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MODULAR LIGHT DEVICES, SYSTEMS, AND METHODS

Abstract

Arc modular light devices, systems, and methods. In at least one exemplary embodiment of a module system of the present disclosure, the module system comprises a plurality of LED modules, each LED module comprising an outer housing, a light source positioned within the outer housing, and a lens positioned so that light from the light source can be emitted through the lens; and a plate configured to couple to each of the plurality of LED modules; wherein the module system is configured to focus light from the LED modules inward when the plate has a concave curvature; and wherein the module system is configured to spread light from the LED modules outward when the plate has a convex curvature.

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Background/Summary

PRIORITY [0001] This present application is related to, claims the priority benefit of, and is a U.S. continuation patent application of, U.S. Nonprovisional patent application Ser. No. 18/383,328, filed Oct. 24, 2023 and issued as U.S. Pat. No. 12,284,991 on Apr. 29, 2025, which is related to, claims the priority benefit of, and is a U.S. continuation patent application of, U.S. Nonprovisional patent application Ser. No. 17/517,611, filed Nov. 2, 2011 and issued as U.S. Pat. No. 11,793,176 on Oct. 24, 2023, which is related to, claims the priority benefit of, and is a U.S. continuation patent application of, U.S. Nonprovisional patent application Ser. No. 16/821,787, filed Mar. 17, 2020 and issued as U.S. Pat. No. 11,160,259 on Nov. 2, 2021, which is related to, claims the priority benefit of, and is a U.S. continuation patent application of, U.S. Nonprovisional patent application Ser. No. 16/365,440, filed Mar. 26, 2019 and issued as U.S. Pat. No. 10,591,149 on Mar. 17, 2020, which is related to, and claims the priority benefit of, U.S. Nonprovisional patent application Ser. No. 15/696,024, filed Sep. 5, 2017 and issued as U.S. Pat. No. 10,240,765 on Mar. 26, 2019, which a) is related to, and claims the priority benefit of, U.S. Provisional Patent Application Ser. No. 62/383,015, filed Sep. 2, 2016, and b) is related to, claims the priority benefit of, and is a U.S. continuation-in-part patent application of, U.S. Nonprovisional patent application Ser. No. 14/337,005, filed Jul. 21, 2014 and issued as U.S. Pat. No. 9,995,472 on Jun. 12, 2018, which is related to, and claims the priority benefit of, U.S. Provisional Application Ser. No. 61/858,460, filed Jul. 25, 2013. The contents of each of the foregoing patent applications are incorporated herein directly and by reference in their entirety.

TECHNICAL FIELD

[0002] Embodiments disclosed herein relate generally to light fixtures, and in particular to LED light fixtures.

BACKGROUND

[0003] Recent decades have seen an accelerating shift toward the use of light-emitting diodes (LEDs) in light fixtures. Compared to other forms of electrical light, such as fluorescent and incandescent lighting, LEDs are extremely energy efficient, reducing electrical bills and reducing the environmental impact of energy used for lighting. LEDs also have much longer useful lifespans than most other forms of electrical lighting, especially when compared to lighting suitable for indoor use. In the past LEDs also had certain disadvantages, such as the tendency to emit light in narrow ranges of wavelengths, often seeming monochromatic, and difficulty matching the luminous power of incandescent and fluorescent lights. As the use of LEDs has expanded, firms across the globe have raced to improve LEDs, shoring up many of their traditional weaknesses. LEDs that produce more lumens and LEDs that produce broader spectra of light have become increasingly ubiquitous and inexpensive. Nonetheless, where a high luminous output, a broad spectrum of wavelengths, or both are desired, LEDs still cannot match competing technologies. For instance, indoor horticulture using artificial light requires high-intensity light with a broad range of wavelengths as a substitute for the sunlight plants naturally crave. Currently available LED fixtures often fail to achieve those requirements, forcing indoor horticulturalists to select less energy-efficient options.

BRIEF SUMMARY

[0004] According to one aspect, a modular lighting fixture includes a housing having a front panel, the front panel having a radius of curvature, and a plurality of LED modules disposed adjacent the front panel. Each of the LED modules includes a heat sink, an LED source mounted to the heat sink, and a lens disposed over the LED source, the lens capable of refracting light emitted by the LED source into a desired distribution pattern. The plurality of LED modules produce a concentrated illuminated area at a pre-determined distance from the front panel as determined by the radius of curvature of the front panel. The heat sink of each LED module may have an internal volume defined by a closed end, a sidewall, and an open end, and the LED source may be mounted within the volume and positioned to emit light toward the open end.

