12c, the original image density of the region the user specified can be detected and a copy is taken on the basis of the detected density.

[Third embodiment]

Fig. 8 is a view showing an analog electrophotographic copying machine in accordance with a third embodiment of the present invention. In Fig. 8, reference numeral 27 designates an imaging lens for forming an image on the photosensitive drum 13 with image light from the original irradiated by the exposure lamp 9, reference numeral 28 designates a light receiving sensor comprising a single light receiving element (for example, phototransistor), which receives a part of image light from the original irradiated by the exposure lamp 9 and others are the same as in Fig. 1.

Fig. 9 is a block diagram showing a control circuit of the electrophotographic copying machine shown in Fig. 8. In Fig. 9, reference numeral R3 designates a control part housing a microcomputer, which receives outputs from the switch 6 for detecting the front end of the original, the switch 7 for detecting the rear end of the original, the light receiving sensor 27, the automatic exposure/manual exposure select key K1 and the input key K2a for inputting the original image density detecting length and outputs them to the original clutch H, the copy operation part C, the light amount control circuit E and the scanning motor control circuit D.

Figs. 10(A) and 10(B) are flowcharts for describing the operation of the above structure. First, "automatic exposure" is selected by the key k1 in step 301. Then, when a length for detecting the original image density (a range in the original feeding direction) is input from the key K2a in steps 302 and 303, scanning operation is started in steps 304 to 307 in the same manner as in the above embodiments of the present invention. Then, the timer (housed in the control part R3) for detecting a position of the original in the feeding direction starts counting in step 308. Then, when the original reaches the position where the original image density detecting is started, which is input by the key K2a, in step 309, the light receiving sensor 27 starts detecting the original image density in step 310. Then. when the original moves by a predetermined length input from the key K2a in step 311, the light receiving sensor 27 completes the operation for detecting the original image density in step 312. Then, average value of the image density detected by the light receiving element 27 is calculated and then an amount of light of the exposure lamp 9 at the time of copying operation is determined in step 313. Then, the original is returned to the original platen 1 in the same manner as in the above embodiments of the present invention and then can be in a state capable of being copied in steps 314 to 319. Then, when the copying operation is started by the copy operation part C, the original is sent from the original platen 1 to the original platen 2. At the same time, the original is irradiated by the exposure lamp 9 and then the image light from the original forms an image on the photosensitive drum 13 through the imaging lens 27. Then, an electrostatic latent image is formed by the formed image light. Thereafter, similar to the first and second embodiments of the present invention, the image is transferred to the paper which is inserted from the paper inlet 16.

Thus, since the region where the original image density is detected can be optionally set in the original feeding direction, it is possible to obtain a copy having density according to user's preference

In addition, although the region for detecting the original image density is input from the key in the above embodiments of the present invention, other means, for example tablet card may be used.

According to the present invention, since density of any region in the original can be detected and accordingly automatic exposure copy is taken, it is possible to obtain a copy according to user's preference.

While only certain presently preferred embodiments have been described in detail, as will be apparent with those skilled in the art, certain changes and modifications can be made without departing from the scope of the invention as defined by the following claims.

Claims

1. An electrophotographic copying machine comprising:
   - detecting means (12,12a,12b,12c;27) for detecting an original image density by scanning an original before a copy is taken;
   - inputting (6,7) means for specifying a desired region where the original image density is detected by the detecting means;
   - exposing means (9) for exposing the original with an amount of light corresponding to the detected original image density at the time of copying;
   - converting means (10) for converting light from the exposed original to image light;
   - a photoconductor (13) receiving the image light and forming an electrostatic latent image;
   - a developper (15) for developing the electrostatic latent image of the photoconductor using toner; and
   - a transcriber (14) for transferring the developed image to paper.

2. An electrophotographic copying machine as set forth in Claim 1, wherein the detecting means further read image data from the original and the converting means comprises means for converting the image data to the image light.

3. An electrophotographic copying machine as set forth in Claim 1, wherein said inputting means comprises selecting means for selecting a desired region from among a plurality of previously set regions.

4. An electrophotographic copying machine as set forth in Claim 1, wherein said inputting means is means for specifying a length and width of a desired region.

5. An electrophotographic copying machine as set forth in Claim 1, wherein said exposing means exposes the original with a light amount corresponding to an average value of the original image density detected by the detecting means.

6. An electrophotographic copying machine as set forth in Claim 1, wherein said detecting means comprises a light receiving element array (12a,126,12c).

7. An electrophotographic copying machine as set forth in Claim 1, wherein said detecting means comprises a single light receiving element (12).

8. A method for detecting density of an original image in an electrophotographic copying

machine in which a copy is taken by exposing original with an amount of light corresponding to the original image density, said method comprising the steps of:

- specifying a desired region where the original image density is detected;
- detecting the original image density in the specified region by scanning the original before copying operation; and
- exposing the original with a light amount corresponding to the detected original image density at the time of copying.

9. A method for detecting density of original as set forth in Claim 8, wherein said step of specifying the region further comprises the step of selecting a desired region from among a plurality of previously set regions.

