



US010223946B2

(12) **United States Patent**  
**Auyeung et al.**

(10) **Patent No.:** **US 10,223,946 B2**  
(45) **Date of Patent:** **Mar. 5, 2019**

(54) **LIGHTING DEVICE WITH TRANSPARENT SUBSTRATE, HEAT SINK AND LED ARRAY FOR UNIFORM ILLUMINATION REGARDLESS OF NUMBER OF FUNCTIONAL LEDS**

(58) **Field of Classification Search**  
CPC ..... F21Y 2105/001; F21S 4/008; F21V 5/08; F21V 5/45; F21V 29/004; F21V 29/74;  
(Continued)

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(21) Appl. No.: **15/969,511**

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(22) Filed: **May 2, 2018**

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(65) **Prior Publication Data**

US 2018/0253999 A1 Sep. 6, 2018

**Related U.S. Application Data**

(60) Continuation of application No. 15/627,089, filed on Jun. 19, 2017, which is a continuation of application  
(Continued)

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(51) **Int. Cl.**

**G09F 13/02** (2006.01)

**G09F 13/22** (2006.01)

(Continued)

(57) **ABSTRACT**

A lighting device includes a heat sink having fins on a first side and a mounting surface of a second side opposite the first side, a substrate attached to the mounting surface, a number of LEDs attached to the substrate, and a single transparent substrate with a number of optical elements, each optical element overlying an associated one of the LEDs. The device configured to direct light from the LEDs towards an area in a manner that does not create hot spots or result in dead spots on the area regardless of whether all of the LEDs of the plurality of LEDs or some of the LEDs of the plurality of LEDs are functional.

(52) **U.S. Cl.**

CPC ..... **G09F 13/22** (2013.01); **F21K 9/60** (2016.08); **F21S 6/006** (2013.01); **F21V 5/007** (2013.01);  
(Continued)

**30 Claims, 13 Drawing Sheets**

