



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.03.2021 Bulletin 2021/10

(51) Int Cl.:
F21S 8/08 ^(2006.01) **F21V 23/04** ^(2006.01)
F21Y 115/10 ^(2016.01)

(21) Application number: **19290077.7**

(22) Date of filing: **04.09.2019**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **OUTDOOR LUMINAIRE**

(57) The invention relates to an outdoor luminaire (100) designed to illuminate a road or street surface, comprising at least one preferably LED based lighting module (101), a sensor (102) configured to detect whether the road or street surface to be illuminated is in a wet state

or a dry state, and a control unit (103) configured to adjust at least one light output characteristic of the lighting module of the luminaire (100) depending on an output of the sensor (102).

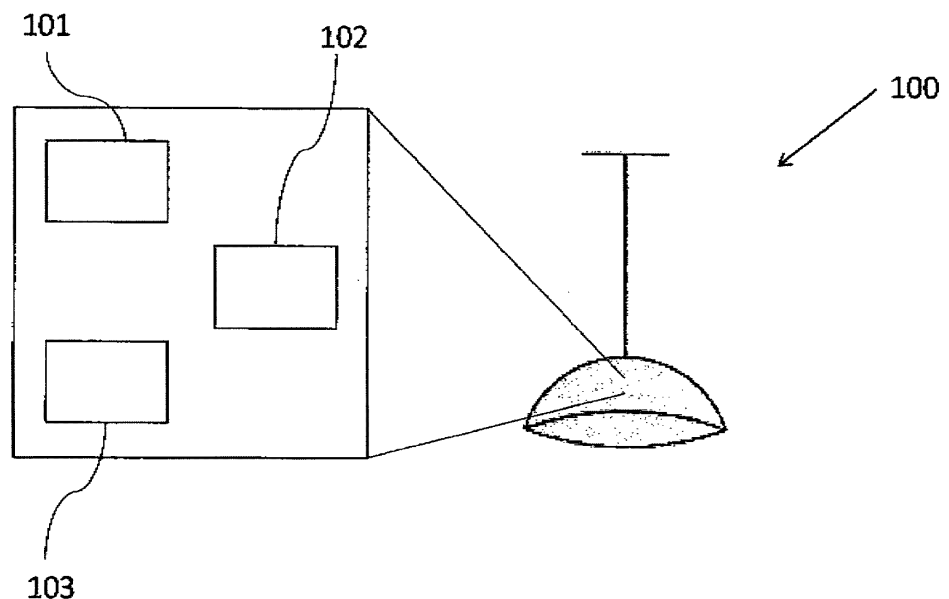


Fig. 1

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The invention relates to an outdoor luminaire. The invention further relates to a method for operating a luminaire.

BACKGROUND OF THE INVENTION

[0002] When it is dark, the risk of accidents increases significantly. Therefore, improving or introducing road lighting can be viewed as a way to reduce the number of accidents. Due to this strong correlation between light conditions and traffic safety, increased light levels should have a direct mitigating effect on the frequency of accidents.

[0003] Moreover, the Commission Internationale de l'Eclairage (CIE) gives three main purposes of road lighting: (1) to allow all road users to proceed safely; (2) to allow pedestrians to see hazards, orientate themselves, recognize other pedestrians and give them a sense of security; and (3) to improve the day- and night-time appearance of the environment.

[0004] Furthermore, guidelines and standards for road lighting are provided in order to help designers achieve these purposes, and, to do so, they provide quantitative recommendations for the appropriate level (luminance or illuminance), color (or other characteristic derived from the spectral power distribution (SPD)) and spatial distribution of light.

[0005] In the European standard EN 13201-2:2015 "Road lighting - Part 2: Performance requirements" a lighting class is defined by a set of photometric requirements aiming at the visual needs of certain road users in certain types of road areas under specified environmental conditions. In this European standard, which has to be implemented by the national standards organizations of the participating countries, there are basically three different sets of lighting classes described: M classes for areas intended for motorized traffic, C classes for conflict areas, and P classes for pedestrian and low speed areas.

[0006] Moreover, there are different regulatory requirements as to the illumination of roads in wet versus dry road conditions..

[0007] Thus, it is an objective to provide for an improved luminaire, for example, for lighting roads both in dry and wet conditions.

SUMMARY OF THE INVENTION

[0008] The object of the present invention is achieved by the solution provided in the enclosed independent claims. Advantageous implementations of the present invention are further defined in the dependent claims.

[0009] According to a first aspect, the invention relates to an outdoor luminaire designed to illuminate a road or

street surface both in dry or wet conditions. The luminaire comprises at least one preferably LED based (white) lighting module, a sensor configured to detect whether the road or street surface to be illuminated is in a wet state or a dry state, and a control unit configured to adjust at least one light output characteristic of the white lighting module of the luminaire depending on an output of the sensor.