[0005] In an additional aspect, the LED source of at least one of the plurality of LED modules further includes at least one light-emitting diode configured to emit red light, at least one light-emitting diode configured to emit orange light, and at least one light-emitting diode configured to emit blue light. In another aspect, the LED source of at least one of the plurality of LED modules further includes at least one light-emitting diode configured to emit red light, at least one light-emitting diode configured to emit green light, and at least one light-emitting diode configured to emit blue light. The LED source of at least one of the plurality of LED modules may also include at least one light-emitting diode configured to emit broad-spectrum white light. At least one of the plurality of LED modules may include a color mixing lens disposed between the LED source and collimating lens; the collimating lens may be a color-mixing lens. The lens may be removably attached to the heat sink, so that different lenses may be substituted within the LED module. The fixture includes four LED modules in one embodiment.

[0006] In an additional aspect, the fixture further includes at least one controller to regulate the voltage and current supplied to the LED sources in the plurality of LED modules. The at least one controller may be a controller incorporated in each LED module. The fixture may include a dimmer switch configured to permit the user to adjust the intensity of light emitted from at least one LED module. The fixture may also include at least one cooling fan positioned to force ambient air across the heat sinks of the plurality of LED modules; the at least one cooling fan may be a cooling fan incorporated in each LED module. The fixture may include a means of adjusting an angle of aim of

a specific LED module relative to the front panel.
[0007] In another aspect, a lighting fixture includes a plurality of modular units, each modular unit including a front panel, the front panel having a radius of curvature and a plurality of LED modules disposed within the housing adjacent the front panel. Each LED module comprises a heat sink, an LED source mounted to the heat sink, and a lens disposed over the LED source, the lens capable of refracting light emitted by the LED source into a desired distribution pattern, wherein the plurality of LED modules produce a concentrated illuminated area at a pre-determined distance from the front panel as determined by the radius of curvature of the front panel. The plurality of modular units may be removably attached to one another to form an array of LED modules. All of the modular units may be arranged to converge their respective emitted light distribution patterns around the same illuminated area. The fixture may also include a means of adjusting the position and attitude of one modular unit relative to another. Each modular unit may have a power interconnect enabling the plurality of modular units to be electrically connected.
[0008] Other aspects, embodiments and features of the light fixture will become apparent from the following detailed description when considered in conjunction with the accompanying figures. The accompanying figures are for schematic purposes and are not intended to be drawn to scale. In the figures, each identical or substantially similar component that is illustrated in various figures is represented by a single numeral or notation. For purposes of clarity, not every component is labeled in every figure. Nor is every component of each embodiment of the system and method shown where illustration is not necessary to allow those of ordinary skill in the art to understand the light fixture.
[0009] In at least one exemplary embodiment of a module system of the present disclosure, the module system comprises a plurality of LED modules, each LED module comprising an outer housing, a light source positioned within the outer housing, and a lens positioned so that light from the light source can be emitted through the lens; and a flexible plate configured to couple to each of the plurality of LED modules; wherein the module system is configured to focus light from the LED modules inward when the flexible plate is curved in a first direction; and wherein the module system is configured to spread light from the LED modules outward when the flexible plate is curved in a second direction opposite the first direction.
[0010] In at least one exemplary embodiment of a module system of the present disclosure, each of the plurality of LED modules and the flexible plate define fastener apertures therein, and wherein a plurality of fasteners can be positioned within the fastener apertures to secure each of the plurality of LED modules to the flexible plate. In at least one exemplary embodiment of a module system of the present disclosure, the flexible plate is configured to couple to a substrate, the substrate selected from the group consisting of a rigid beam, a vehicle, and a building.
[0011] In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a rigid beam coupled to the flexible plate, the rigid beam configured to attach to a vehicle or a building and further configured to retain the flexible plate while the flexible plate is in a straight configuration or a curved configuration.
[0012] In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a pusher comprising a pusher bar extending from a pusher base, the pusher configured to contact the flexible plate to cause the flexible plate to bend from a bent or straight configuration or to cause the flexible plate to straighten from a bent configuration.
[0013] In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a mechanism cradle coupled to the rigid beam and configured to receive the pusher. In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a rotary push plate configured to engage the pusher; a gear assembly configured to engage a worm shaft so to facilitate movement of the pusher; and an adjustment knob configured to engage the worm shaft so that turning the adjustment knob causes the work shaft to rotate, which causes the gear assembly to rotate, and which causes pusher

