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- (71) **Applicant (for all designated States except US):** **GO-LIGHT, INC.** [US/US]; 37146 Old Hwy 17, Culbertson, Nebraska 69024 (US).
- (72) **Inventors; and**
- (75) **Inventors/Applicants (for US only):** **GEBHARD, Albert** [US/US]; 2101 East Alameda Ave., Denver, Colorado 80209 (US). **HOSICK, Colton. D** [US/US]; 37146 Old Hwy 17, Culbertson, Nebraska 69024 (US).
- (74) **Agent:** **SMITH, Abigail;** Oppedahl Patent Law Firm LLC, 12000 N. Pecos St., Suite 252, Westminster, Colorado 80234 (US).

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(54) **Title:** LED SYSTEM AND HOUSING FOR USE WITH HALOGEN LIGHT FIXTURES

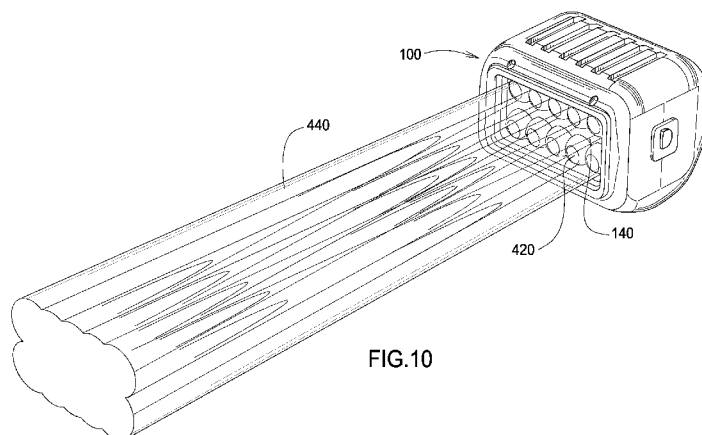


FIG.10

(57) **Abstract:** An LED optical light engine spotlight which can accommodate a variable number of light-emitting diodes (LEDs) is disclosed. An optical projection lens mounted in front of the LEDs merges the separate LED beams into a single beam, similar to the single beam provided by a halogen light and reflector. A heat sink provides convection cooling up to approximately 100 F. An optional fan provides additional heat dissipation for more extreme conditions. The depicted device can include a vertical tilt of over 200. Optimally, the depicted device is designed to have a full vertical tilt range between zenith (0 degrees) to horizontal (90 degrees) to full depression (135 degrees). An optional accessory lens provides additional capabilities, including flood lenses, colored lenses and rock guards, for example. The depicted device can be hard wired or wireless. The depicted device can be adapted to many base units and/or pan and tilt platforms.



**TITLE****LED System and Housing for Use with Halogen Light Fixtures****CROSS REFERENCE APPLICATIONS**

[0001] This application is a non-provisional application claiming the benefits of  
5 provisional application no. 61/506,594 filed July 11, 2011 and provisional application no.  
61/561,162 filed November 17, 2011, the disclosures of each of which are hereby  
incorporated by reference for all purposes.

**BACKGROUND**

[0002] Lighting systems and housings are well known in the art. These prior art housing  
10 suffer from a number of drawbacks. Halogen systems provide a single beam of light  
useful for illuminating large areas (flood) or as a spot. However, halogen lights are  
fragile and require replacement often which is troublesome and often dangerous.  
Halogen lamps burn excessively hotter than many other types of lamp. Light emitting  
diodes (LEDs) burn at a lower temperature and last longer, but fail to provide the intense,  
15 single beam illumination of a halogen light with a spot reflector. Halogen lights and  
LEDs are also disparate in size, making it impossible to simply replace a halogen spot  
light with an LED. Because of the difference in illumination provided by a halogen light  
and an LED, such a substitution would also fail to provide the same amount of light.

[0003] The foregoing example of the related art and limitations related therewith are  
20 intended to be illustrative and not exclusive. Other limitations of the related art will  
become apparent to those of skill in the art upon a reading of the specification and a study  
of the drawings.

**SUMMARY**

[0004] The following embodiments and aspects thereof are described and illustrated in  
25 conjunction with systems, tool and methods which are meant to be exemplary and

illustrative, not limiting in scope. In various embodiments, one or more of the above described problems have been reduced or eliminated, while other embodiments are directed to other improvements.

[0005] The disclosed lamp housing is designed to accommodate a variable number of  
5 light-emitting diodes (LEDs). A projection lens mounted in front of the LEDs merges the separate beams from the LEDs into a single beam, similar to the single beam provided by a halogen light. The LED mounting system allows the LEDs to be placed in a space originally designed for a single halogen lamp. The depicted device can include a vertical tilt between zenith (0 degrees) to horizontal (90 degrees) to full depression (135 degrees).  
10 An optional accessory lens provides additional capabilities, including flood lenses which convert spot performance to flood, colored lenses and rock guards, for example. The depicted device can be hard wired or wireless. The depicted device can be adapted to many base units and/or pan and tilt platforms.

[0006] This LED complete light engine is a plug and play replacement for a halogen unit  
15 with reflector resulting in similar beam performance without the drawbacks of a halogen unit. The disclosed device has a simple and weatherproof design, which allows for easy assembly and maintenance. The disclosed device provides improved durability and weather resistance.

[0007] In addition to the exemplary aspects and embodiments described above, further  
20 aspects and embodiments will become apparent by reference to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

### **BRIEF DESCRIPTION OF THE DRAWINGS**

[0008] Before explaining the disclosed embodiment of the present invention in detail, it  
25 is to be understood that the invention is not limited in its application to the details of the particular arrangement shown, since the invention is capable of other embodiments.

Exemplary embodiments are illustrated in referenced figures of the drawings. It is intended that the embodiments and figures disclosed herein are to be considered illustrative rather than limiting. Also, the terminology used herein is for the purpose of description and not of limitation.

5 [0009] Figure 1 is an exploded view of one embodiment of a light engine assembly of the present application.

[0010] Figure 2 is a front perspective view of the LED lamp of Figure 1 without the pan and tilt platform.

[0011] Figure 3 is a front side elevation view of Figure 2.

10 [0012] Figure 4 is a left side elevation view of Figure 2.

[0013] Figure 5 is a bottom plan view of Figure 2.

[0014] Figure 6 is a back perspective view of Figure 2.

[0015] Figure 7 is a back side elevation view of Figure 2.

[0016] Figure 8 is a right side elevation view of Figure 2.

15 [0017] Figure 9 is a rotated bottom plan view of Figure 2.

[0018] Figure 10 is a front perspective view of a beam pattern of one embodiment of a lens of the present application.

[0019] Figure 11 is a top plan view of Figure 10.

[0020] Figure 12 is a perspective view of a lens according to the present application.

20 [0021] Figure 13 is a front plan view of a lens according to the present application.

[0022] Figure 14 is a diagram representing refraction and total internal reflection.

[0023] Figure 15 is a left or right side plan view of a Fresnel lens.

[0024] Figure 16 is an intensity distribution of a light assembly using the lens of the present application.

### DETAILED DESCRIPTION OF THE DRAWINGS

5 [0025] Figure 1 is an exploded view of light assembly 100. This figure depicts an optional accessory lens 170, which, if present, mounts to bezel 130. Accessory lens 170 can serve a variety of functions, including flood lens, color lens, or rock guard. Heat sink 110 includes a number of cooling fins 330, which radiate from the top and bottom of heat sink 110. The design of the heat sink must be carefully tuned to the LEDs and their  
10 requirements for heat dissipation. In use, heat created by LEDs 160 is dissipated through cooling fins 330. Protective lens 120 attaches to heat sink 110 with silicone, thereby hermetically sealing the parts sandwiched in between. These intervening parts include LEDs 160, which are mounted in printed circuit board (PCB) 190. Projection lens 140 is mounted over PCB 190. In use, projection lens 140 will focus the individual beams of  
15 light from LEDs 160 into a single beam of light which can illuminate a large area, much like a halogen light. Bezel 130 is mounted over protective lens 120 and attaches to heat sink 110. Bezel 130 includes cooling fins 135. When bezel 130 is attached to heat sink 110, air enters at the bottom of bezel 130 and travels over cooling fins 330b at the base of heat sink 110, up over cooling fins 330a on the top of heat sink 110 and exits over  
20 cooling fins 135, allowing for convection and air cooling. The direction of air flow is represented by arrows in Figures 2 and 6. This convection and air cooling will be more pronounced if an optional fan 200 is included.