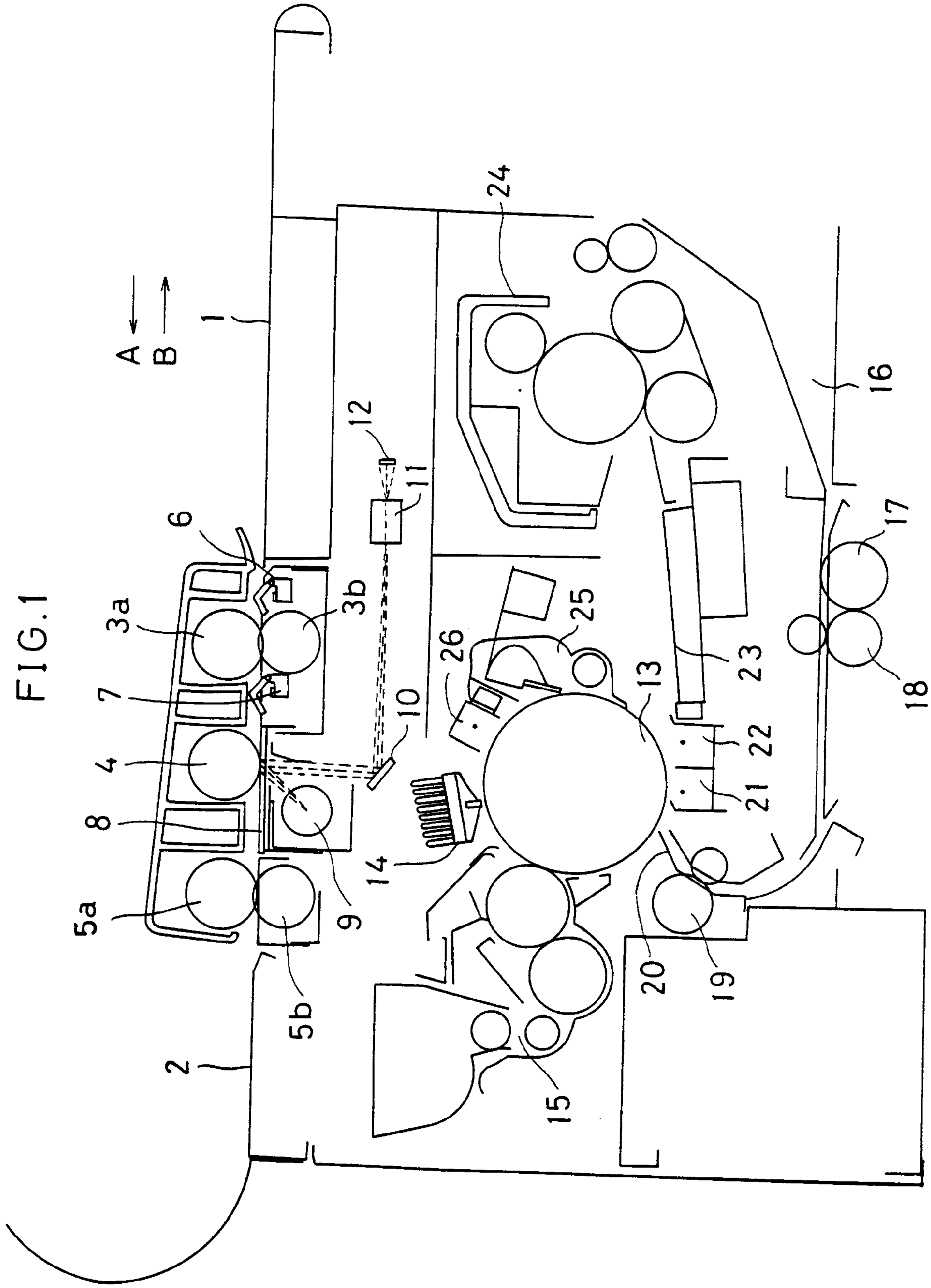

A
B
1
2
3a
3b
4
5a
5b
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

FIG.1

FIG. 2

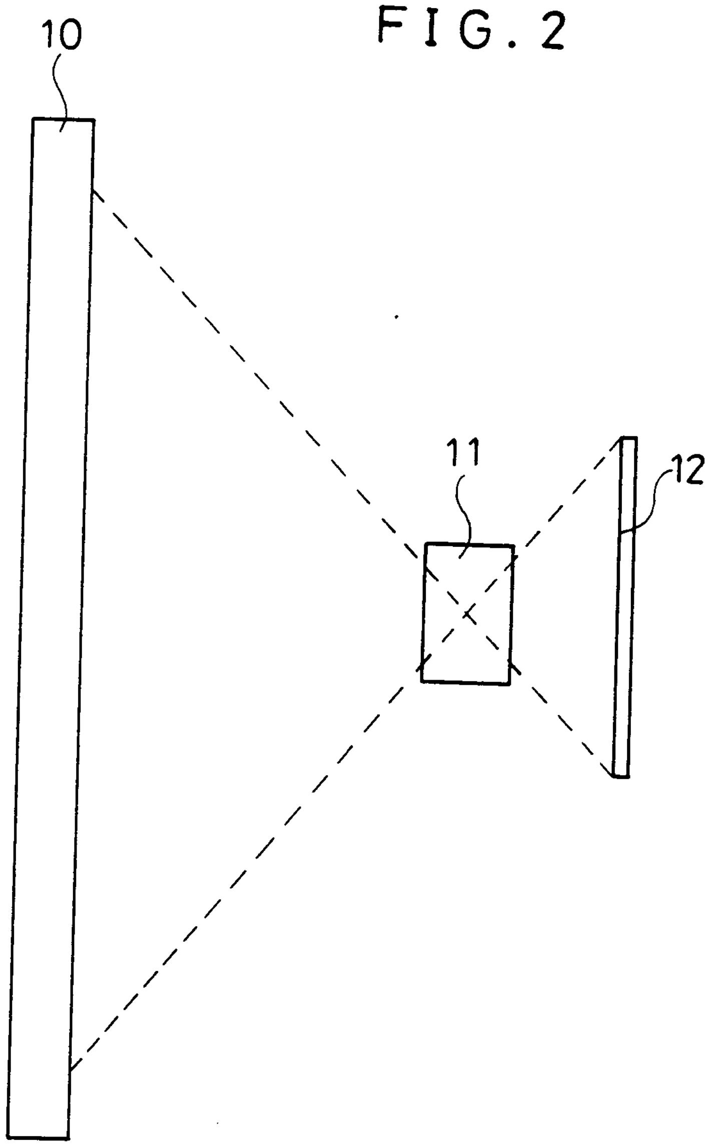


FIG. 3

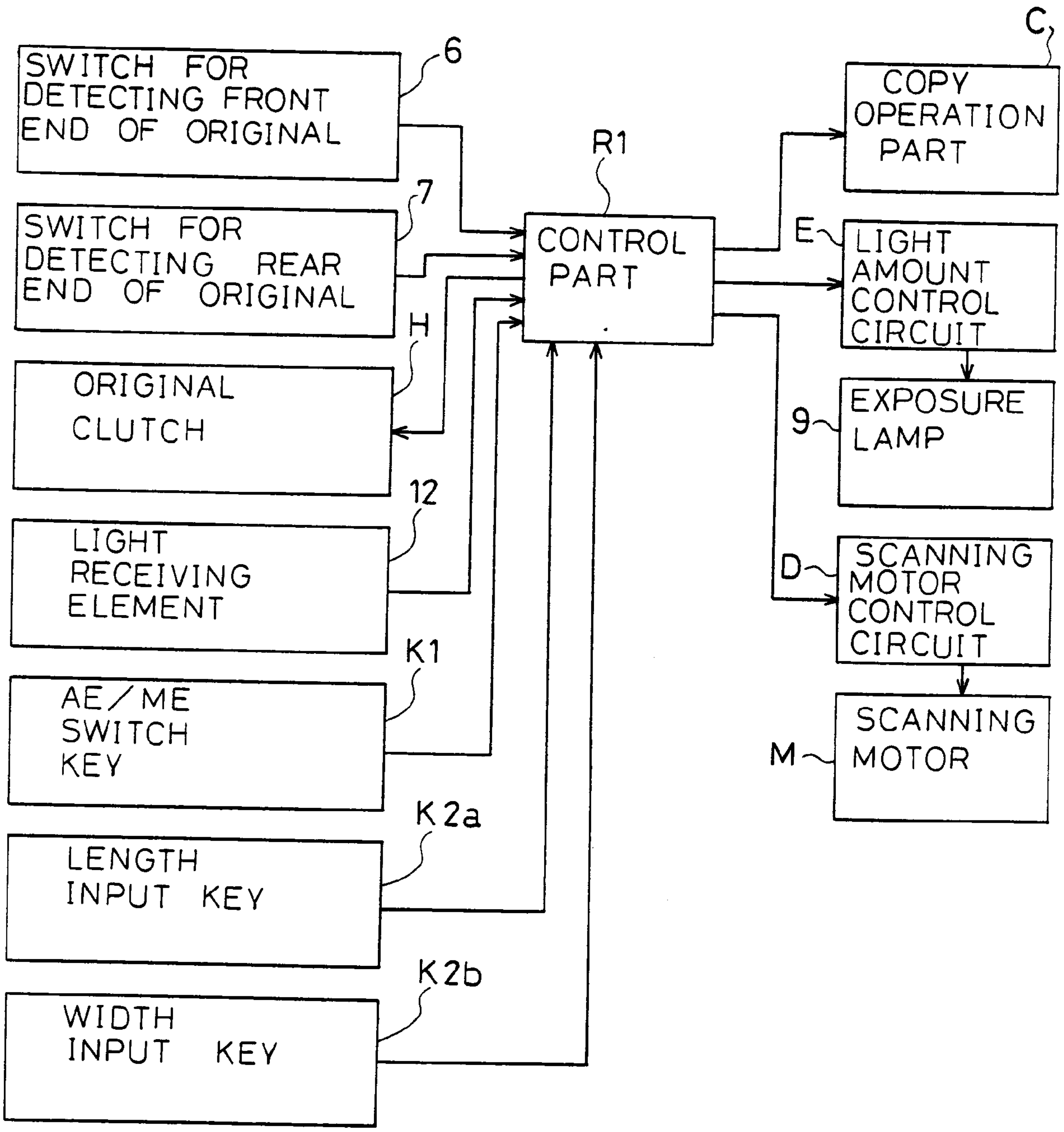
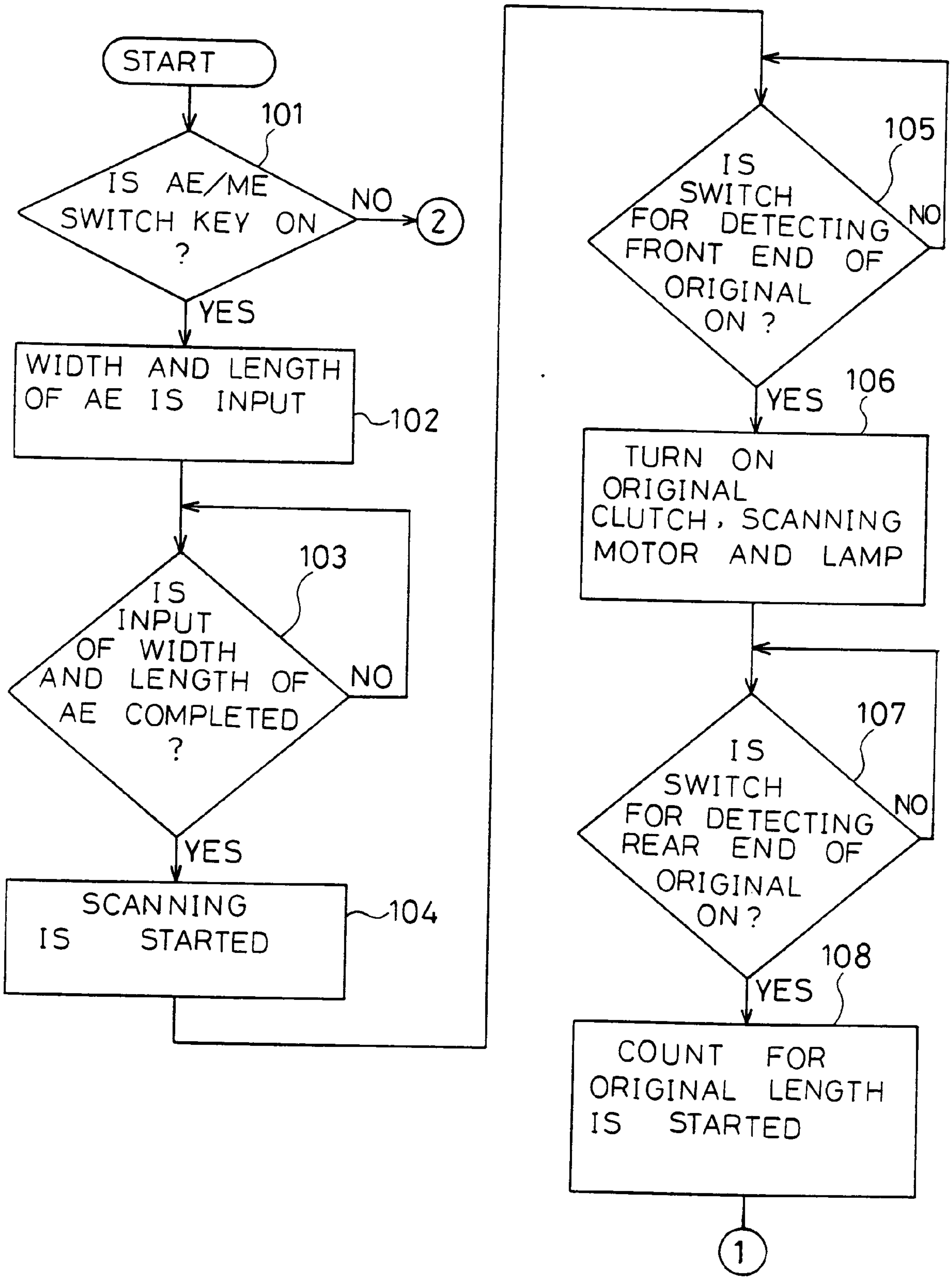

SWITCH FOR DETECTING FRONT END OF ORIGINAL
6
SWITCH FOR DETECTING REAR END OF ORIGINAL
7
ORIGINAL CLUTCH
H
LIGHT RECEIVING ELEMENT
12
AE/ME SWITCH KEY
K1
LENGTH INPUT KEY
K2a
WIDTH INPUT KEY
K2b
CONTROL PART
R1
COPY OPERATION PART
C
LIGHT AMOUNT CONTROL CIRCUIT
E
EXPOSURE LAMP
9
SCANNING MOTOR CONTROL CIRCUIT
D
SCANNING MOTOR
M

FIG. 4 (A)


START
IS AE/ME SWITCH KEY ON ?
101
NO
2
YES
WIDTH AND LENGTH OF AE IS INPUT
102
IS INPUT OF WIDTH AND LENGTH OF AE COMPLETED ?
103
NO
YES
SCANNING IS STARTED
104
IS SWITCH FOR DETECTING FRONT END OF ORIGINAL ON ?
105
NO
YES
106
TURN ON ORIGINAL CLUTCH, SCANNING MOTOR AND LAMP
IS SWITCH FOR DETECTING REAR END OF ORIGINAL ON ?
107
NO
YES
108
COUNT FOR ORIGINAL LENGTH IS STARTED
1

F I G. 4 (B)

