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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

Published:

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(54) Title: MODULAR LIGHT ENGINE FOR VARIABLE LIGHT PATTERN

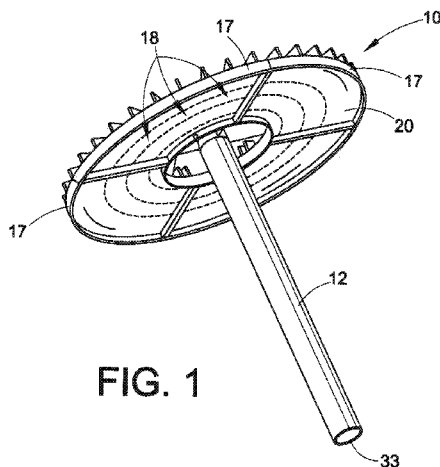


FIG. 1

(57) Abstract: A light fixture (10) suitable for illuminating a remote surface. The fixture (10) includes a post (12) adapted to receive at least two substantially identical light engine modules (14). Each module includes a plurality of light emitting diodes (18). Each module includes an edge adapted for mounting to the post.



MODULAR LIGHT ENGINE FOR VARIABLE LIGHT PATTERN

BACKGROUND

[0001] The present disclosure relates to the art of lighting fixtures, and more particularly to area lighting fixtures for distributing patterns of light on the ground. These lighting fixtures can be used for area lighting, including street, parking lot, walkway, bicycle path, or other similar applications. Additionally, these lighting fixtures can be employed for indoor applications, such as, illuminating basketball or factory building floors.

[0002] In general, lighting fixtures consist of a lamp or other light source, and a reflector for reflecting light from the light source. The shape of the reflector and any shielding typically define the light distribution pattern. More particularly, the light pattern is either controlled by external shielding, for high intensity discharge lamps, or by an optical package for light emitting diode packages. Since shielding is an inefficient blocking of otherwise useable light, the HID solution wastes light power that is not directed in the desired direction.

[0003] Light energy spreads over distance. The illumination of a remote area therefore varies inversely as the square of the distance from the light source. Additionally, since light fixtures directing light to a relatively large target area, the light source is many times smaller than the area to be lighted. Accordingly, the beam of light energy produced by each fixture must be relatively intense to cover a substantial area.

[0004] These characteristics present certain lighting problems. First of all, to maintain a given light level at a distant target area, the light source must produce a much higher level of light energy at the source. This can contribute to glare problems for those viewing the fixtures. Secondly, the use of diverging or converging beams can result in a significant amount of light falling outside the target area. This results in spill. Spill and glare are inefficient use of the light and are frequently objectionable.

[0005] Spill in parking, street and highway lighting results in wide-scale lighting of areas, which makes the actual roadway less distinct from surrounding areas. Additionally, lack of control also translates, in many applications, into the utilization

of more light poles and lighting fixtures, which is expensive and consumes substantial resources.

[0006] Also, most existing light systems have broadcast or spread light over as much of the highway or roadway as possible. However, by doing so, some light is most times projected toward the driver rather than away from the driver in the driver's viewing direction for each lane of the highway. This can contribute to glare for drivers on the roadway.

[0007] In certain embodiments, square distribution lighting fixtures may be preferred by lighting architects. To illuminate a parking lot, for example, the lighting architect can employ fewer lighting fixtures because overlap of distribution patterns can be eliminated. Additionally, lighting architects can eliminate spill at the corners and edges of the parking lot by using a square lighting distribution. Alternatively, round or oval light distributions can be the most efficient wherein little or no shielding of light is necessary.

[0008] Having a light engine which is selectively modifyable to provide a wide array of light distribution patterns allows precise control of light. One advantage of the present disclosure is that by providing an adaptable modular lighting fixture, it is feasible to readily select fixture modules having suitable light distribution and orientation to properly light almost any area or shape with minimal spill and limited viewer glare.

BRIEF DESCRIPTION

[0009] According to one embodiment, a light fixture suitable for illuminating a remote surface is provided. The fixture comprises a post adapted to receive at least two substantially identical light engine modules. The modules include a plurality of light emitting diodes. Each module has a light emitting diode inclusive surface and an opposed surface. Each module further includes an edge adapted for mounting to the post. The fixture also includes an electrical path for providing electrical power to the modules.

[0010] According to another embodiment, a light fixture comprising a post adapted to selectively receive up to four light emitting diode modules is provided.

