

DESCRIPTION

Title of Invention

TESTING DEVICE AND TESTING METHOD

5

Technical Field

[0001]

The present invention relates to a testing device and a testing method for testing a protective device or the like that detects arc light which is generated when a pantograph
10 bounces from a trolley wire in an electric railroad system.

Priority is claimed on Japanese Patent Application No. 2014-119530, filed on June 10, 2014, the content of which is incorporated herein by reference.

Background Art

15 [0002]

In electric railroads, electric power is sent from a transformer station through a trolley wire to a slider of a vehicle and a pantograph. When pantograph bounce is generated due to contact between a trolley wire and a slider being damaged during operation of a train, arc discharge is generated at the point of pantograph bounce. Since
20 such arc discharge causes undesired noise and the attrition of a trolley wire and a slider, it is preferable not to generate arc discharges insofar as possible. For this reason, it is necessary to take countermeasures to prevent occurrence of the arc discharge by accurately detecting points at which arc discharge is generated.

[0003]

25 As a technique for detecting such arc discharge, a pantograph bounce detecting

device disclosed in Patent Documents 1 and 2 is provided. The pantograph bounce detecting device disclosed in Patent Documents 1 and 2 includes an ultraviolet light receiving unit installed in the vicinity of a pantograph, and a plastic optical fiber, disposed inside a vehicle, which transmits light received by the ultraviolet light receiving unit to a light amount measuring device. The ultraviolet light receiving unit includes a filter that allows passage of an ultraviolet light component having a predetermined wavelength or less of arc light, and fluorescent glass that converts ultraviolet light having passed through the filter into visible light.

[0004]

10 In the pantograph bounce detecting device, the ultraviolet light receiving unit removes a non-ultraviolet light component having a predetermined wavelength or greater through the filter, to thereby transmit ultraviolet light contained in arc light at a higher rate than that of sunlight. Thereafter, the ultraviolet light is converted into visible light by the fluorescent glass, and then is transmitted to the light amount measuring device
15 through the plastic optical fiber.

[0005]

Hitherto, there has been a testing device for performing the operation confirmation or calibration of the pantograph bounce detecting device. Normally, in a case where the operation confirmation of the pantograph bounce detecting device is
20 performed, a portable deuterium lamp is used as the testing device. In addition, in a case where the pantograph bounce detecting device is calibrated, facilities for generating an actual arc discharge, or a calibration device including a large-size deuterium lamp and a chopper is used as the testing device. The light-emitting time of the deuterium lamp included in the calibration device is set to 100 microseconds specified by the
25 international standard, and the light-emitting time of the deuterium lamp is controlled

using the chopper.

Citation List

Patent Document

5 [0006]

[Patent Document 1] Japanese Unexamined Patent Application, First
Publication No. 2009-183088

[Patent Document 2] Japanese Unexamined Patent Application, First
Publication No. 2010-233391

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Summary of Invention

Technical Problem

[0007]

Since the portable deuterium lamp for performing the operation confirmation of
15 the pantograph bounce detecting device has a small amount of light as compared to arc
discharge, a plurality of portable deuterium lamps may be required. In addition,
facilities generating arc discharge for calibrating the pantograph bounce detecting device
are large in size, and thus it is necessary to give consideration to safety during discharge.
Further, the calibration device having the large-size deuterium lamp used therein requires
20 complex control based on a chopper, and incurs a rise in device costs.

[0008]

Consequently, an aspect of the present invention is aimed at providing a testing
device and a testing method which are excellent in portability, and are capable of easily
and inexpensively performing an operation test of a device that detects arc discharge.

25

Solution to Problem

[0009]

In order to solve the aforementioned problem, according to an aspect of the present invention, the following testing device or testing method is proposed.

5 In a first aspect of the present invention, there is proposed a testing device including: an optical semiconductor element that emits light containing ultraviolet light contained in arc discharge which is generated in a point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph; and a light-emitting control unit that causes the optical semiconductor element to emit light
10 over a predetermined time.