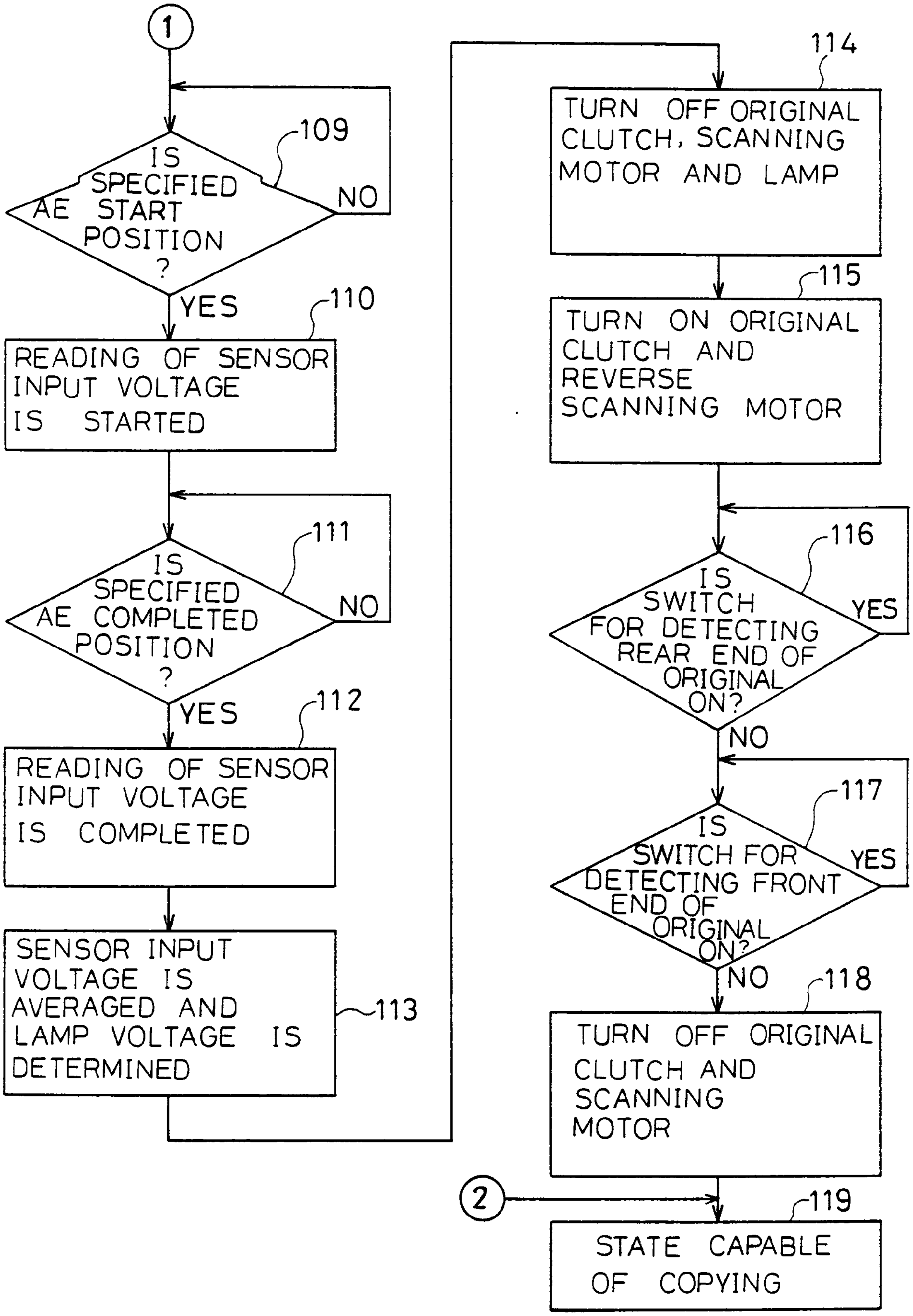

1
109
IS SPECIFIED AE START POSITION ?
NO
YES
110
READING OF SENSOR INPUT VOLTAGE IS STARTED
111
IS SPECIFIED AE COMPLETED POSITION ?
NO
YES
112
READING OF SENSOR INPUT VOLTAGE IS COMPLETED
SENSOR INPUT VOLTAGE IS AVERAGED AND LAMP VOLTAGE IS DETERMINED
113
114
TURN OFF ORIGINAL CLUTCH, SCANNING MOTOR AND LAMP
115
TURN ON ORIGINAL CLUTCH AND REVERSE SCANNING MOTOR
116
IS SWITCH FOR DETECTING REAR END OF ORIGINAL ON?
YES
NO
117
IS SWITCH FOR DETECTING FRONT END OF ORIGINAL ON?
YES
NO
118
TURN OFF ORIGINAL CLUTCH AND SCANNING MOTOR
2
119
STATE CAPABLE OF COPYING