Each module comprises a first edge adapted for mating with the post and a second arcuate edge extending approximately 90°. The light fixture can include four modules to form a substantially circular shape.

[0011] According to a third embodiment, a light engine module for a light fixture is provided. The module comprises a body housing at least two separable light emitting diode arrays. An electronic conversion element for converting AC to DC is also provided. The module further includes a mounting arm extending from the body.

[0012] According to a further embodiment, a light fixture is provided. The fixture includes a post having at least two light engine modules mounted thereto. The modules include at least two light emitting diode arrays wherein the light emitting diodes are in a substantially hemispherical distribution. The arrays of the first module are oriented relative to one another differently than the arrays of the second module.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIGURE 1 is a bottom perspective view of a modular area light fixture assembly;

[0014] FIGURE 2 is a top perspective view of the assembly of Figure 1;

[0015] FIGURE 3 is a bottom perspective view of an individual lamp module;

[0016] FIGURE 4 is a top perspective view of the module of Figure 3;

[0017] FIGURES 5 (a), (b) and (c) are perspective views demonstrating the adaptability of the present assembly;

[0018] FIGURE 6 is a bottom perspective view of an alternative module design;

[0019] FIGURE 7 is a top perspective view of the module of Figure 6 and;

[0020] FIGURES 8 (a), (b), (c) and (d) demonstrate the further adaptability of the modules achieved via orientation of the LED arrays.

DETAILED DESCRIPTION

[0021] Referring now to Figures 1 and 2, a modular area light fixture 10 is depicted. Fixture 10 includes post 12 to which light modules 14 are removably

mounted via screws or bolts 16. With four modules 14 secured to post 12, a light pattern extending 360° is provided. Moreover, each module 14 comprises a sector of a circle having an arcuate outer edge 17 traversing approximately 90°.

[0022] More particularly, each module 14 includes LEDs (light emitting diodes) 18 disposed upon a bottom surface 20. Surface 20 can be reflective to improve light extraction from the fixture. Top surface 22 of each module 14 includes a plurality of vanes 24 to enhance heat dissipation.

[0023] Referring now to Figures 3 and 4, an individual light module 14 is depicted. The individual light module 14 encompasses an area of approximately 90°. In this regard, each module represents a one quarter sector of a circle. The sides of the module 14 are bounded by shoulder elements 26 which meet at inner edge 28 to form a collar element 30. Collar element 30 includes an arcuate shaped surface which is cooperative with the outer surface of post 12. Of course, any suitable cooperative shape between the post and collar element 30 will be acceptable. Passages 32 are formed in collar element 30 to facilitate the removeable attachment of module 14 via bolts or screws to post 12. Some type of mating between the shoulder elements 26 of adjacent modules, such as a clip or other mechanical joiner, may be desirable to increase overall light fixture strength. Power is provided between an end 33 of post 12 via flexible conductors or other circuitry (not shown) and the individual LED arrays.

[0024] Turning now to Figure 3, the LEDs 18 are disposed in four generally concentric arrays 34, 36, 38 and 40. The LEDs are set in concentric arcuate paths. When all four modules 14 are in place, several concentric rings of LEDs are formed (see Figure 1). Of course, any type of LED distribution on surface 20 as dictated by the desired light distribution for the particular application is contemplated by the present disclosure. The LEDs can be of any type known to the skilled artisan including white light generating, saturated color generating or a mixture thereof. In addition, the LEDs can be individually packaged to include an integral optical element or the LEDs can be unpackaged and an optical element could be formed over the entire surface 20.

[0025] Turning next to Figure 5, the functionality achievable by the modularity of the light fixture 10 is demonstrated. Moreover, in Figure 5(a), by providing a single module 14 on post 12, a light dispersion of approximately 90° can be obtained. In this regard, placing the fixture of Figure 5(a) in, for example, the corner of a parking lot, could provide suitable lighting of the corner area without light spill outside of the parking area.

[0026] Turning now to Figure 5(b), approximately 180° of light distribution is provided by light fixture 10 which includes two adjacent modules 14. This light distribution could be suitable, for example, in lighting of an edge of a parking area, or a sidewalk or other applications wherein a linear demarcation exists between the area to be lit and an outlying area.

[0027] Referring now to Figure 5(c), a symmetric light distribution pattern is provided by including two modules 14 on opposed sides of post 12. This orientation can be used when, for example, illuminating a central area of a parking area or perhaps down the center of a highway where lanes on each side are being illuminated.