[0026] In the depicted embodiment, heat sink 110 comprises aluminum and is created from a cast. Those skilled in the art will understand that metal is selected for its heat  
25 dissipation properties. One having an ordinary level of skill in the art will understand that any material having similar properties to aluminum could be used. The figures

depict 10 LEDs, however, one skilled in the art will understand that a variable number of LEDs could be provided. In the depicted embodiment, projection lens 140 is made of acrylic, and is molded as a single piece. In an alternative embodiment, projection lens 140 may comprise acrylic. In the depicted embodiment, a silicone pad connects PCB 190  
5 to heat sink 110. Silicone provides excellent heat transfer to assist in the convection cooling of LEDs 160. Those having an ordinary level of skill in the art will understand that other materials having similar properties to silicone could be used, and that multiple lenses could be manufactured and later attached to one another or to the PCB. In the depicted embodiment, the LEDs are Luxeon star LEDs. A person having ordinary skill in  
10 the art will understand that other brands and types of LEDs could be substituted for Luxeon LEDs. In the depicted embodiment, bezel 130 is made of plastic. A person having ordinary skill in the art will understand that any material having similar properties to plastic could be used to form the bezel.

[0027] Turning next to the mechanical components behind heat sink 110, an optional fan  
15 200 is mounted to the bottom side of heat sink 110 opposite LEDs 160. A clamp 300 attaches fan 200 to heat sink 110. In the depicted embodiment, fan 200 is water resistant. Convection cooling of the LEDs is sufficient for temperatures up to approximately 100°F. Fan 200 can be installed for more extreme conditions, such as temperatures greater than 100°F. Front case 210 and back case 220 enclose driver 230. Back case 220  
20 is wired to LEDs 160 and a power input (not shown). In the depicted embodiment, driver 230 comprises PCB and provides between approximately 10 to 30 volts of power to the LEDs. Those having ordinary skill in the art will understand that cost and location considerations will likely be primary considerations in the decision to use one driver or multiple drivers. A support 240 is mounted behind heat sink 110. Support 240 holds tilt  
25 gear 250 in place. The location of tilt gear 250 in the depicted embodiment is merely exemplary. Tilt gear 250 could be mounted in various positions in light assembly 100 and still be within the scope of the present disclosure. In the depicted embodiment,

support 240 comprises plastic. A person having an ordinary level of skill in the art will understand that any material having similar properties to plastic could be substituted.

[0028] Turning next to Figures 2-9, the LED system is shown assembled, but without a cover. In Figure 2, heat sink 110, bezel 130, protective cover 120, projection lens 140  
5 and LEDs 160 remain visible. Bearings 260 are now visible. Bearings 260 attach to heat sink 110 and allow the unit to tilt vertically. Bearings 260 also reduce wear and add lubricity to pivot points.

[0029] Figure 3 shows all of the foregoing parts, and also displays screws 270, which are used to attach PCB 190 to heat sink 110. A second set of screws 280 attaches bezel 130  
10 to heat sink 110. While screws are depicted, one skilled in the art will understand that any number of fasteners could be used and still remain within the scope of the present disclosure.

[0030] In Figure 4, support 240 and tilt gear 250 are partially visible. Figure 5 shows the bottom of fan 200, front cover 210 and back cover 220. In Figure 6, front case 210 and  
15 back case 220 are visible. From this view, screws 290 can be seen attaching clamp 300 and front case 210 to heat sink 110. Another set of screws 310 attaches tilt gear 250 to heat sink 110 through support 240. While screws are depicted, one skilled in the art will understand that any number of fasteners could be used and still remain within the scope of the present disclosure.

[0031] Figure 7 shows legs 320 extending from front case 210, through which screws  
20 290 attach to heat sink 110. Figures 8 and 9 show the components from the remaining angles to provide a fully 3 dimensional view of the LED system.

[0032] Figure 10 is a front perspective view of light assembly 100. Light assembly 100 includes projection lens 140 that places multiple optical projections lenses in series with  
25 one another. Projection lens 140 includes a series of protrusions 420. Protrusions 420 are semi-spherical in shape. Protrusions 420 are designed to be mounted over LEDs 160

such that each LED 160 is approximately centered within a protrusion 420. This arrangement maximizes the benefits of protrusions 420. In use, each protrusion 420 will focus the individual beams of light 440 from LEDs 160 to converge into a single beam of light which can illuminate a large area, much like a halogen light. The figures depict 10 LEDs, however, one skilled in the art will understand that a variable number of LEDs could be provided. In the depicted embodiment, optical lens 410 is made of acrylic, and is molded as a single piece containing multiple optical projection lenses in series. In the depicted embodiment, the LEDs are Luxeon star LEDs. A person having ordinary skill in the art will understand that other brands and types of LEDs could be substituted for Luxeon LEDs.

[0033] Turning next to Figure 11, a top plan view of light assembly 100 is shown. From this perspective, the effect of projection lens 140 on the beams of light from LEDs 160 can be seen. The shape of protrusions 420 causes the beams of light 440 from LEDs 160 to become more concentrated. The spacing and location of protrusions 420 on projection lens 140 causes the beams of light 440 to converge, providing illumination similar to that provided by a single halogen light. The exact spacing will depend on the size of projection lens 140 and the number of LEDs.

[0034] Figure 12 shows projection lens 140 without light assembly 100.

[0035] Figure 13 is a front plan view of projection lens 140. From this perspective, protrusions 420 are shown to have flattened edges 450 where two protrusions 420 meet. The flattened edges allow the protrusions 420 to be placed closer together. This is useful when it is desired to get the largest number of possible LEDs in a small space. Each protrusion 420 is shaped to focus its beam of light such that the beams of light converge.

[0036] Turning next to Figures 14 and 15, the beam pattern of projection lens 140 is described. Generally speaking, refraction is used to focus individual light rays to create a desired beam pattern. At the same time, the design of projection lens 140 allows a series



of LED lights to achieve a substantially singular focused light intensity of approximately 200,000 candelas, as demonstrated in Figure 16.

[0037] Protrusions 420 can comprise two types of lenses, either of which produces the effects described above. In a first embodiment, protrusions 420 comprise plano-convex  
5 lenses, wherein one side of the lens is curved and the other is flat. In the depicted embodiment, protrusion 420 is a solid semi-sphere wherein the side 430 nearest the light emitting diode 160 is flat and the opposite side 450 is curved. Stated differently, light travels from the flat side 430 of protrusion 420 to the curved side 450 of protrusion 420. The plano-convex lens converges or focuses collimated light travelling parallel to the lens  
10 axis and passing through the lens to a single focal point. The arrangement of the series of protrusions 420 described in the present application concentrates the light from each protrusion 420 to a single beam of light.

[0038] In a second embodiment, protrusions 420 take advantage of the theory of a Fresnel lens. Projection lens 140 is divided into a set of concentric annular sections  
15 known as "Fresnel zones". The outermost zone, marked as Z1 in Figure 15, has the thickest lens. The overall thickness of the lens decreases in each subsequent zone, until reaching the convex center, C, which is nearly flat. At its thickest point, projection lens 140 is about 0.63 inches thick. The design of projection lens 140 allows a substantial reduction in the overall thickness of projection lens 140, which in turn reduces the  
20 volume of material required to produce projection lens 140.

[0039] One skilled in the art will understand that while Fresnel lenses and plano-convex lenses have been discussed separately, it is possible to include protrusions 420 comprising both Fresnel lenses and plano-convex lenses in a single projection lens 140.

[0040] A lighting system according to the present application has several advantages  
25 over existing lighting systems. The depicted device replaces a halogen light bulb in a lighting system with a plurality of light emitting diodes, allowing the lighting system to

perform longer and undergo less part replacement. The present lighting system includes a projection lens which merges the beams of light from the plurality of light emitting diodes into a single beam of light. This single beam of light provides illumination equivalent to a halogen light. Further, the present lighting system houses the light emitting diodes in a compact, sealed housing assembly. Finally, the light assembly may include a tilt mechanism, providing the device with an ability to vertically tilt.

[0041] While a number of exemplary aspects and embodiments have been discussed above, those of skill in the art will recognize certain modifications, permutations, additions and sub-combinations therefore. It is therefore intended that the following appended claims hereinafter introduced are interpreted to include all such modifications, permutations, additions and sub-combinations are within their true spirit and scope. Each apparatus embodiment described herein has numerous equivalents.

[0042] The terms and expressions which have been employed are used as terms of description and not of limitation, and there is no intention in the use of such terms and expressions of excluding any equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed. Thus, it should be understood that although the present invention has been specifically disclosed by preferred embodiments and optional features, modification and variation of the concepts herein disclosed may be resorted to by those skilled in the art, and that such modifications and variations are considered to be within the scope of this invention as defined by the appended claims. Whenever a range is given in the specification, all intermediate ranges and subranges, as well as all individual values included in the ranges given are intended to be included in the disclosure. When a Markush group or other grouping is used herein, all individual members of the group and all combinations and subcombinations possible of the group are intended to be individually included in the disclosure.

