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(71) Applicant: **Koito Manufacturing Co., Ltd.**
Tokyo 108-8711 (JP)

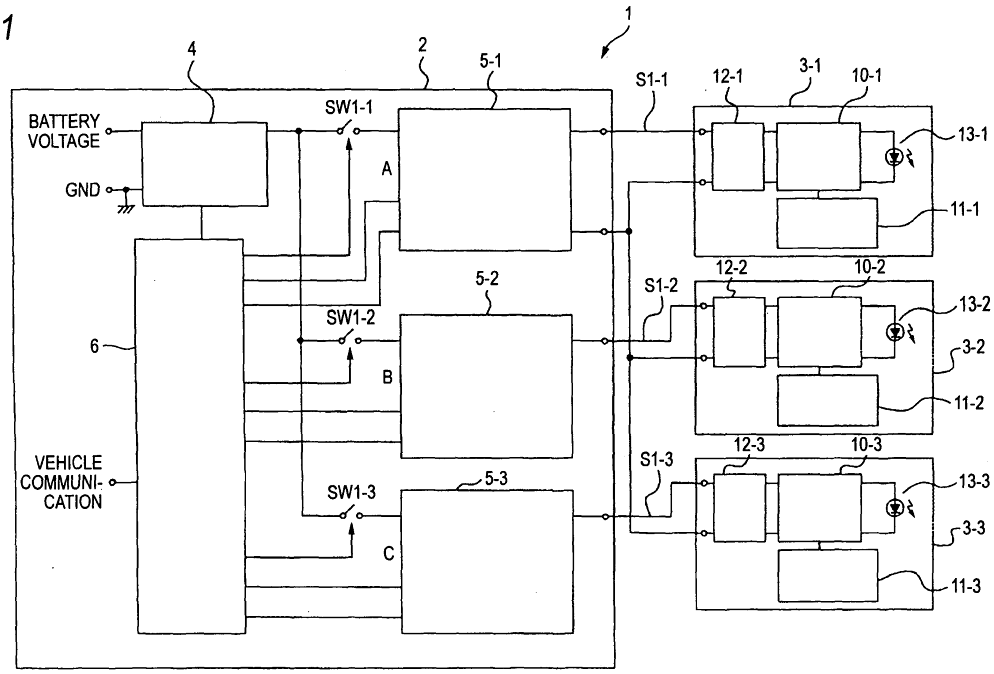
(72) Inventors:
- **Murakami, Kentarou**
Shizuoka-shi
Shizuoka (JP)
- **Ito, Masayasu**
Shizuoka-shi
Shizuoka (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) **Device for controlling turning on and off of a vehicular lamp**

(57) There is provided a device for controlling turning on and off of a vehicular lamp. The device includes a plurality of semiconductor light sources; a plurality of abnormality detecting parts, one abnormality detecting part provided for each semiconductor light source, that detect currents or voltages supplied to the plurality of semiconductor light sources so as to output detection signals used to detect abnormalities of the respective semiconductor light sources; and a control part that detects the respective detection signals at a regular detection period at a different detection timing for each of the detection signals. When, for each semiconductor light source, a time period between a detection timing of the detection signal in one detection period and a detection timing of the detection signal in a next detection period is defined as an acquisition period for the respective semiconductor light sources, the acquisition period of at least one semiconductor light source is different from the other acquisition periods for the other semiconductor light sources.

FIG. 1



EP 2 170 012 A1

Description

BACKGROUND OF THE INVENTION

Technical Field

[0001] The present disclosure relates to a device for controlling the turning on and off of a vehicular lamp, and more particularly, to a device for controlling the turning on and off of a vehicular lamp that includes a control part for determining the abnormality of a semiconductor light source.

Related Art

[0002] In general, a device for controlling the turning on and off of a vehicular lamp includes a plurality of light source units and a control unit. Each light source unit includes a semiconductor light source, and a current control part that controls drive current for driving the semiconductor light source. The control unit is connected to the plurality of light source units through power supply lines, respectively (see e.g., JP-A-2006-73400).

[0003] The control unit includes a plurality of abnormality detecting parts that detect the abnormalities of the plurality of light source units, and a control part that determines whether an abnormality occurs in each of the light source units. The abnormality detecting parts detect the values of the current or voltages that are supplied through the power supply lines, respectively. The abnormality detecting parts send the detected values of the current or voltages to the control part as detection signals, respectively. Each of the detection signals is input to the control unit at regular detection periods. The respective input detection signals are detected at different detection timings for every detection signal, and the detection timings of the respective detection signals at the respective periods are the same. Whether abnormality occurs in each light source unit is determined on the basis of the corresponding detected detection signal.

[0004] A detection processing program, which is previously stored in a Central Processing Unit (CPU) built in the control part of the control unit, runs, so that the detection of each of the detection signals is performed.

[0005] For example, a detection signal (hereinafter, referred to as a "detection signal A1") is sent to the control part from a first abnormality detecting part corresponding to one semiconductor light source (hereinafter, referred to as a "first semiconductor light source"). In this case, if the detection signal A1 includes noise that is substantially synchronized with the length of the first detection period, a detection signal (hereinafter, referred to as a "detection signal A2"), which is sent from the first abnormality detecting part at the second or later detection period, includes the noise. Accordingly, a detection signal including noise is repeatedly detected.

[0006] Therefore, due to the detection signal A2 that is affected by noise, it is erroneously determined that an abnormality has occurred in the corresponding semiconductor light source. When a false detection is caused as described above, the semiconductor light source is temporarily turned off, which causes a problem in that safety deteriorates during the driving of a vehicle.

SUMMARY OF THE INVENTION

[0007] It is an aspect of the invention to prevent false detection, which is caused by the influence of noise, during the detection of a detection signal including noise, and to improve safety during the driving of a vehicle.

[0008] According to one or more aspects of the present invention, there is provided a device for controlling turning on and off of a vehicular lamp. The device comprises: a plurality of semiconductor light sources; a plurality of abnormality detecting parts, one abnormality detecting part provided for each semiconductor light source, that detect currents or voltages supplied to the plurality of semiconductor light sources so as to output detection signals used to detect abnormalities of the respective semiconductor light sources; and a control part that detects the respective detection signals at a regular detection period at a different detection timing for each of the detection signals. When, for each semiconductor light source, a time period between a detection timing of the detection signal in one detection period and a detection timing of the detection signal in a next detection period is defined as an acquisition period for the respective semiconductor light sources, the acquisition period of at least one semiconductor light source is different from the other acquisition periods for the other semiconductor light sources.