[0028] Referring now to Figures 6 and 7, an alternative design of a module 140 is depicted. Module 140 includes a housing 142, within which a pair of LED arrays 144 are disposed. LED arrays 144 are substantially identical units which can be individually attached to module 140 and separately powered. LED arrays 144 are more particularly comprised of a reflective substrate 146 upon which a plurality of hemispherical LED arrays 148 and 150 are disposed. As shown reflective substrate 146 includes a surface shaped to create a slightly directed (see arrows 147) light distribution. Housing 142 further includes a compartment covered by a door 152 which includes electronic circuitry (not shown) for converting alternating current to direct current. Housing 142 is further provided with an arm 154 including bracket 156 suitable for mating with a post.

[0029] Turning now to Figure 8, the ability of the present embodiment to provide highly tuned light distributions is depicted. Moreover, in addition to the ability to have between 90 and 360° of light distribution (see Figure 5), each individual module can be tailored by modifying the orientation of LED arrays 144. For example, with

reference to Figure 8(a), LED arrays 144 are oriented with opposed array directions such that a symmetrical light distribution (i.e., 360° from the module) is provided. In contrast, referring to Figures 8(b) an asymmetric right light distribution (147) and in Figure 8(d) and an asymmetric left light distribution (147) is provided. This can advantageously direct light down onto a street but also canted in the direction a vehicle is being driven. In this manner, glare experienced by the vehicle operator can be reduced. With further reference to 8(c), a forward light distribution (147) is provided.

[0030] The present disclosure describes modules allowing the number placed on a pole along with the orientation on the pole to dictate the illumination pattern on the ground. This can reduce the acquisition cost since only the number of modules are substantially identical the product costs can be controlled. There are not different part numbers to track and manufacture for various light patterns, because only one light engine module that can satisfy all light patterns needed. Similarly, since the same heat sink and other parts can be used, cost of manufacturing and maintenance is reduced. However, the modules can be attached to the post in varying numbers, e.g., 1 to 4, and since the LED arrays in each module can be oriented left, right or forward, as desired, the light pattern emitted by the fixture is highly flexible.

[0031] The exemplary embodiment has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS:

1. A light fixture comprising a post adapted to receive at least two light engine modules, said modules including a plurality of light emitting diodes, said modules being at least substantially identical, each module including a light emitting diode inclusive surface and an opposed surface, each module further including an edge adapted for mounting to said post, said fixture further comprising an electrical path for providing electrical power to said modules.
2. The fixture of claim 1 consisting of four modules.
3. The fixture of claim 1 wherein said opposed surface includes a plurality of vanes.
4. The fixture of claim 1 wherein said light emitting diodes reside in at least two generally concentric arcuate arrays.
5. The fixture of claim 1 wherein said light emitting diode including surface is reflective.
6. A light fixture comprising a post adapted to selectively receive up to four light emitting diode modules, each of said modules including a first edge adapted for mating with said post and a second arcuate edge extending approximately 90°, wherein the light fixture can optionally include four modules to form a substantially circular shape.
7. The fixture of claim 6 wherein each module comprises a sector of a circle.
8. The fixture of claim 7 wherein each module includes side walls extending from said first edge and forming an angle of approximately 90°.
9. The fixture of claim 8 wherein said side walls interconnect at a bracket, said bracket shaped to cooperatively engage an outer surface of said post.

10. A light engine module for a light fixture, said module comprising a body housing at least two separable light emitting diode arrays and an electronic conversion element for converting AC to DC, said module further including a mounting arm extending from said body.

11. The module of claim 10 wherein each light emitting diode array comprises a reflective surface including a plurality of light emitting diodes disposed in a hemispherical pattern.

12. The module of claim 11 wherein said arrays are oriented in opposed direction and emit a symmetric light pattern.

13. The module of claim 11 wherein said arrays are oriented in the same direction and emit an asymmetric light pattern.

14. The module of claim 11 wherein comprising at least two concentric hemispherical patterns of light emitting diodes.

15. A light fixture comprising a pole including at least two light engine modules mounted to said pole; each of said modules including at least two light emitting diode arrays, said arrays comprising a substantially hemispherical distribution of diodes, wherein the arrays of a first module are oriented relative to one another differently than the arrays of a second module.

16. The light fixture of claim 15 wherein said light emitting diode arrays comprise at least two concentric substantially hemispherical distributions of diodes.