[0010]

According to the first aspect of the present invention, since the optical semiconductor element emits light containing ultraviolet light over a predetermined time under the control of the light-emitting control unit, the device that detects arc discharge
15 which is generated at the point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph receives light which is emitted from the optical semiconductor element, thereby allowing an operation test of the device that detects arc discharge to be performed without generating an arc discharge.

[0011]

20 In a second aspect of the present invention in accordance with the testing device of the first aspect of the present invention, for example, there is proposed a testing device in which the optical semiconductor element is an ultraviolet light-emitting diode.

According to the second aspect of the present invention, it is possible to simulate arc discharge which is generated at the point of pantograph bounce between a trolley
25 wire and a slider.

In a third aspect of the present invention in accordance with the testing device of the first or second aspect of the present invention, for example, there is proposed a testing device in which the light-emitting control unit includes an oscillator that oscillates at a predetermined oscillation frequency, a counter that starts counting in response to an oscillation output of the oscillator, and stops counting when a count value reaches a predetermined set value, and a drive circuit that drives the optical semiconductor element on the basis of a counting result of the counter.

According to the third aspect of the present invention, it is possible to control the light-emitting time of the optical semiconductor element in accordance with the set value of the counter.

[0012]

In a fourth aspect of the present invention in accordance with the testing device of the third aspect of the present invention, for example, there is proposed a testing device in which the oscillator includes a time constant circuit constituted by a variable resistor and a capacitor, and oscillates at a frequency according to a time constant which is determined by a resistance value of the variable resistor and a capacitance value of the capacitor.

According to the fourth aspect of the present invention, it is possible to correct the oscillation frequency of the oscillator by adjusting the resistance value of the variable resistor.

[0013]

In a fifth aspect of the present invention in accordance with the testing device of any one of the first to fourth aspects of the present invention, for example, there is proposed a testing device further including a light detection unit that detects light emitted by the optical semiconductor element; and a light-emitting time correction unit that

corrects a light-emitting time of the optical semiconductor element on the basis of a detection result of the light detection unit.

According to the fifth aspect of the present invention, it is possible to perform feedback control so that the light-emitting time of the optical semiconductor element is set to a predetermined time.

[0014]

In a sixth aspect of the present invention, there is proposed a testing method including: a light-emitting control step of causing an optical semiconductor element to emit light over a predetermined time, the optical semiconductor element emitting light containing ultraviolet light contained in arc discharge which is generated in a point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph, wherein the light-emitting control step includes a step of causing an oscillator to oscillate at a predetermined oscillation frequency, a step of causing a counter to start counting in response to an oscillation output of the oscillator, and stop counting when a count value reaches a predetermined set value, and a step of causing a drive circuit to drive the optical semiconductor element on the basis of a counting result of the counter.

According to the sixth aspect of the present invention, it is possible to obtain the same technical effect as that of the invention according to the aforementioned testing device.

Advantageous Effects of Invention

[0015]

According to the aspects of the present invention, it is possible to enhance portability, and to easily and inexpensively perform an operation test of a detection

device that detects arc discharge.

Brief Description of Drawings

[0016]

5 FIG. 1 is a diagram illustrating a configuration example of a testing device according to a first embodiment of the present invention.

FIG. 2 is a waveform diagram illustrating operations of the testing device according to the first embodiment of the present invention.

10 FIG. 3 is a diagram illustrating a configuration example of a testing device according to a second embodiment of the present invention.

FIG. 4 is a waveform diagram illustrating operations of the testing device according to the second embodiment of the present invention.

Description of Embodiments

15 [0017]

Hereinafter, embodiments of the present invention will be described with reference to the accompanying drawings.

(First Embodiment)

20 FIG. 1 is a diagram illustrating a configuration example of a testing device according to a first embodiment of the present invention.

The testing device 10 is used for the operation confirmation or calibration of a detection device that detects arc discharge which is generated at the point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph.

25 The testing device 10 includes a light source 11 constituted by a light-emitting diode which is a type of optical semiconductor element, and a light-emitting control unit 12 that

causes the light source 11 to emit light over a predetermined time in response to a predetermined light-emitting start signal ST.