[0010] This provides the advantage that costs for the production of the luminaire are reduced. Moreover, the luminaire is more reliable compared to prior art solutions, since it relies on road characteristics and not on weather conditions.

[0011] In an implementation form of the luminaire, the sensor is a reflectivity sensor.

[0012] In an implementation form of the luminaire, the sensor is a photocell.

[0013] This provides the advantage that the power consumption of the luminaire is optimized.

[0014] In an implementation form of the luminaire, the photocell comprises an optic configured to act as a light concentrator.

[0015] This provides the advantage that the performance of the luminaire is enhanced.

[0016] This provides the advantage that integration and costs are optimized.

[0017] In an implementation form of the luminaire, the sensor is a camera.

[0018] In an implementation form of the luminaire, the control unit is configured to adjust the colour temperature (CT) of the at least one light output.

[0019] In an implementation form of the luminaire, the luminaire further comprises a receiver configured to receive weather forecast information indicating wet or dry conditions and the control unit is configured to adjust the at least one light output of the luminaire depending on the received weather forecast conditions.

[0020] In an implementation form of the luminaire, the at least one light output of the luminaire comprises a variable light distribution.

[0021] In an implementation form of the luminaire, the at least one light output of the luminaire comprises a variable spectrum.

[0022] In an implementation form of the luminaire, the at least one light output of the luminaire comprises a variable spectrum and variable light distribution.

[0023] According to a second aspect, the invention relates to a method for operating a luminaire, comprising detecting whether a surface to be illuminated is wet or dry, and adjusting at least one light output of the luminaire depending on an output of a sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The invention will be explained in the followings together with the figures.

Fig. 1 shows a luminaire according to an embodiment;

Fig. 2 shows the luminaire according to another embodiment; and

Fig. 3 shows a method for operating the luminaire according to an embodiment.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] Aspects of the present invention are described herein in the context of a luminaire.

[0026] The present invention is described more fully hereinafter with reference to the accompanying drawings, in which various aspects of the present invention are shown. This invention however may be embodied in many different forms and should not be construed as limited to the various aspects of the present invention presented through this disclosure. Rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the present invention to those skilled in the art. The various aspects of the present invention illustrated in the drawings may not be drawn to scale. Rather, the dimensions of the various features may be expanded or reduced for clarity. In addition, some of the drawings may be simplified for clarity. Thus, the drawings may not depict all of the components of a given apparatus.

[0027] Various aspects of a luminaire will be presented. However, as those skilled in the art will readily appreciate, these aspects may be extended to aspects of luminaires without departing from the invention.

[0028] The term "LED luminaire" shall mean a luminaire with a light source comprising one or more LEDs. LEDs are well-known in the art, and therefore, will only briefly be discussed to provide a complete description of the invention.

[0029] It is further understood that the aspect of the present invention might contain integrated circuits that are readily manufacturable using conventional semiconductor technologies, such as complementary metal-oxide semiconductor technology, short "CMOS". In addition, the aspects of the present invention may be implemented with other manufacturing processes for making optical as well as electrical devices. Reference will now be made in detail to implementations of the exemplary aspects as illustrated in the accompanying drawings. The same reference signs will be used throughout the drawings and the following detailed descriptions to refer to the same or like parts.

[0030] Now referring to Fig. 1, an outdoor luminaire is shown according to an embodiment.

[0031] The outdoor luminaire 100 is designed to illuminate a road or street surface and comprises at least one preferably LED based lighting module 101, a sensor 102 configured to detect whether the road or street surface to be illuminated is in a wet state or a dry state, and a control unit 103 configured to adjust at least one light output characteristic of the lighting module of the luminaire 100 depending on an output of the sensor 102.

naire 100 depending on an output of the sensor 102.

[0032] Moreover, according to an embodiment, in a single road lighting luminaire 100 at least two different LED modules are present. One LED module is optimized for wet road conditions while the other one is optimized for dry road conditions.

[0033] The luminaire 100 is functionally connected with a road condition sensor 102, such as for example a photocell, a reflectivity sensor, camera, or with weather forecast information indicating wet for dry conditions.

[0034] Depending on the output signal of this sensor 102, the luminaire 100 is set for the wet for dry road illumination conditions, respectively.

[0035] Fig. 2 shows the luminaire 100 according to an embodiment.

[0036] In this embodiment, the luminaire 100 comprises the LED based lighting module 101.

[0037] During lighting calculations in luminance, another additional parameter should be taken into account, namely the wet parameter U_o .

[0038] The wet parameter or uniformity U_o should be checked on specific road surfaces, since it is representative of the wet condition. This is also linked to CIE characterized surfaces, which sort the different roads with two coefficients Q_0 and S_1 (obtained from many measurements).

