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(54) Title: LIGHT FIXTURE

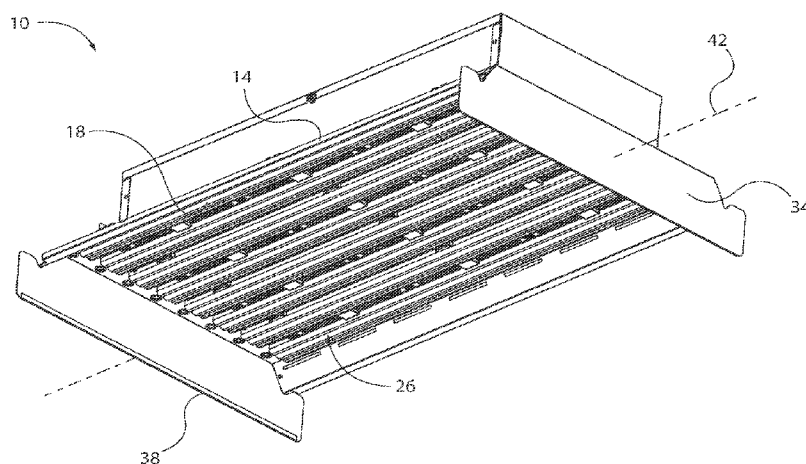


FIG. 2

(57) Abstract: A light fixture includes a housing, a light-emitting element, and a lens extending over the light-emitting element. The housing includes a support surface, and the light-emitting element is coupled to the support surface. The lens includes a refractor portion having an inner surface and an outer surface. The inner surface is positioned proximate the light-emitting element. The inner surface is oriented at an angle such that the light generated by the light-emitting element exhibits total internal reflection within the lens until the light reaches the outer surface.



Published:

— with international search report (Art. 21(3))

— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

LIGHT FIXTURE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of co-pending, prior-filed U.S. Provisional Patent Application No. 62/154,984, filed April 30, 2015, and U.S. Provisional Patent Application No. 62/293,022, filed February 9, 2016. The entire contents of these documents are incorporated by reference herein.

BACKGROUND

[0002] The present application relates generally to light fixtures and particularly to a lens for a light-emitting element.

[0003] Conventional lighting fixtures include a reflector and a board supporting a number of LEDs. The board is in electrical communication with a power source. A lens, such as a refractor or a diffuser may be positioned over the LEDs.

SUMMARY

[0004] In one aspect, a light fixture includes a housing, a light-emitting element, and a lens extending over the light-emitting element. The housing includes a support surface, and the light-emitting element is coupled to the support surface. The lens includes a refractor portion having an inner surface and an outer surface. The inner surface is positioned proximate the light-emitting element. The inner surface is oriented at an angle such that the light generated by the light-emitting element exhibits total internal reflection within the lens until the light reaches the outer surface.

[0005] In another aspect, light fixture includes a housing, a light-emitting element, and a lens extending over the light-emitting element. The housing includes a first end, a second end, and a longitudinal axis extending therebetween. The housing includes a support surface positioned between the first end and the second end. The light-emitting element includes at least one elongated board supporting at least one light-emitting diode (LED). The board defining a first end, a second end, and a board axis extending therebetween. The board coupled to the support surface and oriented such that the board axis is parallel to the longitudinal axis. The lens extends

over the light-emitting element and includes a refractor portion having an inner surface and an outer surface. The inner surface is positioned proximate the light-emitting element and oriented at an angle such that the light generated by the light-emitting element exhibits total internal reflection within the lens.

[0006] In yet another aspect, a light fixture include a housing, a light emitting element, and a bracket coupled to the housing. The housing includes a first end, a second end, and a longitudinal axis extending therebetween. The housing includes a support surface positioned between the first end and the second end. The light-emitting element is coupled to the support surface. The bracket includes a channel defining an elongated slot oriented parallel to the longitudinal axis, the slot configured to receive a support member.

[0007] Other aspects will become apparent by consideration of the detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1 is a perspective view of a luminaire.

[0009] FIG. 2 is a perspective view of the luminaire of FIG. 1 with a cover removed.

[0010] FIG. 3 is an exploded view of the luminaire of FIG. 1.

[0011] FIG. 4 is an exploded view of a light-emitting element and a lens.

[0012] FIG. 5 is a perspective view of the light-emitting element and the lens of FIG. 4.

[0013] FIG. 6 is an enlarged perspective view of a portion of the lens of FIG. 4.

[0014] FIG. 7 is a top view of a lens according to another embodiment.

[0015] FIG. 8 is an end view of the lens of FIG. 7.

[0016] FIG. 9 is a perspective view of the luminaire of FIG. 1 and a support assembly.

[0017] FIG. 10 is a perspective view of the support assembly of FIG. 9 and a portion of the luminaire.

[0018] FIG. 11 is a perspective view of the support assembly of FIG. 9 and a portion of the luminaire.

[0019] FIG. 12 is a perspective view of a bracket.

[0020] FIG. 13 is a side view of the bracket of FIG. 12.

[0021] FIG. 14 is an end view of the bracket of FIG. 12.

DETAILED DESCRIPTION

[0022] Before any embodiments are explained in detail, it is to be understood that the disclosure is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The disclosure is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. Use of "including" and "comprising" and variations thereof as used herein is meant to encompass the items listed thereafter and equivalents thereof as well as additional items. Use of "consisting of" and variations thereof as used herein is meant to encompass only the items listed thereafter and equivalents thereof. Unless specified or limited otherwise, the terms "mounted," "connected," "supported," and "coupled" and variations thereof are used broadly and encompass both direct and indirect mountings, connections, supports, and couplings.

[0023] FIGS. 1-3 illustrate a light fixture or luminaire 10. In one embodiment, the luminaire 10 is used in a commercial or industrial environment. The luminaire 10 includes a housing 14 defining a support surface 18, a light emitting element 22 (FIG. 3) coupled to the housing 14, and a lens 26. In one embodiment, the luminaire 10 also includes a cover 30 (FIGS. 1 and 3) extending over the length of the support surface 18, the light-emitting element 22, and the lens 26. The cover 30 may have hook-shaped sides that engage the housing 14. In some embodiments, the cover 30 is a diffuser that diffuses light generated by the light-emitting element 22. As shown in FIG. 2, the housing 14 includes a first end 34 and a second end 38 and defines a longitudinal axis 42 extending between the first end 34 and the second end 38. The housing 14 may be formed from a sheet of metallic material and is secured to a ceiling (not

shown). As shown in FIG. 3, the housing 14 may include a driver or controller enclosure 46 containing controller hardware.

[0024] As shown in FIG. 4, the light assembly 22 may include multiple light-emitting diode (LED) boards 50. Each LED board 50 includes multiple LEDs supported on an elongated circuit board (e.g., a printed circuit board or PCB). The circuit board is secured to the support surface 18 (FIG. 3). The LEDs may be arranged in a linear manner along the length of the circuit board, and the LED board 50 may be oriented parallel to the longitudinal axis 42 (FIG. 2) of the housing 14. In the illustrated embodiment, the light assembly 22 includes eight LED boards 50 arranged parallel to one another; in other embodiments, the light assembly 22 may include fewer or more light boards 50.

[0025] Referring now to FIGS. 5 and 6, the lens 26 includes refractors 62, and each refractor extends over one of the LED boards 50. In some embodiments, each refractor 62 is secured directly to the support surface 18 (FIG. 3) and is formed from an acrylic material. Each refractor 62 may be coupled to one another by connecting portions 66 (FIG. 6) extending laterally between the refractors 62, and the refractors 62 may be formed integrally with one another. In one embodiment, four of the refractors 62 are formed integrally with one another. In other embodiments (FIGS. 7 and 8), two of the refractors 62 are formed integrally with one another. In still other embodiments, fewer or more refractors 62 may be formed together. Forming the refractors 62 integrally with one another reduces the number of connection points and fasteners that must be used to couple the lens 26 to the housing 14.