FIG.5

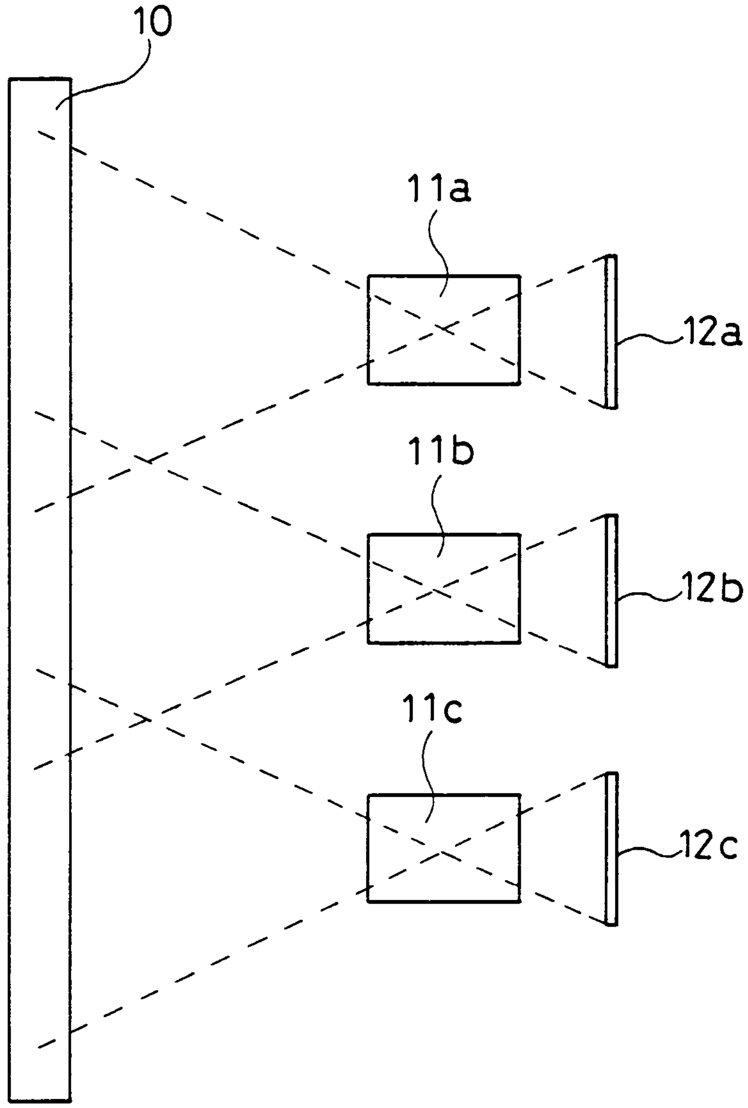


FIG. 6

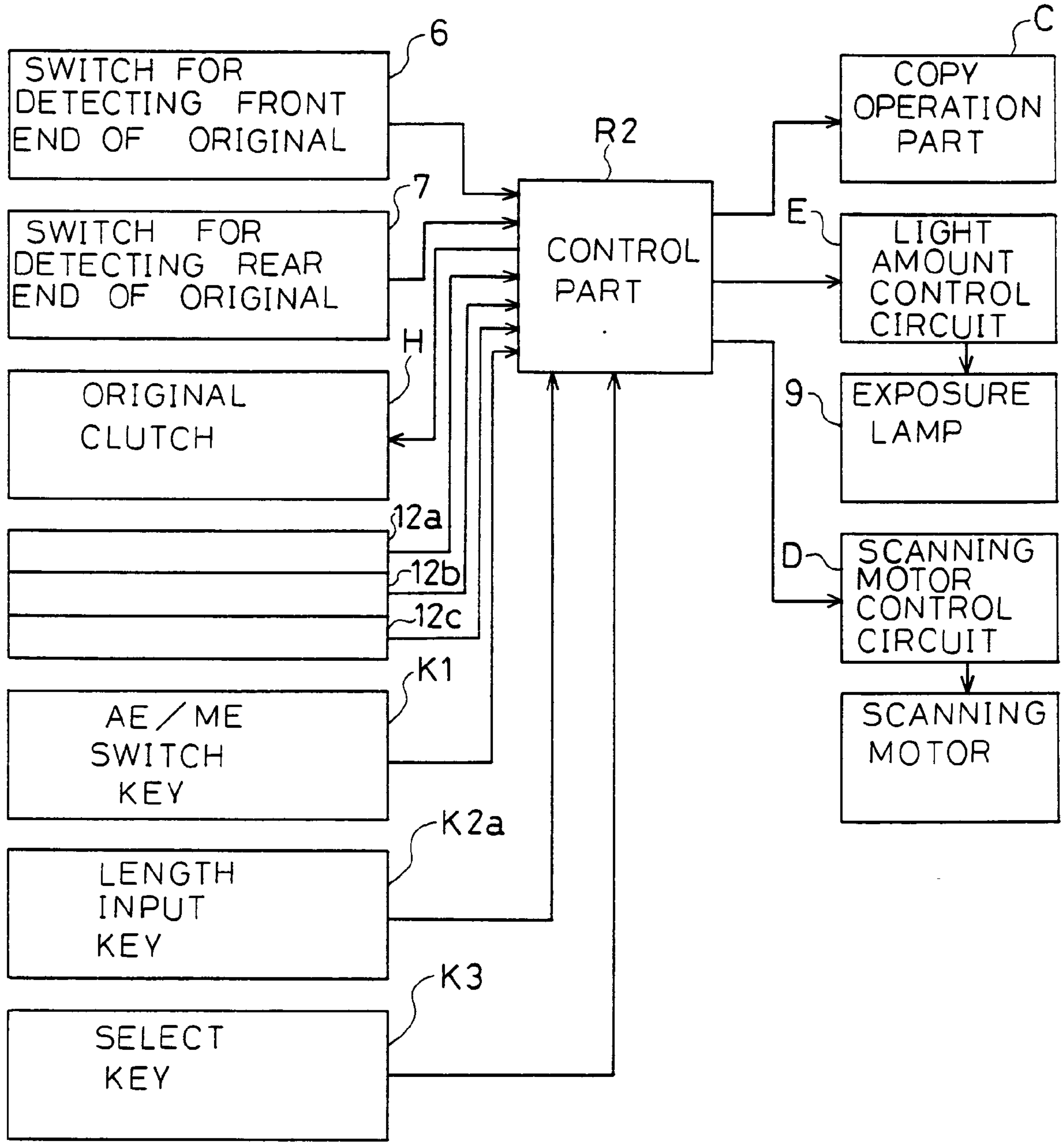
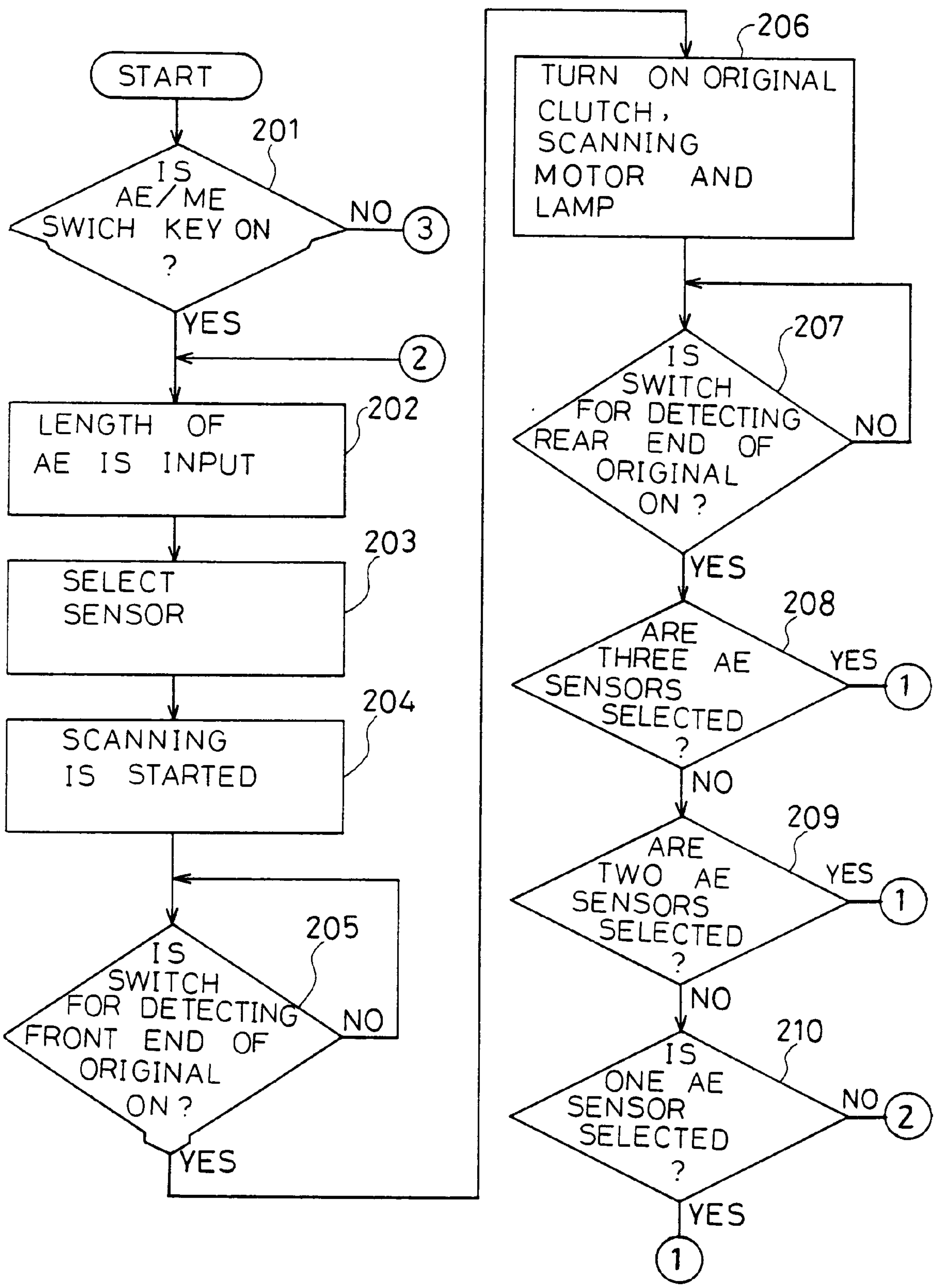

6
SWITCH FOR DETECTING FRONT END OF ORIGINAL
7
SWITCH FOR DETECTING REAR END OF ORIGINAL
H
ORIGINAL CLUTCH
12a
12b
12c
K1
AE/ME SWITCH KEY
K2a
LENGTH INPUT KEY
K3
SELECT KEY
R2
CONTROL PART
C
COPY OPERATION PART
E
LIGHT AMOUNT CONTROL CIRCUIT
9
EXPOSURE LAMP
D
SCANNING MOTOR CONTROL CIRCUIT
SCANNING MOTOR

FIG. 7 (A)


START
201
IS AE/ME SWICH KEY ON ?
NO
3
YES
2
202
LENGTH OF AE IS INPUT
203
SELECT SENSOR
204
SCANNING IS STARTED
205
IS SWITCH FOR DETECTING FRONT END OF ORIGINAL ON ?
NO
YES
206
TURN ON ORIGINAL CLUTCH, SCANNING MOTOR AND LAMP
207
IS SWITCH FOR DETECTING REAR END OF ORIGINAL ON ?
NO
YES
208
ARE THREE AE SENSORS SELECTED ?
YES
1
NO
209
ARE TWO AE SENSORS SELECTED ?
YES
1
NO
210
IS ONE AE SENSOR SELECTED ?
NO
2
YES
1