to move the flexible plate.
[0014] In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a controller for providing power to each of the plurality of LED modules to power the light source within each LED module.
[0015] In at least one exemplary embodiment of a module system of the present disclosure, the module system is configured so to permit an LED module of the plurality of LED modules to be removed and replaced with another LED module while the remaining LED modules of the plurality of LED modules are operable to emit light therefrom.
[0016] In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a motor in communication with the flexible plate, the motor powered by the controller; and a control module in communication with the motor; wherein operation of the motor, controlled using the control module, causes the flexible plate to bend from a bent or straight configuration or to cause the flexible plate to straighten from a bent configuration. In at least one exemplary embodiment of a module system of the present disclosure, the flexible plate can be manually or automatically curved or otherwise moved from a bent or straight configuration.
[0017] In at least one exemplary embodiment of a module system of the present disclosure, the module system comprises a plurality of LED modules, each LED module comprising an outer housing, a light source positioned within the outer housing, and a lens positioned so that light from the light source can be emitted through the lens; a flexible plate configured to couple to each of the plurality of LED modules; a rigid beam coupled to the flexible plate, the rigid beam configured to attach to a vehicle or a building and further configured to retain the flexible plate while the flexible plate is in a straight configuration or a curved configuration; and a controller for providing power to each of the plurality of LED modules to power the light source within each LED module; wherein the module system is configured to focus light from the LED modules inward when the flexible plate is curved in a first direction; and wherein the module system is configured to spread light from the LED modules outward when the flexible plate is curved in a second direction opposite the first direction.
[0018] In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a pusher comprising a pusher bar extending from a pusher base, the pusher configured to contact the flexible plate to cause the flexible plate to bend from a bent or straight configuration or to cause the flexible plate to straighten from a bent configuration; and a mechanism cradle coupled to the rigid beam and configured to receive the pusher.
[0019] In at least one exemplary embodiment of a module system of the present disclosure, the module system is configured so to permit an LED module of the plurality of LED modules to be removed and replaced with another LED module while the remaining LED modules of the plurality of LED modules are operable to emit light therefrom.
[0020] In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a motor in communication with the flexible plate, the motor powered by the controller; and a control module in communication with the motor; wherein operation of the motor, controlled using the control module, causes the flexible plate to bend from a bent or straight configuration or to cause the flexible plate to straighten from a bent configuration.
[0021] In at least one exemplary embodiment of a module system of the present disclosure, the module system further comprises a remote configured to communicate with the control module and further configured to control operation of the control module. In at least one exemplary embodiment of a module system of the present disclosure, the flexible plate can be manually or automatically curved or otherwise moved from a bent or straight configuration. In at least one exemplary embodiment of a module system of the present disclosure, each of the plurality of LED modules and the flexible plate define fastener apertures therein, and wherein a plurality of fasteners can be positioned within the fastener apertures to secure each of the plurality of LED modules to

