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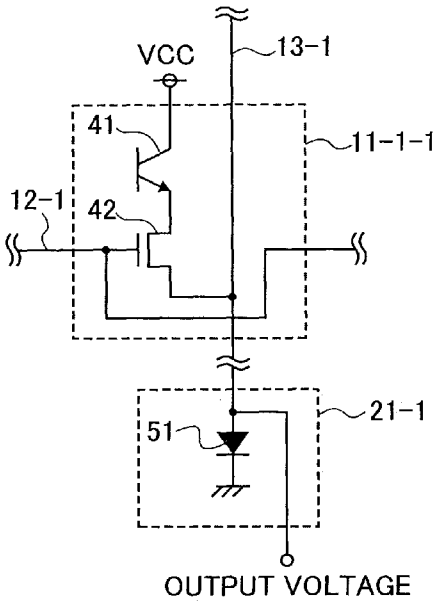
[Continued on next page]

(54) Title: PHOTOELECTRIC CONVERTOR, IMAGING DEVICE AND IMAGE-FORMING APPARATUS

FIG.2



(57) Abstract: A photoelectric convertor comprises at least one photoelectric conversion device including a phototransistor which generates an output current having a magnitude corresponding to an intensity of incident light and a current-voltage conversion unit which converts the output current of the photoelectric conversion device to an output voltage. The current-voltage conversion unit compresses a dynamic range of the output voltage to a dynamic range of the output current.

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DESCRIPTION

PHOTOELECTRIC CONVERTOR, IMAGING DEVICE AND IMAGE-FORMING APPARATUS

PRIORITY CLAIM

The present application is based on and claims priority from Japanese Patent Application No. 2013-000292, filed on January 7, 2013, the disclosure of which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0001]

The present invention relates to a photoelectric convertor which converts incident light into an electric signal, an imaging device and an image-forming apparatus including the photoelectric convertor.

BACKGROUND ART

[0002]

In an image-forming apparatus using a photodiode such as a CMOS sensor, electric charge generated by incident light is accumulated in a junction capacitance of a photodiode, and the electric charge is converted into an electric signal. However, when the photodiode receives strong light, the generated electric charge exceeds the amount of electric charge which can be accumulated in the junction capacitance. Thus, a detectable dynamic range of incident light is limited.

[0003]

In order to address a problem in which the dynamic range is limited, a technique which photographs a plurality of images by changing a time for

irradiation or a time for accumulating electric charge generated by light, and obtaining an image without saturation from a weak light portion to a strong light portion by combining these images is well-known. An example of such a technique includes the invention described in Patent Documents, JP3592106B, JP3875461B and JP4289244B.

[0004]

For example, the invention described in JP3592106B describes a solid-state image pickup apparatus including a plurality of pixels comprising: a photoelectric conversion device, a transfer unit which transfers a signal charge from the photoelectric conversion device, a capacitance which maintains the transferred signal charge, and an amplifier which outputs a signal corresponding to the signal charge maintained in the capacitance. The capacitance includes a capacitance unit having a first capacitance value and an additional capacitance which adds a capacitance to the capacity in parallel so as to increase the capacity of the capacitance from the first capacitance value to the second capacitance value. A unit which reads out a signal from the amplifier includes a first reading-out mode which reads out a signal by maintaining the signal charge in the capacitance and the additional capacitance connected in parallel with the capacitance, and a second reading-out mode which reads out a signal by maintaining the signal charge in the capacitance. The signal obtained by the first read-out mode and the signal obtained by the second read-out mode are added.

[0005]

When two signals each having a different accumulation time are read from the same pixel, and the two signals are combined, so as to expand a dynamic range, it is necessary to accumulate signal charge by re-changing the accumulation time after accumulating signal charge in a certain accumulation time. For this reason,

the signals to be obtained are image signals each having a different accumulation time. According to the invention described in JP3592106B, this problem is solved, and an image signal having a different dynamic range can be obtained by using a signal charge having the same accumulation time.

[0006]

In the conventional image-forming apparatus such as the invention described in JP3592106B, the dynamic range can be expanded. However, the control of the device becomes complex, and additional hardware or software is required because a plurality of images are photographed by changing the time for irradiation or the time for accumulating an electric charge generated by light, and are combined.

[0007]

In addition, in the conventional image-forming apparatus, it is necessary to photograph a plurality of images, and therefore it takes a longer time than that of a single photographing. Therefore, the conventional image-forming apparatus has a disadvantage in photographing a subject moving at high speed.

SUMMARY OF INVENTION

[0008]

It is, therefore, an object of the present invention to provide a photoelectric convertor for an image-forming apparatus, which does not require complex control or a process externally of the photoelectric convertor, and generates a broad dynamic range image, and an image-forming apparatus including the electric convertor.

[0009]

A photoelectric convertor according to an embodiment of the present invention comprises at least one photoelectric conversion device including a phototransistor which generates an output current having a magnitude corresponding to an intensity of incident light, and a current-voltage conversion unit which converts the output current of the photoelectric conversion device to an output voltage. The current-voltage conversion unit compresses a dynamic range of the output voltage to a dynamic range of the output current.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

The accompanying drawings are included to provide further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the specification, serve to explain the principle of the invention.

FIG. 1 provides a block diagram illustrating a configuration of a photoelectric convertor according to an embodiment of the present invention.

FIG. 2 provides a circuit diagram illustrating a detailed configuration of an image cell 11-1-1 and an IV convertor 21-1 in FIG. 1.

FIG. 3 provides a graph schematically illustrating a property of the IV convertor 21-1 in FIG. 2.

FIG. 4 provides a graph illustrating a vertical axis of the graph in FIG. 3 with a log.

FIG. 5 provides a circuit view illustrating a detailed configuration of an image pixel cell 11-1-1 and an IV convertor 21-1A according to a first modified example of the embodiment of the present invention.

FIG. 6 provides a circuit view illustrating a detailed configuration of a pixel cell 11-1-1 and an IV convertor 21-1B according to a second modified example of the embodiment of the present invention.

FIG. 7 provides a graph schematically illustrating a property of the IV convertor 21-1B in FIG. 6.

FIG. 8 provides a graph illustrating a vertical axis of the graph in FIG. 7 to the one half power.