[0018]

The light source 11 emits light containing ultraviolet light contained in arc
5 discharge which is generated at the point of pantograph bounce between a trolley wire
and a slider of a pantograph, and an example of the light source to be used includes an
ultraviolet light-emitting diode (UV LED). However, without being limited to such an
example, any optical semiconductor element (light-emitting element) can be used as the
light source 11, with the limits of the capability to simulate the arc discharge which is
10 generated at the point of pantograph bounce between a trolley wire and a slider of a
pantograph.

[0019]

The light-emitting start signal ST is a trigger signal for causing the light source
11 to emit light by starting up the testing device 10. For example, in a case where the
15 testing device 10 is brought under the control of a high-order control device such as a
computer, the light-emitting start signal ST is a control signal which is supplied from a
high-order control device. In addition, in a case where the testing device 10 is started
up manually, the light-emitting start signal ST is a signal indicating a manual operation.

[0020]

20 In addition, in the first embodiment, the predetermined time which is a
light-emitting time of the light source 11 is 100 microseconds specified by the
international standard with respect to the detection of the arc discharge which is
generated at the point of pantograph bounce between a trolley wire and a slider of a
pantograph. In this international standard, regarding the detection sensitivity of the
25 detection device of the arc discharge, it is specified that the detection device has to react

to the start and termination of the arc discharge at a time of 100 microseconds or less.

However, the predetermined time can be arbitrarily set in accordance with the use of the testing device 10.

[0021]

5 The anode of a light-emitting diode constituting the light source 11 is connected to an output unit of the light-emitting control unit 12, and the cathode thereof is grounded. In a case where the light source 11 is caused to emit light, an output current I_{out} of the light-emitting control unit 12 is supplied to the light source 11. The output current I_{out} of the light-emitting control unit 12 may be a direct current, and may be a high-frequency
10 current. However, in the first embodiment, the output current I_{out} of the light-emitting control unit 12 is assumed to be a direct current.

[0022]

 The light-emitting control unit 12 is constituted by an oscillator 121, a counter 122, and a drive circuit 123. The oscillator 121 is constituted by a monostable
15 multivibrator. In the first embodiment, the oscillator 121 is a so-called CR oscillator including a time constant circuit constituted by a variable resistor and a capacitor which are not shown in the drawing. However, without being limited to such an example, the configuration of the oscillator 121 is arbitrary, and the oscillator 121 may be constituted by, for example, a crystal oscillation circuit. The oscillator 121 oscillates at a
20 predetermined oscillation frequency according to a time constant which is determined by the resistance value of the variable resistor and the capacitance value of the capacitor.

[0023]

 In the first embodiment, the oscillator 121 is a component for obtaining the fundamental frequency of the light-emitting period (cycle) of the light source 11, and is
25 configured to be capable of adjusting an oscillation frequency in a frequency domain

inclusive of 10 kHz. In addition, in the first embodiment, the frequency domain of the oscillator 121 is divided into a first frequency domain of approximately 2 kHz or lower and a second frequency domain from 2 kHz to 10 kHz. Such a division of the frequency domain is based on the constitution of the time constant circuit of the oscillator 121 using two capacitors having different capacitance values and one variable resistor, in order to secure a wide range of frequency bands as the frequency band of the oscillator 121. Such constitution of the time constant circuit by a combination of two capacitors having different capacitance values and one variable resistor stabilizes the oscillation frequency over a wide range of frequency bands which are not obtained by only the variable resistor, and improves the accuracy of the oscillation frequency. However, the oscillation frequency of the oscillator 121 can be arbitrarily set with the limits of the capability to obtain a desired light pulse. The waveform of the oscillation output of the oscillator 121 is subjected to waveform shaping, and is output from the oscillator 121 as a clock signal CLK.

