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(72) Inventor: **Taskula, Kari**

00760 Helsinki (FI)

(74) Representative:

Järveläinen, Pertti Tauno Juhani et al

Heinänen Oy

Annankatu 31-33 C

00100 Helsinki (FI)

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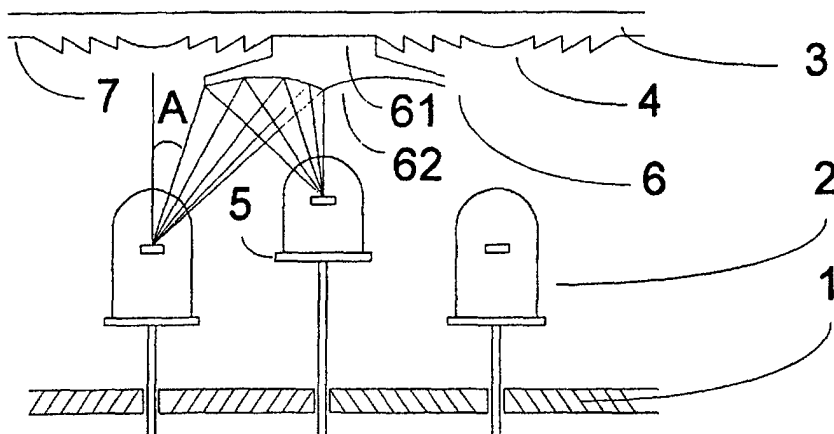
(71) Applicant: **Oy Sabik AB**

07370 Pellinki (FI)

(54) **Apparatus for monitoring and controlling a traffic control light**

(57) An apparatus for monitoring and/or controlling a traffic control light, the light source of said control light consisting of LEDs (2) connected on a circuit board (1), said control light being controlled by means of a control unit, and said control light comprising a lens dome part (3) which is fitted in front of the LEDs and contains transparent light directing elements (4), and said apparatus comprising detectors (5) disposed in connection with the

LEDs used as light sources on the same side of the circuit board (1) with these, some of the light reflected from the LEDs being directed to said detectors, which are used to provide optical feedback for the monitoring and/or control of the operation of the control light. The apparatus comprises non-transparent reflectors (6) arranged between the light directing elements to reflect some of the light emitted by the LEDs (2) in the direction of illumination to the detectors (5).



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Description

[0001] The present invention relates to an apparatus for controlling and monitoring control lights used in traffic control, such as traffic lights, railway semaphores or waterway lights, the light source of said lights consisting of LEDs connected to a circuit board, said lights being controlled by means of a control unit and provided with light directing elements fitted in front of the LEDs.

[0002] At present, the control lights for land and water traffic are mainly implemented using incandescent lamps. Incandescent lamps involve the problems of a high power consumption, a short service life and consequent high maintenance costs.

[0003] Patent specification FI 970672 presents a control light designed for land and water traffic and implemented using light-emitting diodes (LED) as a light source. In the control light described in this specification, a Fresnel lens is fitted in the lens dome opposite to each LED to direct the light emitted by the diode. The Fresnel lens comprises a central lens part and lens ring parts disposed around it. The lens dome part has a smooth outer surface, and the Fresnel lenses are fitted inside the lens dome part.

[0004] Control lights are currently monitored by monitoring the electric power supplied to the lights. In the case of malfunction, the supply of power to the control light is interrupted by means of a signal box and e.g. in the event of a short circuit by means of fuses. However, when LED technology is applied, measuring the current is an insufficient and relatively inaccurate method of monitoring the control lights and does not provide information about their actual working condition in all situations.

[0005] EP 974 947 presents a traffic light system based on optical feedback and comprising a light source consisting of a matrix of light-emitting diodes, and a monitoring apparatus for monitoring the light-emitting diodes. The monitoring apparatus comprises a detector monitoring the light of the LEDs, and a comparison unit connected to it. Placed in front of the LEDs is a transparent plate. The light detector is placed in the same plane with the LEDs and, like the LEDs, directed toward the dome part, so that the light detector receives part of the light reflected from the transparent dome.

[0006] The solution presented in the above-mentioned EP specification is electronically rather complicated, and monitoring the scattered radiation received from the transparent plate gives relatively inaccurate results. Moreover, the solution is relatively susceptible to interference from light sources present in the environment.

[0007] The object of the present invention is to eliminate the disadvantages of prior-art solutions and to achieve an apparatus that produces information about the actual working condition of a control light. The monitoring apparatus of the invention utilizes optical feedback which makes it possible to monitor and regulate

the operation of LEDs used as a light source. The invention uses separate non-transparent reflectors placed between the transparent light directing elements of the lens dome part. The details of the features characteristic of the apparatus of the invention are presented in the claims below.

[0008] By applying the invention, a very simple and reliable monitoring apparatus for the monitoring of traffic control lights is achieved. The reflectors prevent light and/or other radiation, e.g. UV and/or IR radiation, emitted from outside the control light from being admitted to the detector, which means that illumination and/or other radiation conditions outside the control light will not interfere with the operation of the apparatus for monitoring and controlling the control light. In addition, the optical feedback can be utilized in the regulation of the luminous intensity of the light source.