[0009] Accordingly, detection is performed by the control part so that at least one acquisition period is different from the other acquisition periods for every semiconductor light source.

[0010] Furthermore, since at least one acquisition period is different from the other acquisition periods, it may be possible to prevent the false detection that is caused by the influence of the noise of the detection signal.

[0011] Furthermore, when two semiconductor light sources are provided, it may be possible to prevent the false detection that is caused by the influence of the noise of each detection signal.

[0012] Furthermore, when a plurality of semiconductor light sources is provided, it may be possible to prevent the false detection that is caused by the influence of the noise of each detection signal.

[0013] Furthermore, according to one or more aspects of the present invention, a plurality of semiconductor light sources is provided, and a signal detected at the last detection timing of an arbitrary detection period is detected at the first detection timing of the next detection period. Therefore, it may be possible to prevent the false detection that is caused by the influence of the noise on each detection signal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Fig. 1 is a view showing an example of a configuration of a device for controlling the turning on and off according to a first exemplary embodiment of the invention;
Fig. 2 is a flowchart illustrating operation of the device according to the first exemplary embodiment;
Fig. 3 is a view showing an example of a detection period and detection timing;
Fig. 4 is a flowchart illustrating operation of the device according to a second exemplary embodiment;
Fig. 5 is a view showing another example of a detection period and detection timing;
Fig. 6 is a flowchart illustrating the operation of the device for controlling the turning on and off according to a third exemplary embodiment; and
Fig. 7 is a view showing yet another example of a detection period and detection timing.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0015] A device for controlling the turning on and off of a vehicular lamp according to a first exemplary embodiment of the invention will be described below.
Fig. 1 is a view showing an example of a configuration of a device for controlling the turning on and off according to a first exemplary embodiment of the invention. Fig. 2 is a flowchart illustrating operation of the device of Fig. 1 according to the first exemplary embodiment. Fig. 3 is a view showing an example of a detection period and detection timing.

[0016] As shown in Fig. 1, a device 1 for controlling the turning on and off includes a control unit 2 and a plurality of light source units 3-1 to 3-3. In this exemplary embodiment, three light source units are provided. However, the number of light source units is not limited and fewer or more may be provided. The control unit 2 is electrically coupled to the light source units 3-1 to 3-3 through power supply lines S1-1 to S1-3. The control unit 2 includes an input circuit 4, abnormality detecting parts 5-1 to 5-3 that detect abnormalities of the LEDs (to be described below) provided in the respective light source units 3-1 to 3-3, a control part 6, and switch parts SW1-1 to SW1-3 that control the turning on and off of the respective light source units 3-1 to 3-3.

[0017] The input circuit 4 includes a noise filter and a surge protection element, for example, a surge absorber or a power zener diode such as a dump surge.

[0018] Each of the abnormality detecting parts 5-1 to 5-3 includes a current detecting circuit (not shown) and a voltage detecting circuit (not shown). The switch parts SW1-1 to SW1-3 are electrically coupled to the input sides of the abnormality detecting parts 5-1 to 5-3, respectively. The light source units 3-1 to 3-3 are electrically coupled to the output sides of the abnormality detecting parts 5-1 to 5-3 through the power supply lines S1-1 to S1-3, respectively.

[0019] For example, the respective current detecting circuits include shunt resistors that are electrically coupled to the switch parts SW1-1 to SW1-3 in series, and PNP transistors of which the bases are electrically coupled to one another. Collectors of the PNP transistors are electrically coupled to the control part 6. For example, the voltage detecting circuit includes two resistors, and a node between the two resistors is electrically coupled to the control part 6.

[0020] For example, a switch element such as a PMOS transistor is used as each of the switch parts SW1-1 to SW1-3.

[0021] The respective light source units 3-1 to 3-3 respectively include switching regulators 10-1 to 10-3 that are used as current control parts, control circuits 11-1 to 11-3, resonant circuits (noise filters) 12-1 to 12-3, and LEDs 13-1 to 13-3 that are used as semiconductor light sources. Each of the resonant circuits 12-1 to 12-3 includes at least a coil and a capacitor.

[0022] The operation of the device for controlling the turning on and off according to the first exemplary embodiment will be described below.

[0023] The LEDs 13-1 to 13-3 are turned on and off by controlling a DC voltage, which is applied to the light source units 3-1 to 3-3, through the turning on and off of the respective switch parts SW1-1 to SW1-3.

[0024] The abnormality detecting parts 5-1 to 5-3 detect the values of the current or voltages that are supplied to the LEDs 13-1 to 13-3 through the power supply lines S1-1 to S1-3, respectively. The detected values of the current or voltages are sent to a CPU (not shown), which is built in the control part 6, as detection signals that are used to detect the abnormalities of the LEDs 13-1 to 13-3, respectively.

[0025] The CPU determines whether abnormalities occur in the LEDs 13-1 to 13-3 on the basis of the detection signals detected by the respective abnormality detecting parts 5-1 to 5-3.

[0026] The determination of the abnormalities of the LEDs 13-1 to 13-3, which is performed by the CPU, is performed by running a detection processing program that detects a corresponding detection signal, and an abnormality determining program that determines whether an abnormality exists on the basis of each detected detection signal, every detection period. The detection period may be predetermined.

[0027] The control of the turning on and off of, for example, two LEDs 13-1 and 13-2 will be described below with reference to Figs. 2 and 3. In this example, the switch parts SW1-1 and SW1-2 are turned on and the switch part SW1-3 is turned off. Meanwhile, in the following description, the detection signals output from the abnormality detecting parts 5-1 and 5-2 are referred to as detection signals A and B, respectively.

[0028] In Fig. 2, "Detection Processing A" and "Detection Processing B" denote the detection of detection signals A and B, respectively.

[0029] The sections, which are denoted by "A" and "B" in Fig. 3, are sections during which the detection processing programs for detecting the detection signals A and B run, respectively. The other sections are sections during which the abnormality determining programs, which determine whether abnormalities occur in the LEDs 13-1 and 13-2, run and sections during which other control programs run.

[0030] When the detection signals A and B are sent from the abnormality detecting parts 5-1 and 5-2, respectively, the detection processing program shown in Fig. 2 runs. The detection processing program runs at the n-th or later detection periods (n being an integer of 2 or more).

[0031] Referring to Fig. 2, a counter (not shown) built in the CPU is initialized (Operation S100) and counts up (Operation S101), and it is determined whether a count is larger than 1 (Operation S102).

[0032] Since the counter is 1 at a first detection period, the detection signal A is detected (Operation S103). The detection timing at this time is t1 shown in Fig. 3. After that, the detection signal B is detected (Operation S104). The detection timing at this time is t2.