[0026] As shown in FIG. 8, each refractor 62 includes a pair of side portion 70 extending parallel to one another, and a bridge or refractor portion 74 extending between the side portions 70. The side portions 70 may curve through an angle of approximately 90 degrees. The refractor portion 74 has an inner surface 78 positioned proximate the LEDs and an outer surface 82 facing opposite the inner surface 78. In the illustrated embodiment, the outer surface 82 has a convex shape extending outwardly with respect to the LED board 50. The outer surface 82 has sides that are recessed below the side portions 70, but the apex of the outer surface 82 extends above the side portions 70. In the illustrated embodiment, the outer surface 82 has diamond shaped formations 86 (FIG. 7) formed on the surface 82.

[0027] In the illustrated embodiment, the inner surface 78 includes a pair of transition portions 90 and a center portion 94 extending between the transition portions 90. The transition portions 90 have a curved, convex shape extending downwardly toward the support surface 18 (FIG. 3). The center portion 94 forms a slot or recess between the transition portions 90 to accommodate the LEDs. The slot is formed by walls 98 that are generally straight. The junction between the transition portion 90 and each wall 98 forms an edge. In one embodiment, the center portion 94 has a slight curvature extending inwardly toward the LED. The center portion 94 has a slight groove positioned adjacent the LEDs and extending along the LED board 50.

[0028] The structure of the refractor 62 causes the light emitted by each LED to be totally internally reflected (TIR) from the inner surface 78 until it reaches the outer surface 82. The light leaves the outer surface 82 along a linear path parallel to the longitudinal axis 42. The refractor 62 focuses the light output by the LED board 50 such that the light is distributed along a linear path (also known as linear aisle lighting or “LAL”) without the need for a reflector. In one embodiment, each refractor 62 directs light output from the LEDs toward a vertical surface of a retail shelf (not shown) to provide a desired illuminance or light intensity while requiring a lower power consumption than conventional light fixtures. In one embodiment, the LED board 50 is powered by a power source providing 90-110 watts, and the board 50 and refractor 62 provide 25 foot-candles at a vertical height of 14 feet. Each refractor may be optically clear and stabilized with respect to ultraviolet (UV) light, and each refractor may have a refractive index of approximately 1.49.

[0029] The housing 14 design provides a compact fixture while providing high light output. In addition, the fixture 10 may include a cover 30 (FIG. 1), such as a smooth frosted acrylic wrap lens, to provide a wide light distribution to minimize glare and mimic the appearance of a skylight.

[0030] FIGS. 9-14 illustrate a support assembly for supporting the luminaire 10 (e.g., suspending the luminaire 10 from a ceiling). As best shown in FIGS. 10 and 11, the support assembly includes a support member 110 coupled to a wall or ceiling surface (not shown) and a pair of brackets 114, each of the brackets 114 coupled to one side of the luminaire 10. In the illustrated embodiment, the support member 110 includes a pair of arms 118 extending parallel

to the longitudinal axis 42 (FIG. 2) of the housing 14. Each bracket 114 also extends parallel to the longitudinal axis 42. Each arm 118 includes an end 122 including a finger or hook extending inwardly toward the axis 42 (FIG. 2). The ends 122 of the arms 118 engage one of the bracket 114.

[0031] Referring to FIGS. 12-14, the bracket 114 includes a first portion 130 and a second portion 134. In the illustrated embodiment, the first portion 130 is secured to a side wall of the controller enclosure 46, and the second portion 134 is formed as a C-shaped channel positioned along an upper edge of the first portion 130. The C-shaped portion forms a first or upper leg 142, a second or lower leg 146, and a third leg or bridge 150 extending between the upper leg 142 and the lower leg 146. In the illustrated embodiment, the bridge 150 includes an elongated slot 154 extending parallel to the longitudinal axis of the bracket 114 and parallel to the longitudinal axis 42 (FIG. 2) of the luminaire 10. Each end 122 of the arms 118 of the support member 110 is received within one of the slots 154 and positioned between the first leg 142 and the second leg 146, thereby coupling the luminaire 10 to the support member 110 to support the luminaire relative to a ceiling or wall surface. In other embodiments, the bracket 114 may be formed in another manner to provide another type of engagement between the bracket 114 and the support member 110.

[0032] Although certain embodiments have been described in detail, variations and modifications exist within the scope and spirit of one or more independent aspects as described.

CLAIMS

We claim:

1. A light fixture comprising:
a housing including a support surface;
a light-emitting element coupled to the support surface; and
a lens extending over the light-emitting element, the lens including a refractor portion having an inner surface and an outer surface, the inner surface positioned proximate the light-emitting element, the inner surface oriented at an angle such that the light generated by the light-emitting element exhibits total internal reflection within the lens.
2. The light fixture of claim 1, wherein the light-emitting element is at least one light-emitting diode (LED) supported on a board, the board coupled to the support surface of the housing.
3. The light fixture of claim 2, wherein the housing includes a first end and a second end and defines a longitudinal axis extending therebetween, wherein the board is oriented in a direction parallel to the longitudinal axis, wherein the lens is oriented parallel to the longitudinal axis.
4. The light fixture of claim 2, wherein the light-emitting element includes multiple boards oriented parallel to one another, each board supporting at least one LED.
5. The light fixture of claim 4, wherein the lens includes multiple lenses, each lens extending over the light-emitting element of each board, wherein each lens is connected to at least one other lens.
6. The light fixture of claim 1, wherein the lens is coupled to the support surface of the housing.
7. The light fixture of claim 1, wherein the outer surface has a convex shape with respect to the light-emitting element and the light emitted through the lens is substantially linear and oriented parallel to a length of the lens.

8. The light fixture of claim 1, wherein the outer surface includes a plurality of diamond-shaped formations.
9. The light fixture of claim 1, wherein a portion of the inner surface has a convex shape curving from a position away from the light-emitting element toward the light-emitting element.
10. A light fixture comprising:
 - a housing including a first end, a second end, and a longitudinal axis extending therebetween, the housing including a support surface positioned between the first end and the second end;
 - a light-emitting element including at least one elongated board supporting at least one light-emitting diode (LED), the board defining a first end, a second end, and a board axis extending therebetween, the board coupled to the support surface and oriented such that the board axis is parallel to the longitudinal axis; and
 - a lens extending over the light-emitting element, the lens including a refractor portion having an inner surface and an outer surface, the inner surface positioned proximate the light-emitting element, the inner surface oriented at an angle such that the light emitted by the light-emitting element exhibits total internal reflection within the lens.
11. The light fixture of claim 10, wherein the light-emitting element includes multiple boards, each board supporting at least one LED, wherein the lens includes multiple lenses, each lens extending over the light-emitting element of each board, wherein each lens is connected to at least one other lens.
12. The light fixture of claim 10, wherein the lens is coupled to the support surface of the housing.
13. The light fixture of claim 10, wherein the outer surface has a convex shape with respect to the light-emitting element.
14. The light fixture of claim 10, wherein the outer surface includes a plurality of diamond-shaped formations.
15. The light fixture of claim 10, wherein a portion of the inner surface has a convex shape

curving from a position away from the light-emitting element toward the light-emitting element.

16. The light fixture of claim 10, further comprising a diffuser coupled to the housing and extending over the light-emitting element and the lens.

17. A light fixture comprising:

a housing including a first end, a second end, and a longitudinal axis extending therebetween, the housing including a support surface positioned between the first end and the second end;

a light-emitting element coupled to the support surface; and

a bracket coupled to the housing, the bracket including a channel defining an elongated slot oriented parallel to the longitudinal axis, the slot configured to receive a support member.

18. The light fixture of claim 17, wherein the housing includes an enclosure containing a controller for the light-emitting element, wherein the bracket is secured to the enclosure.

19. The light fixture of claim 17, wherein the channel has a C-shaped cross-section defining a first leg, a second leg, and a third leg extending between the first leg and the second leg, wherein the slot is positioned on the third leg.

20. The light fixture of claim 19, wherein the slot is spaced apart from an enclosure on the housing such that at least a portion of the support member extends through the slot and is positioned between the first leg and the second leg.