F I G . 7(B)

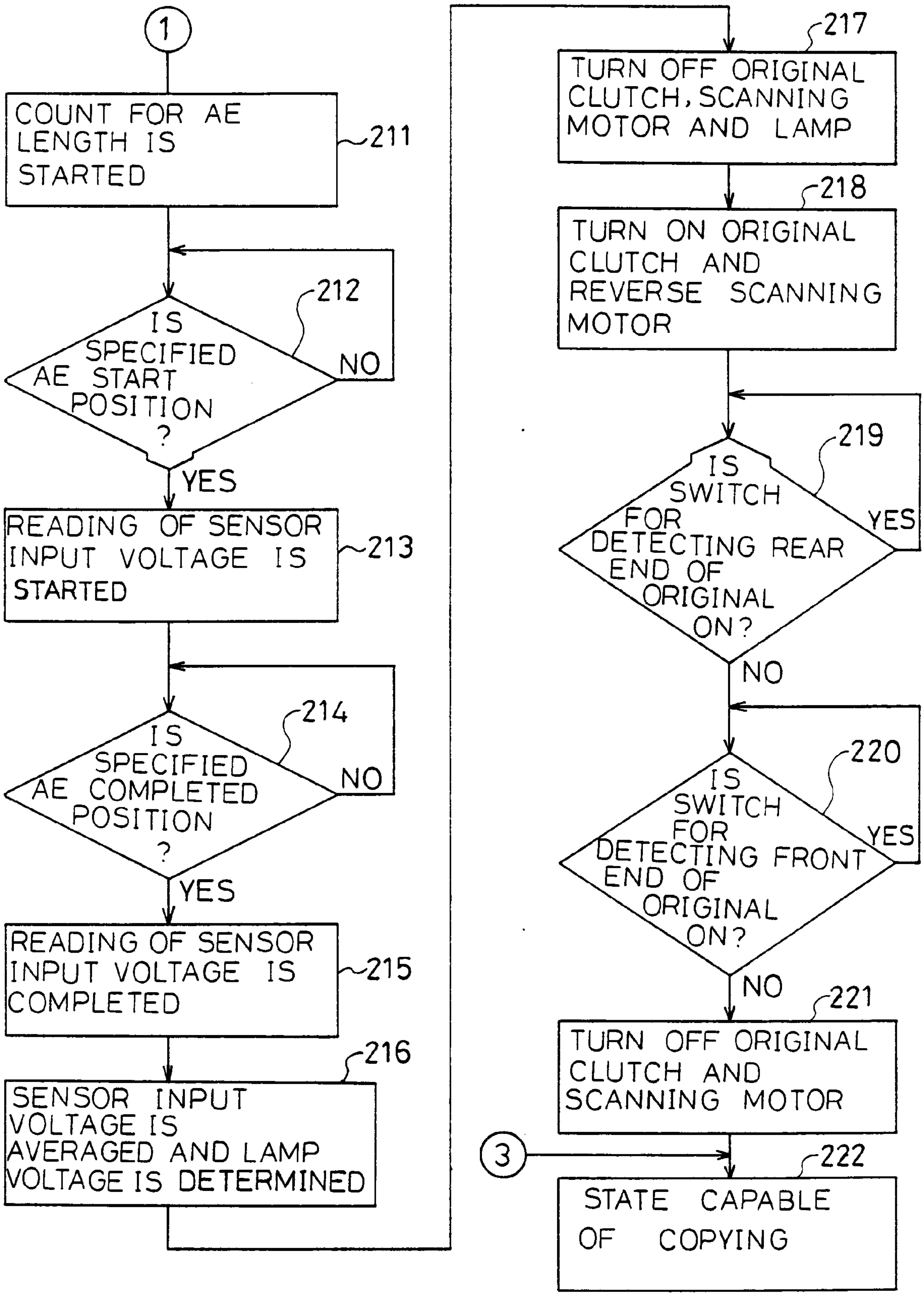

1
COUNT FOR AE LENGTH IS STARTED
211
IS SPECIFIED AE START POSITION ?
212
NO
YES
READING OF SENSOR INPUT VOLTAGE IS STARTED
213
IS SPECIFIED AE COMPLETED POSITION ?
214
NO
YES
READING OF SENSOR INPUT VOLTAGE IS COMPLETED
215
SENSOR INPUT VOLTAGE IS AVERAGED AND LAMP VOLTAGE IS DETERMINED
216
TURN OFF ORIGINAL CLUTCH, SCANNING MOTOR AND LAMP
217
TURN ON ORIGINAL CLUTCH AND REVERSE SCANNING MOTOR
218
IS SWITCH FOR DETECTING REAR END OF ORIGINAL ON?
219
YES
NO
IS SWITCH FOR DETECTING FRONT END OF ORIGINAL ON?
220
YES
NO
TURN OFF ORIGINAL CLUTCH AND SCANNING MOTOR
221
3
STATE CAPABLE OF COPYING
222