[0039] The "clarity" coefficient Q_0 indicates the capacity of the road to reflect the light in total. Weak Q_0 surfaces need more flux than high Q_0 . On the other hand, the S_1 coefficient represents the "specularity", that is to say, the quantity of non-diffuse reflections that create a privileged direction with the reflected light. So the wet models get high S_1 coefficients.

[0040] A wet road is very specular (mirror effect), and achieving sufficient uniformity $U_o(\text{wet})$ implies specific optical characteristics.

[0041] Fig. 3 shows a method 300 for operating a luminaire 100 according to an embodiment.

[0042] The method comprises the steps of:

- detecting 301 whether a surface to be illuminated is wet or dry; and
- adjusting 302 at least one light output of the luminaire 100 depending on an output of a sensor 102.

[0043] All features of all embodiments described, shown and/or claimed herein can be combined with each other.

[0044] While various embodiments of the present invention have been described above, it should be understood that they have been presented by way of example only and not limitation. Numerous changes to the disclosed embodiments can be made in accordance with the disclosure herein without departing from the spirit of scope of the invention. Thus, the breadth and scope of the present invention should not be limited by any of the above-described embodiments. Rather, the scope of the

invention should be defined in accordance with the following claims and their equivalence.

[0045] Although the invention has been illustrated and described with respect to one or more implementations, equivalent alternations and modifications will occur to those skilled in the art upon the reading of the understanding of the specification and the annexed drawings. In addition, while a particular feature of the invention may have been disclosed with respect to only of the several implementations, such features may be combined with one or more other features of the other implementations as may be desired and advantage for any given or particular application.

Claims

1. Outdoor luminaire (100) designed to illuminate a road or street surface, comprising:

- at least one preferably LED based lighting module (101),
- a sensor (102) configured to detect whether the road or street surface to be illuminated is in a wet state or a dry state; and
- a control unit (103), operatively connected to the sensor (102) and configured to adjust at least one light output characteristic of the lighting module of the luminaire (100) depending on an output of the sensor (102).

2. The luminaire (100) of claim 1, wherein the sensor (102) is a reflectivity sensor.

3. The luminaire (100) of claim 1, wherein the sensor (102) is a photocell.

4. The luminaire (100) of claim 3, wherein the photocell comprises an optic configured to act as a light concentrator.

5. The luminaire (100) of claim 1, wherein the sensor (102) is a camera.

6. The luminaire (100) of claim 1 or 2, wherein the control unit (103) is configured to adjust the colour temperature (CT) of the at least one light output.

7. The luminaire (100) of any one of the preceding claims, wherein the luminaire (100) further comprises a receiver configured to receive, using a wireless or wirebound communication link of the luminaire, weather forecast information indicating wet or dry conditions and the control unit (103) is configured to adjust the at least one light output of the luminaire depending on the received weather forecast conditions.

8. The luminaire (100) of any one of the preceding claims, wherein the at least one light output of the luminaire (100) comprises a variable light distribution.

9. The luminaire (100) of any one of the preceding claims 1 to 8, wherein the at least one light output of the luminaire (100) comprises a variable spectrum.

10. The luminaire (100) of any one of the preceding claims 1. to 8, wherein the at least one light output of the luminaire (100) comprises a variable spectrum and variable light distribution.

11. The luminaire (100) of any one of the preceding claim, wherein the light output characteristic of the lighting module of the luminaire (100) is one or more of:

- the light distribution,
- the light intensity,
- the white light color temperature , and
- the spectrum-

12. A method (300) for operating an outdoor luminaire (100) designed to illuminate a road or street surface, comprising:

- detecting (301) whether a surface to be illuminated is wet or dry; and
- adjusting (302) at least one light output of the luminaire (100) depending on an output of a sensor (102) .