[0033] When the detection signal B is completely detected, counting-up is performed again (Operation S101) and the process proceeds to a second detection period. At the second detection period, the count is increased and becomes 2. It is determined whether the count is larger than 1 (Operation S102). Since the count is 2, the detection signal B is detected (Operation S105). The detection timing at this time is t1. Then, the detection signal A is detected (Operation S106). The detection timing at this time is t2. After that, the counter is cleared and returns to an initial state (Operation S107).

[0034] As described above, Operations S103 and S104 are performed at the first detection period and Operations S105 and S 106 are performed at the second detection period. After that, the following processing is repeated even at the n-th or later detection periods.

[0035] The time between the detection timing of the detection signal A at an arbitrary detection period and the detection timing at the next detection period is referred to as an acquisition period. In the example shown in Fig. 3, the time between the detection timing of the detection signal A at the first detection period and the detection timing at the second detection period is an acquisition period Ta1, and the time between the detection timing of the detection signal A at the second detection period and the detection timing of the detection signal A at the third detection period is an acquisition period Ta2. In the detection processing of the detection signal A, the acquisition period Ta1 and the acquisition period Ta2 are alternately repeatedly perfromed even at the n-th or later detection periods.

[0036] Likewise, the time between the detection timing of the detection signal B at the first detection period and the detection timing of he detection signal B at the second detection period is an acquisition period Tb1, and the time between the detection timing of the detection signal B at the second detection period and the detection timing of the detection signal B at the third detection period is an acquisition period Tb2. In the detection of the detection signal B, the acquisition period Tb1 and the acquisition period Tb2 are alternately repeatedly performed even at the n-th or later detection periods.

[0037] The time Ta, which is obtained by dividing the time, which is obtained by adding the acquisition period Ta1 to the acquisition period Ta2, by the number of the detection periods, i.e. two, is referred to as the time per detection period. Likewise, the time Tb, which is obtained by dividing the time, which is obtained by adding the acquisition period Tb1 to the acquisition period Tb2, by the number of the detection periods, i.e. two, is also referred to as the time per detection period. The time Tb is equal to the time Ta.

[0038] The acquisition periods Ta1 and Ta2 or the acquisition periods Tb1 and Tb2, having different lengths, are alternately repeatedly performed as described above. Accordingly, for example, even if the detection signal A of the first detection period includes noise that is substantially synchronized with the length of the detection period, the detection signal A of the second or later detection period is not affected by the noise. Accordingly, it may be possible to prevent the false detection that is caused by the influence of the noise of the detection signal A.

[0039] A device for controlling the turning on and off of a vehicular lamp according to a second exemplary embodiment of the invention will be described below. Fig. 4 is a flowchart illustrating operation of the device according to a second exemplary embodiment. Fig. 5 is a view showing another example of a detection period and detection timing.

[0040] The second exemplary embodiment relates to the control of the turning on and off of, for example, five LEDs. In the following description, detection signals, which detect whether abnormalities occur in the five LEDs, are referred to as detection signals A, B, C, D, and E, respectively. In Fig. 4, "Detection Processing A", "Detection Processing B", ... "Detection Processing E" denote the detection of the detection signals A to E, respectively. The sections, which are denoted by "A" to "E" in Fig. 5, are sections during which the detection processing programs for detecting the detection signals A to E run, respectively. The other sections are sections during which the abnormality determining programs which determine whether abnormalities occur in the LEDs run and sections during which other control programs run. Here, t1 to t5 are the detection timings of the detection signals A to E, respectively.

[0041] When the detection signals A to E are sent from five abnormality detecting parts, respectively, the detection processing program shown in Fig. 4 runs. The detection processing program runs at an n-th detection period (n is an integer of 2 or more).

[0042] First, a counter (not shown) built in the CPU is initialized (Operation S200) and counts up (Operation S201), and the present count (Operation S202) is determined. Since the count is 1 (Operation S203) at the first detection period, the detection signals A, B, C, D, and E are detected in this order (Operation S204). The detection timings of the detection signals A to E at this time are t1 to t5 as shown in Fig. 5, respectively.

[0043] When the detection signals A, B, C, D, and E are completely detected, it is then determined whether the count is greater than 4 (Operation S213). Since the count is 1, counting-up is performed again (Operation S201) and the process proceeds to a second detection period. At the second detection period, the count is 2 (Operation S205) and the detection signals E, A, B, C, and D are detected in this order (Operation S206). Detection timings at this time are t1 to t5, respectively.

[0044] When the detection signals E, A, B, C, and D are completely detected, it is again determined whether the count is greater than 4 (Operation S213). Since the count is 2, counting-up is performed again (Operation S201) and the process proceeds to a third detection period. At the third detection period, the count is 3 (Operation S207) and the detection signals D, E, A, B, and C are detected in this order (Operation S208). Detection timings at this time are t1 to t5, respectively.

[0045] When the detection signals D, E, A, B, and C are completely detected, it is again determined whether the count is greater than 4 (Operation S213). Since the count is 3, counting-up is performed again (Operation S201) and the process proceeds to a fourth detection period. At the fourth detection period, the count is 4 (Operation S209) and the detection signals C, D, E, A, and B are detected in this order (Operation S210). Detection timings at this time are t1 to t5, respectively.

[0046] When the detection signals C, D, E, A, and B are completely detected, it is again determined whether the count is greater than 4 (Operation S213). Since the count is 4, counting-up is performed again (Operation S201) and the process proceeds to a fifth detection period. At the fifth detection period, the count is 5 (Operation S211) and the detection signals B, C, D, E, and A are detected in this order (Operation S212). Detection timings at this time are t1 to t5, respectively. After the detection signals B, C, D, E, and A are completely detected, it is determined whether the count is greater than 4 (Operation S213). Since the count is 5, and hence is larger than 4, the counter is cleared and returns to the initial state (Operation S214).

[0047] As described above, Operations S203 and S204 are performed at the first detection period, Operations S205 and S206 are performed at the second detection period, Operations S207 and S208 are performed at the third detection period, Operations S209 and S210 are performed at the fourth detection period, and Operations S211 and 212 are performed at the fifth detection period. After that, the processing corresponding to the counts 1 to 5 is repeatedly performed even at the n-th or later detection periods.