the flexible plate. In at least one exemplary embodiment of a module system of the present disclosure, each of the plurality of LED modules are waterproof.
[0022] In at least one exemplary embodiment of a kit of the present disclosure, the kit comprises a plurality of LED modules, each LED module comprising an outer housing, a light source positioned within the outer housing, and a lens positioned so that light from the light source can be emitted through the lens; a flexible plate configured to couple to each of the plurality of LED modules; a rigid beam configured to couple to the flexible plate, the rigid beam configured to attach to a vehicle or a building and further configured to retain the flexible plate while the flexible plate is in a straight configuration or a curved configuration; and a controller for providing power to each of the plurality of LED modules to power the light source within each LED module.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0023] The disclosed embodiments and other features, advantages, and disclosures contained herein, and the matter of attaining them, will become apparent and the present disclosure will be better understood by reference to the following description of various exemplary embodiments of the present disclosure taken in conjunction with the accompanying drawings, wherein:
[0024] FIG. **1** shows an isometric view of an embodiment of an arc modular LED light fixture according to the present disclosure;
[0025] FIG. **2** shows a cut-away plan view of an embodiment of an arc modular LED light fixture according to the present disclosure.
[0026] FIG. **3** shows a cross-sectional plan view taken at a plane **3**-**3** of the embodiment of the ark modular LED light fixture of FIG. **4**;
[0027] FIG. **4** shows a cross-sectional front view taken at plane **4**-**4** of the embodiment of the arc modular LED light fixture of FIG. **2**;
[0028] FIG. **5** shows a front wireframe view of an embodiment of an arc modular LED light fixture according to the present disclosure;
[0029] FIG. **6** shows an isometric view of an embodiment of an arc modular LED light fixture according to the present disclosure;
[0030] FIG. **7** shows an isometric view of an embodiment of an arc modular LED light fixture according to the present disclosure;
[0031] FIG. **8**A shows a perspective view of an embodiment of an LED module, according to the present disclosure;
[0032] FIG. **8**B shows a top view of an embodiment of an LED module, according to the present disclosure;
[0033] FIG. **8**C shows a side view of an embodiment of an LED module, according to the present disclosure;
[0034] FIG. **8**D shows a front view of an embodiment of an LED module, according to the present disclosure;
[0035] FIG. **9**A shows a front perspective view of an embodiment of a module system, according to the present disclosure;
[0036] FIG. **9**B shows a rear perspective view of an embodiment of a module system, according to the present disclosure;
[0037] FIG. **10**A shows a perspective view of an embodiment of a flexible plate, according to the present disclosure;
[0038] FIG. **10**B shows a top view of an embodiment of a flexible plate, according to the present disclosure;
[0039] FIG. **10**C shows a side view of an embodiment of a flexible plate, according to the present

disclosure;
[0040] FIG. **10**D shows a front view of an embodiment of a flexible plate, according to the present disclosure;
[0041] FIG. **11**A shows a perspective view of an embodiment of a rigid beam, according to the present disclosure;
[0042] FIG. **11**B shows a front view of an embodiment of a rigid beam, according to the present disclosure;
[0043] FIG. **11**C shows a side view of an embodiment of a rigid beam, according to the present disclosure;
[0044] FIG. **11**D shows a top view of an embodiment of a rigid beam, according to the present disclosure;
[0045] FIG. **11**E shows a perspective view of an embodiment of a rigid beam having end pins welded thereto, according to the present disclosure;
[0046] FIG. **12**A shows a perspective view of an embodiment of an end pin, according to the present disclosure;
[0047] FIG. **12**B shows a side view of an embodiment of an end pin, according to the present disclosure;
[0048] FIG. **13**A shows a perspective view of an embodiment of a pusher, according to the present disclosure;
[0049] FIG. **13**B shows a front view of an embodiment of a pusher, according to the present disclosure;
[0050] FIG. **13**C shows a side view of an embodiment of a pusher, according to the present disclosure;
[0051] FIG. **13**D shows a bottom view of an embodiment of a pusher, according to the present disclosure;
[0052] FIG. **14**A shows a perspective view of an embodiment of a mechanism cradle, according to the present disclosure;
[0053] FIG. **14**B shows a bottom view of an embodiment of a mechanism cradle, according to the present disclosure;
[0054] FIG. **14**C shows a front view of an embodiment of a mechanism cradle, according to the present disclosure;
[0055] FIG. **14**D shows a side view of an embodiment of a mechanism cradle, according to the present disclosure;
[0056] FIG. **15**A shows a perspective view of a rotary push plate, according to the present disclosure;
[0057] FIG. **15**B shows a pack view of a rotary push plate, according to the present disclosure;
[0058] FIG. **15**C shows a horizontal side view of a rotary push plate, and FIG. **15**D shows a vertical side view of a rotary push plate, according to the present disclosure;
[0059] FIGS. **16**A and **16**B show perspective views of pushers, according to the present disclosure;
[0060] FIG. **17**A shows a perspective view of a gear assembly, according to the present disclosure;
[0061] FIG. **17**B shows a side view of a gear assembly, according to the present disclosure;
[0062] FIG. **17**C shows a top view of a gear assembly, according to the present disclosure;
[0063] FIG. **17**D shows a bottom view of a gear assembly, according to the present disclosure;
[0064] FIG. **18**A shows a perspective view of a worm shaft, according to the present disclosure;
[0065] FIG. **18**B shows a front view of a worm shaft, according to the present disclosure;
[0066] FIGS. **18**C and **18**D show side views of a worm shaft, according to the present disclosure;
[0067] FIG. **19**A shows a perspective view of an adjustment knob, according to the present disclosure;
[0068] FIG. **19**B shows a front view of an adjustment knob, according to the present disclosure;
[0069] FIG. **19**C shows a side view of an adjustment knob, according to the present disclosure;