[0024]

The counter 122 generates a counting signal CNT for determining the light-emitting time of a light pulse of the light source 11, starts counting in response to the oscillation output of the oscillator 121, and stops counting when a count value reaches a predetermined set value. In the first embodiment, the counter 122 starts counting using the rising edge of the clock signal CLK included in the oscillation output of the oscillator 121 as a trigger. The counter 122 outputs the counting signal CNT having a pulse width according to the set value by performing counting until the count value reaches a predetermined set value.

[0025]

The set value of the counter 122 specifies the pulse width of a light pulse

generated by the light source 11, that is, a desired light-emitting time of the light source 11. The set value is arbitrarily determined so that the light pulse having a desired light-emitting time (100 microseconds) is emitted from the light source 11. In the first embodiment, the set value is determined so that the light pulse of 100 microseconds specified by the international standard is obtained.

[0026]

The drive circuit 123 drives the light source 11 on the basis of the counting result of the counter 122. In the first embodiment, the drive circuit 123 causes the light source 11 to emit light by current-driving the light source 11 constituted by an ultraviolet light-emitting diode. The drive circuit 123 current-drives the light source 11 on the basis of the counting signal CNT which is output from the counter 122. Specifically, the drive circuit 123 starts the current drive of the light source 11 when the counting signal CNT is set to be at a high level, and stops the current drive of the light source 11 when the counting signal CNT is set to be at a low level. Thereby, the drive circuit 123 causes the light source 11 to emit light by the current drive thereof, for a period in which the counting signal CNT is set to be at a high level. In addition, the drive circuit 123 may include a booster circuit, as necessary, in order to obtain a current for driving the light source 11 constituted by a light-emitting diode, and known techniques can be used in the drive system itself.

[0027]

Next, operations of the testing device 10 according to the first embodiment of the present invention will be described with reference to FIG. 2.

FIG. 2 is a waveform diagram illustrating operations of the testing device 10 according to the first embodiment of the present invention. In FIG. 2, the vertical axis represents the amplitude of each waveform, and the horizontal axis represents a time.

In addition, the waveform on the uppermost stage represents the waveform of the light-emitting start signal ST, the waveform on the second stage from the top represents the waveform of the clock signal CLK which is output from the oscillator 121, the waveform on the third stage from the top represents the waveform of the counting signal CNT which is output from the counter 122, and the waveform on the lowermost stage represents the waveform of the output current Iout of the drive circuit 123. The scales of the respective waveforms shown in FIG. 2 are different from those in reality, and FIG. 2 schematically illustrates a change in the status of each waveform.

[0028]

10 In FIG. 2, when the power-supply switch (not shown) of the testing device 10 is closed by a worker before time t1, the oscillator 121 starts an oscillation operation, and the oscillation frequency of the oscillator 121 after the elapse of a certain period of time is stabilized to a constant oscillation frequency according to the time constant of the time constant circuit of the oscillator 121.

15 [0029]

When the light-emitting start signal ST is supplied to the testing device 10 at time t1 in a state where the oscillator 121 has oscillated, and the signal level of the light-emitting start signal ST transitions from a low level to a high level, the drive circuit 123 supplies the output current Iout to the light source 11 in response to the rising edge of the counting signal CNT corresponding to the rising edge of the clock signal CLK which initially arrives at time t2 after the light-emitting start signal ST transitions to a high level. Thereby, the drive circuit 123 starts driving the light source 11, and the light source 11 emits light.

[0030]

25 On the other hand, when the signal level of the light-emitting start signal ST

transitions from a low level to a high level at time t1, the counter 122 starts counting.

When the counter 122 starts counting, the signal level of the counting signal CNT

transitions from a low level to a high level. Thereafter, when the count value of the

counter 122 reaches a predetermined set value at time t3, the counter 122 transitions the

5 signal level of the counting signal CNT from a high level to a low level.

[0031]

In FIG. 2, waveform portions shown by dotted lines indicate an example of

waveforms in a case where the predetermined set value of the counter 122 is increased, in

order to increase the light-emitting time of a light pulse. In this example, the counting

10 signal CNT transitions from a high level to a low level at time t3' after time t3, and the

light-emitting time of the light pulse is prolonged in accordance with an increment in the

set value of the counter 122. However, without being limited to this example, the set

value can also be reduced so that the light-emitting time of the light pulse is reduced.