[0048] An example of the control of the turning on and off of five LEDs has been described above. However, if the first to m-th detection signals (m being an integer of 2 or more) are input to a CPU at one detection period in the above-mentioned example, detection where the detection timings of the first to m-th detection signals at one detection period are t1 to tm is repeatedly performed n times. In this case, the detection signal, which has been detected at the detection timing t1 of an arbitrary detection period, is detected at the detection timing t2 of the next detection period. The detection signal, which is detected at the detection timing tm of the arbitrary detection period, is detected at the detection timing t1 of the next detection period.

[0049] That is, in the above-mentioned example, the detection signal A, which has been detected at the detection timing t1 of the first detection period, is detected at the detection timing t2 of the second detection period. Further, the detection signal E, which has been detected at the detection timing t5 of the first detection period, is detected at the detection timing t1 of the second detection period, and so on.

[0050] Accordingly, when the above-mentioned detection processing program runs, at least one acquisition period is different from the other acquisition periods for each LED as described above. For example, even if the detection signal A of the first detection period includes noise that is substantially synchronized with the length of the detection period, the detection signal A of the second detection period is not affected by the noise. Accordingly, it may be possible to prevent the false detection that is caused by the influence of the noise of the detection signal A.

[0051] A device for controlling the turning on and off of a vehicular lamp according to a third exemplary embodiment of the invention will be described below. Fig. 6 is a flowchart illustrating the operation of the device for controlling the turning on and off according to a third exemplary embodiment. Fig. 7 is a view showing yet another example of a detection period and detection timing.

[0052] The third exemplary embodiment is the same as the second exemplary embodiment in that the turning on and off of five LEDs is controlled. However, the third exemplary embodiment is different from the second exemplary embodiment in terms of the detection order of the detection signals A to E after the second detection period.

[0053] When the detection signals A to E are sent from five abnormality detecting parts, respectively, the detection processing program shown in Fig. 6 runs. The detection processing program runs at an n-th detection period (n being an integer of 2 or more).

[0054] First, a counter (not shown) built in the CPU counts up (Operation S301), and the present count is determined (Operation S302). Since the count is 1 (Operation S303) at the first detection period, the detection signals A, B, C, D, and E are detected in this order (Operation S304). The detection timings of the detection signals A to E at this time are t1 to t5 as shown in Fig. 7, respectively.

[0055] When the detection signals A, B, C, D, and E are completely detected, it is determined whether the count is greater than 4 (oepraiton S313). Since the count is 1, counting-up is performed again (Operation S301) and the process proceeds to a second detection period. At the second detection period, the count is 2 (Operation S305) and the detection signals B, C, D, E, and A are detected in this order (Operation S306). Detection timings at this time are t1 to t5, respectively.

[0056] When the detection signals B, C, D, E, and A are completely detected, it is determined whether the count is greater than 4 (oepraiton S313). Since the count is 2, counting-up is performed again (Operation S301) and the process proceeds to a third detection period. At the third detection period, the count is 3 (Operation S307) and the detection signals C, D, E, A, and B are detected in this order (Operation S308). Detection timings at this time are t1 to t5, respectively.

[0057] When the detection signals C, D, E, A, and B are completely detected, it is determined whether the count is greater than 4 (oepraiton S313). Since the count is 3, counting-up is performed again (Operation S301) and the process proceeds to a fourth detection period. At the fourth detection period, the count is 4 (Operation S309) and the detection signals D, E, A, B, and C are detected in this order (Operation S310). Detection timings at this time are t1 to t5, respectively.

[0058] When the detection signals D, E, A, B, and C are completely detected, it is determined whether the count is greater than 4 (oepraiton S313). Since the count is 4, counting-up is performed again (Operation S301) and the process proceeds to a fifth detection period. At the fifth detection period, the count is 5 (Operation S311) and the detection signals E, A, B, C, and D are detected in this order (Operation S312). Detection timings at this time are t1 to t5, respectively. After the detection signals E, A, B, C, and D are completely detected, it is determined whether the count is greater than 4 (oepraiton S313). Since the count is 5, and hence is greater than 4, the counter is cleared and returns to the initial state (Operation S314).

[0059] As described above, Operations S303 and S304 are performed at the first detection period, Operations S305 and S306 are performed at the second detection period, Operations S307 and S308 are performed at the third detection period, Operations S309 and S310 are performed at the fourth detection period, and Operations S311 and S312 are performed at the fifth detection period. After that, the processing corresponding to counts 1 to 5 is repeated even at the n-th or later detection periods.

[0060] An example of the control of the turning on and off of five LEDs has been described above. However, if the first to m-th detection signals (m being an integer of 2 or more) are input to a CPU at one detection period in the above-mentioned example, the detection where the detection timings of the first to m-th detection signals at one detection period are t1 to tm is repeated n times. In this case, the detection signal, which has been detected at the detection timing tm of an arbitrary detection period, is detected at the detection timing tm-1 of the next detection period. The detection signal, which is detected at the detection timing t1 of the arbitrary detection period, is detected at the detection timing tm of the next detection period.

[0061] That is, in the above-mentioned example, the detection signal E, which has been detected at the detection timing t5 of the first detection period, is detected at the detection timing t4 of the second detection period. Further, the detection signal A, which has been detected at the detection timing t1 of the first detection period, is detected at the detection timing t5 of the second detection period.

[0062] Accordingly, when the above-mentioned detection processing program runs, at least one acquisition period is different from the other acquisition periods for each LED. For example, even if the detection signal A of the first detection period includes noise that is substantially synchronized with the length of the detection period, the detection signal A of the second detection period is not affected by the noise. Accordingly, it may be possible to prevent the false detection that is caused by the influence of the noise of the detection signal A.

[0063] Each of the above-mentioned exemplary embodiments is merely illustrative, and the present invention may have various modifications without departing from the scope of the invention.

Claims

1. A device for controlling turning on and off of a vehicular lamp, the device comprising:

    a plurality of semiconductor light sources;
    a plurality of abnormality detecting parts, one abnormality detecting part provided for each semiconductor light source, that detect currents or voltages supplied to the plurality of semiconductor light sources so as to output detection signals used to detect abnormalities of the respective semiconductor light sources; and
    a control part that detects the respective detection signals at a regular detection period at a different detection timing for each of the detection signals,

    wherein when, for each semiconductor light source, a time period between a detection timing of the detection signal in one detection period and a detection timing of the detection signal in a next detection period is defined as an acquisition period for the respective semiconductor light sources, the acquisition period of at least one semiconductor light source is different from the other acquisition periods for the other semiconductor light sources.

2. The device according to claim **1**, wherein the semiconductor light sources comprise two semiconductor light sources, wherein the acquisition period for each semiconductor light source comprises a first acquisition period that is longer than the detection period; and a second acquisition period that is shorter than the detection period, and the first acquisition period and the second acquisition period are alternately repeated.