FIG. 9 provides a circuit view illustrating a detailed configuration of an image pixel cell 11-1-1 and an IV convertor 21-1C according to a third modified example of the embodiment of the present invention.

FIG. 10 provides a schematic view of an imaging device according to an embodiment of the present invention.

FIG. 11 provides a schematic view of an image-forming apparatus according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0011]

Hereinafter, a photoelectric convertor which is to be provided in the image-forming apparatus according to an embodiment of the present invention will be described with reference to FIGS. 1-9.

[0012]

FIG. 1 provides a block view illustrating the configuration of the photoelectric convertor according to the embodiment of the present invention. The photoelectric convertor in FIG. 1 includes a plurality of two-dimensionally arrayed pixel cells 11-1-1 to 11-M-N, a plurality of two-dimensionally arrayed

line selection lines 12-1 to 12-M, a plurality of column output lines 13-1 to 13-N, a line selector 10, an IV conversion circuit 20, and an AD conversion circuit 30.

[0013]

Each of the pixel cells 11-1-1 to 11-M-N operates as a photoelectric convertor including a phototransistor which generates an output current having a magnitude corresponding to the intensity of incident light. Each of the pixel cells 11-1-1 to 11-M-N are connected to one of the line-selection lines 12-1 to 12-M, and is further connected to one of the column output lines 13-1 to 13-N. The pixel cells 11-1-n to 11-M-n connected to each of the different line-selection lines 12-1 to 12-M is connected to one column output line 13-n ($1 \leq n \leq N$). The line selector 10 enables only one of the pixel cells 11-1-n to 11-M-n by using the line-selection lines 12-1 to 12-M. Upon the incidence of light, the enabled pixel cell sends an output current having a magnitude corresponding to the intensity of incident light to an IV conversion circuit 20 through the column output line.

[0014]

The IV conversion circuit 20 includes IV convertors 21-1 to 21-N connected to each of the column output lines 13-1 to 13-N. The IV convertors 21-1 to 21-N operate as current voltage convertors which convert an output current of a pixel cell into an output voltage. Each of the IV convertors 21-1 to 21-N compresses a dynamic range of the output voltage to the dynamic range of the output current when converting the output current of the pixel cell into the output voltage.

[0015]

The AD conversion circuit 30 executes a process such as analogue/digital conversion to the output voltage of the IV conversion circuit 20, so as to generate an output image signal.

[0016]

FIG. 2 is a circuit view illustrating the detailed configuration of the pixel cell 11-1-1 and the IV convertor 21-1 in FIG. 1.

[0017]

The pixel cell 11-1-1 in FIG. 2 includes a phototransistor 41 and a switch 42. The collector of the phototransistor 41 is connected to a voltage source VCC. The emitter of the phototransistor 41 is connected to the column output line 13-1 through the switch 42. The switch 42 is turned on while the line-selection line 12-1 is at a high level, and enables the pixel cell 11-1-1.

[0018]

According to the conventional technique, the pixel cell of the CMOS image sensor outputs the voltage by the charge accumulated in the photodiode by the incident light through the source follower of the MOS transistor. A pixel cell of a CCD image sensor generally transfers and outputs the charge accumulated in the photodiode by the incident light. These image sensors are configured to accumulate the charge in the photodiode, and generate the output signal from the accumulated charge. However, the amount of charge which can be accumulated in the photodiode is limited, so that the dynamic range is limited to about four digits. On the other hand, the phototransistor includes a dynamic range wider than that of a photodiode, and is able to generate an output current which linearly changes corresponding to incident light having a six-digit dynamic range. The pixel cell 11-1-1 in FIG. 2 includes a phototransistor 42, so as to generate the output current having a wide dynamic range.

[0019]

The IV convertor 21-1 in FIG. 2 includes a diode 51 for converting an output current of a pixel cell into an output voltage. The line-output line 13-1 is

connected to the anode of the diode 51, and the cathode of the diode is grounded. A difference in electric potential of both ends of the diode 51 becomes the output voltage of the IV convertor 21-1. Even if the output current which linearly changes to incident light having a wide dynamic range is obtained by using the phototransistor 41, it is difficult to process the output current having a wide dynamic range as it is. Accordingly, the IV convertor 21-1 in FIG. 2 converts the output current of the pixel cell into the output voltage. In this case, the IV convertor 21-1 compresses the dynamic range of the output voltage to the dynamic range of the output current with a predetermined conversion property.

[0020]

FIG. 3 provides a graph schematically illustrating the property of the IV convertor 21-1 in FIG. 2. FIG. 4 provides a graph illustrating a vertical axis of the graph in FIG. 3 with a log. The IV convertor 21-1 in FIG. 2 includes the diode 51, so that the output voltage V varies as the log of the output current I ($V = V_0 \cdot \log (I / I_0)$, where V_0 is an initial value of voltage and I_0 is an initial value of current). The output voltage converted by the IV convertor 21-1 includes a compressed dynamic range, while processing the incident light of dynamic range. Thus, a latter stage signal process can be simplified.

[0021]

Another pixel cell and another IV convertor are configured similarly to the pixel cell 11-1-1 and the IV convertor 21-1 in FIG. 2.

[0022]

As described above, according to the photoelectric convertor of the present embodiment, a photoelectric convertor for an image-forming apparatus is provided which does not require complex control or a process in externally of the photoelectric convertor for generating an essentially broad dynamic range image.

[0023]

According to the photoelectric convertor of the present embodiment, the pixel cell including the phototransistor is used as the photoelectric convector, and the dynamic range of the output voltage is compressed corresponding to the dynamic range of the output current when converting the output current of the pixel cell into the output voltage by the IV convertor, so that incident light having a wide dynamic range can be processed.

[0024]

According to the photoelectric convertor of the present embodiment, the photoelectric convertor including an amplifying function such as a phototransistor is used, so that the effects in which a certain magnitude output current can be generated when incident light is weak, and noise requirements in the latter stage circuit can be reduced. The amplifying function such as a phototransistor contributes to an increase in a sensitivity of the photoelectric convertor.