17. The light fixture of claim 15 wherein the arrays of a first light engine module are oriented in an opposed direction and emit a symmetric light pattern and the arrays of a second light engine module are oriented in the same direction and emit an asymmetric light pattern.

18. The light fixture of claim 17 wherein said asymmetric light pattern is one of asymmetric forward, right or left.

19. The light fixture of claim 15 further comprising an electronic conversion element disposed within a housing of said module and accessible by a selectively openable door.

20. The light fixture of claim 15 wherein said light emitting diode arrays are substantially identical.

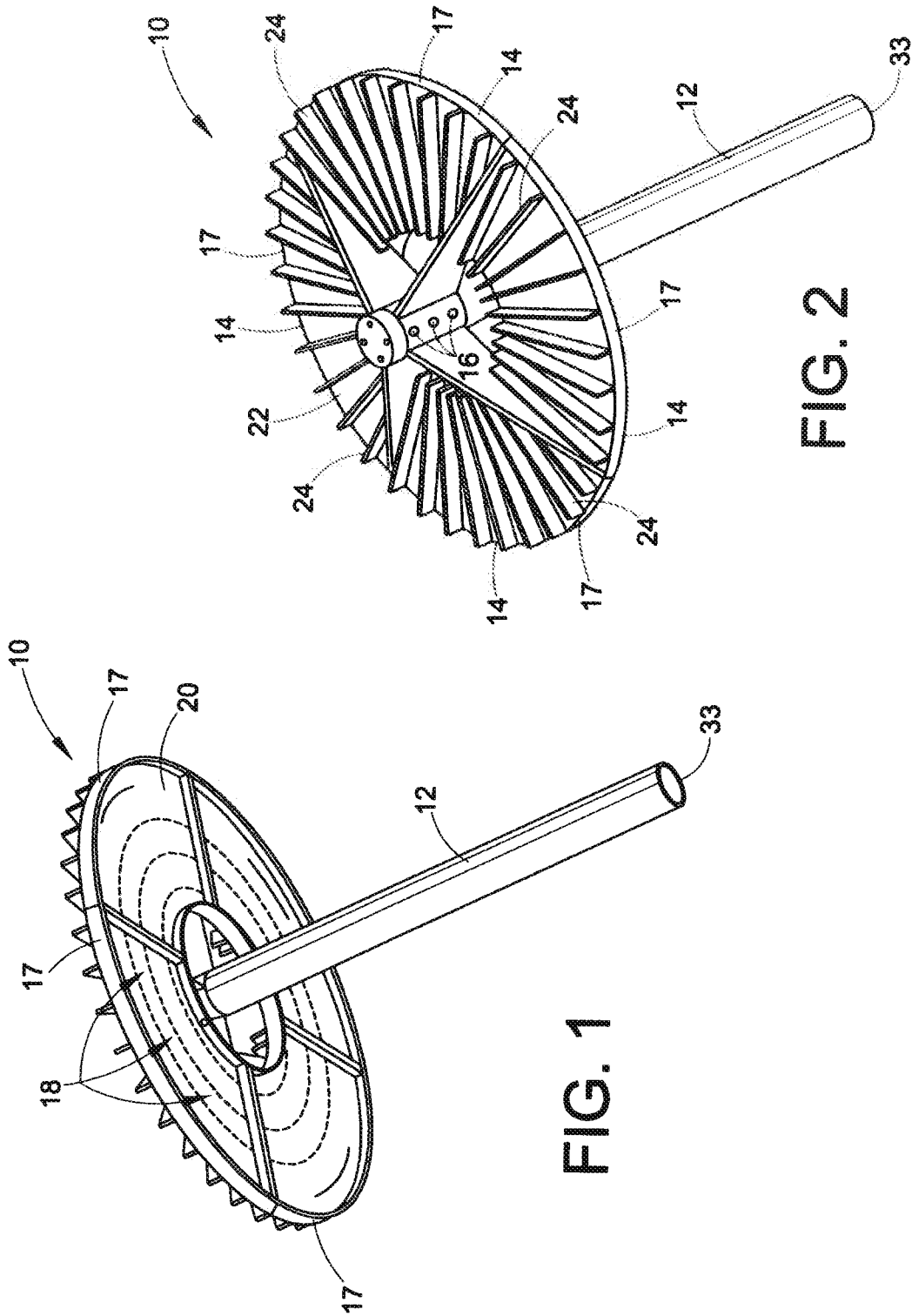


FIG. 1