[0043] In general the terms and phrases used herein have their art-recognized meaning, which can be found by reference to standard texts, journal references and contexts known to those skilled in the art. The above definitions are provided to clarify their specific use in the context of the invention.

5 [0044] All patents and publications mentioned in the specification are indicative of the levels of skill of those skilled in the art to which the invention pertains. All references cited herein are hereby incorporated by reference to the extent that there is no inconsistency with the disclosure of this specification. Some references provided herein are incorporated by reference herein to provide details concerning additional starting  
10 materials, additional methods of synthesis, additional methods of analysis and additional uses of the invention.

**I CLAIM:**

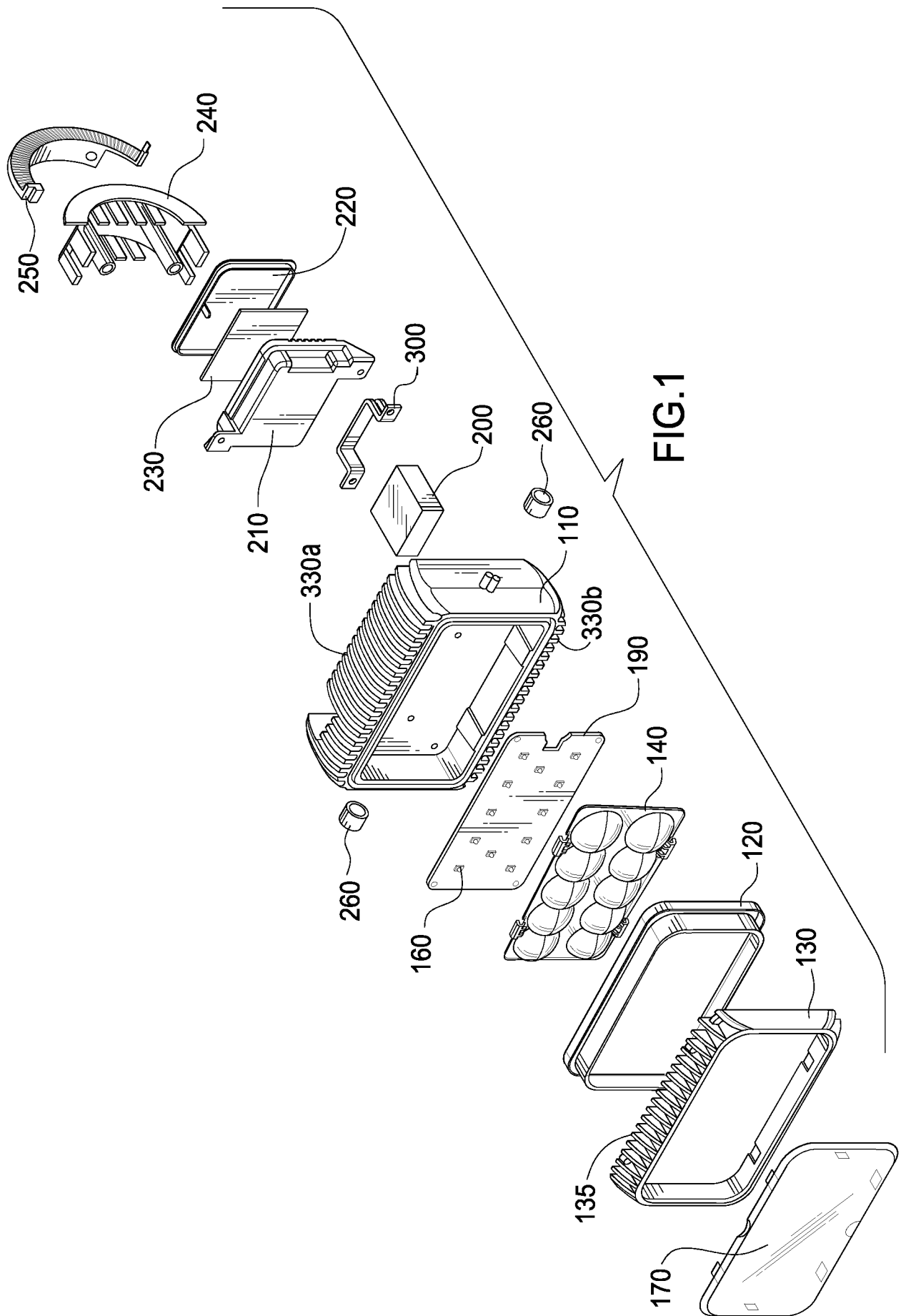
1. A light assembly comprising:
  - a heat sink;
  - said heat sink having a first side and a second side;
  - 5 a length of printed circuit board mounted to said first side of said heat sink;
  - at least one light emitting diode mounted to said printed circuit board;
  - a lens mount over said printed circuit board;
  - a bezel connecting said projection lens and said printed circuit board to said first
  - side of said heat sink;
  - 10 a case mounted to said second side of said heat sink; and
  - said case enclosing a driver.
2. The light assembly of claim 1, wherein the light assembly is sealed.
3. The light assembly of one of claims 1 or 2, further comprising a tilt gear mounted
- to said light assembly.
- 15 4. The light assembly of one of claims 1 to 3, further comprising a protective cover
- mounted between said bezel and said lens.
5. The light assembly of one of claims 1 to 4, further comprising an accessory lens
- mounted to said bezel.
6. The light assembly of claim 4, wherein said accessory lens is chosen from a group
- 20 comprising flood lens, colored lens and rock guard.
7. The light assembly of one of claims 1 to 6, further comprising a fan mounted to
- said heat sink.
8. The light assembly of one of claims 1 to 7, wherein said heat sink further
- comprises a base and a top; and
- 25 wherein said base of said heat sink includes cooling fins; and
- wherein said top of said heat sink includes cooling fins.
9. The light assembly of one of claims 1 to 8, wherein:
- said bezel comprises a base and a top; and

- wherein said top of said bezel includes cooling fins.
10. The light assembly of one of claims 1 to 9, wherein:  
wherein air enters at said base of said bezel, travels behind said heat sink, and  
exits at said top of said bezel, transferring heat away from said cooling fins.
- 5 11. The light assembly of one of claims 1 to 10, wherein said lens comprises:  
a plurality of protrusions;  
each protrusion having varying thickness;  
wherein the outermost edges of said protrusion have the thickest measurement;  
wherein the center of said protrusion has the thinnest measurement; and  
10 wherein said plurality of protrusions is adapted to merge individual beams of light  
into a single beam of light.
12. The light assembly of one of claims 1 to 10, wherein said lens comprises:  
a plurality of protrusions;  
each protrusion comprising a plano-convex lens;  
15 wherein said plurality of protrusions is adapted to merge individual beams of light  
into a single beam of light.
13. The light assembly of one of claims 11 or 12, wherein each protrusion is mounted  
over a light emitting diode.
14. The light assembly of one of claims 11 to 13, wherein each light emitting diode is  
20 approximately centered in each protrusion.
15. The light assembly of one of claims 12 to 14, wherein said plano-convex lens  
comprises a flat side and a curved side;  
and wherein light travels from said flat side to said curved side.
16. A lens comprising:  
25 a plurality of protrusions;  
each protrusion having varying thickness;  
wherein the outermost edges of said protrusion have the thickest measurement;  
wherein the center of said protrusion has the thinnest measurement; and

wherein said plurality of protrusions is adapted to merge individual beams of light into a single beam of light.

17. The lens of claim 16, wherein the protrusions are semi-circular.
18. The lens of one of claims 16 or 17, wherein at abutting borders of said protrusions  
5 are flattened.
19. A lens comprising:  
a plurality of protrusions;  
each protrusion comprising a plano-convex lens;  
wherein said plurality of protrusions is adapted to merge individual beams of light  
10 into a single beam of light.
20. The lens of claim 19, wherein the protrusions are semi-circular.
21. The lens of one of claims 19 or 20, wherein abutting borders of said protrusions  
are flattened.
22. A light system comprising:  
15 a housing means supporting a plurality of light emitting diodes;  
a lens means attached to said housing means over said plurality of light emitting  
diodes; and  
said lens means comprising a series of protrusions;  
wherein said plurality of protrusions is adapted to merge individual beams of light  
20 into a combined single beam of light.
23. The lens means of claim 22, wherein each protrusion has a varying thickness;  
wherein the outermost edges of said protrusion have the thickest measurement;  
and  
wherein the center of said protrusion has the thinnest measurement.
- 25 24. The lens means of one of claims 22 or 23, wherein each protrusion comprises a  
plano-convex lens.
25. The light system of one of claims 22 to 24, wherein each of said plurality of light  
emitting diodes is approximately centered in a protrusion.