[0025]

FIG. 5 provides a circuit view illustrating a detailed configuration of an image pixel cell 11-1-1 and an IV convertor 21-1A according to a first modified example of the embodiment of the present invention. The IV convertor 21-1A in FIG. 5 includes an operational amplifier 61 and a diode 62. The output impedance in the output terminal of the IV convertor 21-1A can be reduced by using the operational amplifier 61. The input impedance in the input terminal of the IV convertor 21-1A can be reduced by using the operational amplifier 61.

[0026]

FIG. 6 provides a circuit view illustrating a detailed configuration of a pixel cell 11-1-1 and an IV convertor 21-1B according to a second modified example of the embodiment of the present invention. The IV convertor 21-1B in

FIG. 6 includes a MOS transistor 71 connected to a diode. The IV convertor 21-B in FIG. 6 compresses the dynamic range of the output voltage corresponding to the dynamic range of the output current with a predetermined property by converting the output current of the pixel cell into the output voltage.

[0027]

FIG. 7 provides a graph schematically illustrating a property of the IV convertor 21-1B in FIG. 6. FIG. 8 provides a graph illustrating a vertical axis of the graph in FIG. 7 to the one half power. The IV convertor 21-1B in FIG. 6 includes the MOS transistor 71, so that the output voltage V changes in accordance with a square root of the output current I ($V = V_0 + K \sqrt{I}$, where V_0 is an initial value of voltage and K is constant). The output voltage converted by the IV convertor 21-1B includes the compressed dynamic range while processing incident light having the dynamic range. Thus, the latter stage signal process can be simplified.

[0028]

FIG. 9 provides a circuit view illustrating a detailed configuration of an image pixel cell 11-1-1 and an IV convertor 21-1C according to a third modified example of the embodiment of the present invention. The IV convertor 21-1C in FIG. 9 includes an operational amplifier 81 and a MOS transistor 82. The output impedance in the output terminal of the IV convertor 21-1 can be reduced by using the operational amplifier 81. The input impedance of the input terminal of the IV convertor 21-1C can be reduced by using the operational amplifier 81.

[0029]

[Modified Example]

The embodiment of the present invention is not limited to the above-described embodiment. For example, the IV convertor can use another

non-linear element in addition to a diode and MOS transistor in order to compress a dynamic range of output voltage to a dynamic range of output current when converting output current of a pixel cell into output voltage.

[0030]

Each of the pixel cells may include a current-amplifying function or a function which resets the base potential of a phototransistor.

[0031]

The IV convertor can be disposed in each of column output lines, or one IV convertor can be used in two or more column output lines. In the latter case, a function to elect a column output line should be added to the IV convertor.

[0032]

The AD convertor can be disposed in each of the IV convertors, or one AD convertor can be disposed for output voltages of two IV convertors or more and used in turn to convert each voltage.

[0033]

A sensor, imaging device, and image-forming apparatus such as an office machine or a scientific instrument can be provided by using the photoelectric convertor according to the above-described embodiment and modified examples.

[0034]

Hereinafter, an example of an imaging device is described. FIG. 10 provides an embodiment of the imaging device. The imaging device 10 includes a lens barrel 30 in which an optical element 40 is inserted, a light-receiving circuit 50 having an imaging element 52 and a drive substrate, as shown in FIG. 10. The above-described photoelectric convertor can be provided in the imaging device 10.

[0035]

Furthermore, FIG. 11 provides an example of an image-forming apparatus 500.

The image-forming apparatus 500 is, for example, a tandem type color printer which prints multi-color images by superimposing and transferring black, yellow, magenta, and cyan color toner images onto sheets of paper. The image-forming apparatus 500 as shown in FIG. 11 comprises an optical scan apparatus 100, four photoconductive drums 30A to 30D, a transfer belt 40, a paper feed tray 60, a paper feed roller 54, a first resist roller 56, a second resist roller 52, a fuse roller 50, a paper discharge roller 58, a not-shown controller collectively controlling the respective components, and a housing 501 in a rectangular solid shape accommodating the components.

[0036]

A paper discharge tray 501a on which printed sheets are discharged is formed on the top surface of the housing 501. The optical scan apparatus 100 is disposed under the paper discharge tray 501a.

[0037]

The optical scan apparatus 100 scans the photoconductive drum 30A with a light beam for black image components modulated by image information supplied from a higher-level device (such as personal computer). Similarly, it scans the photoconductive drum 30B with a light beam for cyan image components, the photoconductive drum 30C with a light beam for magenta image components, and the photoconductive drum 30D with a light beam for yellow image components.

[0038]

The four photoconductive drums 30A to 30D are cylindrical members and have photoconductive layers on their surfaces which become electrically

conductive when illuminated with a light beam. They are disposed with an equal interval in an X-axis direction under the optical scan apparatus 100 in FIG. 11.

[0039]

The photoconductive drum 30A is disposed at an end of a reverse X-axis direction (left side in FIG. 11) inside the housing 501 so that its longitudinal direction is to be the Y-axis direction. The photoconductive drum 30A is rotated by a not-shown rotation mechanism clockwise (as indicated by black arrows in FIG. 11). An electric charger 32A at the 12 o'clock position (upper side), a toner cartridge 33A at 2 o'clock position and a cleaning case 31A at the 10 o'clock position are disposed around the photoconductive drum 30A.

[0040]

The electric charger 32A is disposed with a predetermined clearance over the surface of the photoconductive drum 30A with its longitudinal direction as the Y-axis direction. It electrically charges the surface of the photoconductive drum 30A with a predetermined voltage.

[0041]

The toner cartridge 33A includes a cartridge body containing a toner of black image components and a developing roller charged with a voltage of reverse polarity of that of the photoconductive drum 30A, and the like. The toner cartridge 33A supplies the toner in the cartridge body to the surface of the photoconductive drum 30A via the developing roller.

[0042]

The cleaning case 31A is provided with a cleaning blade of a rectangular shape with its longitudinal direction as the Y-axis direction, and it is disposed so that one end of the cleaning blade comes in contact with the surface of the photoconductive drum 30A. The toner adhering on the surface of the

photoconductive drum 30A is removed by the cleaning blade along with the rotation of the photoconductive drum 30A and collected in the cleaning case 31A.