3. The device according to claim 1, wherein a number of the plurality of semiconductor light sources is m, m being an integer of 2 or more, when first to m-th detection signals are input to the control part, the number of the detection signals that are detected at one detection period is m, and wherein when the detection timings of the first to m-th detection signals in a detection period are defined as t_1 to t_m, the detection timings of the second to (m-1)-th detection signals are t_3 to t_m or t_1 to t_{m-2} in the next detection period.

4. The device according to claim 3, wherein the detection periods comprise first to n-th detection periods, n being an integer of 2 or more, and wherein the detection signal whose detection timing is t_1 at one of the detection periods is detected at the detection timing t_2 at the next detection period, and the detection signal whose detection timing is t_m at one of the detection periods is detected at the detection timing t_1 at the next detection period.

5. The device according to claim 3, wherein the detection periods include first to n-th detection periods, n being an integer of 2 or more, and wherein the detection signal whose detection timing is t_m at one of the detection periods is detected at the detection timing t_{m-1} at the next detection period, and the detection signal whose detection timing is t_1 at one of the detection periods is detected at the detection timing t_m at the next detection period.

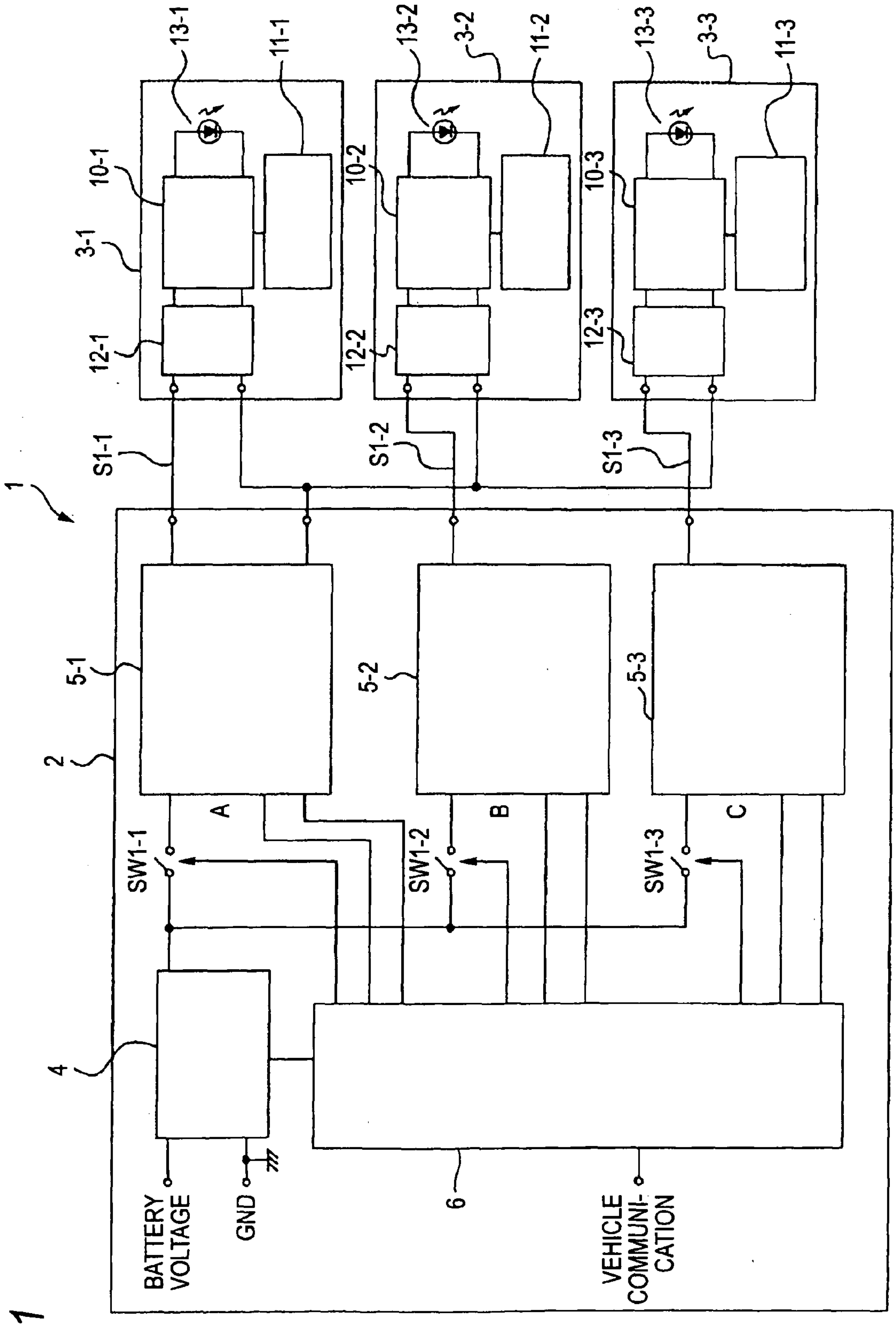

1
2
4
5-1
5-2
5-3
6
A
B
C
SW1-1
SW1-2
SW1-3
S1-1
S1-2
S1-3
3-1
3-2
3-3
10-1
10-2
10-3
11-1
11-2
11-3
12-1
12-2
12-3
13-1
13-2
13-3
BATTERY VOLTAGE
GND
VEHICLE COMMUNI-CATION