[0070] FIG. **20**A shows a perspective view of a portion of a rigid beam in the process of having a mechanism cradle **1400** fastened thereto, according to the present disclosure;
[0071] FIG. **20**B shows a perspective view of portions of a module system whereby mechanism cradle is fastened to rigid beam, according to the present disclosure;
[0072] FIG. **21**A shows a gear assembly being installed into module system, according to the present disclosure;
[0073] FIG. **21**B shows a gear assembly installed into module system, according to the present disclosure;
[0074] FIG. **21**C shows portions of a gear assembly, according to the present disclosure;
[0075] FIG. **22**A shows a worm shaft retainer being installed into a module system, according to the present disclosure;
[0076] FIG. **22**B shows an adjuster support and portions of a module system shown in a perspective view, according to the present disclosure;
[0077] FIG. **23**A shows an adjuster support being installed into a module system, according to the present disclosure;
[0078] FIG. **23**B shows a flexible plate connected to a rigid beam, according to the present disclosure;
[0079] FIG. **24**A shows LED modules being coupled to a flexible plate, according to the present disclosure;
[0080] FIG. **24**B shows a pusher being installed as part of a module system, according to the present disclosure;
[0081] FIGS. **25**A and **25**B show pushers installed as parts of module systems, according to the present disclosure;
[0082] FIG. **26**A shows an adjustment knob in the process of being fastened to a worm shaft, according to the present disclosure;
[0083] FIG. **26**B shows a rear portion of a module system having an adjustment knob coupled thereto, according to the present disclosure; and
[0084] FIG. **27** shows a block component diagram of components of a module system, according to the present disclosure.
[0085] An overview of the features, functions and/or configurations of the components depicted in the various figures will now be presented. It should be appreciated that not all of the features of the components of the figures are necessarily described. Some of these non-discussed features, such as various couplers, etc., as well as discussed features are inherent from the figures themselves. Other non-discussed features may be inherent in component geometry and/or configuration.

DETAILED DESCRIPTION

[0086] The present application discloses various embodiments of an arc-shaped modular light emitting diode (“LED”) light fixture and methods for using and constructing the same. According to one aspect of the present disclosure, an arc modular fixture array having a plurality of LED modules, suitable for horticulture, aquaculture, and general area light is disclosed. For the purposes of promoting an understanding of the principles of the present disclosure, reference will now be made to the embodiments illustrated in the drawings, and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of this disclosure is thereby intended.
[0087] FIG. **1** shows an arc modular LED light fixture **100** according to at least one embodiment of the present disclosure. As shown in FIG. **1**, the fixture **100** may include a housing **10** having a back panel **14** and a front panel **12** joined together by one or more side panels **16**. The front panel **12** may have a curved or arced shape in profile that defines a substantially uniform radius of curvature between the side panels **16**. The back panel **14** may be similarly arced in profile, though the radius of the back panel **14** need not be identical to the radius of the front panel **12**. In some embodiments, the back panel **14** may be substantially flat. The housing **10** may include one or more vents **18**