FIG. 2

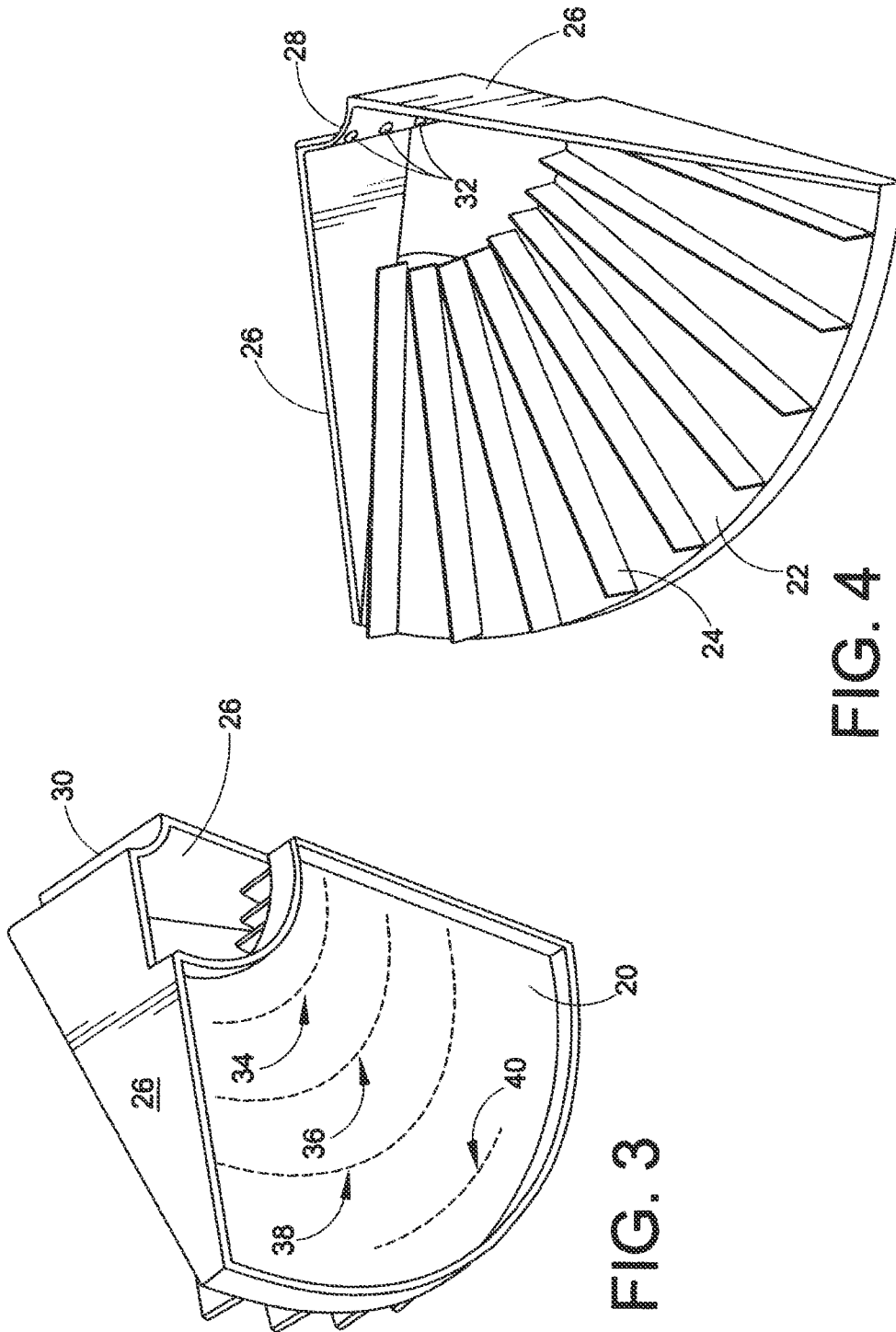


FIG. 4

FIG. 3

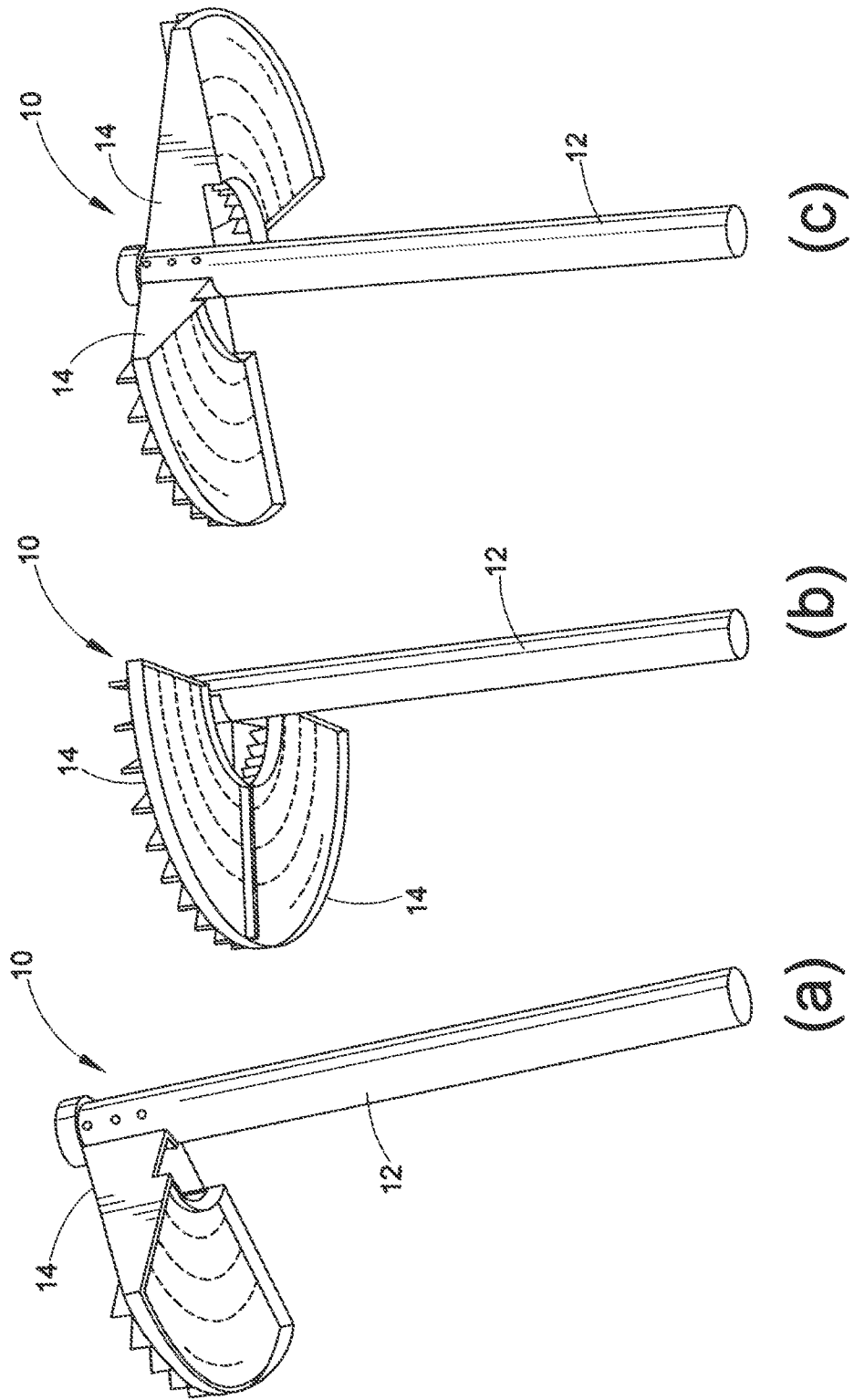


FIG. 5

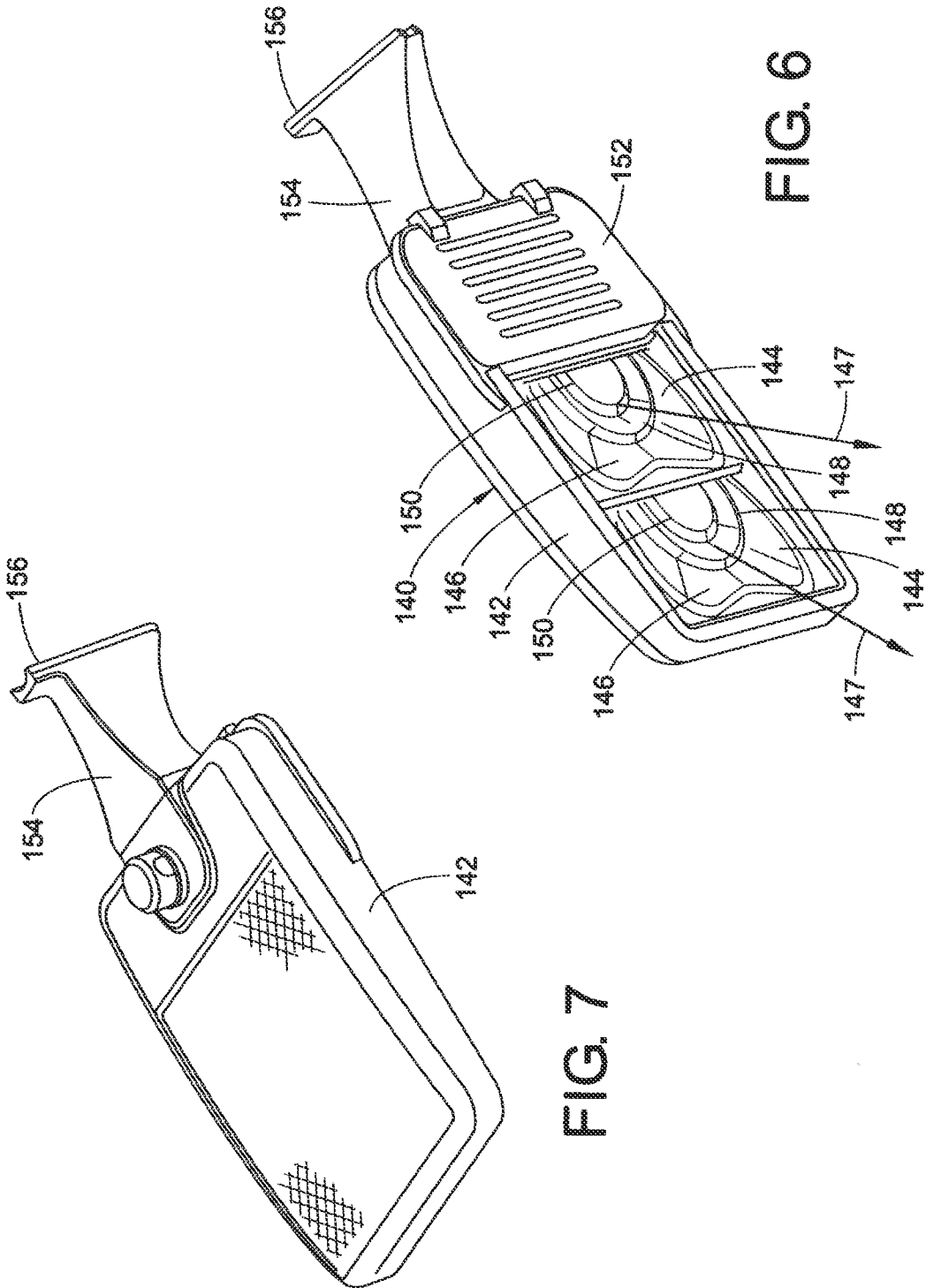


FIG. 6

FIG. 7

FIG. 8(a)

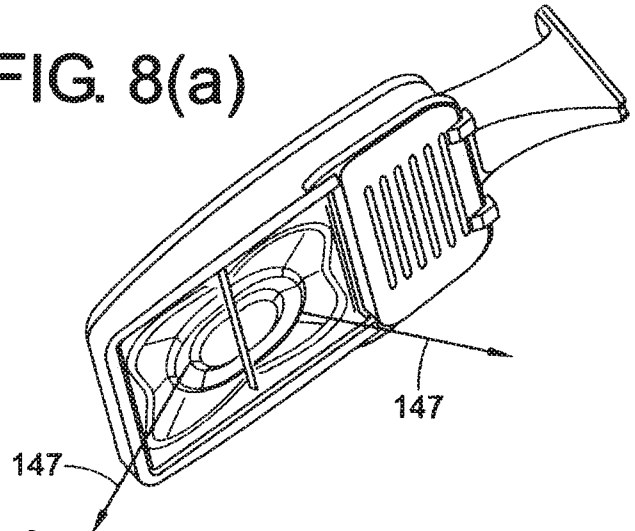


FIG. 8(b)