FIG. 1

FIG. 2

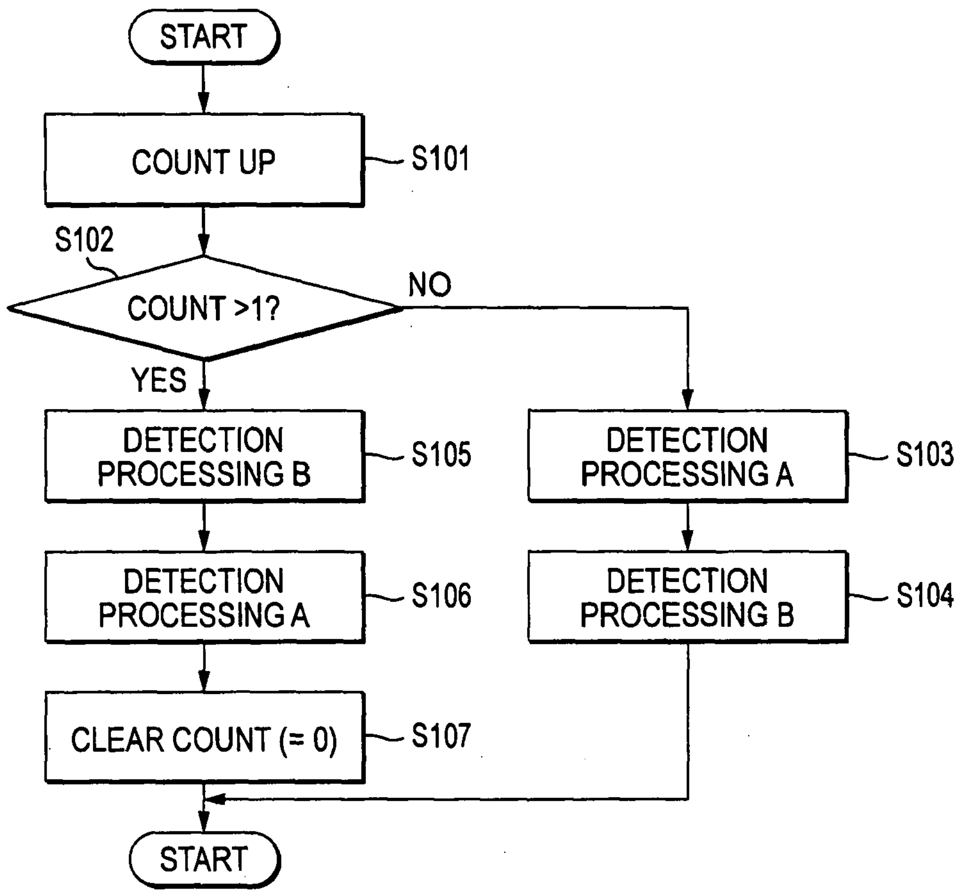
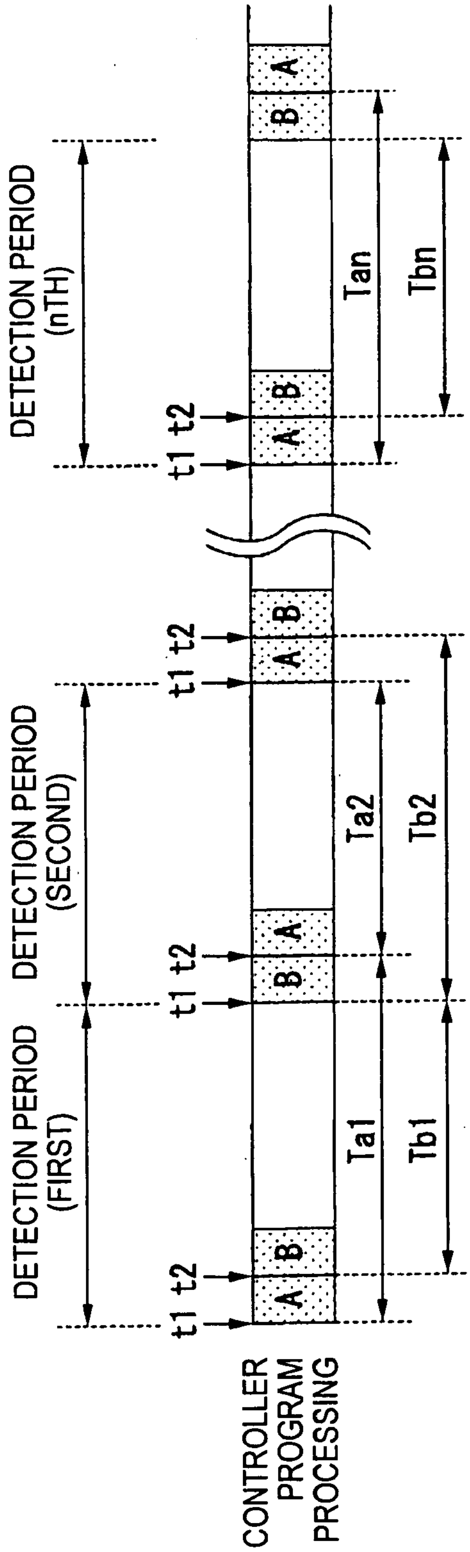

START
COUNT UP
S101
S102
COUNT >1?
NO
YES
DETECTION PROCESSING B
S105
DETECTION PROCESSING A
S103
DETECTION PROCESSING A
S106
DETECTION PROCESSING B
S104
CLEAR COUNT (= 0)
S107
START

FIG. 3


DETECTION PERIOD (FIRST)
DETECTION PERIOD (SECOND)
DETECTION PERIOD (nTH)
t1 t2
A
B
Ta1
Tb1
Ta2
Tb2
Tan
Tbn
CONTROLLER PROGRAM PROCESSING