formed therethrough to enable the flow of ambient air into, through, and out of the housing **10**.
[0088] FIG. **2** shows a cut-away plan view of the fixture according to the present disclosure. As shown in FIG. **2**, the fixture **100** may include a plurality of LED modules **20** disposed within the housing **10** and mounted adjacent the front panel **12**. Each LED module **20** is capable of generating or emitting a pre-determined light distribution pattern as described further herein. The plurality of LED modules **20** may be disposed adjacent the front panel **12** such that each LED module **20** is aimed or directed toward the same central point **30** of the radius of curvature of the front panel **12**. In such an embodiment, the plurality of LED modules **20** may be arranged to converge their respective emitted light distribution patterns around the same center point **30**, thereby generating a single, fully convergent distribution pattern with an intensity proportional to the number of individual LED modules **20**. By generating a fully convergent distribution pattern, the fixture **100** enables a uniform illuminated area without lighting areas outside the intended area, which would result in inefficiencies.
[0089] As shown in FIG. **3**, each LED module **20** may include a heat sink **24** having an internal volume **40** defined by a closed end **42**, a sidewall **43**, and an open end **44**. The heat sink **24** may further include a plurality of cooling fins **46** extending from the sidewall **43**. In at least one embodiment, the internal volume **40** may be generally cylindrically shaped, and the cooling fins **46** may extend radially outward from the volume **40**.
[0090] Each LED module **20** may further include an LED source **22** disposed within the internal volume **40** adjacent the closed end **42** of the heat sink **24**. The LED source **22** may be a single light emitting diode or an array of multiple light emitting diodes depending upon the desired characteristics of the emitted light. As a non-limiting example, in at least one embodiment, the LED light source **22** may include at least three light-emitting diodes, at least one configured to emit red light at wavelengths between 610 and 760 nanometers (nm), at least one configured to emit orange light at wavelengths between 590 and 610 nm, and at least one configured to emit the blue light at wavelengths between 450 and 500 nm. In an alternative embodiment, the LED source **22** may include at least three light emitting diodes, at least one configured to emit red light at wavelengths between 610 and 760 nm, at least one configured to emit green light at wavelengths between 500 and 570 nm, and at least one configured to emit blue light at wavelengths between 450 and 500 nm. In yet another embodiment, the LED source **22** may include one light emitting diode configured to emit broad-spectrum white light.
[0091] The desired character of the light distribution produced by the fixture **100** may depend upon the intended use. For example, an aquarium flora grower may want a light distribution comprised mostly of broad-spectrum white light with some blue light and a very small amount of red light. Accordingly, different LED sources **22** may be selected for the LED modules **20** depending on the aesthetic or performance goals of the end user. Further, the power consumption of the LED source **22** may be selected to produce a pre-determined intensity of emitted light.
[0092] The LED source **22** may be positioned such that light emitted therefrom is emitted toward the open end **44** of the heat sink **24** where it falls incident upon a lens **26** disposed adjacent the open end **44**. In at least one embodiment, the lens **26** may be a collimating lens that narrows the distribution of light emitted by the LED source **22** to align the emitted light rays in a more specific direction. Thus, the lens **26** enables the LED module **20** to emit a concentrated distribution of light aimed or directed toward an arca about a central point **30** of the radius of curvature of the front panel **12**. In at least one embodiment, the lens **26** may be a positive or converging lens that focuses the distribution of light emitted by the LED source **22** to direct the emitted light rays to a specific point. Further, the lens **26** may be selected to provide a desired concentration of the emitted light. For example, the lens **26** may be a 90° lens, which will result in an illuminated area approximately **36** inches (in.) in diameter at a distance of **18** in. from the fixture **100**. Alternatively, the lens **26** may be a 60°, 45°, 15°, or any desired concentration angle selected to produce the desired illuminated area at a desired distance. Thus, the lens **26** enables the LED module **20** to emit the

desired concentrated distribution of light aimed or directed toward the central point **30** of the radius of curvature of the front panel **12**.

[0093] The LED module **20** may further include a color-mixing lens **27** disposed between the LED source **22** and the lens **26** to enable the LED module **20** to emit a uniform desired color of light. The lens **26** may be removably attached to the heat sink **24** using a retainer **28**, which enables the substitution of different lenses **26** within a given fixture **100**. In some embodiments, the lens **26** may enable color mixing such that a separate lens **27** is not needed.

[0094] By disposing multiple LED modules **20** along the arc of the front panel **12**, the fixture **100** may generate a concentrated field of light around the center point **30**. In at least one embodiment of the present disclosure as shown in FIGS. **2-5**, the fixture **100** may include four LED modules **20**, each positioned along the arc of the front panel **12** and aimed at the same center point **30**. For example, the fixture **100** may be configured to produce an illuminated area **36** in. in diameter at a distance of **18** in. from the fixture **100**.