FIG. 8

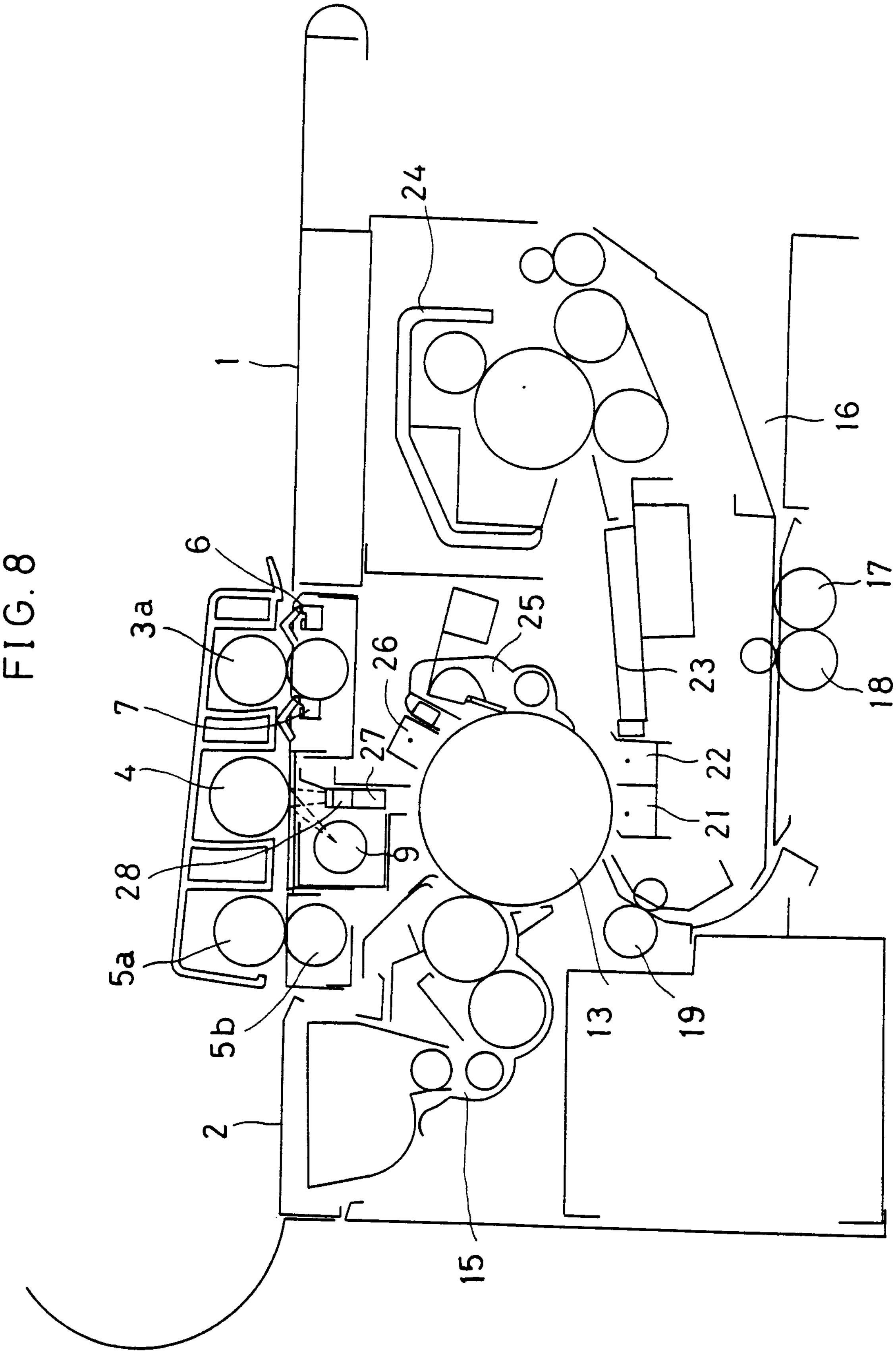


FIG. 9

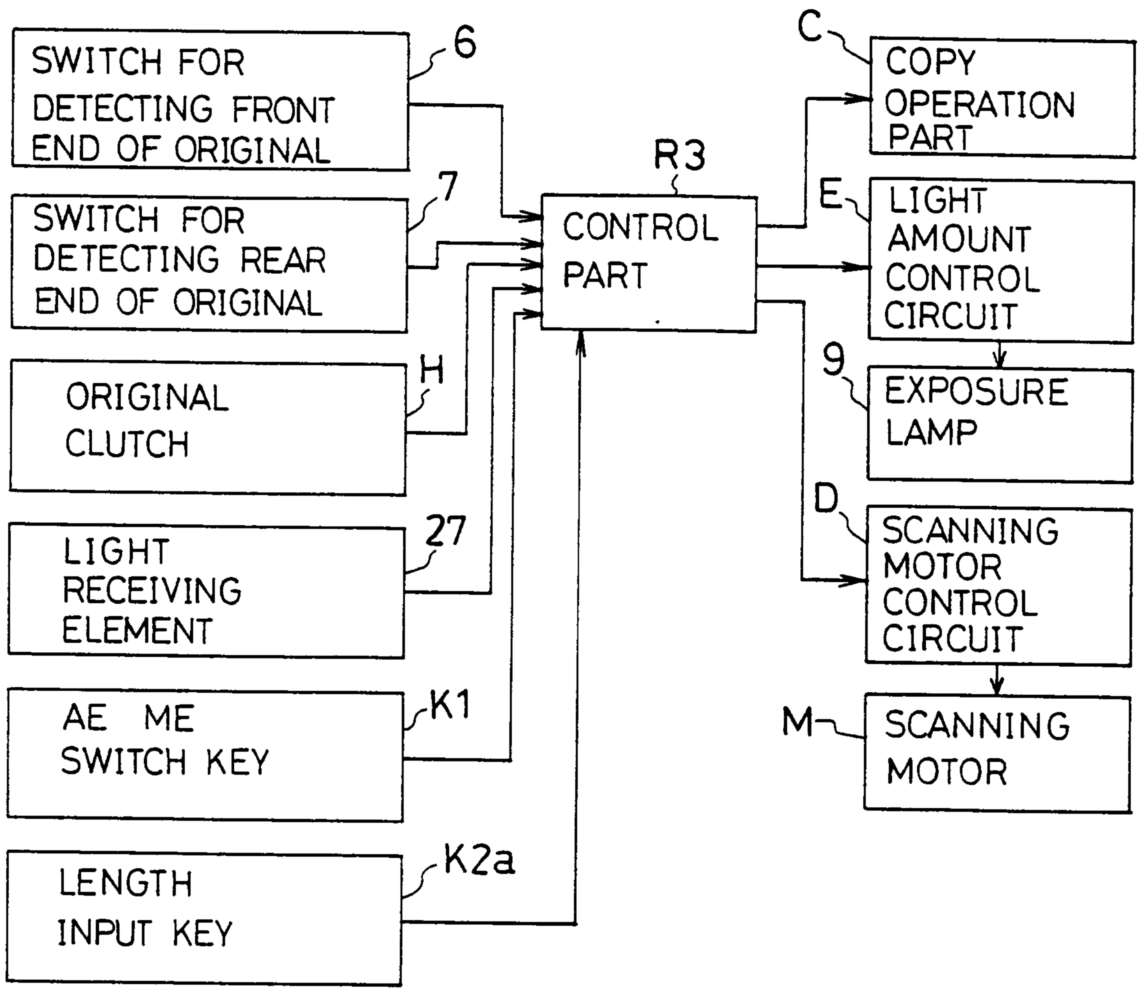
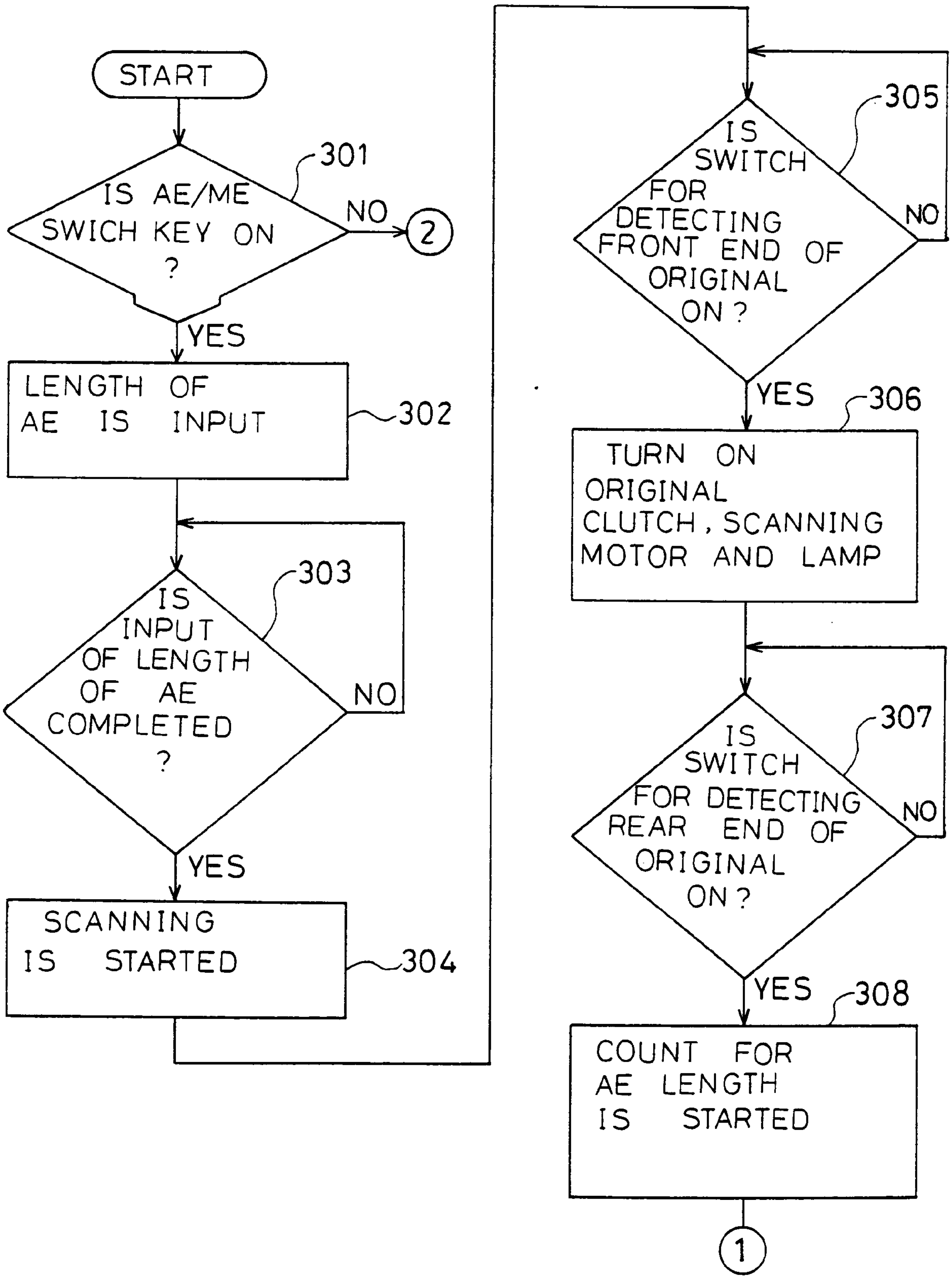
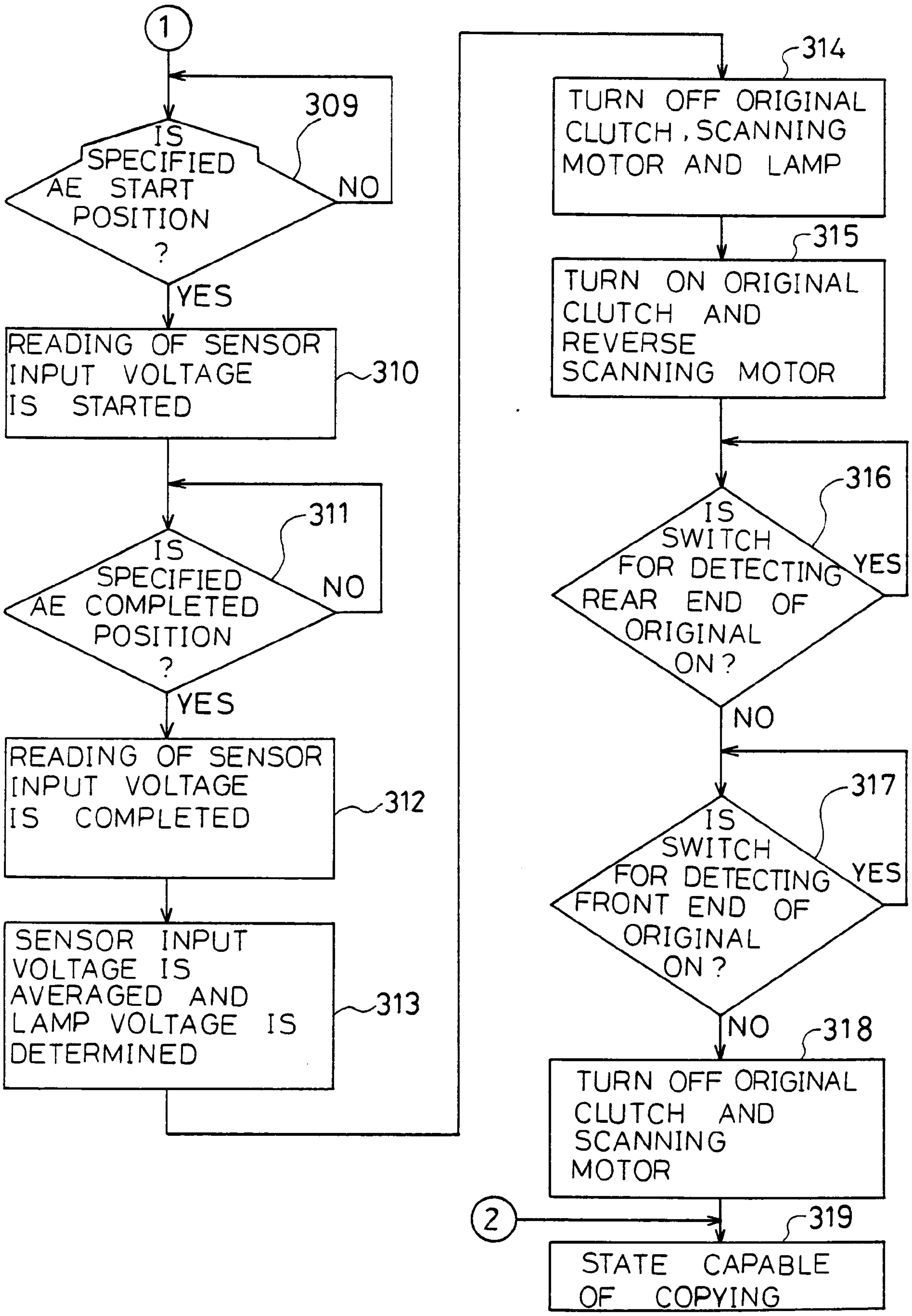