[0043]

The photoconductive drums 30B, 30C, 30D with the same structure as that of the photoconductive drum 30A are placed in sequence on the right side of the photoconductive drum 30A with a predetermined interval. They are rotated by a not-shown rotation mechanism clockwise (as indicated by the black arrows in FIG. 11). Similarly to the photoconductive drum 30A, electric chargers 32B, 32C, 32D, toner cartridges 33B, 33C, 33D, and cleaning cases 31B, 31C, 31D are disposed around the photoconductive drums 30B, 30C, 30D, respectively.

[0044]

The electric chargers 32B, 32C, 32D with the same structure as that of the electric charger 32A are disposed to electrically charge the surfaces of the photoconductive drums 30B, 30C, 30D with a predetermined voltage, respectively.

[0045]

The toner cartridges 33B, 33C, 33D include cartridge bodies containing toners of cyan, magenta, yellow image components and developing rollers charged with a voltage of reverse polarity of that of the photoconductive drums 30B, 30C, 30D, and the like, respectively. The toner cartridges 33B, 33C, 33D supply the toners in the cartridge bodies to the surfaces of the photoconductive drums 30B, 30C, 30D via the developing rollers, respectively.

[0046]

The structure and function of the cleaning cases 31B, 31C, 31D are the same as those of the cleaning case 31A.

[0047]

Hereinafter, a unit of the photoconductive drum 30A, the electric charger 32A, the toner cartridge 33A, and the cleaning case 31A is to be referred to as the first image-forming station; likewise, a unit of the photoconductive drum 30B, the electric charger 32B, the toner cartridge 33B, and the cleaning case 31B as the second image-forming station, a unit of the photoconductive drum 30C, the electric charger 32C, the toner cartridge 33C, and the cleaning case 31C as the third image-forming station, and a unit of the photoconductive drum 30D, the electric charger 32D, the toner cartridge 33D, and the cleaning case 31D as the fourth image-forming station.

[0048]

The transfer belt 40 is a free end ring-like member and rolls over driven rollers 40a, 40c placed under the photoconductive drums 30A, 30D, respectively, and rolls over a drive roller 40b which is placed at a slightly lower position than the driven rollers 40a, 40c. The upper end surface of the transfer belt 40 is in contact with the lower end surfaces of the photoconductive drums 30A, 30B, 30C, 30D. The transfer belt 40 is rotated counterclockwise (as indicated by the black arrows in FIG. 11) by counterclockwise rotation of the drive roller 40b. A transfer charger (transfer unit) 48 is applied with a voltage of a reverse polarity of that of the electric chargers 32A, 32B, 32C, 32D and is placed close to one end of the transfer belt 40 in the X-axis direction (right side in FIG. 11).

[0049]

The paper feed tray 60 of a substantially rectangular solid shape is placed under the transfer belt 40 and contains stacked-up paper sheets 61 for printing. The paper feed tray 60 has a feeder outlet of a rectangular shape close to one end of the upper surface thereof in the X-axis direction (right side in FIG. 11).

[0050]

The paper feed roller 54 extracts paper sheets 61 one by one from the paper feed tray 60 to feed them to a gap formed between the transfer belt 40 and the transfer charger 48 via the first resist roller 56 composed of a pair of rotary rollers.

[0051]

The fuse roller 50 is composed of a pair of rotary rollers, and applies heat and pressure to the paper sheets 61 to feed the paper sheets 61 to the discharge roller 58 via the resist roller 52 composed of a pair of rotary rollers. The discharge roller 58 is composed of a pair of rotary rollers and discharges the paper sheets 61 to the discharge tray 501a.

[0052]

The above-described photoelectric convertor can be provided in the image-forming apparatus. The above-described photoelectric convertor can be also provided as a scanner in the image-forming apparatus. Otherwise, an imaging device including the above-described photoelectric convertor can be disposed in the image-forming apparatus.

Although the embodiment including examples of the present invention has been described above, the present invention is not limited thereto. It should be appreciated that variations may be made in the embodiment described by persons skilled in the art without departing from the scope of the present invention.

CLAIMS

1. A photoelectric convertor, comprising:

at least one photoelectric conversion device including a phototransistor which generates an output current having a magnitude corresponding to an intensity of incident light; and

a current-voltage conversion unit which converts the output current of the photoelectric conversion device to an output voltage; wherein

the current-voltage conversion unit compresses a dynamic range of the output voltage to a dynamic range of the output current.

2. The photoelectric convertor according to Claim 1, wherein the current-voltage conversion unit converts the output current into the output voltage by using a diode.

3. The photoelectric convertor according to Claim 1, wherein the current-voltage conversion unit converts the output current into the output voltage by using a diode-connected MOS transistor.

4. The photoelectric convertor according to Claim 2 or 3, wherein the current-voltage conversion unit comprises an operational amplifier.

5. The photoelectric convertor according to any one of Claims 1 to 4, comprising a plurality of photoelectric conversion device arrays.