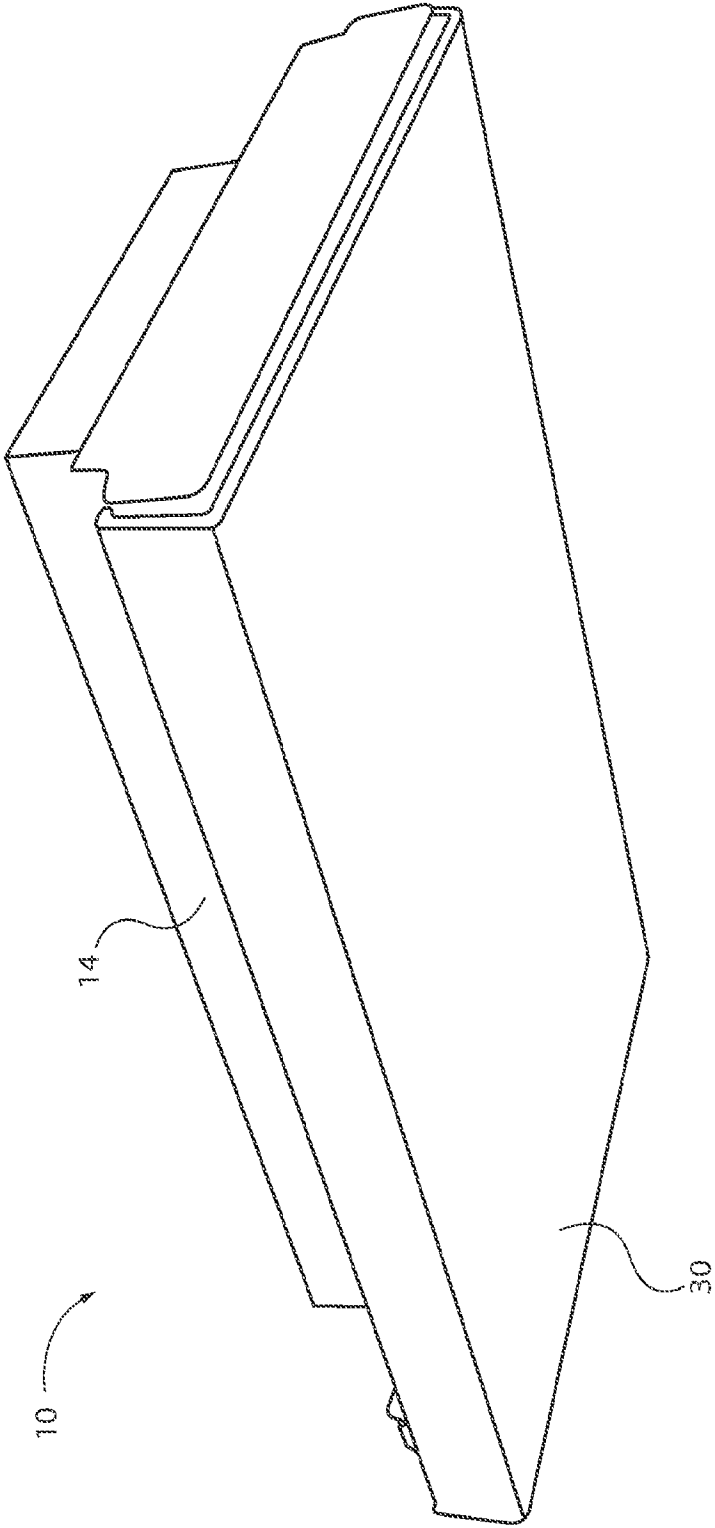


FIG. 1

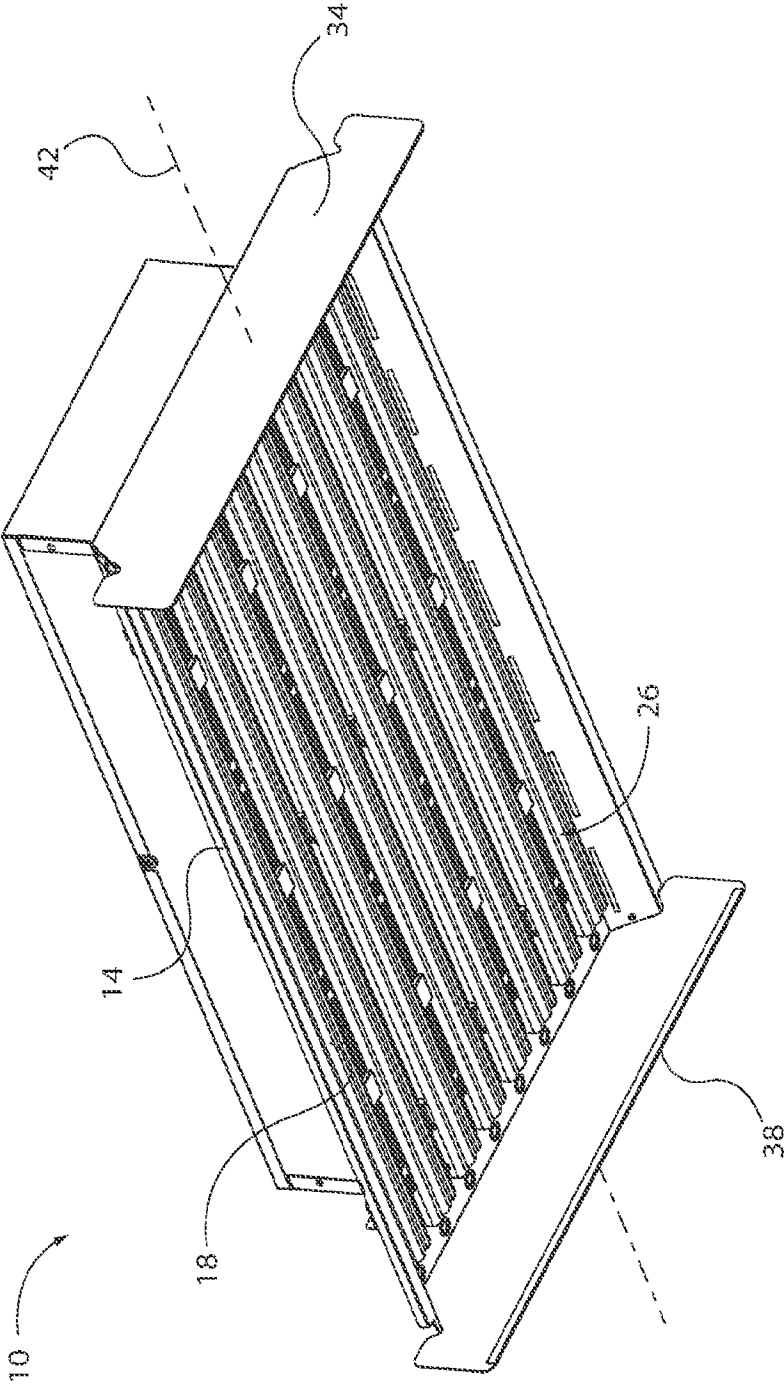


FIG. 2

3/13

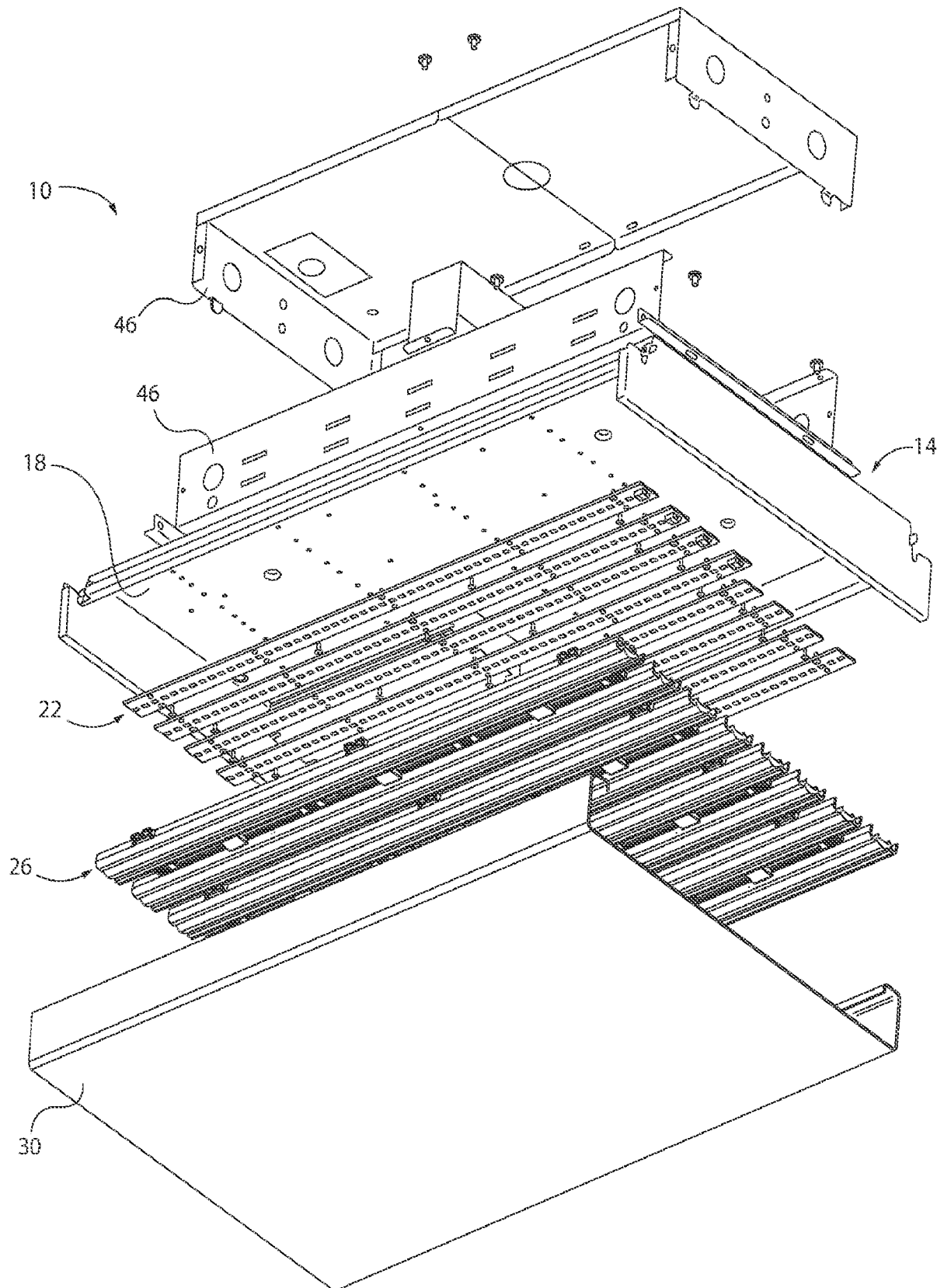


FIG. 3

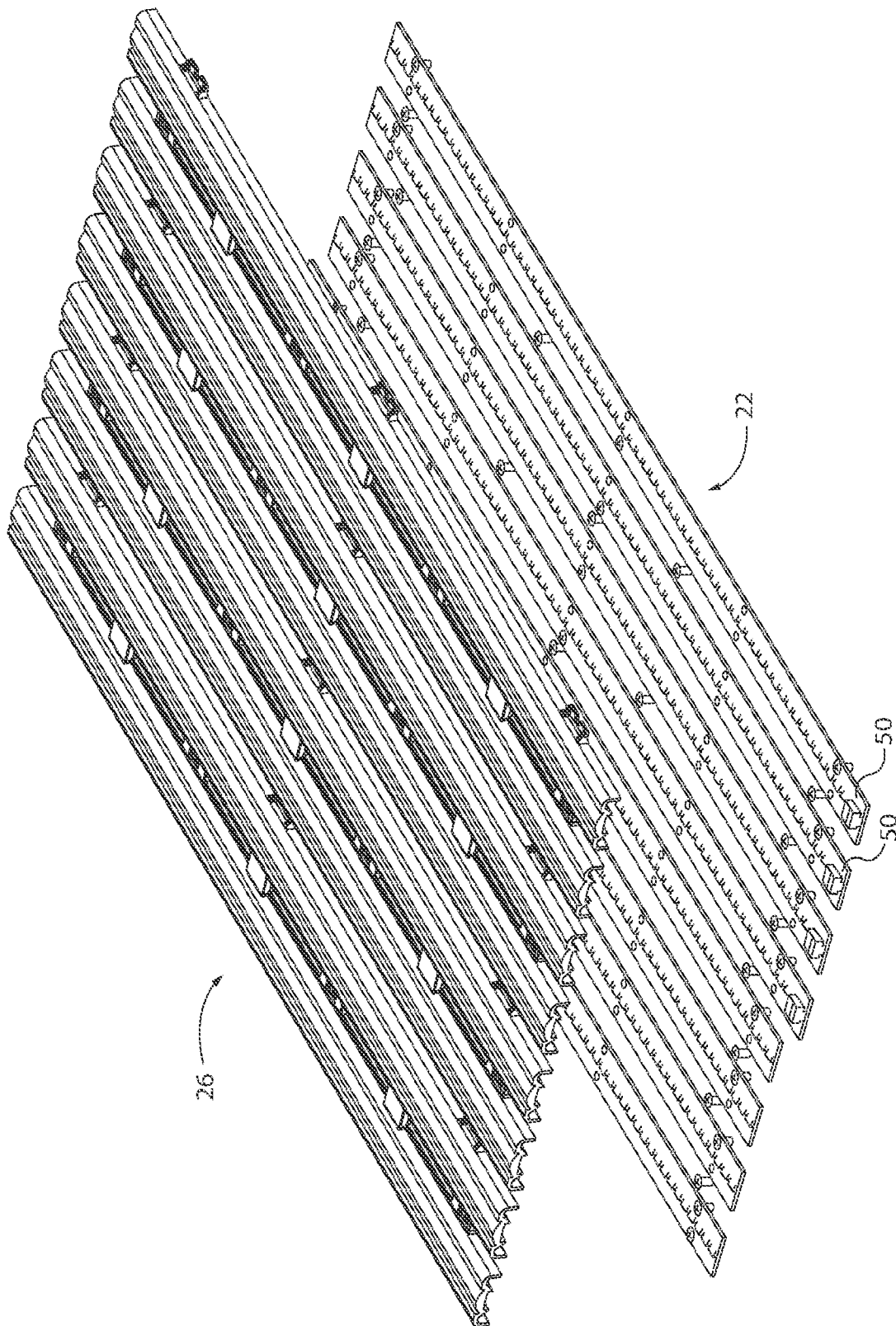


FIG. 4

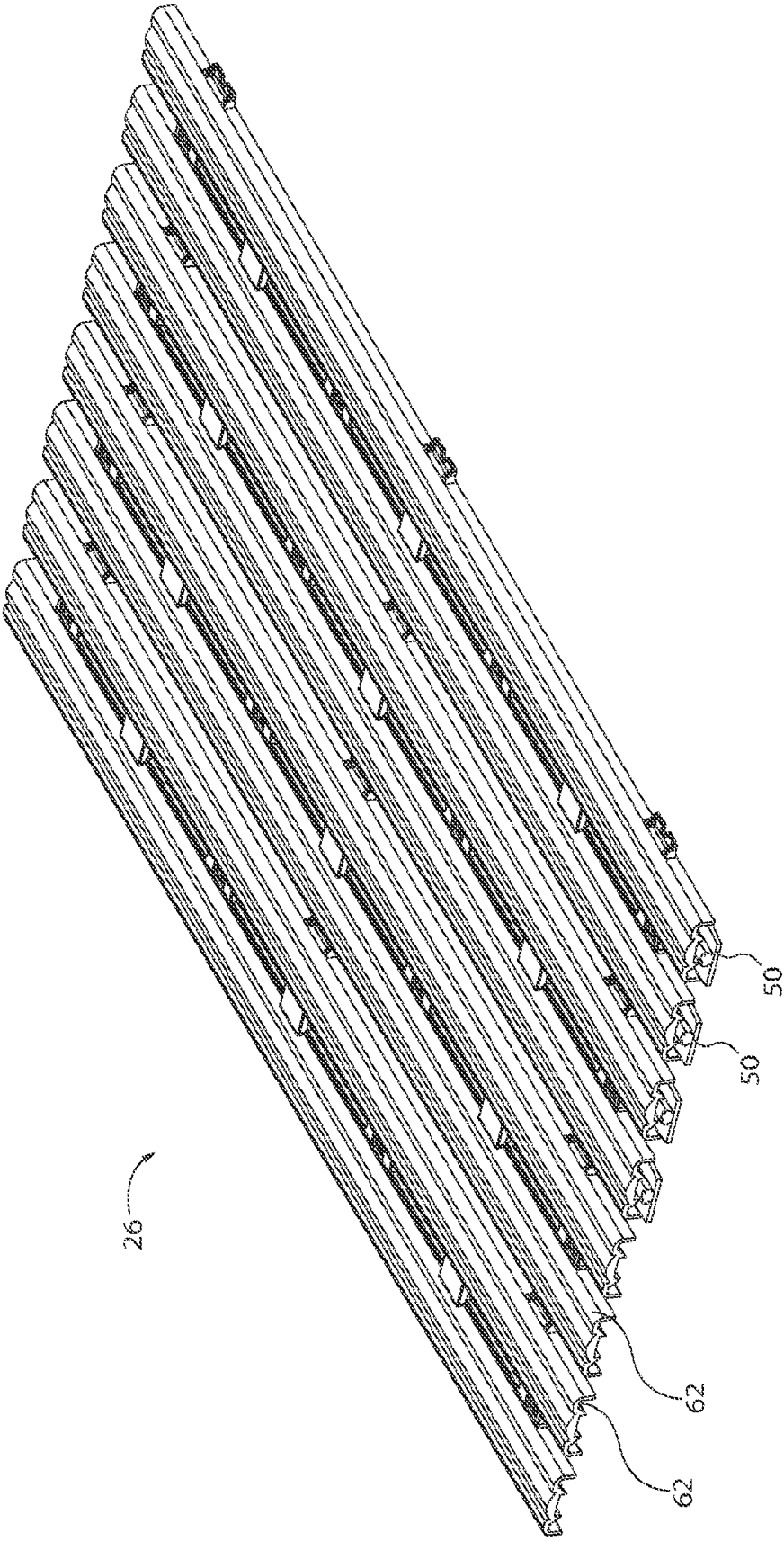


FIG. 5

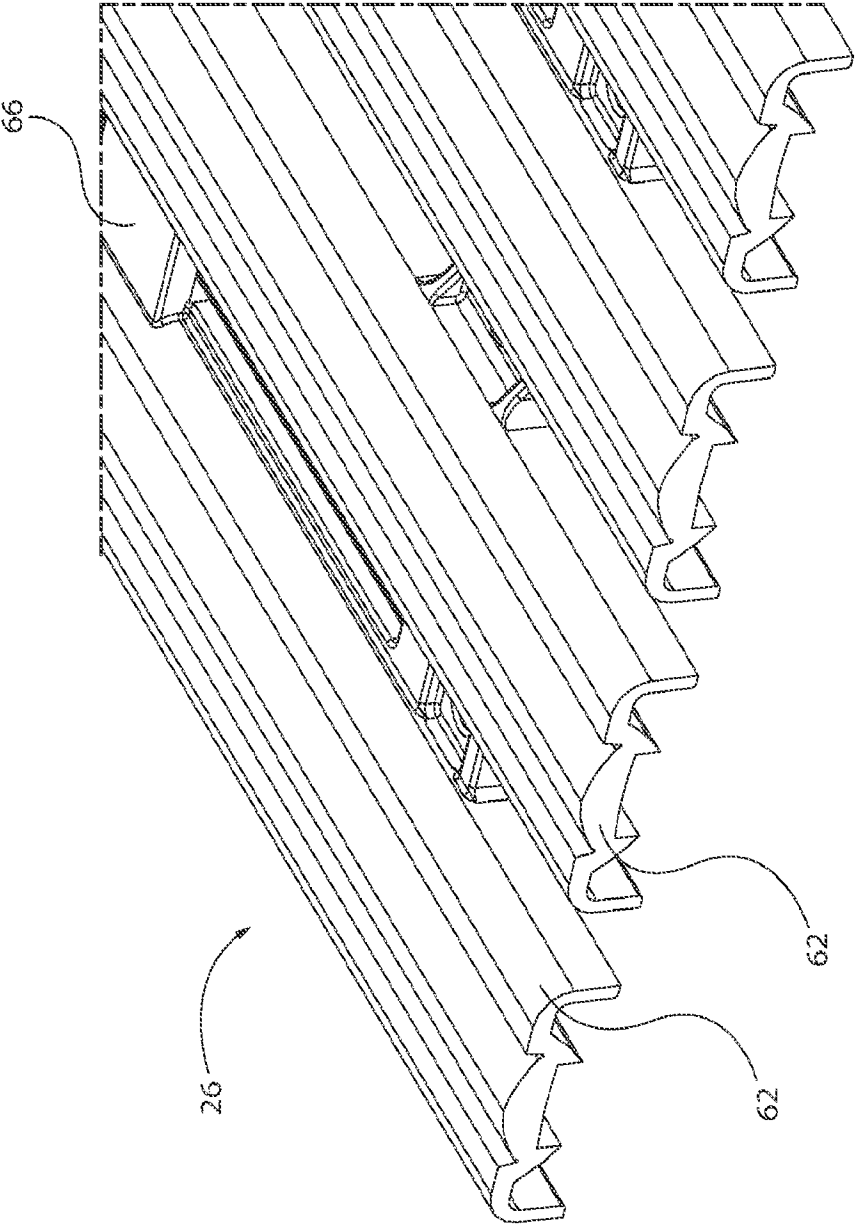


FIG. 6

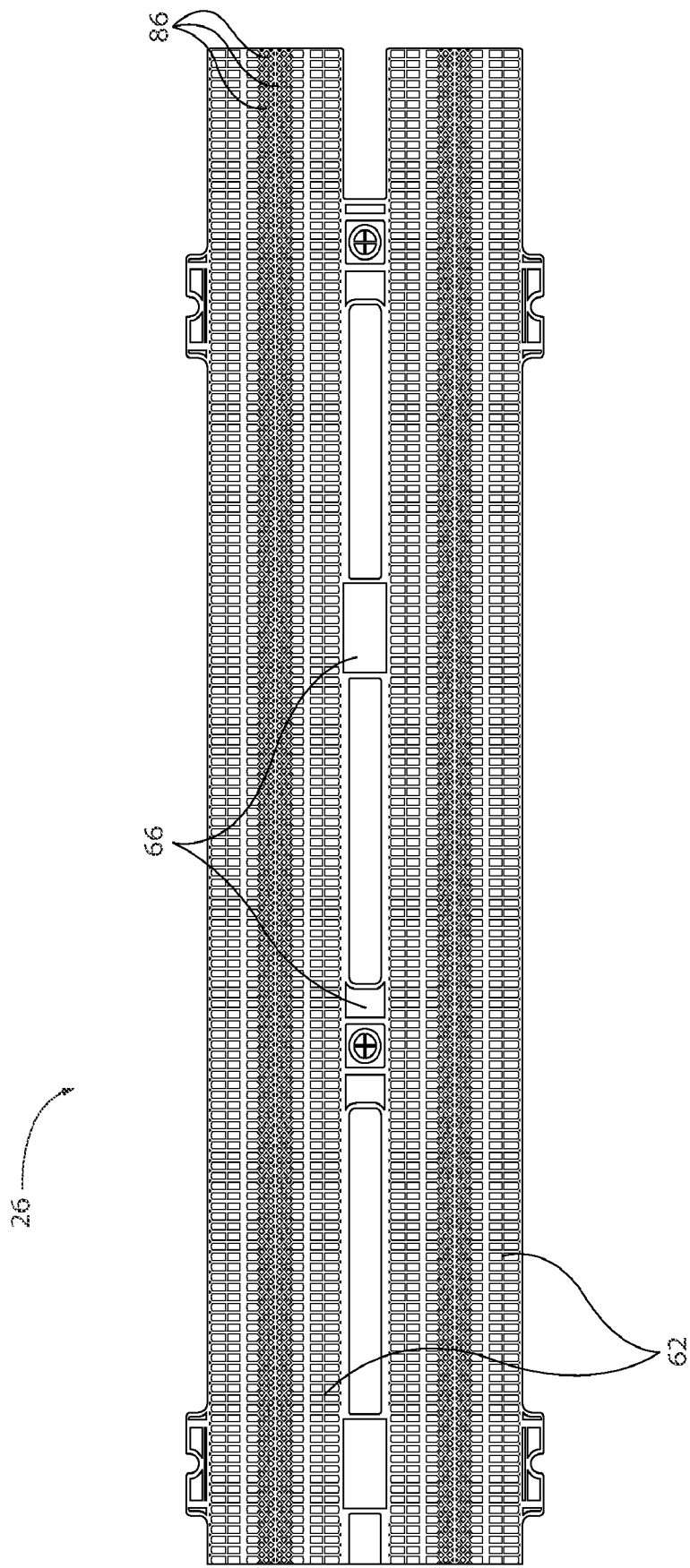


FIG. 7

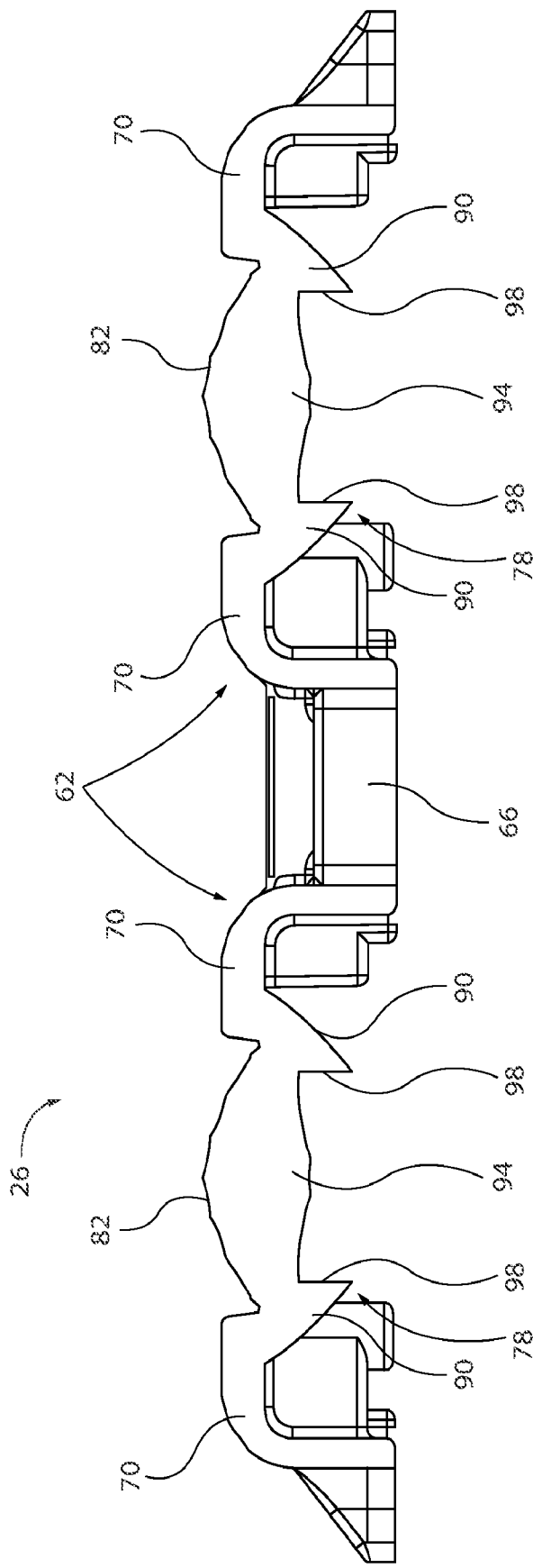


FIG. 8

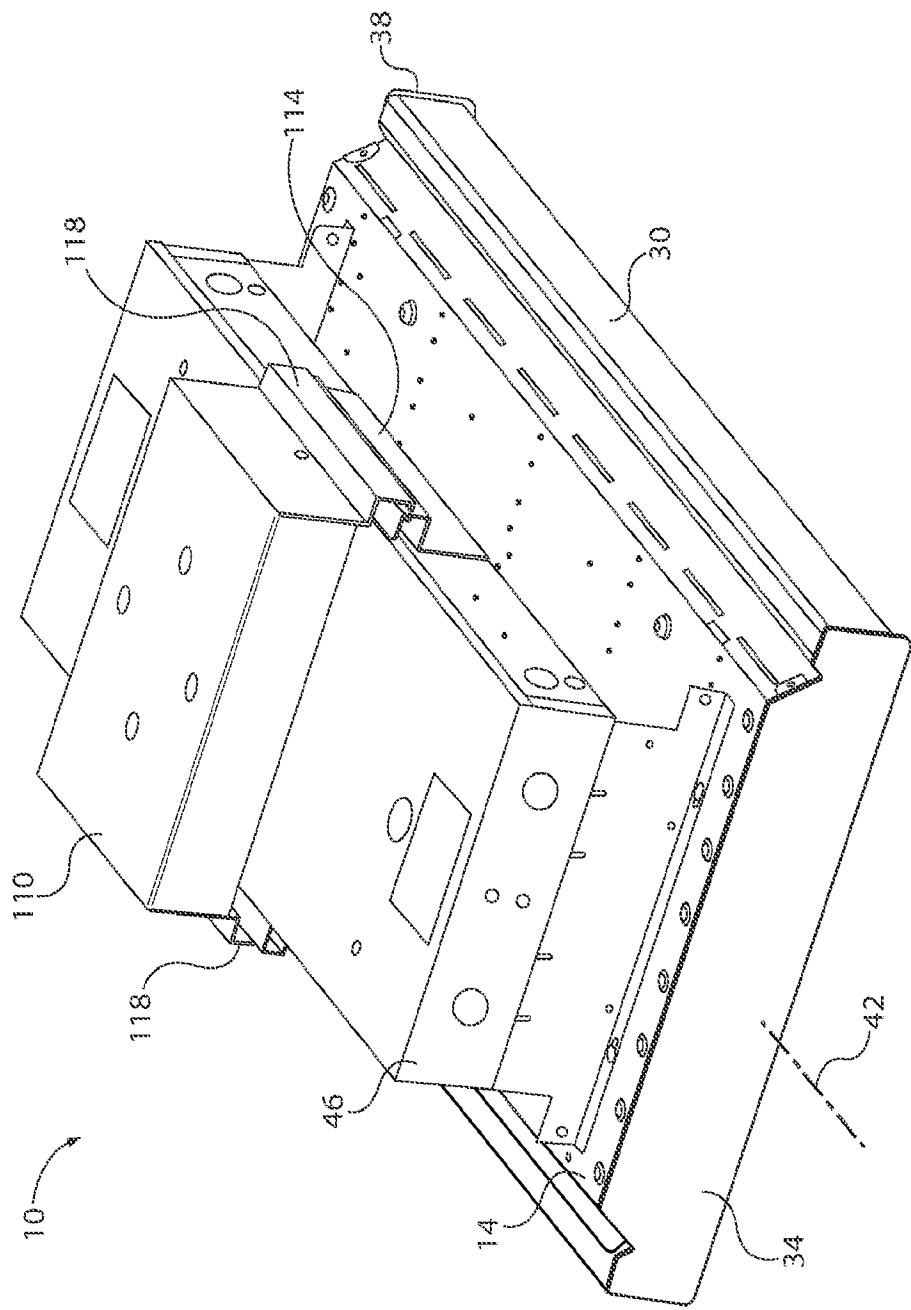


FIG. 9

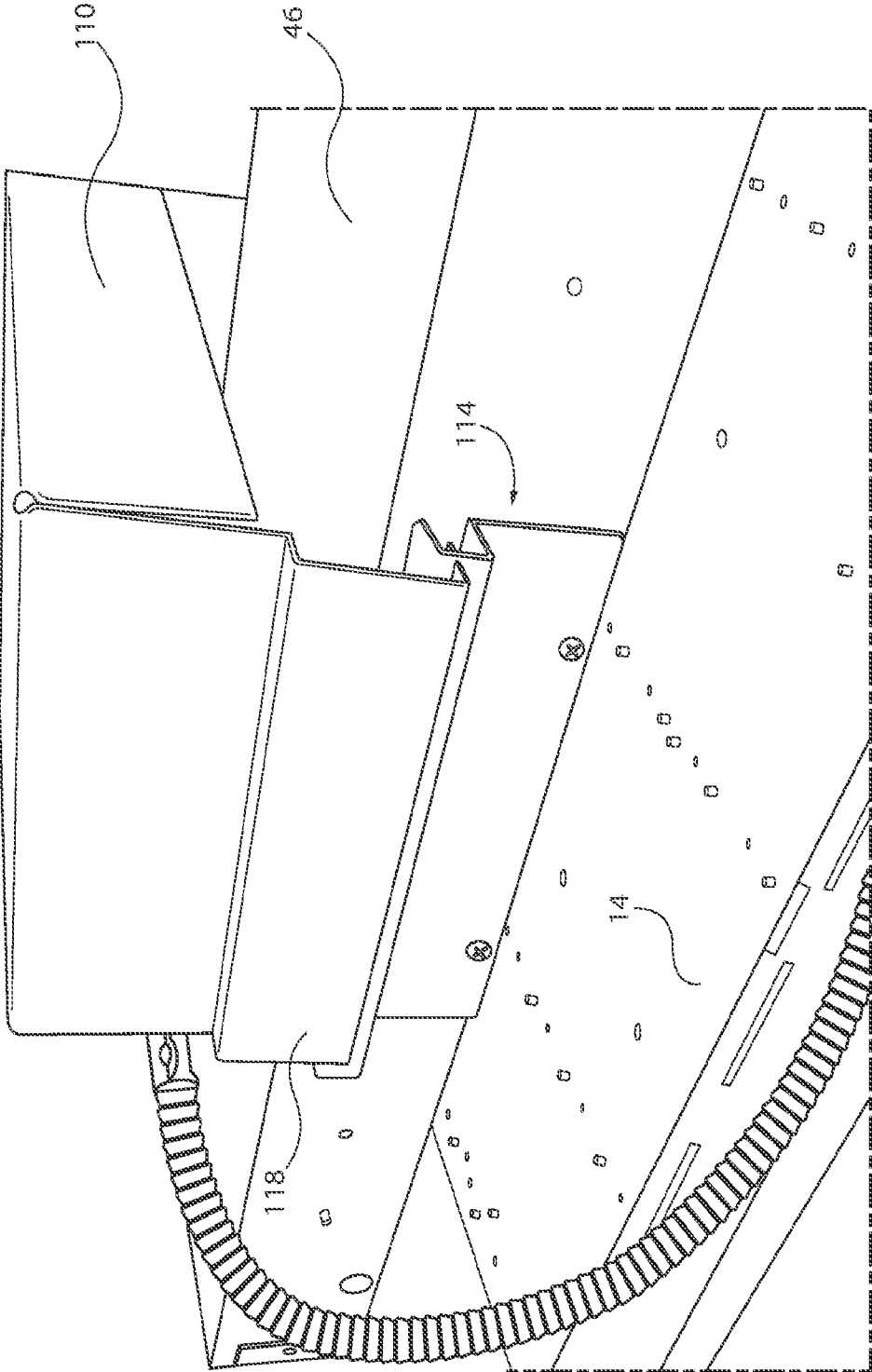


FIG. 10

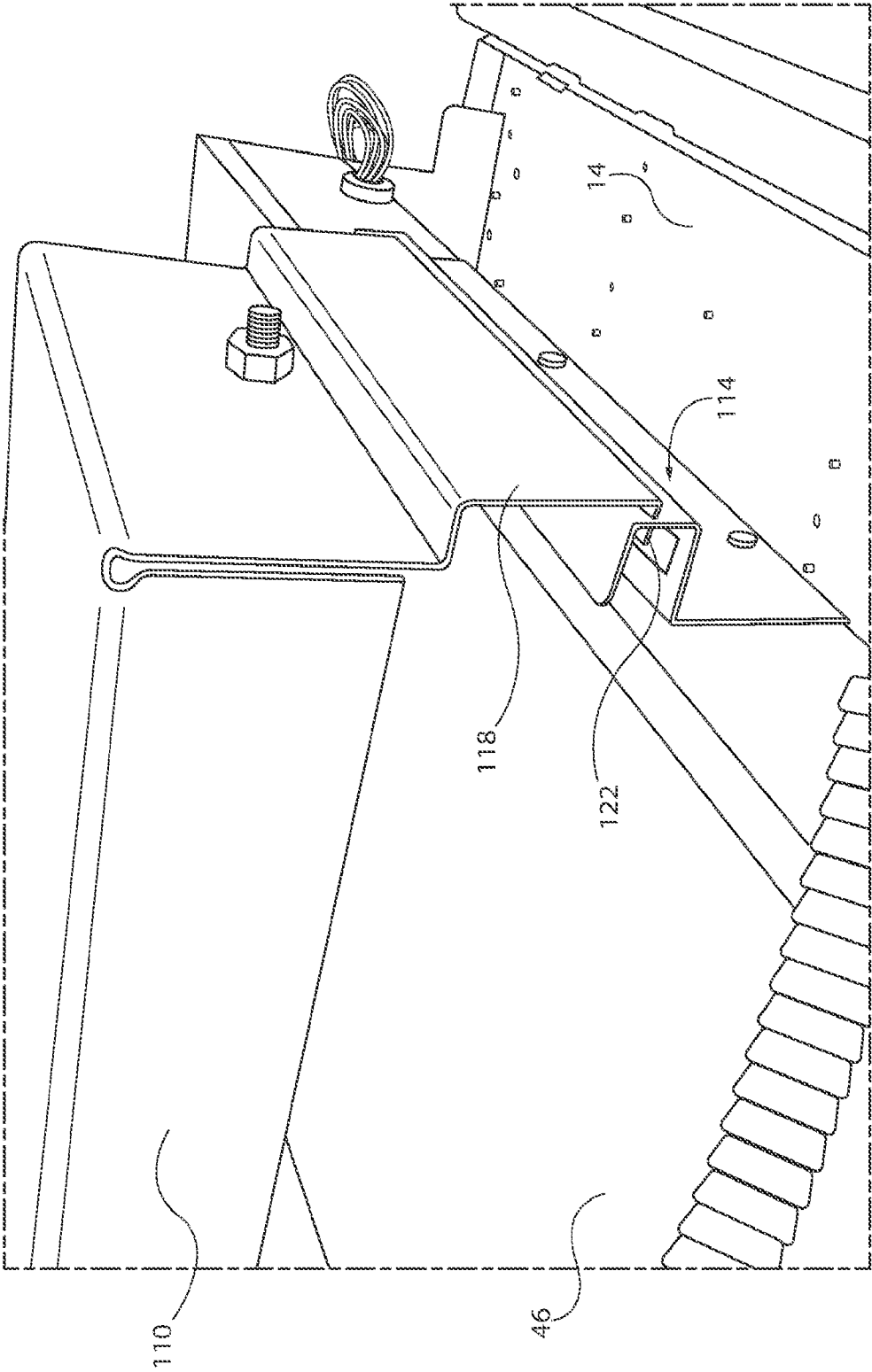


FIG. 11

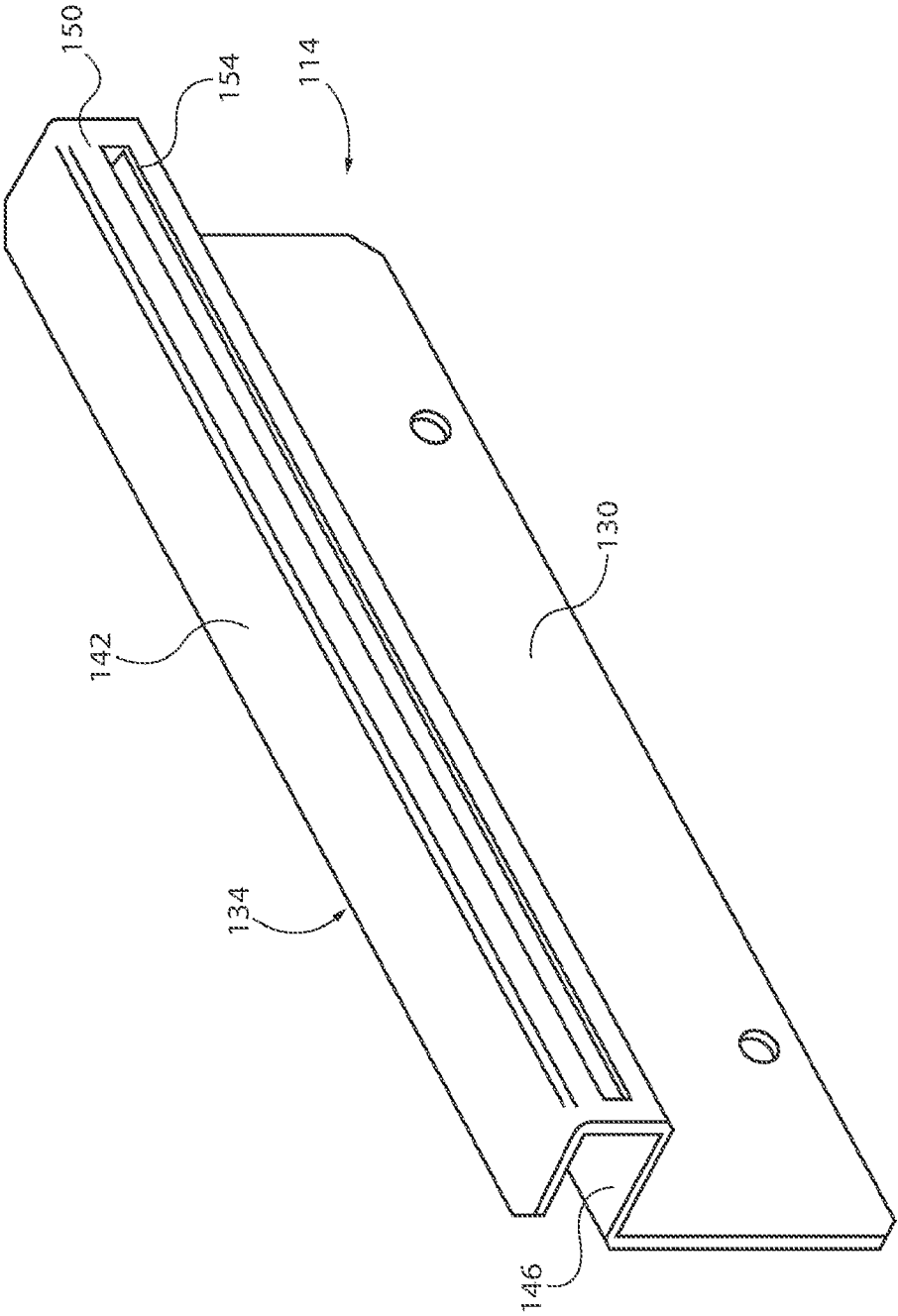


FIG. 12

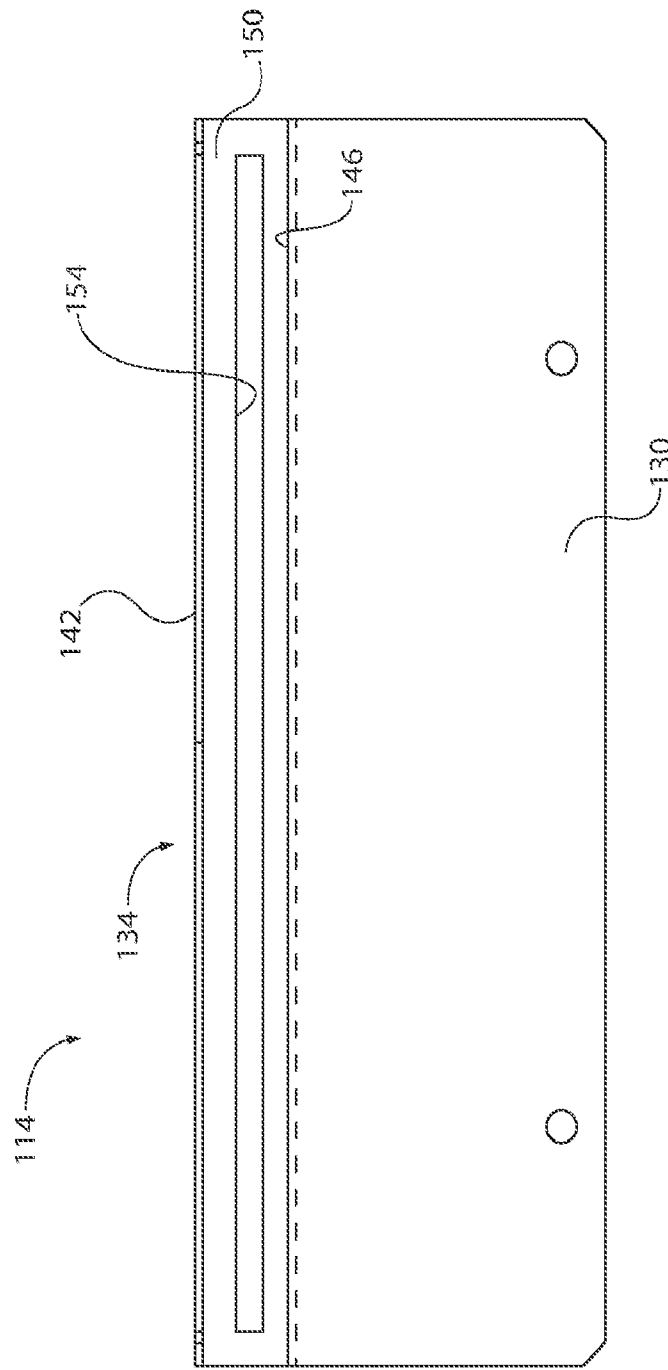


FIG. 13

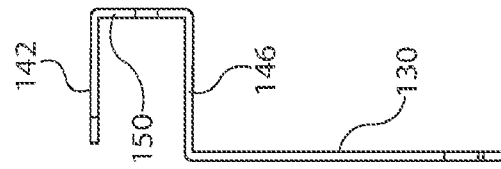


FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2016/030186

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - F21V 5/04; F21V 7/00; G02B 3/02 (2016.01)

CPC - F21V 5/04; F21V 7/00; G02B 3/02 (2016.05)

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)

IPC - F21V 5/00; F21V 5/04; F21V 7/00; G02B 3/02; G02B 27/30

CPC - F21V 5/00; F21V 5/002; F21V 5/007; F21V 5/04; F21V 7/00; G02B 3/02; G02B 27/30

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

USPC - 362/308; 362/310; 362/327; 362/338; 362/455 (keyword delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Patbase, Google Patents, Google

Search terms used: LED fixture, total internal reflection

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/0149581 A1 (JIANG) 23 June 2011 (23.06.2011) entire document	1-16
A	US 7,580,192 B1 (CHU et al) 25 August 2009 (25.08.2009) entire document	1-16
A	US 8,075,165 B2 (JIANG et al) 13 December 2011 (13.12.2011) entire document	1-16
A	US 2003/0206416 A1 (MULLALLY et al) 06 November 2003 (06.11.2003) entire document	1-16

☐ 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 application or patent 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

22 August 2016

Date of mailing of the international search report

07 SEP 2016

Name and mailing address of the ISA/

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PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2016/030186

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 supplemental page

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 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.:
1-16

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.

Continued from Box No. III Observations where unity of invention is lacking

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-16, drawn to a light fixture.

Group II, claims 17-20, drawn to a light fixture comprising: a housing including a first end, a second end, and a longitudinal axis extending therebetween.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: the inner surface positioned proximate the light-emitting element, the inner surface oriented at an angle such that the light generated by the light-emitting element exhibits total internal reflection within the lens as claimed therein is not present in the invention of Group II. The special technical feature of the Group II invention: bracket coupled to the housing, the bracket including a channel defining an elongated slot oriented parallel to the longitudinal axis, the slot configured to receive a support member as claimed therein is not present in the invention of Group I.

Groups I and II lack unity of invention because even though the inventions of these groups require the technical feature of a light fixture comprising: a housing including a first end, a second end, and a longitudinal axis extending therebetween, the housing including a support surface positioned between the first end and the second end; a light-emitting element coupled to the support surface, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2003/0206416 A1 (MULLALLY et al) 06 November 2003 (06.11.2003) teaches a light fixture comprising: a housing including a first end, a second end, and a longitudinal axis extending therebetween (Paras. 9 and 19-20 and Figs. 1-5), the housing including a support surface positioned between the first end and the second end (Para. 20 and Figs. 3-4); a light-emitting element coupled to the support surface (light sources 80 disposed on light support 26, Para. 24 and Figs. 3-4).

Since none of the special technical features of the Group I or II inventions are found in more than one of the inventions, unity of invention is lacking.