[0032]

15 When the counting signal CNT is set to be at a low level, the drive circuit 123

stops supplying the output current Iout, and stops driving the light source 11. Thereby,

a current pulse of 100 microseconds is obtained as the output current Iout from time t2 to

time t3, and the light source 11 which is supplied with this current pulse emits a light

pulse of 100 microseconds. Thereafter, the counter 122 and the drive circuit 123 have

20 the operation states thereof initialized, and are prepared for the next light-emitting
operation.

[0033]

The light pulse of 100 microseconds generated by the light source is applied
toward a receiving unit of an inspection device under test. In the inspection device,

25 various calibrations of, for example the receiving sensitivity or the like in each frequency

band are performed so as to react to the light pulse received from the testing device 10.

[0034]

According to the first embodiment, since a light pulse is generated using the light source 11 constituted by a light-emitting diode, it is possible to obtain a large amount of light as compared to a case where a light pulse is generated using a portable deuterium lamp.

[0035]

In addition, according to the first embodiment, large-size facilities required in a case where the arc discharge is generated are not required, and thus it is possible to realize the testing device 10 at a low price and at a small size as compared to a case where a deuterium lamp or a chopper is used.

[0036]

Further, according to the first embodiment, as compared to a case where a light pulse is obtained by the arc discharge, it is possible to simplify preparatory work for generating a light pulse, and to reduce the burden of a worker.

In addition, according to the first embodiment, a ultraviolet light-emitting diode is used as the light source 11. Thereby, a small-sized ultraviolet light source capable of blinking relatively fast can be realized as a light source of a testing device for an ultraviolet detection device to evaluate and test a pantograph bounce arc, and light-emitting control can be performed in a period with good accuracy in a constant frequency range.

[0037]

As stated above, while the first embodiment of the present invention has been described, the function of the testing device 10 according to the first embodiment can be realized in any form of hardware and software. In a case of realization in a form of

software, for example, the testing device 10 has a microcomputer mounted therein, and thus various functions of the testing device 10 can be realized as programs which are executed on this microcomputer. In this case, a crystal oscillation circuit of the microcomputer may be diverted to the oscillator 121. In addition, in this case, the testing device 10 may include a touch panel-type liquid crystal panel as a user interface. Thereby, various types of switches can be made efficient.

[0038]

In addition, in the first embodiment, the present invention is represented as a testing device, but the present invention can also be represented as a testing method. In this case, the testing method according to the present invention can be represented as a testing method including a light-emitting control step of causing an optical semiconductor element to emit light over a predetermined time, the optical semiconductor element emitting light containing ultraviolet light contained in arc discharge which is generated in a point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph, wherein the light-emitting control step includes a step of causing an oscillator to oscillate at a predetermined oscillation frequency, a step of causing a counter to start counting in response to an oscillation output of the oscillator, and stop counting when a count value reaches a predetermined set value, and a step of causing a drive circuit to drive the optical semiconductor element on the basis of a counting result of the counter.

[0039]

(Second Embodiment)

Next, a second embodiment of the present invention will be described.

FIG. 3 is a diagram illustrating a configuration example of a testing device according to the second embodiment of the present invention.

The testing device 20 according to the second embodiment further includes a light detection unit 13 and a light-emitting time correction unit 14, in the configuration of the testing device 10 shown in FIG. 1 according to the first embodiment described above. Other configurations are the same as those in the first embodiment.

5 [0040]

The light detection unit 13 is a component for detecting light emitted by the light source 11, and is disposed in the vicinity of, for example, a receiving unit of a detection device under test. The light detection unit 13 is constituted by a load resistor 131 and a phototransistor 132. One end (first end) of the load resistor 131 is connected to a power supply VDD, and the other end (second end) of the load resistor 131 is connected to the collector of the phototransistor 132. The emitter of the phototransistor 132 is connected to a ground GND. A voltage signal of a connection point between the load resistor 131 and the collector of the phototransistor 132 is supplied to the light-emitting time correction unit 14, as a detection signal SEN.