6. An imaging device comprising the photoelectric convertor according to any one of Claims 1 to 5.

7. An image-forming apparatus comprising the photoelectric convertor according to any one of Claims 1 to 5.

FIG.1

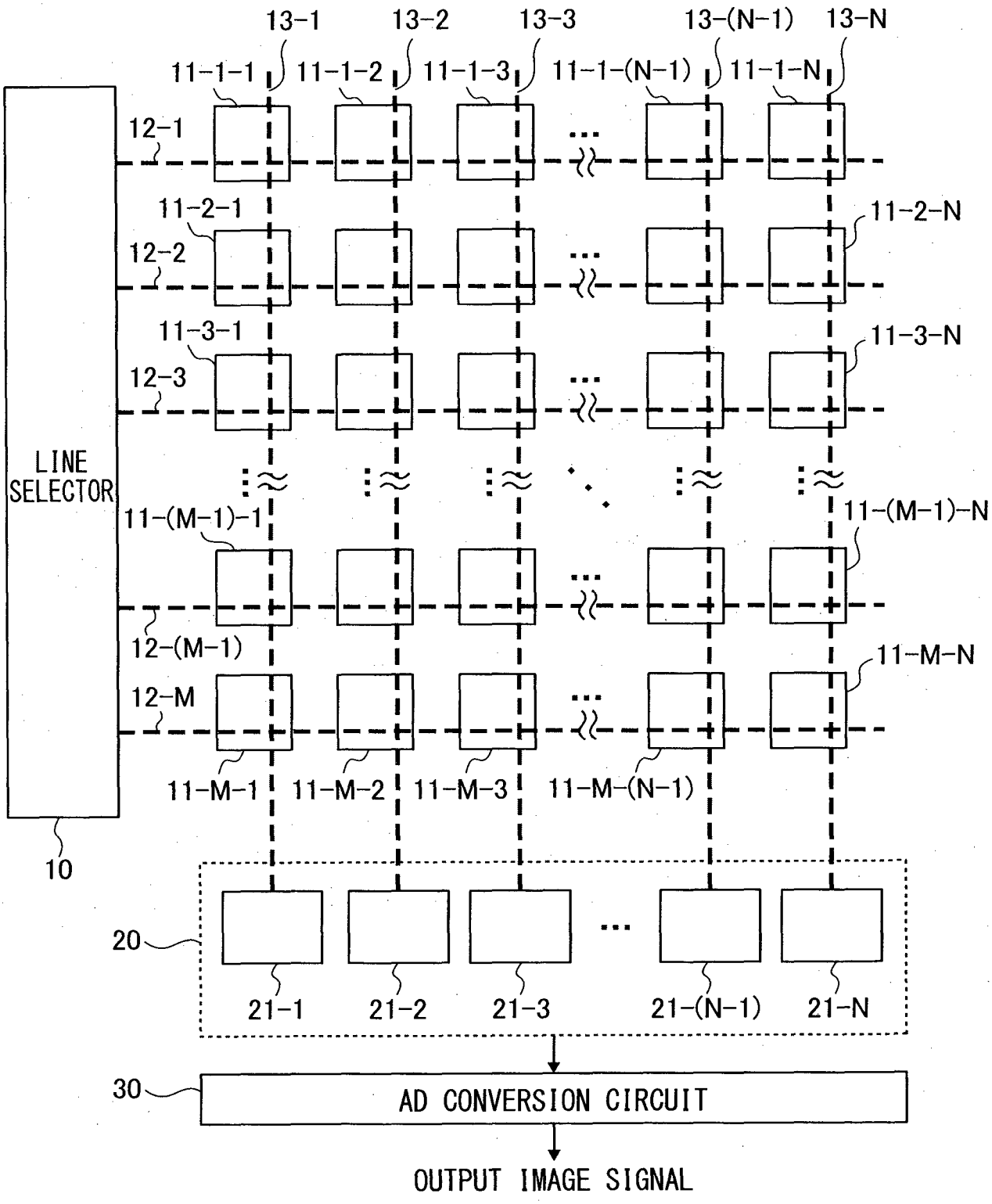

13-1
13-2
13-3
13-(N-1)
13-N
11-1-1
11-1-2
11-1-3
11-1-(N-1)
11-1-N
12-1
11-2-1
11-2-N
12-2
11-3-1
11-3-N
12-3
LINE SELECTOR
11-(M-1)-1
11-(M-1)-N
12-(M-1)
11-M-N
12-M
11-M-1
11-M-2
11-M-3
11-M-(N-1)
10
20
21-1
21-2
21-3
21-(N-1)
21-N
30
AD CONVERSION CIRCUIT
OUTPUT IMAGE SIGNAL