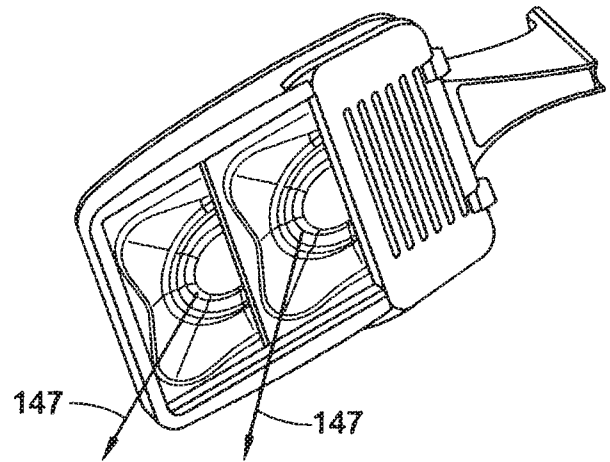
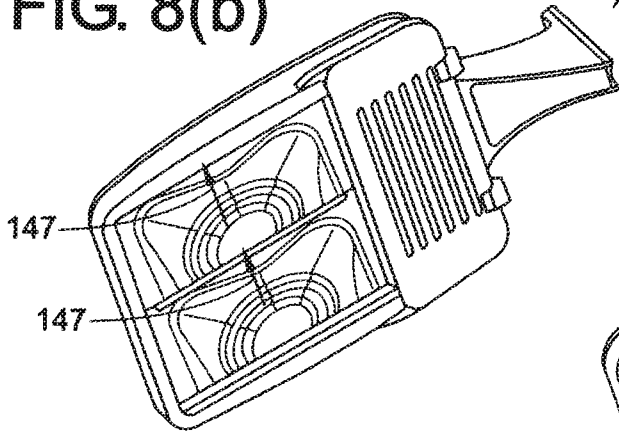
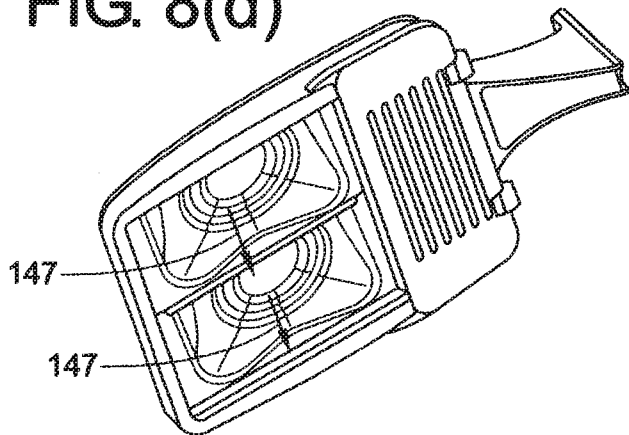


FIG. 8(c)

FIG. 8(d)



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/056142

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21S2/00 F21S8/00 F21S8/08
ADD.
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
F21S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/244881 A1 (BUTLER DOYLE SCOTT [US]) 1 October 2009 (2009-10-01) paragraph [0020] - paragraph [0042] -----	1-5
X	US 2005/117326 A1 (MA OLIVER J [US] MA OLIVER JOEN-AN [US]) 2 June 2005 (2005-06-02) paragraph [0046] - paragraph [0061]; figures 1-22 -----	1,6-9
X	US D 558 908 S1 (WAEDELED PETER [CN]) 1 January 2008 (2008-01-01) the whole document -----	1,6-9
X,P	US 7 934 851 B1 (BOISSEVAIN CHRIS [US] ET AL) 3 May 2011 (2011-05-03) column 2, line 6 - column 7, line 37; figures 1-4 ----- -/--	1-3,5-9

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search 25 January 2012	Date of mailing of the international search report 03/02/2012
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Arboreanu, Antoniu

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/056142

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/056142

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/062689 A1 (VILLARD RUSSELL GEORGE [US]) 13 March 2008 (2008-03-13)	10-12,14
A	paragraph [0041] - paragraph [0118]; figures 1-9	15-20

X	EP 1 956 290 A1 (WISSENLUX SPA [IT]) 13 August 2008 (2008-08-13)	10,11,13
	paragraph [0021] - paragraph [0075]; figures 1-5	

X	US 2010/103668 A1 (LUEKEN THOMAS C [US] ET AL) 29 April 2010 (2010-04-29)	10
	paragraph [0044] - paragraph [0065]; figures 1-24	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2011/056142

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FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-9

Light fixture with two to four identical light modules

2. claims: 10-20

Light fixture comprising at least two different light modules