[0095] Multiple fixtures **100** may be combined to produce a wider and/or more intense illuminated area. As shown in FIG. **6**, two fixtures **100** may be positioned adjacent one another to form the fixture **200**, having two rows of LED modules **20** arranged along parallel arcs determined by the radius of curvature of the respective front panels **12** of the individual modular fixtures **100**. In the fixture **200**, the modular fixtures **100** may be arranged to converge their respective emitted light distribution patterns around the same center point **30**, thereby generating a single, fully convergent distribution pattern of increased intensity. As shown in FIG. **7**, multiple modular fixtures **100** may be positioned adjacent one another to form the fixture **300**, having multiple rows of LED modules **20** arranged along parallel arcs to form an array of LED modules **20**. Similar to the fixture **200**, the modular fixtures **100** of the fixture **300** may be arranged to converge their respective emitted light distribution patterns around the same center point **30**, thereby generating a single, fully convergent distribution pattern of increased intensity. Consequently, any number of modular fixtures **100** may be arranged to converge their respective emitted light distribution patterns around the same center point **30**, thereby generating a single, fully convergent distribution pattern of increased intensity. Alternatively the modular fixtures **100** of the fixture **200** or the fixture **300** may be arranged to generate a wider resultant distribution pattern of substantially uniform intensity.

[0096] In the fixture **200** and the fixture **300**, the modular fixtures **100** may be removably attached to one another by any suitable means. In at least one embodiment, the modular fixtures **100** may be attached to one another by magnets. Alternatively, the modular fixtures **100** may be attached to one another by fasteners, including but not limited to screws or clips. The means of attachment may further enable the modular fixtures **100** to be adjusted relative to one another such that the resultant distribution pattern may be adjusted. In at least one embodiment, the modular fixtures **100** may be attached to one another or removed from one another without having to open any part of the exterior body of the modular fixtures. In at least one embodiment, a dowel pin links the exterior body of a modular fixture with the exterior body of one or more other modular fixtures by weaving through a hole or plurality of holes through housing **10**, enabling the modular fixtures to affix to each other.

[0097] The retainer **28** of the LED module **20** may be adjustable such that the angel of aim of an individual LED module **20** within the fixture **200** or the fixture **300** may be adjusted relative to the radius of curvature of the front panel **12** and to other LED modules **20** with the fixture **200**, **300**. Accordingly, the illuminated area produced by the fixture **200** or the fixture **300** may be adjusted—either narrowed or widened—as desired by adjusting the aim of individual LED modules **20** within a given fixture **200**, **300**. Alternatively, the means of attaching the modular fixtures **100** to one another within the fixture **200** or fixture **300** may be adjustable such that one fixture **100** may be aimed independent of an adjacent fixture **100**, thereby either narrowing or widening the illuminated area produced by a given fixture **200**, **300** as desired. The angle of aim of an individual LED module **20** may be adjusted by other adjusting means besides the retainer **28**.