15 [0041]

The light-emitting time correction unit 14 corrects the light-emitting time of the light source 11 on the basis of the detection signal SEN which is supplied as a detection result from the light detection unit 13. Specifically, the light-emitting time correction unit 14 measures a time for which the detection signal SEN supplied from the light detection unit 13 is set to be at a low level, and corrects the set value of the counter 122 so that a difference between the time obtained by the measurement and a desired light-emitting time (target value) is reduced.

[0042]

Next, operations according to the second embodiment of the present invention will be described.

FIG. 4 is a waveform diagram illustrating operations of the testing device 20 according to the second embodiment of the present invention. In FIG. 4, the vertical axis represents the amplitude of each waveform, and the horizontal axis represents a time. In addition, the waveform on the uppermost stage represents the waveform of the light-emitting start signal ST, the waveform on the second stage from the top represents the waveform of the clock signal CLK which is output from the oscillator 121, the waveform on the third stage from the top represents the waveform of the counting signal CNT which is output from the counter 122, the waveform on the fourth stage from the top represents the waveform of the output current Iout of the drive circuit 123, and the waveform on the lowermost stage represents the detection signal SEN which is output from the light detection unit 13. The scales of the respective waveforms shown in FIG. 4 are different from those in reality, and FIG. 4 schematically illustrates a change in the status of each waveform.

[0043]

Similarly to the above-described first embodiment, when the power-supply switch of the testing device 20 is closed before time t1, the clock signal CLK having a constant frequency is output from the oscillator 121. When the signal level of the light-emitting start signal ST transitions from a low level to a high level at time t1, the drive circuit 123 supplies the output current Iout to the light source 11 in response to the rising edge of the clock signal CLK which initially arrives at time t2 after the light-emitting start signal ST transitions to a high level. Thereby, the light source 11 emits light.

[0044]

On the other hand, when the signal level of the light-emitting start signal ST transitions from a low level to a high level at time t1, the counter 122 starts counting in

response to the rising edge of the clock signal CLK at time t2 after time t1, and outputs the counting signal CNT of a high level in a period from time t2 to time t3.

[0045]

The drive circuit 123 starts supplying the output current Iout to the light source 11 when the counting signal CNT is set to be at a high level at time t2, and stops supplying the output current Iout when the counting signal CNT is set to be at a low level at time t3. Thereby, the light source 11 generates a light pulse by emitting light from time t2 to time t3.

[0046]

The light detection unit 13 receives the light pulse generated by the light source 11, and supplies the detection signal SEN of a low level to the light-emitting time correction unit 14 for a period in which this light pulse is received. The light-emitting time correction unit 14 measures a time for which the detection signal SEN which is supplied from the light detection unit 13 is maintained at a low level. The light-emitting time correction unit 14 adjusts the set value of the counter 122 so that a difference between the time for which the detection signal SEN is maintained at a low level and a desired light-emitting time is reduced. That is, the light-emitting time correction unit 14 performs feedback control on the set value of the counter 122 so that the light-emitting time of the light source 11 is set to a predetermined time (desired light-emitting time).

[0047]

In the second embodiment, the light-emitting time of the light source 11 is controlled by performing feedback control on the set value of the counter 122, but the light-emitting time of the light source 11 may be controlled by controlling the oscillation frequency of the oscillator 121, and any circuit parameter may be adjusted with the limits of the capability to control the light-emitting time of the light source 11.

[0048]

According to the second embodiment, since feedback control is performed on the set value of the counter 122 so that the light-emitting time of the light source 11 is set to a predetermined time, it is possible to improve the accuracy of the light-emitting time of the light pulse generated by the light source 11, as compared to the first embodiment.

Therefore, it is possible to enhance the accuracy of the operation confirmation or calibration of a detection device that detects arc discharge which is generated at the point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph.