FIG.2

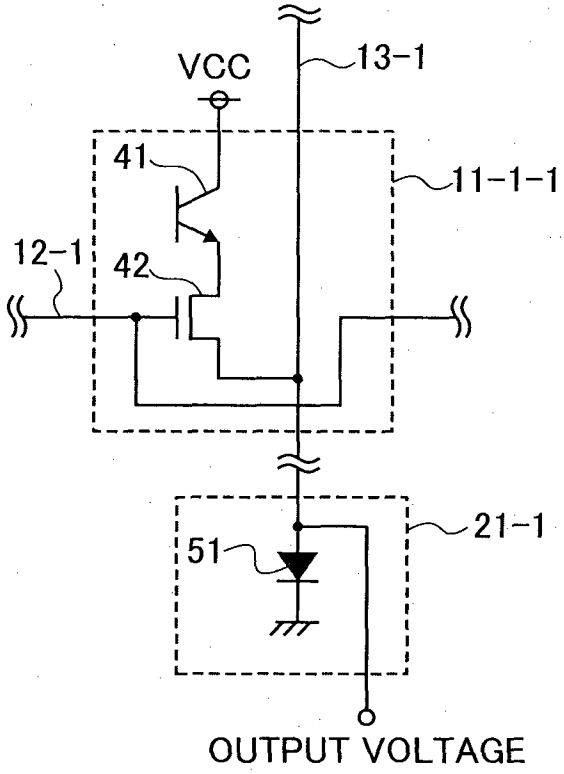


FIG.3

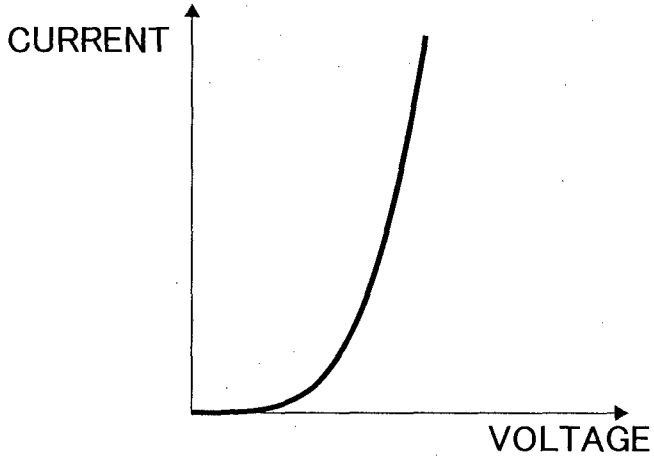


FIG.4

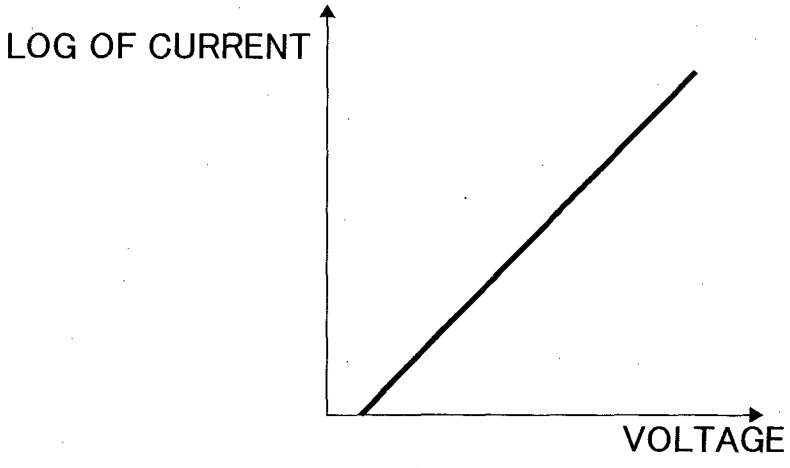


FIG.5

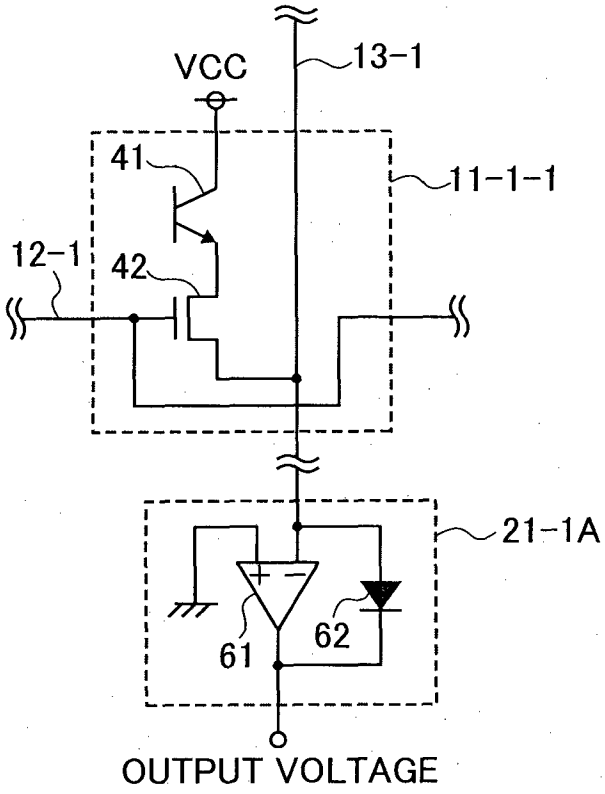

VCC
13-1
41
11-1-1
12-1
42
21-1A
61
62
OUTPUT VOLTAGE

FIG.6