26. The lens means of one of claims 22 to 25, wherein the protrusions are semi-circular.
27. The lens means of one of claims 22 to 26, wherein abutting borders of said protrusions are flattened.
- 5 28. The light assembly of one of claims 24 to 27, wherein said plano-convex lens comprises a flat side and a curved side; and wherein light travels from said flat side to said curved side.
29. The light assembly of one of claims 1 to 10 wherein the lens is the one of the lenses claimed in claims 16 to 18.
- 10 30. The light assembly of one of claims 1 to 10 wherein the lens is the one of the lenses claimed in claims 19 to 21.
31. The light system of claim 22 wherein said lens means is one of the lenses claimed in claims 16 to 18.
- 15 32. The light system of claim 22 wherein said lens means is one of the lenses claimed in claims 19 to 21.





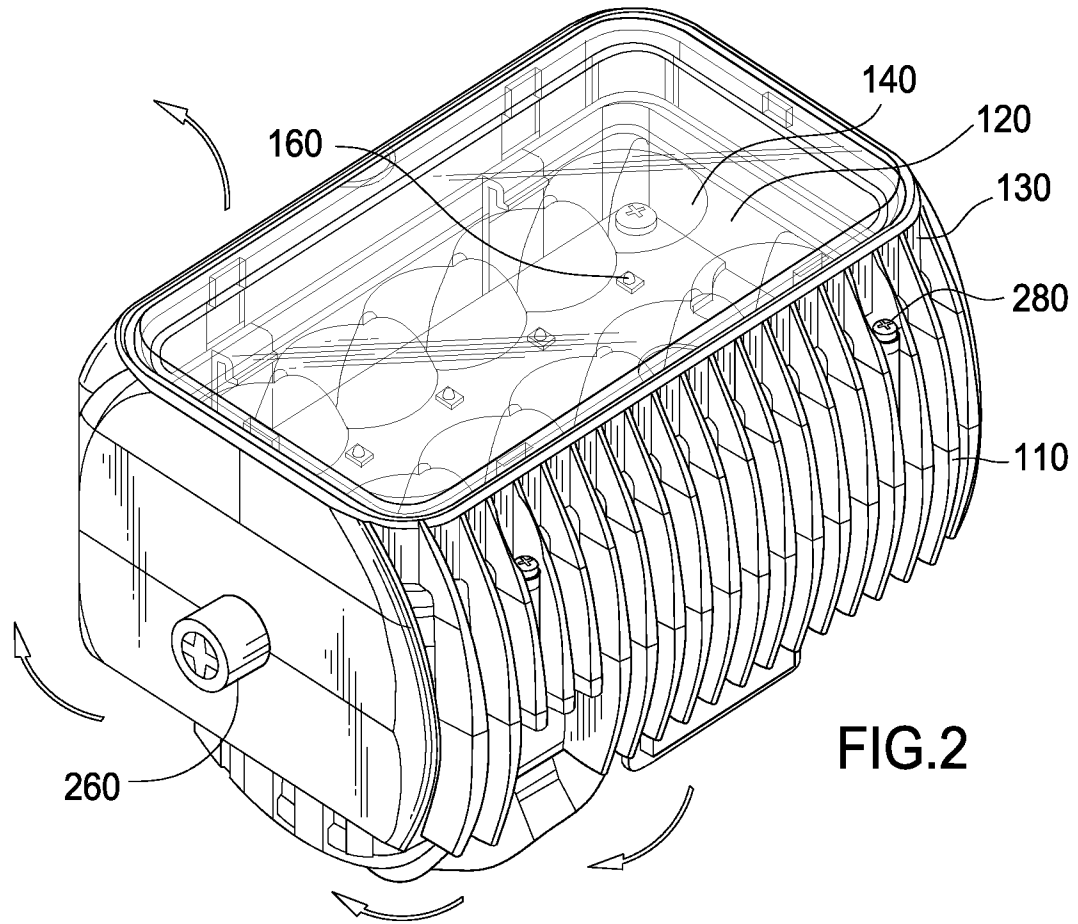


FIG. 2

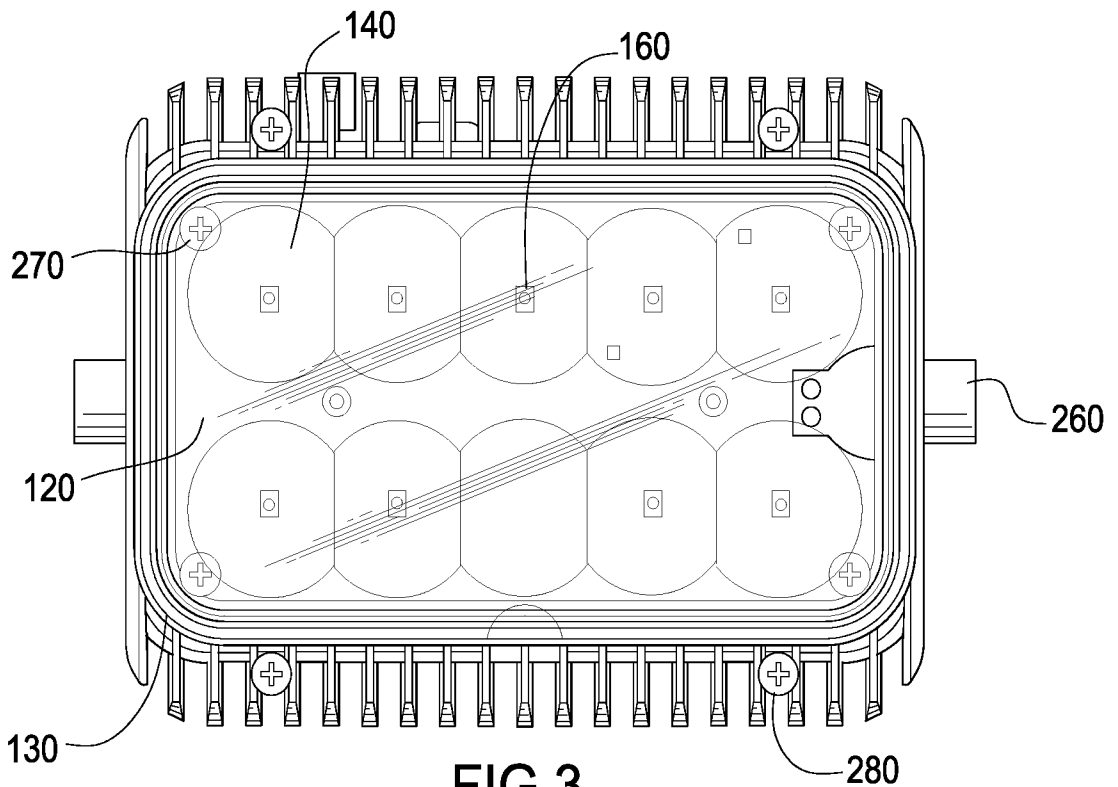


FIG. 3

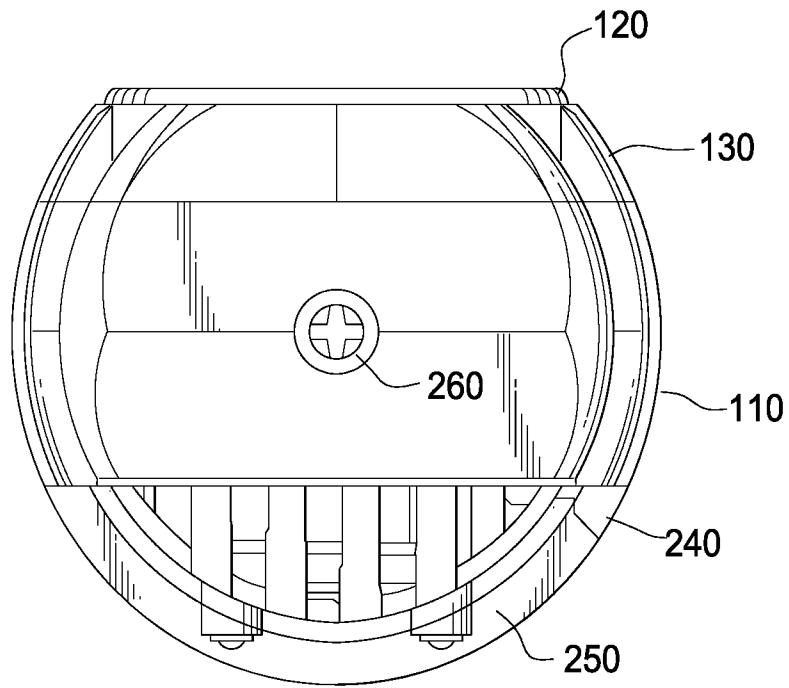


FIG. 4

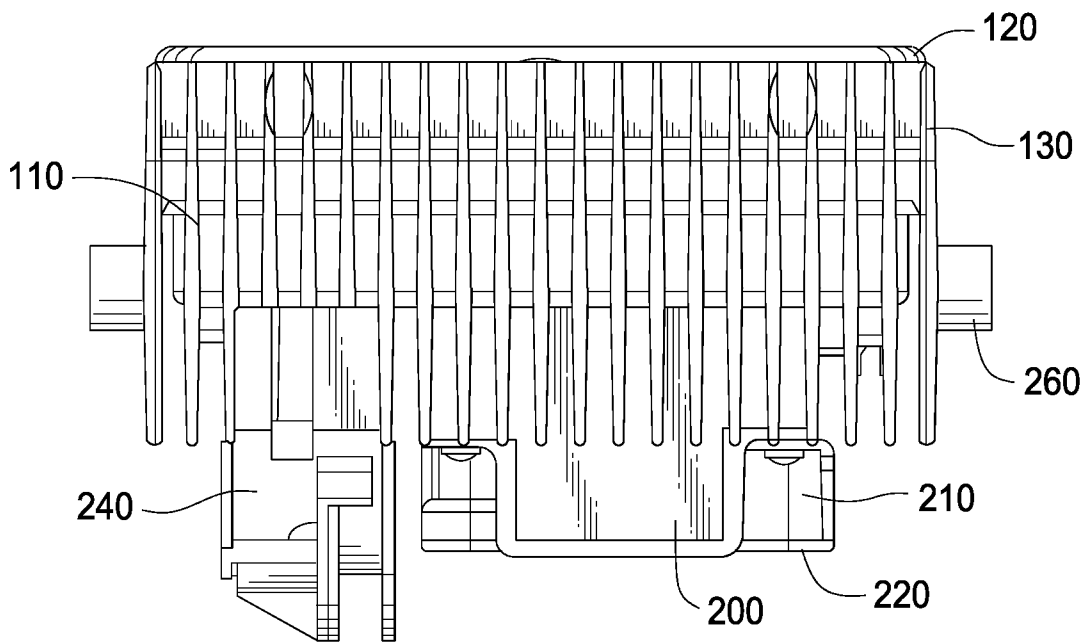
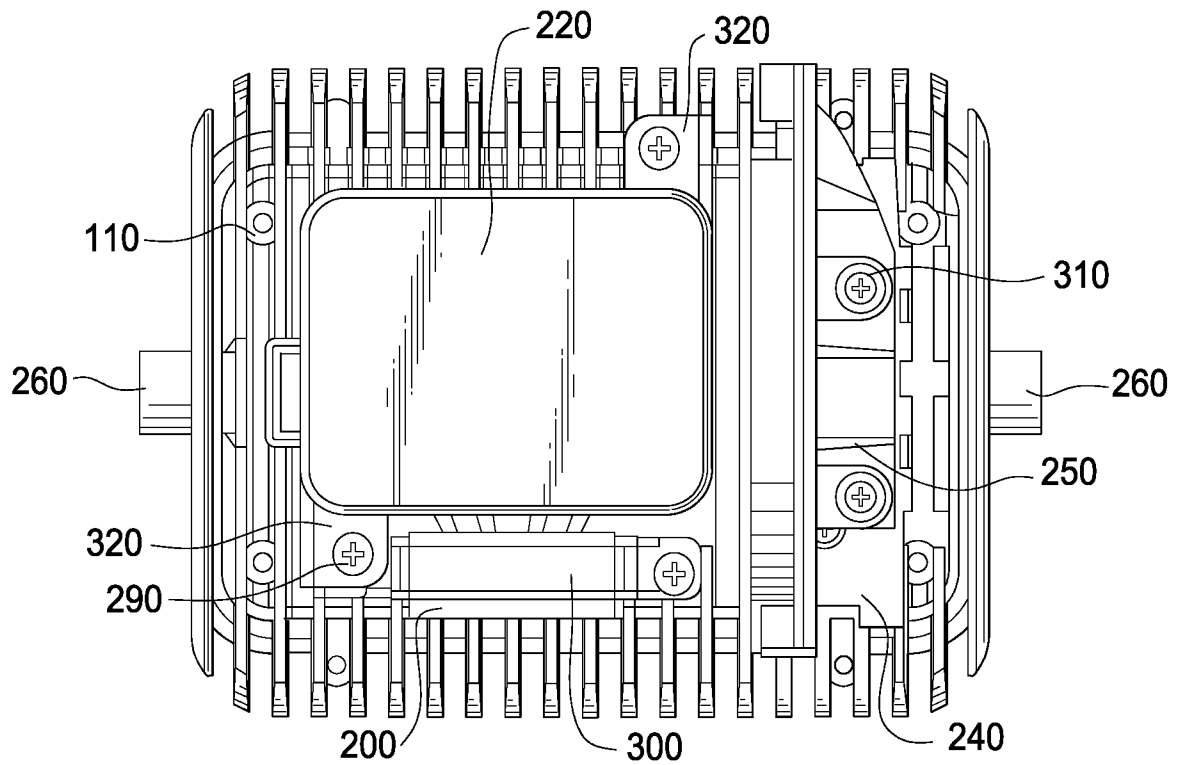
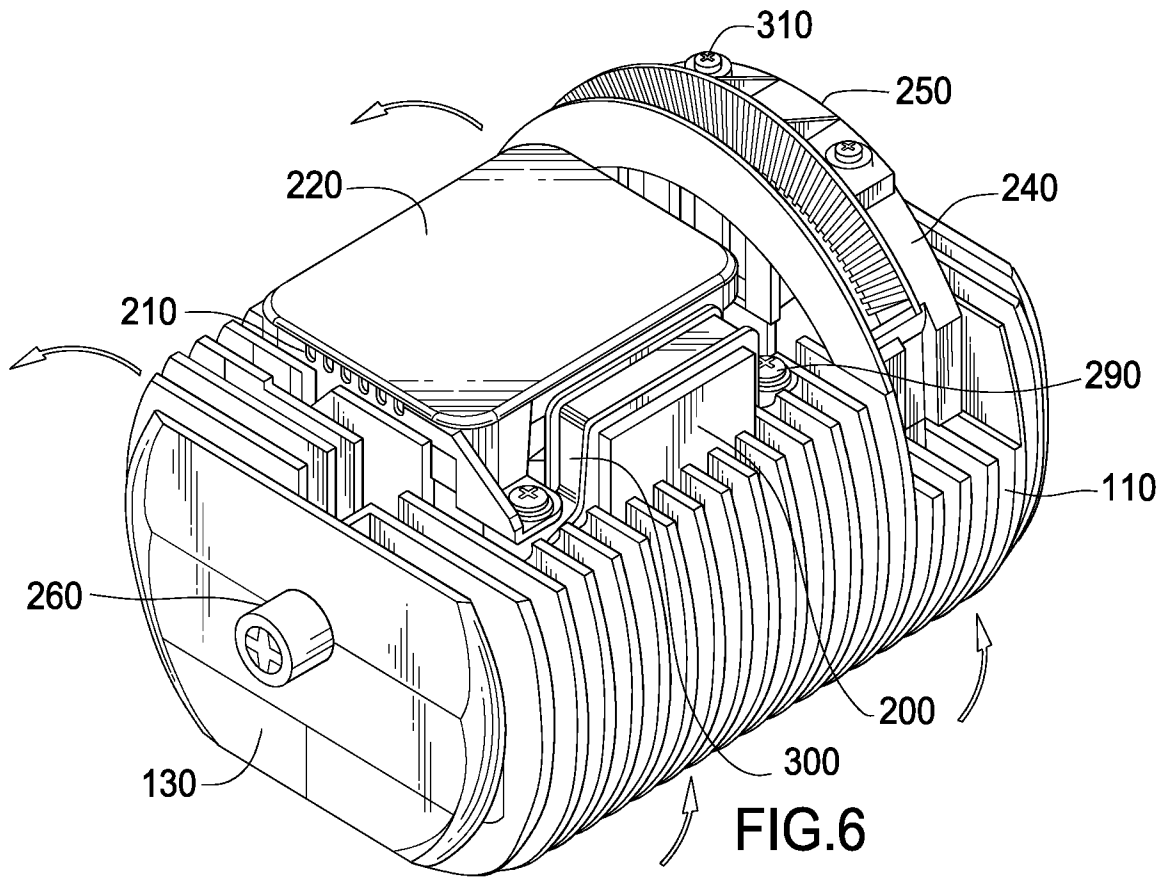