4/7

FIG. 4

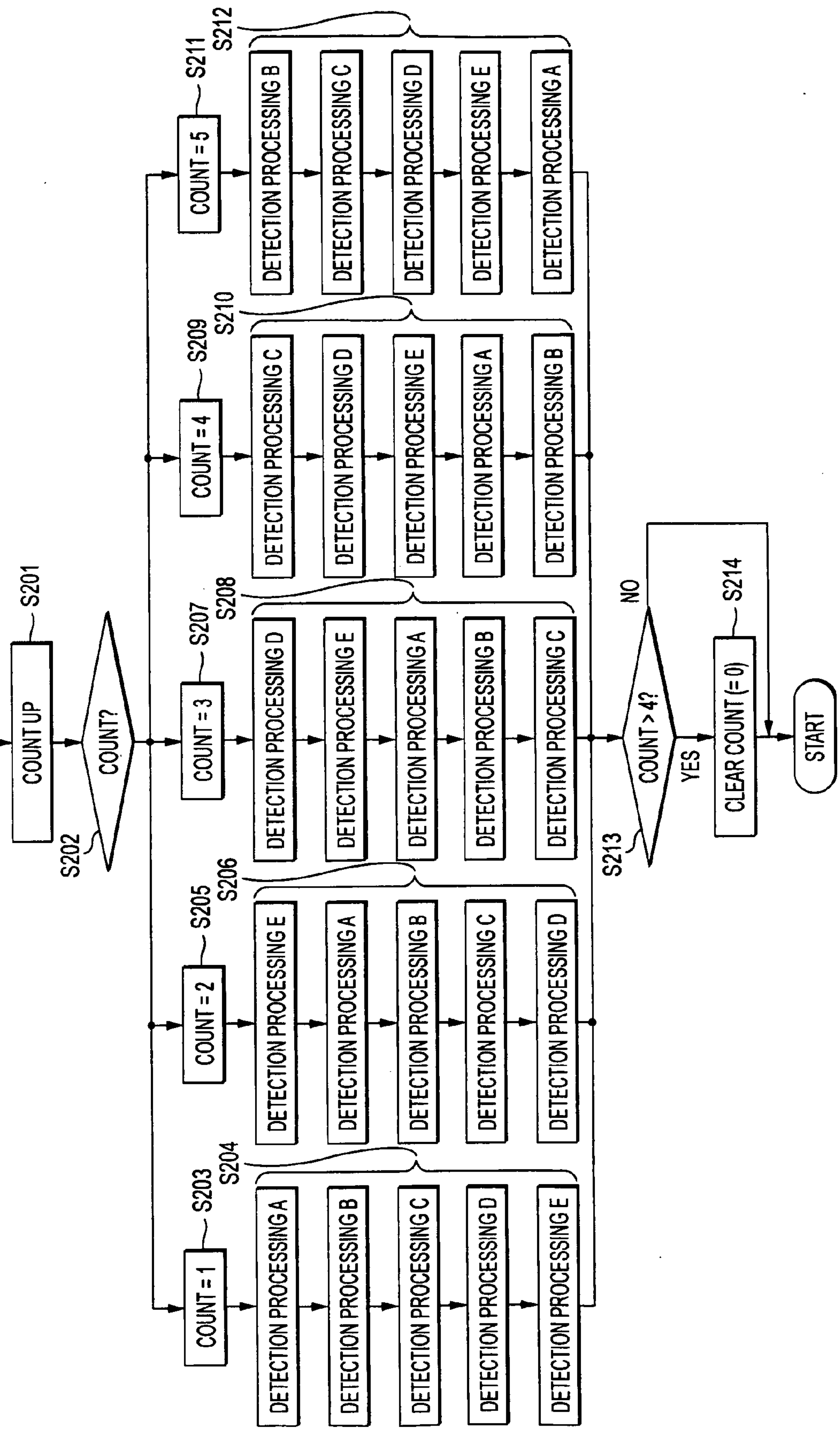

START
COUNT UP
S201
COUNT?
S202
COUNT = 1
S203
S204
DETECTION PROCESSING A
DETECTION PROCESSING B
DETECTION PROCESSING C
DETECTION PROCESSING D
DETECTION PROCESSING E
COUNT = 2
S205
S206
DETECTION PROCESSING E
DETECTION PROCESSING A
DETECTION PROCESSING B
DETECTION PROCESSING C
DETECTION PROCESSING D
COUNT = 3
S207
S208
DETECTION PROCESSING D
DETECTION PROCESSING E
DETECTION PROCESSING A
DETECTION PROCESSING B
DETECTION PROCESSING C
COUNT = 4
S209
S210
DETECTION PROCESSING C
DETECTION PROCESSING D
DETECTION PROCESSING E
DETECTION PROCESSING A
DETECTION PROCESSING B
COUNT = 5
S211
S212
DETECTION PROCESSING B
DETECTION PROCESSING C
DETECTION PROCESSING D
DETECTION PROCESSING E
DETECTION PROCESSING A
COUNT > 4?
S213
NO
YES
CLEAR COUNT (= 0)
S214
START

FIG. 5

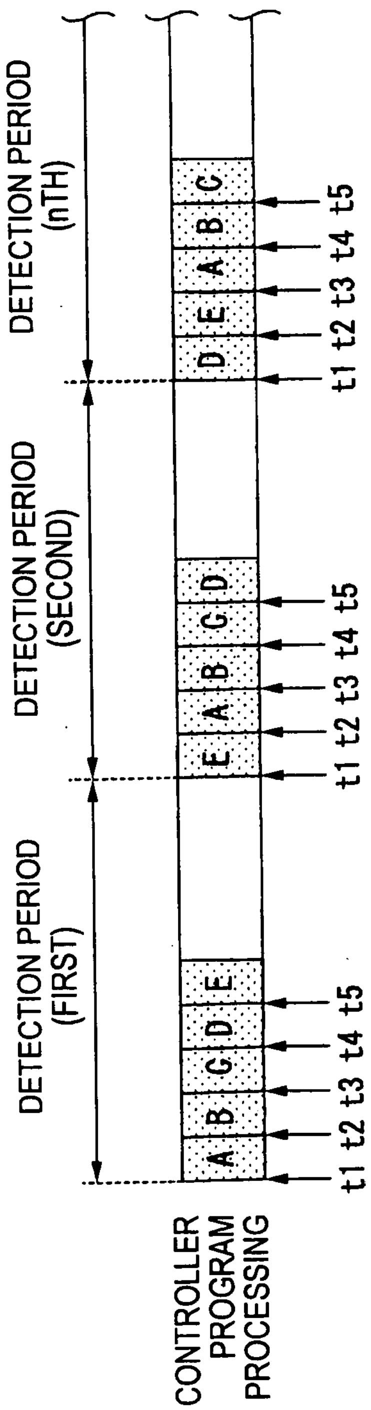

DETECTION PERIOD (FIRST)
DETECTION PERIOD (SECOND)
DETECTION PERIOD (nTH)
CONTROLLER PROGRAM PROCESSING
A B C D E
E A B C D
D E A B C
t1 t2 t3 t4 t5

