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(12) United States Patent

Ducharme et al.

(54) LIGHT SOURCE USING EMITTING PARTICLES TO PROVIDE VISIBLE LIGHT

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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 301 days.
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Related U.S. Application Data

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- (51) Int. Cl. *H01J 1/62* (2006.01) *H05B 33/00* (2006.01)
- (58) Field of Classification Search 313/512;

257/98–100, 103 See application file for complete search history.

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(10) Patent No.: US 7,088,040 B1

(45) **Date of Patent:** Aug. 8, 2006

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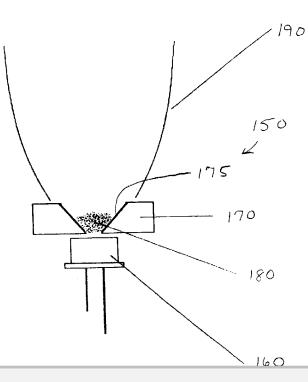
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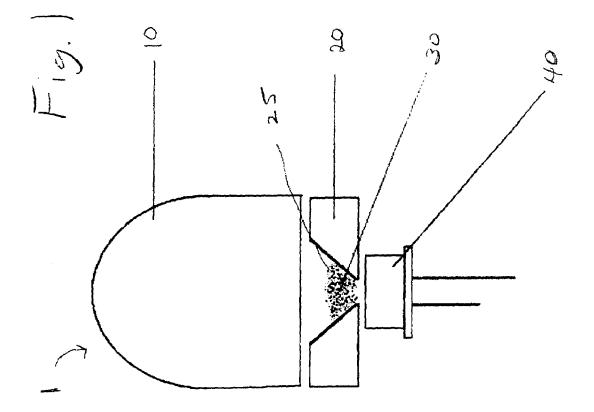
(57) ABSTRACT

Upconversion methods and devices that converts near-infrared light to the visible spectrum using a rare-earth-doped crystalline host for use as general and decorative lighting. The pseudo-monochromatic output of the processes can be specified by altering the amount and type of rare-earth material used and by selection of an appropriate host. Using rare-earth materials such as ytterbium-erbium or ytterbiumthulium can produce red, green and blue emissions, where the additive mixture of these colors yields a high-quality white light. The materials can be adjusted to achieve white light with any color temperature and high color-rendering index (CRI) for any general and decorative lighting applications both indoors and outdoors.

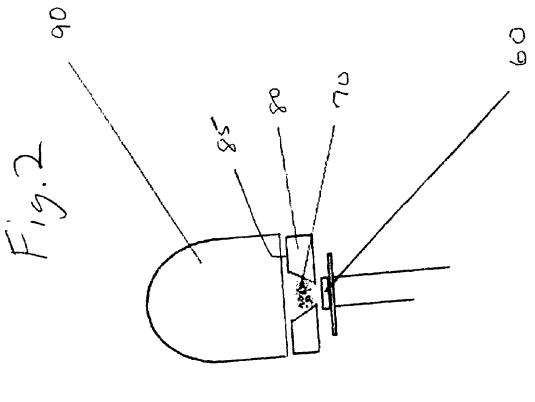
29 Claims, 11 Drawing Sheets



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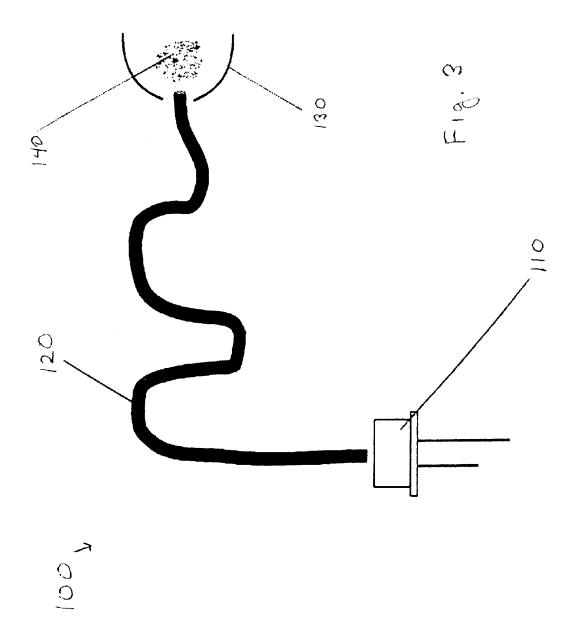


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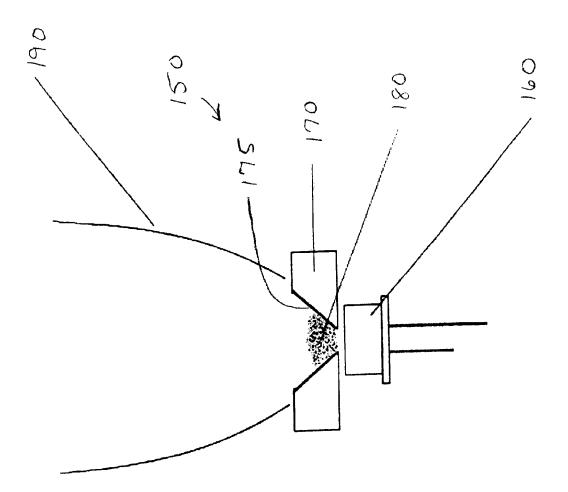




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