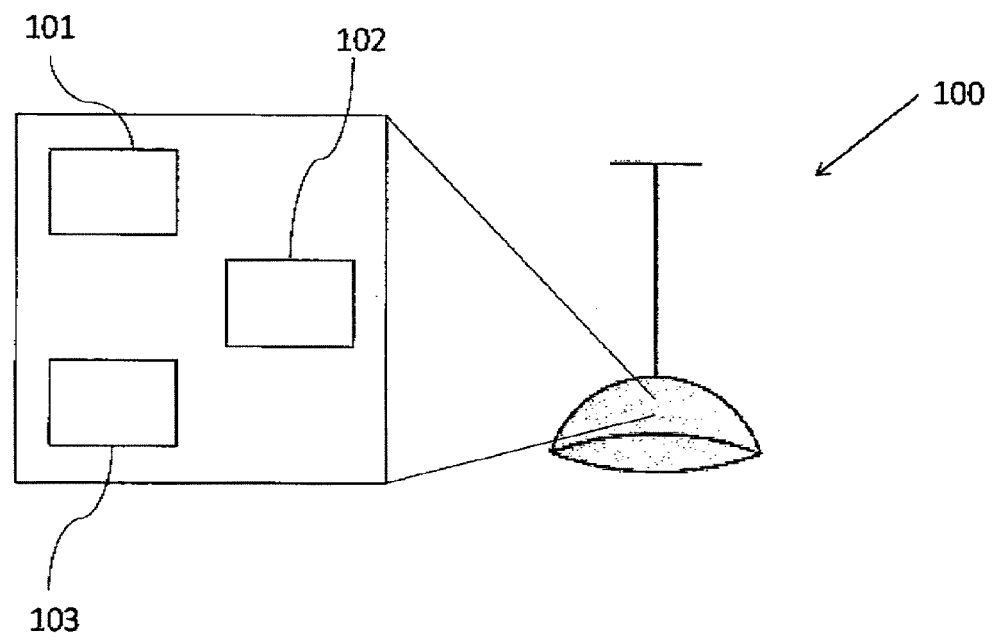


Fig. 1

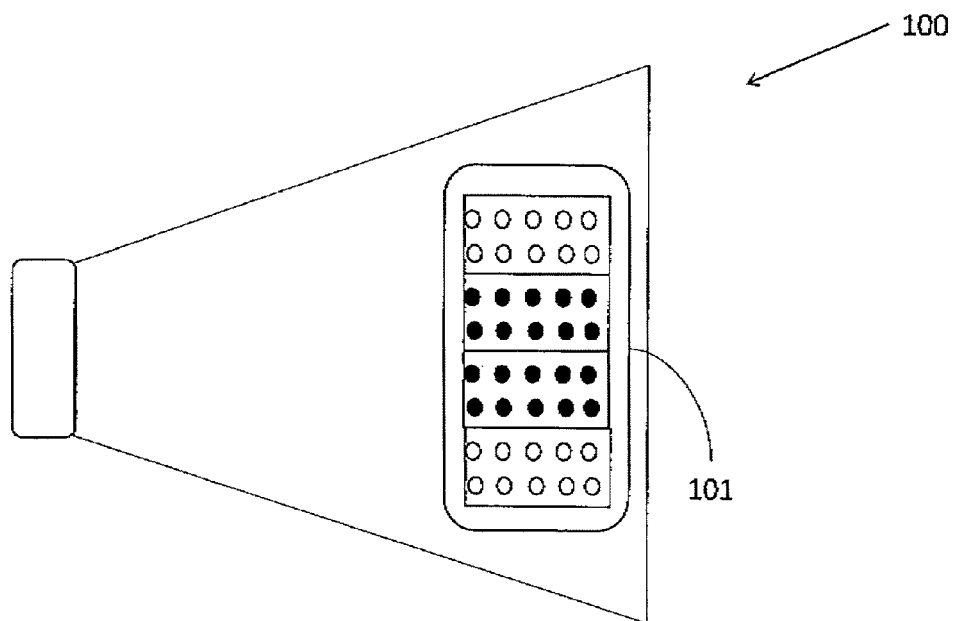


Fig. 2

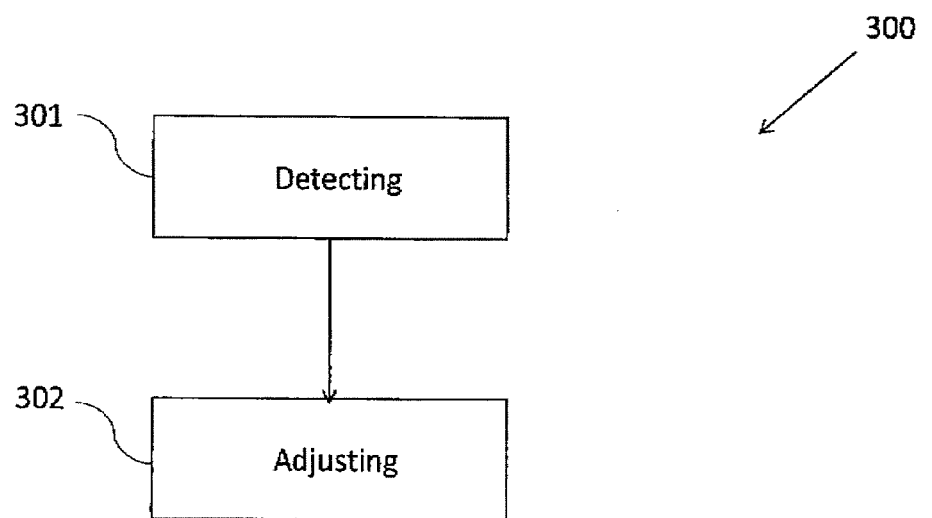


Fig. 3



EUROPEAN SEARCH REPORT

Application Number
EP 19 29 0077

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Place of search The Hague		Date of completion of the search 15 January 2020	Examiner Thibaut, Arthur
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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