FIG. 5



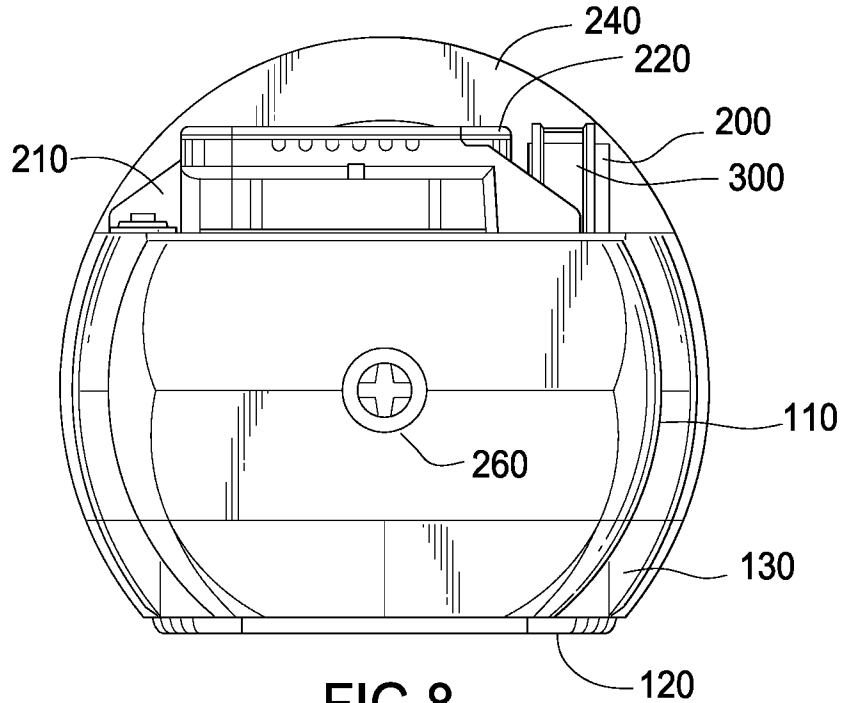


FIG. 8

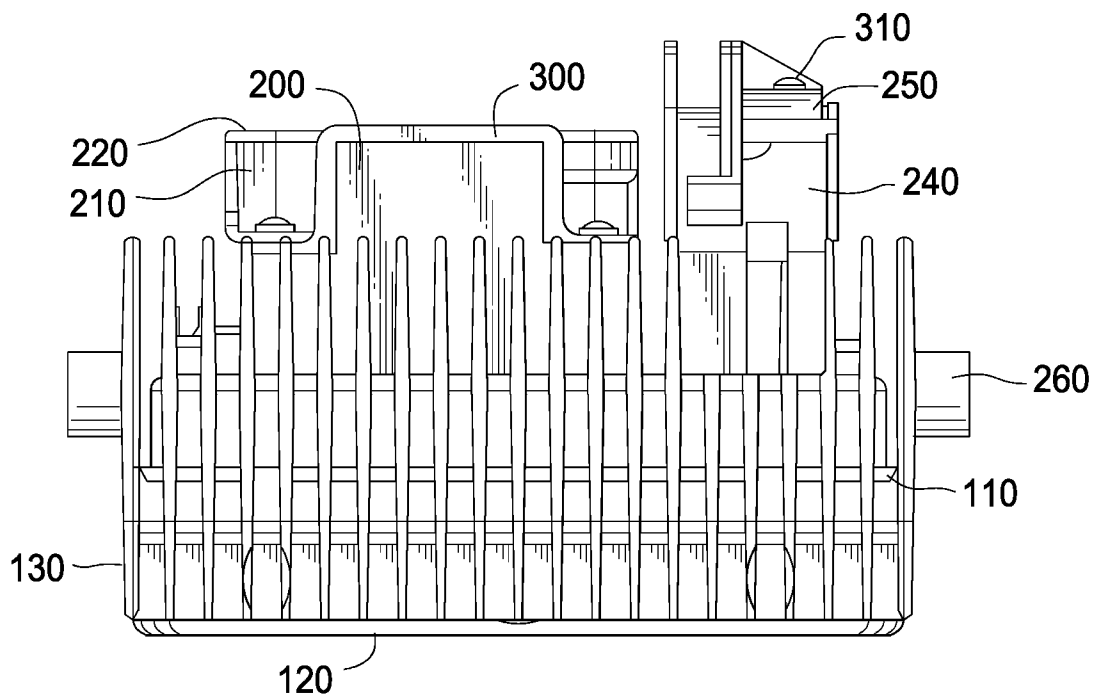


FIG. 9

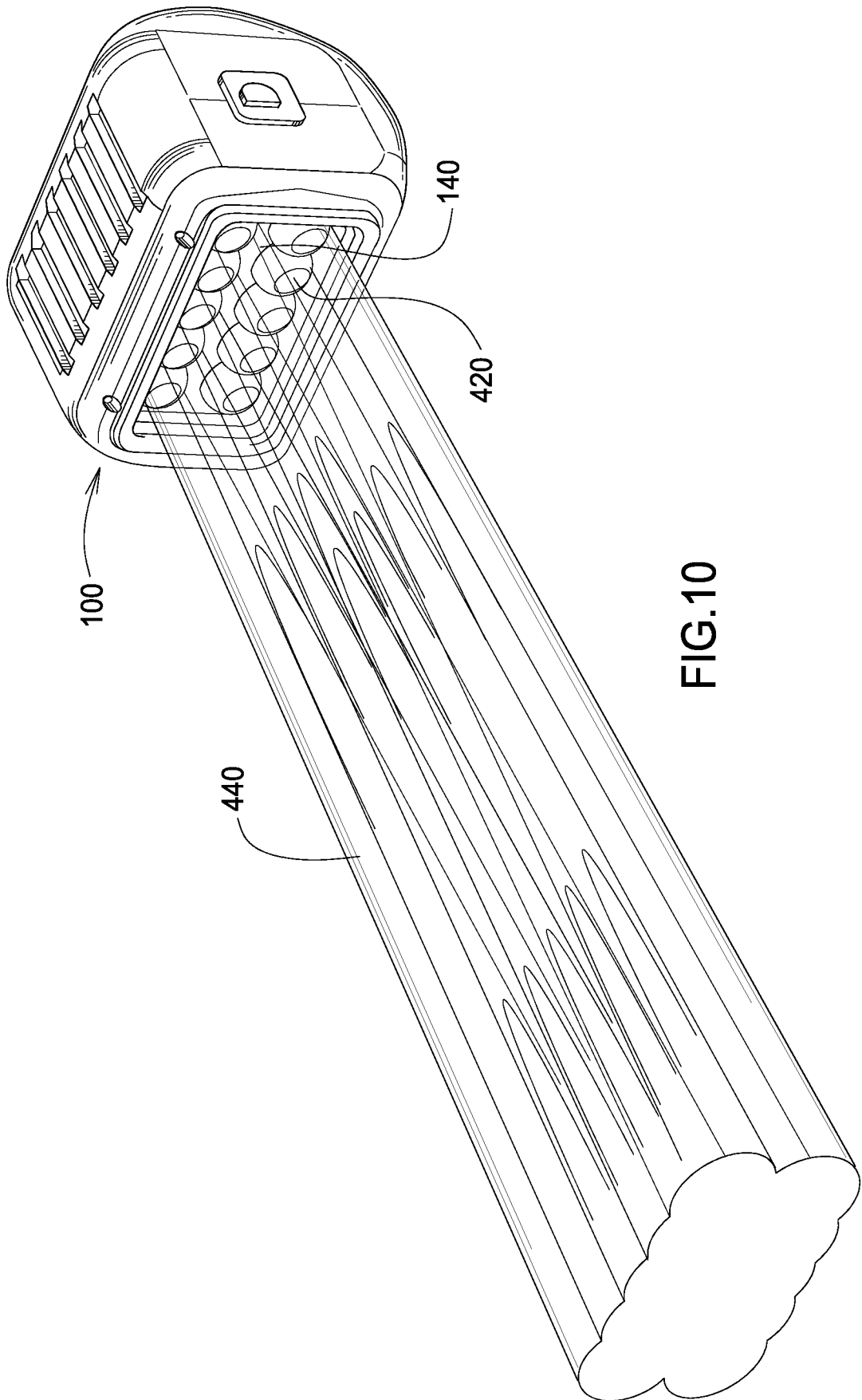


FIG.10

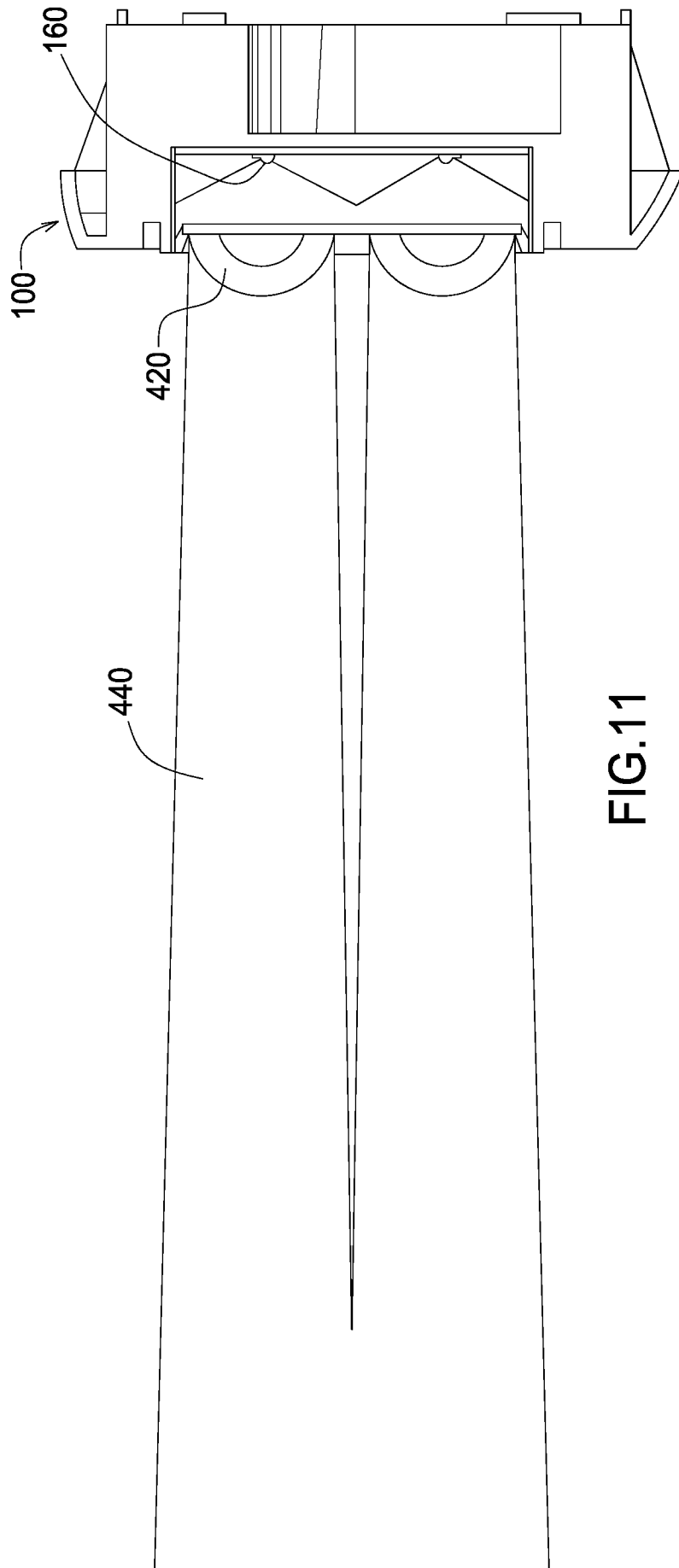