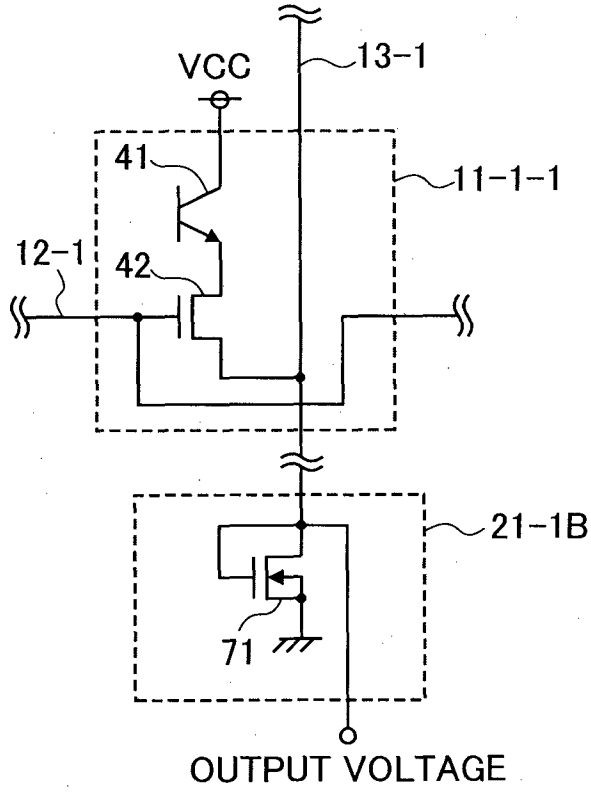

VCC
13-1
41
11-1-1
12-1
42
21-1B
71
OUTPUT VOLTAGE

FIG.7

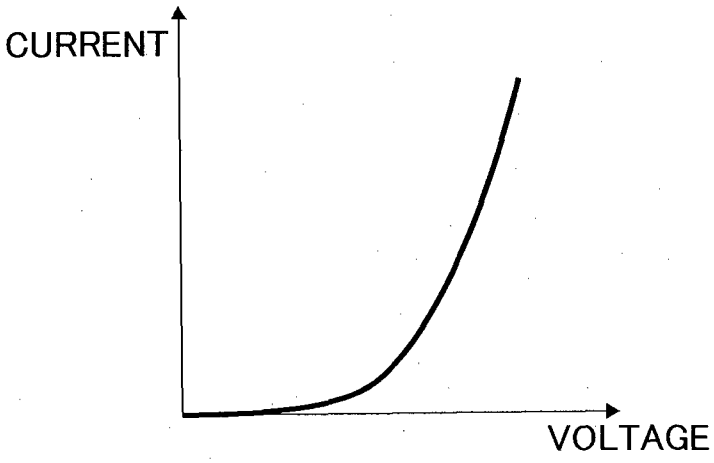


FIG.8

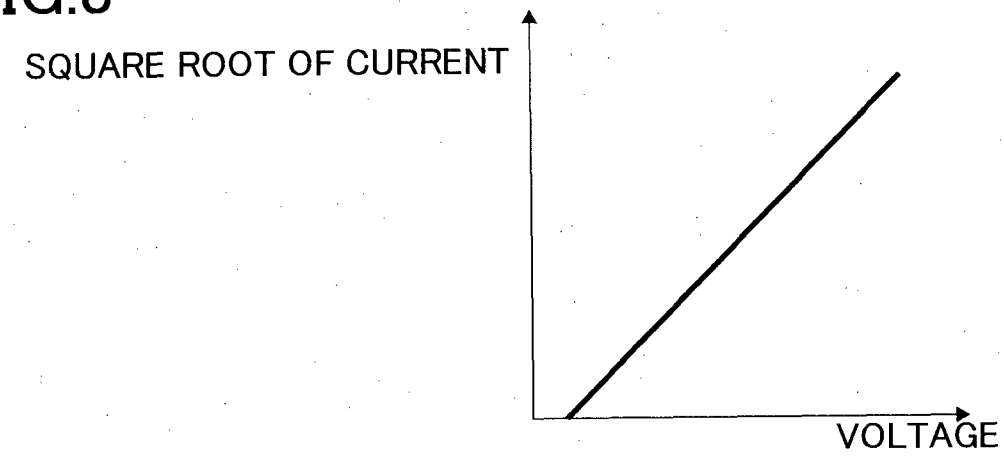


FIG.9

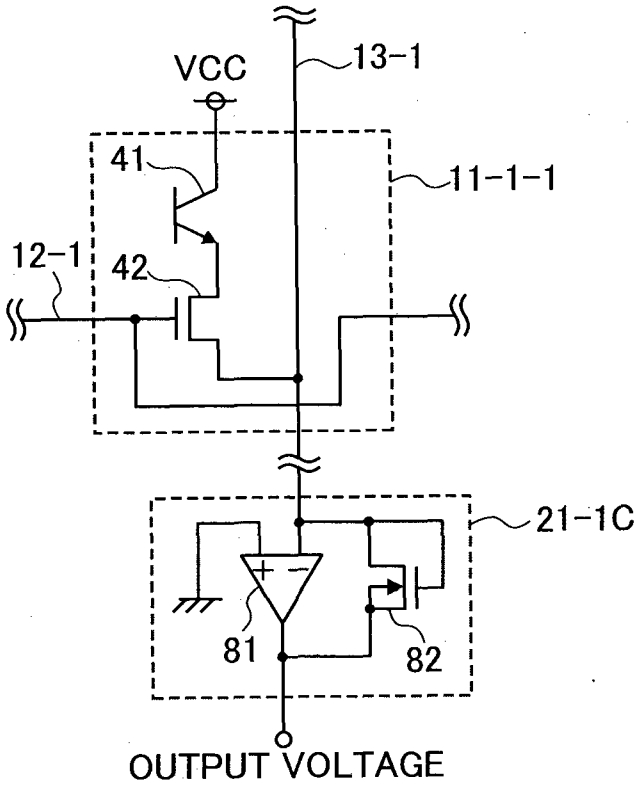
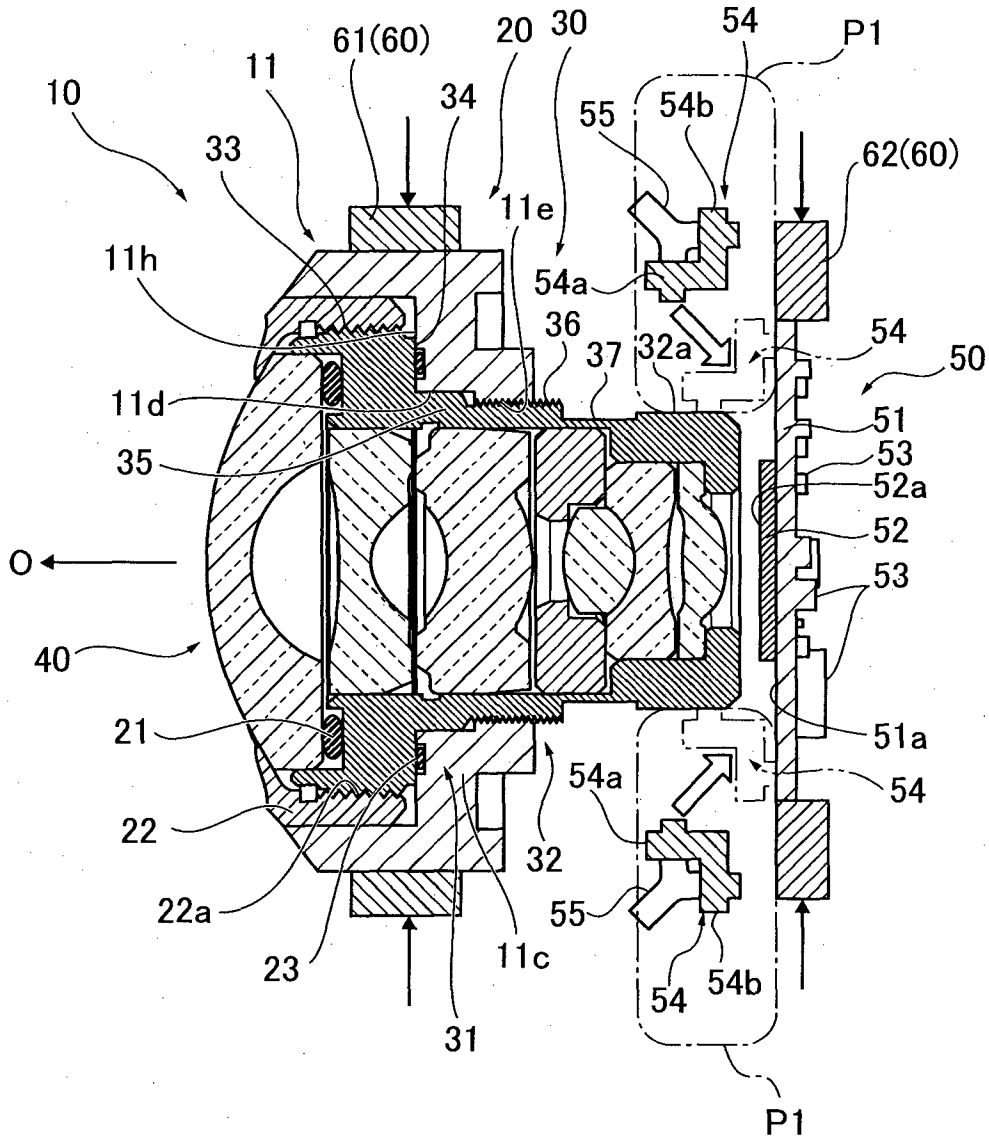