SWITCH FOR DETECTING FRONT END OF ORIGINAL
6
SWITCH FOR DETECTING REAR END OF ORIGINAL
7
ORIGINAL CLUTCH
H
LIGHT RECEIVING ELEMENT
27
AE ME SWITCH KEY
K1
LENGTH INPUT KEY
K2a
R3
CONTROL PART
C
COPY OPERATION PART
E
LIGHT AMOUNT CONTROL CIRCUIT
9
EXPOSURE LAMP
D
SCANNING MOTOR CONTROL CIRCUIT
M
SCANNING MOTOR

FIG.10 (A)


START
IS AE/ME SWICH KEY ON ?
301
NO
2
YES
LENGTH OF AE IS INPUT
302
IS INPUT OF LENGTH OF AE COMPLETED ?
303
NO
YES
SCANNING IS STARTED
304
IS SWITCH FOR DETECTING FRONT END OF ORIGINAL ON ?
305
NO
YES
306
TURN ON ORIGINAL CLUTCH, SCANNING MOTOR AND LAMP
IS SWITCH FOR DETECTING REAR END OF ORIGINAL ON ?
307
NO
YES
308
COUNT FOR AE LENGTH IS STARTED
1

F I G . 10(B)


1
IS SPECIFIED AE START POSITION ?
309
NO
YES
READING OF SENSOR INPUT VOLTAGE IS STARTED
310
IS SPECIFIED AE COMPLETED POSITION ?
311
NO
YES
READING OF SENSOR INPUT VOLTAGE IS COMPLETED
312
SENSOR INPUT VOLTAGE IS AVERAGED AND LAMP VOLTAGE IS DETERMINED
313
314
TURN OFF ORIGINAL CLUTCH, SCANNING MOTOR AND LAMP
315
TURN ON ORIGINAL CLUTCH AND REVERSE SCANNING MOTOR
316
IS SWITCH FOR DETECTING REAR END OF ORIGINAL ON ?
YES
NO
317
IS SWITCH FOR DETECTING FRONT END OF ORIGINAL ON ?
YES
NO
318
TURN OFF ORIGINAL CLUTCH AND SCANNING MOTOR
2
319
STATE CAPABLE OF COPYING