[0009] In the following, the invention will be described in detail by the aid of an example with reference to the attached drawing, which presents a cross-sectional view of a LED control light provided with a monitoring apparatus according to the invention.

[0010] The figure presents a control light as used e.g. in a railway semaphore, implemented using LEDs as a light source. The control light produces a unidirectional light beam which is directed from a long distance at the locomotive of an approaching train so that the locomotive driver can observe the light of the semaphore in good time and act according to the color of the light. The control light comprises a frame which is provided e.g. with an edge flange by means of which it can be connected to a semaphore in place of incandescent lamps. The frame can accommodate a transformer and other equipment needed for controlling the control light, as well as a circuit board 1.

[0011] The control electronics is fitted on the circuit board 1 or on a separate circuit board. Connected on the surface of the circuit board 1 are LEDs 2. These are typically disposed in straight rows in both vertical and horizontal directions. The number of rows is typically more than 10. Placed over the circuit board 1 is a transparent lens dome part 3 made of plastic, e.g. polycarbonate, which may be colorless or colored and has a smooth and planar outer surface which thus forms the outer surface of the control light and is easy to keep clean. Placed opposite to each LED inside the lens dome part is a lens element, which in this figure is a Fresnel lens 4.

[0012] To allow the operation of the control light to be monitored, it is provided with optical feedback which is used to monitor the operation of the LEDs, by directing some of the light of the LED 2 via optical feedback to the control electronics, where the detection and adjustment of the luminous intensity of the light source, the level measurement and fault detection in case of malfunctions and disturbances can be performed.

[0013] For optical feedback, the circuit board 1 is provided with detectors, such as photosensitive transistors

5, placed between the LEDs on the same side of the circuit board 1, for detecting the light emitted by the LEDs. The signals produced by the detectors are input to the control electronics. Some of the light received from the LEDs 2 is passed to the photosensitive transistors 5 via non-transparent reflectors 6 attached between the lenses 4.

[0014] The reflectors 6 consist of an arm 61 serving to connect them to the inner surface 7 of the lens dome between the lenses 4 and of a reflector element, which has for each of the four LEDs 2 placed beside the reflector 6 a concave reflector surface 62 which deflects some of the light received from the LED 2 to the photosensitive transistor 5. The reflector surfaces 62 are typically silver-plated, and they may partially overlap the Fresnel lenses 4 so that light emitted toward the reflector at an angle equal to or larger than angle A relative to the center axis 8 of the LED 2 will proceed to the reflector 6 and further to the transistor 5. The angle A may be e. g. about 20°.

[0015] The reflector 6 mounted in front of the photosensitive transistor 5 prevents light coming from outside the control light from being admitted to the photosensitive transistor 5, which means that illumination conditions outside the control light will not have a disturbing effect on the operation of the apparatus monitoring and controlling the control light. In addition, the reflector protects the detectors from other undesirable radiation (e. g. UV and IR radiation) received from outside the control light.

[0016] It is obvious to the person skilled in the art that different embodiments of the invention are not limited to the example described above, but that they may be varied within the scope of the claims presented below. The control light may be provided with a required number of reflectors and transistors so that a reliable representation of the operation of the control light is obtained. The length and shape of the arm of the reflector may be adapted so that the monitoring apparatus can be used for different types of LEDs and lenses.

characterized in that the apparatus comprises non-transparent reflectors (6) arranged between the light directing elements, by means of which reflectors some of the light emitted by the LEDs (2) in the direction of illumination is reflected to the detectors (5).

2. Apparatus as defined in claim 1, **characterized in that** the detectors are photosensitive switching devices, e.g. photosensitive semiconductor switches.
3. Apparatus as defined in claim 1, **characterized in that** the detectors are connected to the circuit board (1).
4. Apparatus as defined in claim 1, **characterized in that** the reflectors have at least one reflector surface (62).
5. Apparatus as defined in claim 1, **characterized in that** the reflectors are fitted between the light directing elements and have a reflector surface (62) for each LED placed beside it.
6. Apparatus as defined in claim 1, **characterized in that** the reflector surface has a coating of reflective material.
7. Apparatus as defined in claim 1, **characterized in that** a reflector (6) is fitted in front of each detector (5), so that it prevents light and/or other radiation coming from outside the control light from being admitted to the detector (5).

Claims

1. Apparatus for monitoring and/or controlling a traffic control light, the light source of said control light consisting of LEDs (2) connected on a circuit board (1), said control light being controlled by means of a control unit, and said control light comprising a lens dome part (3) which is fitted in front of the LEDs and contains transparent light directing elements (4), and said apparatus comprising detectors (5) disposed in connection with the LEDs used as light sources on the same side of the circuit board (1) with these, some of the light reflected from the LEDs being directed to said detectors, which are used to provide optical feedback for the monitoring and/or control of the operation of the control light,