10 [0049]

In the second embodiment, the present invention is represented as a testing device, but the present invention can also be represented as a testing method. In this case, the testing method according to the present invention can be represented as a testing method including a light-emitting control step of causing an optical semiconductor element to emit light over a predetermined time, the optical semiconductor element emitting light containing ultraviolet light contained in arc discharge which is generated in a point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph, and further including a light detecting step of causing a light detection unit to detect light emitted by the optical semiconductor element, and a light-emitting time step of causing a light-emitting time correction unit to correct a light-emitting time of the optical semiconductor element on the basis of a detection result of the light detection unit.

[0050]

As stated above, according to the first and second embodiments, it is possible to enhance the portability of a testing device, and to easily and inexpensively perform an

operation test of a detection device that detects arc discharge.

[0051]

As stated above, while the embodiments of the present invention have been described, the present invention is not limited to the aforementioned embodiments, and
5 can be modified variously without departing from the scope of the present invention.

For example, in the first and second embodiments described above, the light-emitting control unit 12 includes the oscillator 121 and the counter 122, but the configuration thereof is arbitrary with the limits of the capability to obtain a light pulse having a desired pulse width. For example, a pulse signal generation circuit that
10 generates one-shot pulse signal having a predetermined pulse width in response to the light-emitting start signal ST can also be used instead of the oscillator 121 and the counter 122.

[0052]

In addition, an ultraviolet light-emitting diode is assumed to be used as the light
15 source 11, but any light-emitting elements can be used with the limits of the capability to represent arc discharge which is generated at the point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph, and the number of light-emitting elements and the arrangement thereof are arbitrary.

20 Reference Signs List

[0053]

10, 20: TESTING DEVICE

11: LIGHT SOURCE

12: LIGHT-EMITTING CONTROL UNIT

25 13: LIGHT DETECTION UNIT

14: LIGHT-EMITTING TIME CORRECTION UNIT

121: OSCILLATOR

122: COUNTER

123: DRIVE CIRCUIT

5 131: LOAD RESISTOR

132: PHOTOTRANSISTOR

CLAIMS

1. A testing device comprising:
 - an optical semiconductor element that emits light containing ultraviolet light
 - 5 contained in arc discharge which is generated in a point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a pantograph;
 - a light-emitting control unit that causes the optical semiconductor element to emit light over a predetermined time, the light-emitting control unit further comprising:
 - an oscillator that oscillates at a predetermined oscillation frequency,
 - 10 a counter that starts counting in response to an oscillation output of the oscillator, and stops counting when a count value reaches a predetermined set value, and
 - a drive circuit that drives the optical semiconductor element on the basis of a counting result of the counter;
 - 15 a light detection unit that detects light emitted by the optical semiconductor element; and
 - a light-emitting time correction unit that corrects a light-emitting time of the optical semiconductor element by controlling the oscillation frequency on the basis of a detection result of the light detection unit.
- 20 2. The testing device according to claim 1, wherein the optical semiconductor element is an ultraviolet light-emitting diode.
3. The testing device according to claim 1 or 2, wherein the oscillator further
25 comprising a time constant circuit constituted by a variable resistor and a capacitor, and oscillates at a frequency according to a time constant which is determined by a resistance value of the variable resistor and a capacitance value of the capacitor.
4. A testing method comprising:

a light-emitting control step of causing an optical semiconductor element to emit light over a predetermined time, the optical semiconductor element emitting light containing ultraviolet light contained in arc discharge which is generated in a point of pantograph bounce between a trolley wire in an electric railroad system and a slider of a
5 pantograph, wherein
the light-emitting control step includes:
a step of causing an oscillator to oscillate at a predetermined oscillation frequency,
a step of causing a counter to start counting in response to an oscillation output of
10 the oscillator, and stop counting when a count value reaches a predetermined set value,
a step of causing a drive circuit to drive the optical semiconductor element on the basis of a counting result of the counter,
a step of detecting light emitted by the optical semiconductor element, and
a step of correcting a light-emitting time of the optical semiconductor element
15 by controlling the oscillation frequency on the basis of a detection result of the step of detecting light.