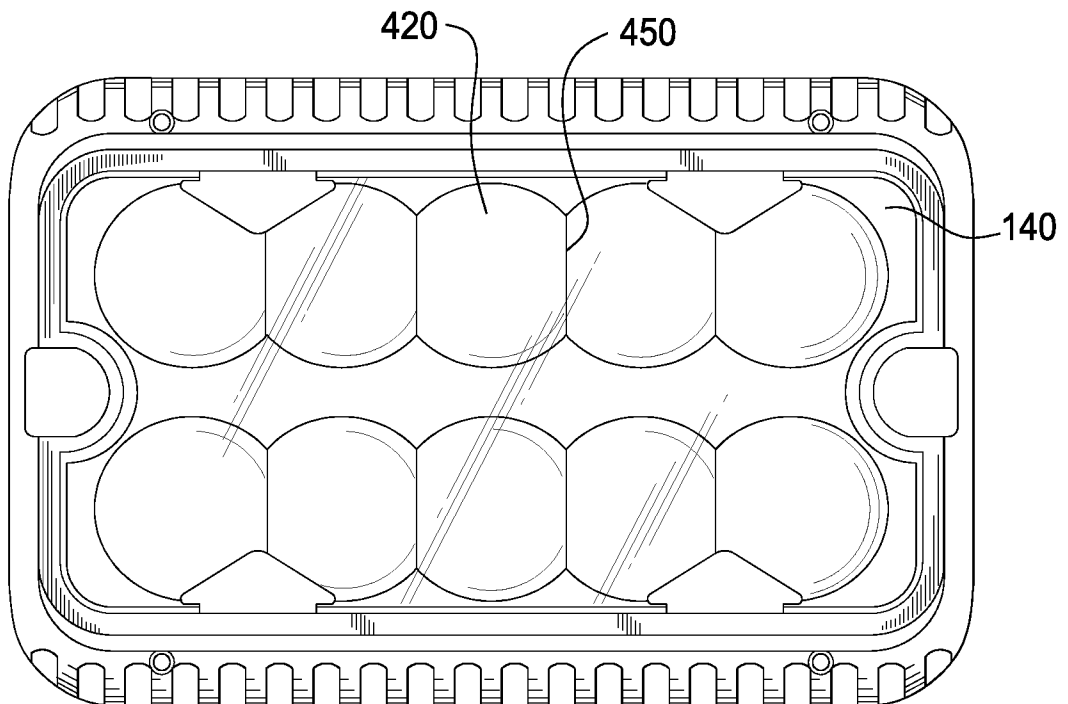
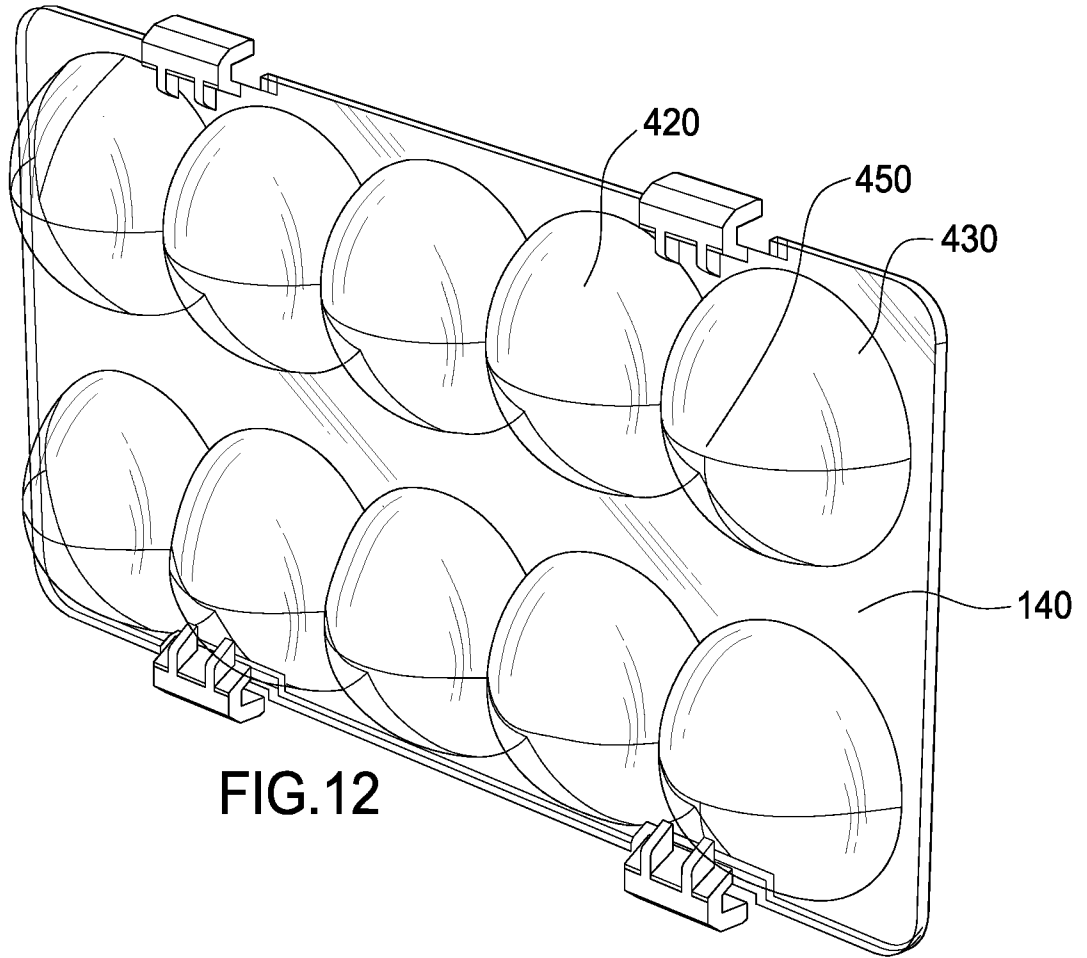
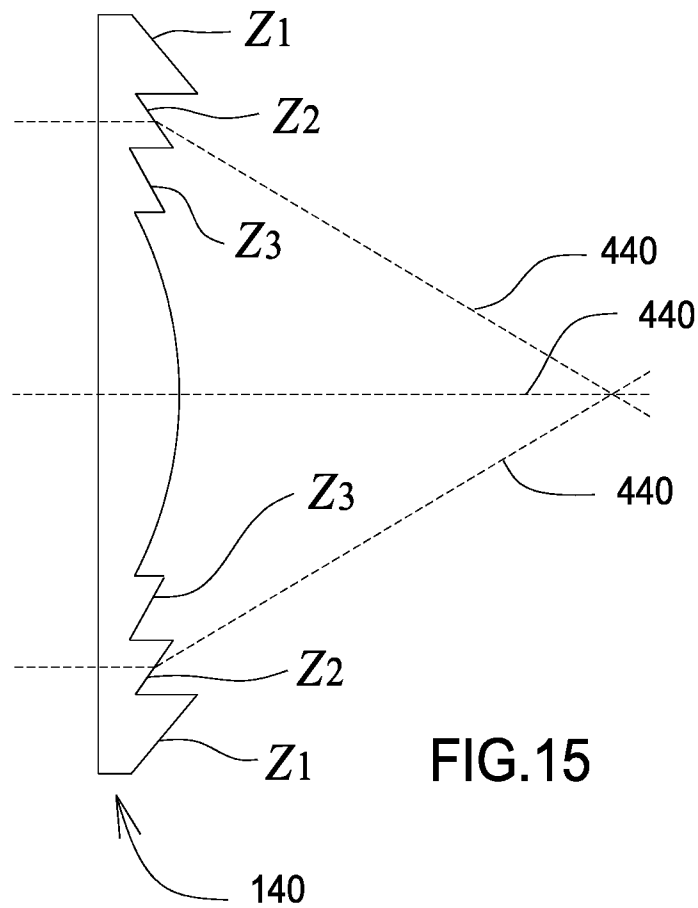
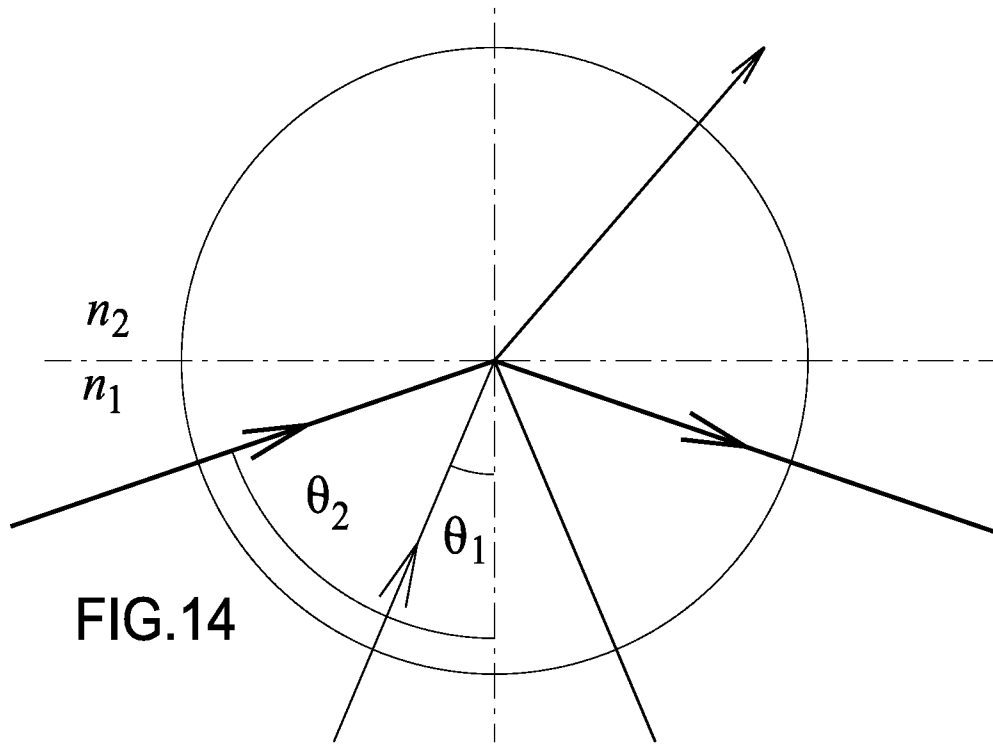