FIG. 6

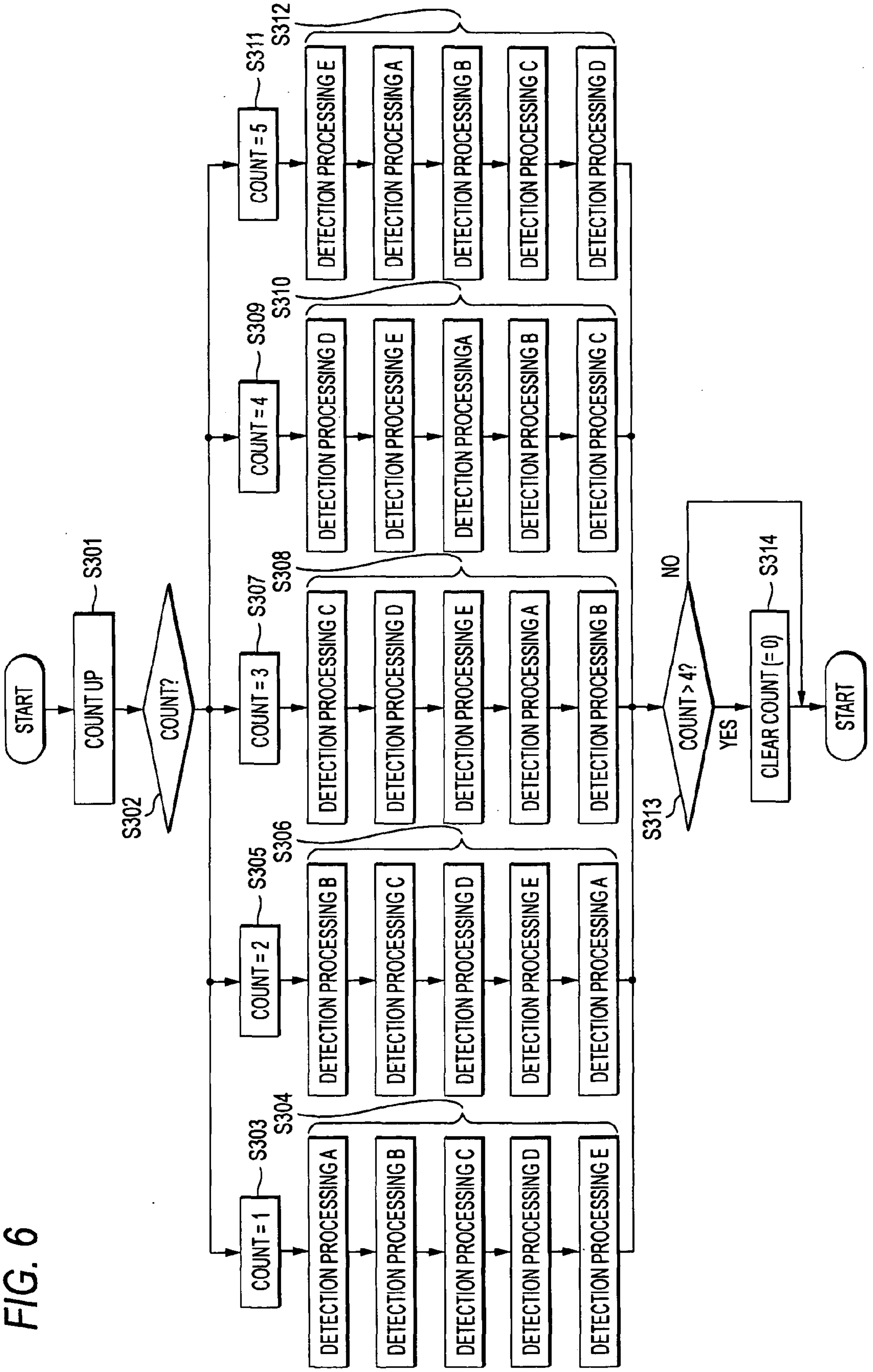
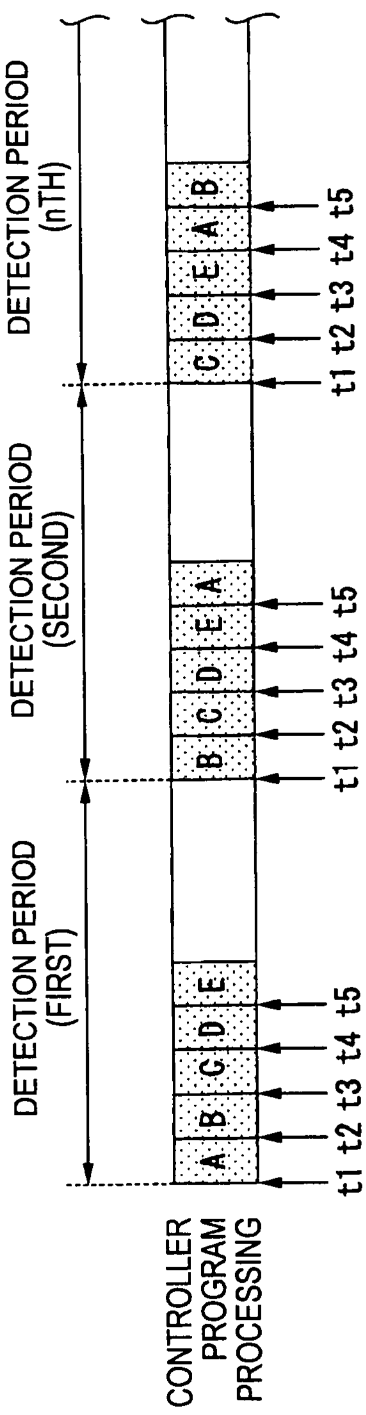

START
COUNT UP
S301
COUNT?
S302
COUNT = 1
S303
S304
DETECTION PROCESSING A
DETECTION PROCESSING B
DETECTION PROCESSING C
DETECTION PROCESSING D
DETECTION PROCESSING E
COUNT = 2
S305
S306
DETECTION PROCESSING B
DETECTION PROCESSING C
DETECTION PROCESSING D
DETECTION PROCESSING E
DETECTION PROCESSING A
COUNT = 3
S307
S308
DETECTION PROCESSING C
DETECTION PROCESSING D
DETECTION PROCESSING E
DETECTION PROCESSING A
DETECTION PROCESSING B
COUNT = 4
S309
S310
DETECTION PROCESSING D
DETECTION PROCESSING E
DETECTION PROCESSING A
DETECTION PROCESSING B
DETECTION PROCESSING C
COUNT = 5
S311
S312
DETECTION PROCESSING E
DETECTION PROCESSING A
DETECTION PROCESSING B
DETECTION PROCESSING C
DETECTION PROCESSING D
COUNT > 4?
S313
NO
YES
CLEAR COUNT (= 0)
S314
START

FIG. 7


DETECTION PERIOD (FIRST)
DETECTION PERIOD (SECOND)
DETECTION PERIOD (nTH)
CONTROLLER PROGRAM PROCESSING
A B C D E
B C D E A
C D E A B
t1 t2 t3 t4 t5
t1 t2 t3 t4 t5
t1 t2 t3 t4 t5

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EUROPEAN SEARCH REPORT

Application Number
EP 09 01 2268

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	US 2006/055244 A1 (ITO MASAYASU [JP] ET AL) 16 March 2006 (2006-03-16) * the whole document * -----	1-5	INV. H05B33/08
A	WO 2007/096868 A1 (POWERDSINE LTD [IL]; KORCHARZ DROR [IL]; FERENTZ ALON [IL]; BLAUT RONI) 30 August 2007 (2007-08-30) * paragraph [0103] - paragraph [0109]; figures 2, 5 * -----	1-5	

TECHNICAL FIELDS SEARCHED (IPC)
H05B

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 January 2010	Morrish, Ian

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