FIG.10


10
11
61(60)
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30
54
P1
33
34
55
54b
62(60)
11e
11h
54a
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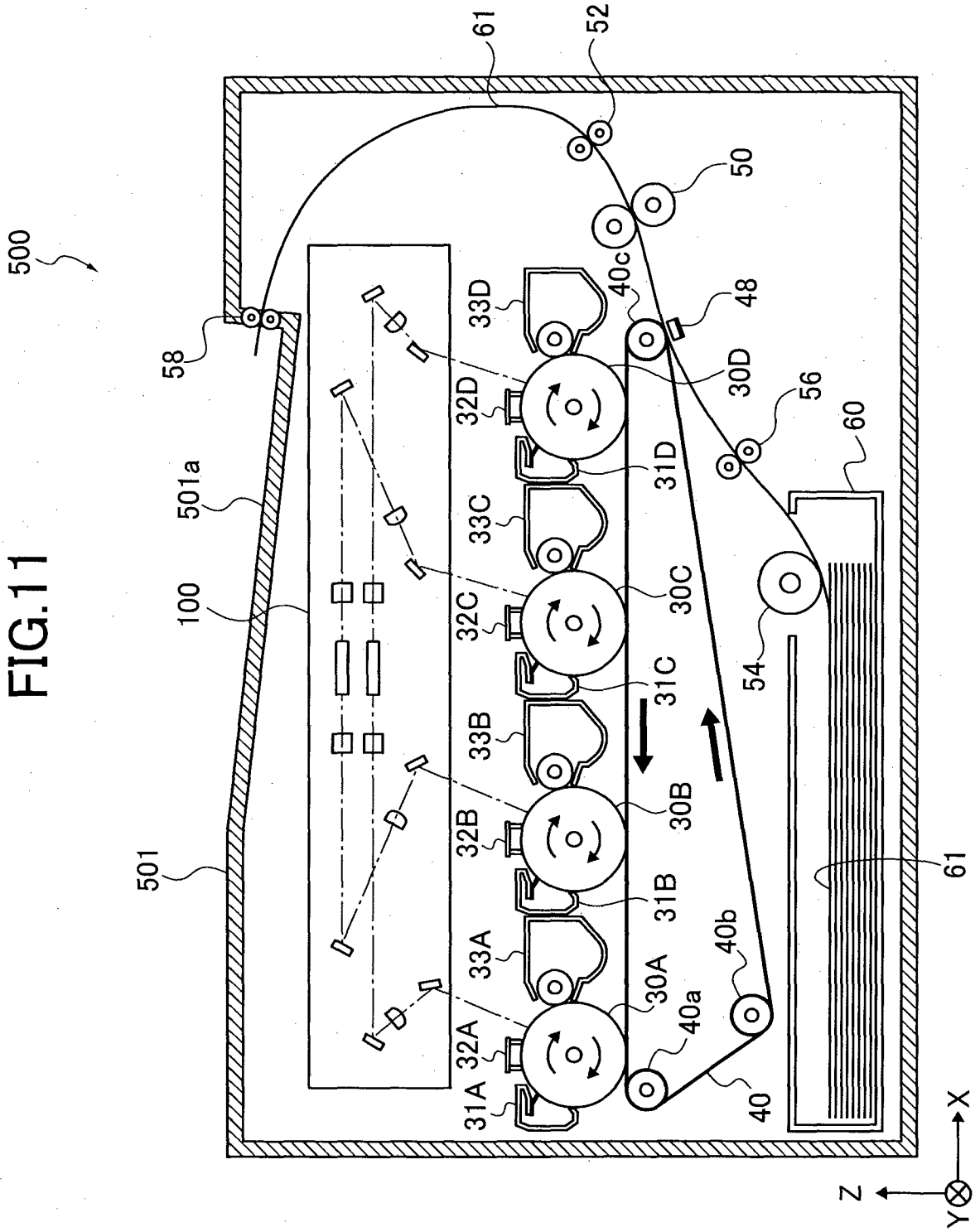
37
32a
54
50
11d
51
35
53
52a
O
52
53
40
21
51a
54a
54
22
32
22a
55
23
11c
54
54b
31
P1

FIG.11


500
61
52
50
58
40c
48
33D
32D
30D
56
60
501a
31D
33C
100
32C
30C
54
31C
33B
32B
30B
501
31B
61
33A
40b
30A
40a
32A
31A
40
X
Z
Y

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/085319

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. H04N5/3745(2011.01)i, G01J1/44(2006.01)i, H01L31/10(2006.01)i, H04N5/355(2011.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. H04N5/3745, G01J1/44, H01L31/10, H04N5/355

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2014
Registered utility model specifications of Japan 1996-2014
Published registered utility model applications of Japan 1994-2014

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2000-244004 A (CANON KABUSHIKI KAISHA) 2000.09.08, Pars.【0002】,【0023】,【0038】-【0041】, Figs.1-5 (No Family)	1-2,4-5
X	JP 2005-241306 A (MATSUSHITA ELECTRIC WORKS,LTD.) 2005.09.08, Pars.【0022】-【0028】, Figs.1-2 & TW 243487 B & KR 10-2006-0042897 A & CN 1661343 A	1-2,4
X	US 2003/0160882 A1 (Christiane Henno) 2003.08.28, Pars.[0018],[0021]-[0022], Fig.1 & JP 2003-523153 A & WO 2001/061990 A1 & DE 10007689 A & TW 564635 B	1,3-7

☑ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13.03.2014	25.03.2014

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2013/085319

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 11-155105 A (HONDA GIKEN KOGYO KABUSHIKI KAISHA) 1999.06.08, Pars.【0019】-【0020】,【0034】-【0037】, Fig.1 (No Family)	1,3,5-7
X	WO 1997/021304 A1 (THE SECRETARY OF STATE FOR DEFENCE) 1997.06.12, Page 8, lines 22-27, Page 10, lines 4-21, Figs.2-3 & JP 2000-502224 A & US 6683645 B1 & GB 2322759 A & EP 1239666 A2 & DE 69532777 T & CA 2239117 A	1,3,5-7
X	US 2008/0179498 A1 (Takayuki SHIMIZU) 2008.07.31, Pars.[0063],[0072], Fig.5 & JP 2008-192324 A & CN 101236105 A	1
A	JP 64-42992 A (OLYMPUS OPTICAL CO.,LTD.) 1989.02.15, Fig.8 & US 4939579 A	1-7