FIG.11







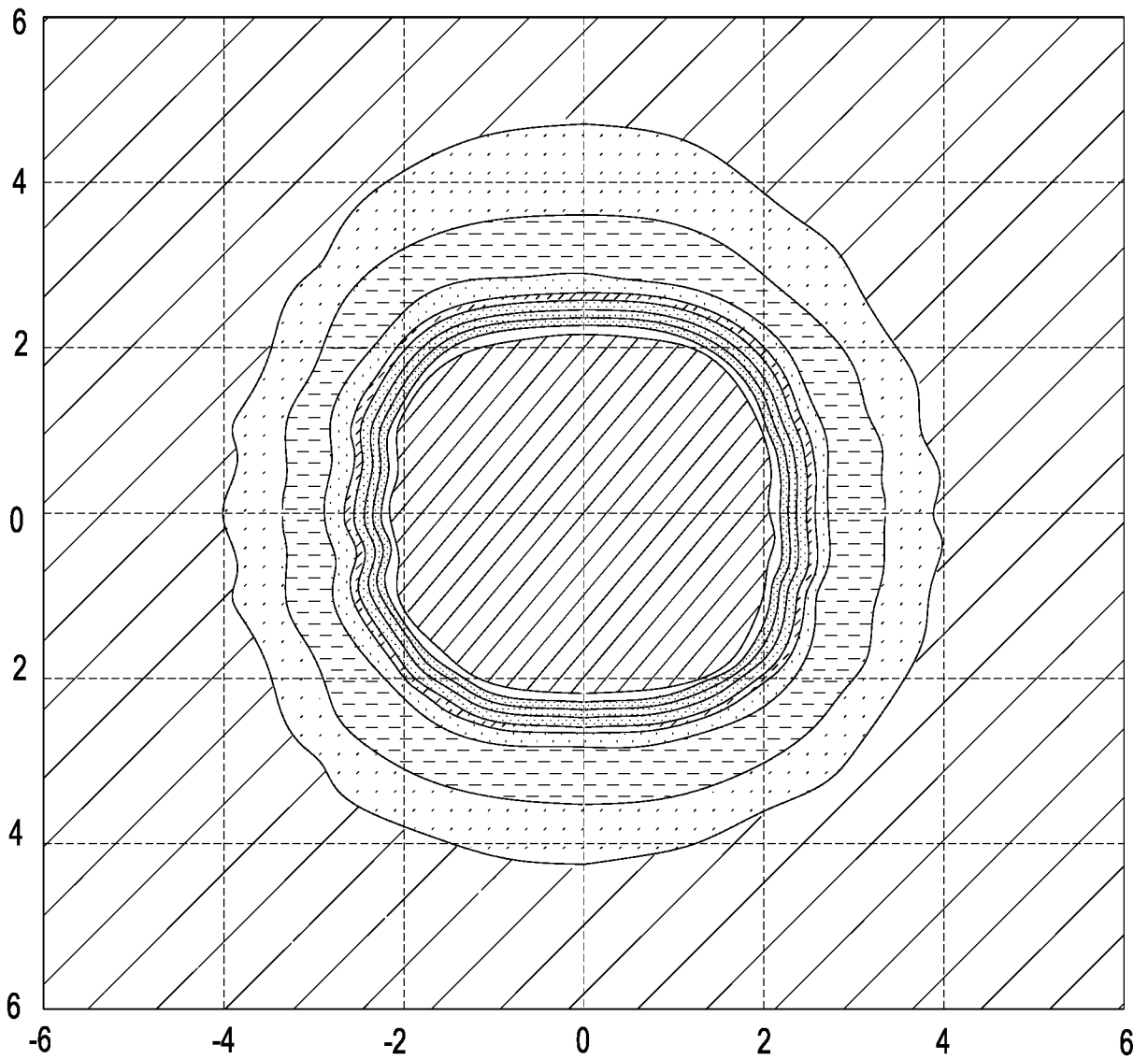


FIG.16