[0098] Referring now to FIG. **2**, the fixture **100** may further include a cooling fan **52** and a fan driver disposed within the housing **10**. In at least one embodiment, the cooling fan **52** is disposed adjacent the back panel **14** at or near a vent **18**. The cooling fan **52** may increase the transfer of heat from the LED modules **20** by forcing ambient air across the heat sink **24**, including cooling fins **44**, by drawing ambient air into, through, and out of the housing **10** via the vents **18**.
[0099] The fixture **100** may further include one or more controllers **50** disposed within the housing **10** to provide electrical power to the LED modules **20**. In at least one embodiment, each controller **50** may be electrically connected to a corresponding LED module **20**. Alternatively, one controller **50** may be electrically connected to a plurality or to all the LED modules **20** included in the fixture **100**. The one or more controllers **50** may include control circuitry capable of power management functions for the LED modules **20**, and, specifically, the LED source **22**. The one or more controllers **50** may include constant current control circuitry that regulates the power provided to the LED source **22** at a prescribed current level, thereby protecting the LED source **22** from undesirable conditions, such as voltage spikes. The one or more controllers **50** may further include a power transformer to convert input alternating current to direct current suitable for the LED source **22**. In at least one embodiment according to the present disclosure, the LED module **20** may include the controller **50**, the cooling fan **52**, the fan driver **54**, and all necessary electrical connections. In such an embodiment, the housing **10** may include only the front panel **12**, where the front panel **12** may include only a minimal structure necessary to support the plurality of LED modules **20**. Such an embodiment may improve the transfer of heat from the heat sink **24** because the LED module **20** is not enclosed within side panels **16** and the back panel **14**. In other embodiments, the housing **10** may fully enclose the LED module **20** in an airtight, watertight manner. The airtight, watertight enclosure in an embodiment is desirable especially in the specific context where watering of plants takes place in the vicinity of the embodiment of the invention.
[0100] Referring to FIG. **1**, the fixture **100** may include a power connector **60** disposed through the housing **10** and electrically connected to the one or more controllers **50**. The fixture **100** may include a power switch **62** disposed through the housing **10** and electrically connected between the power connector and the one or more controllers **50**. The fixture **100** may further include a power interconnect **64** to enable a plurality of fixtures **100** to be electrically linked in parallel to form an array of fixtures **100**, such as the fixture **200** and the fixture **300**. The fixture **100** may include a dimmer **66** to enable adjustment of the electrical power supplied to the LED modules **20** and, thereby, adjust and vary the intensity of the light emitted by the fixture **100**.
[0101] FIGS. **8**A-**8**D show additional exemplary embodiments of LED modules **20** of the present disclosure. As shown therein, LED modules **20** can each comprise an outer housing **800** configured to be mounted to a flexible plate **1000** (as described in further detail hercin). Housings **800** can comprise any number of overall shapes, such as a relatively square or cube shape, and as shown in FIGS. **8**B and **8**C, for example, defining a tapered portion **802** extending from a relative front **804** to a relative back **806** of said housing, as identified in FIG. **8**B. One or more lenses **26**, such as a plurality of lenses **26** shown in FIG. **8**D, can be positioned at or near a relative front **804** of said module **20** so that LED sources **22** present therein (such as shown in FIG. **22**) can emit light from LED module **20** and through lenses **26**. Outer housings **800** may have one or more fastener apertures **808** or fastener holes **2000** defined therein, such as shown in FIG. **8**D, configured to receive one or more fasteners **902**, as shown in FIG. **9**A, for example. Housings **800** can also define a screw hole **810**, such as shown in FIG. **8**C, so that a screw (an exemplary fastener **902**) can be used to couple housing **800** to any desired substrate. A relief **812**, such as shown in FIG. **8**A, can offer clearance for end pins **1200** (discussed in further detail herein) when flexible plate **1000** flexes during operation of an exemplary module system **900** of the present disclosure.
[0102] FIGS. **9**A and **9**B show perspective views of exemplary module systems **900** of the present disclosure. Module systems **900**, as shown therein, comprise a plurality of LED modules **20**, such as shown in FIGS. **8**A-**8**D for example, and other componentry configured to retain said LED

modules. Cabling **1110** can be tracked along a rear lip **1112** of rigid beam **1100**, such as shown in FIG. **9**B, and/or apertures **1114** can be defined within rear lip **1112** of rigid beam **1100**. FIG. **9**A shows a front perspective view, and FIG. **9**B shows a rear perspective view, of exemplary module systems **900** of the present disclosure.

[0103] FIGS. **10**A-**10**D show an exemplary embodiment of a flexible plate **1000** of the present disclosure. Flexible plates **1000**, as referenced herein, are configured to engage a plurality of LED modules **20**, such as shown in FIG. **9**A, whereby flexible plate(s) **1000** become part of exemplary module systems **900** of the present disclosure, as shown in FIG. **9**A. Flexible plates **1000** of the present disclosure have lens apertures **1002** defined therein, such as shown in FIG. **10**D, so that when a LED module **20** is coupled to flexible plate **1000**, some or all of lens **26** can be seen from a relative front of flexible plate **1000** within a corresponding lens aperture **1002**, so that light from LED module **20** can be directed from LED module **20**, through lens **26**, and through lens aperture **1002**, such as shown in FIG. **9**A. FIG. **10**A shows a perspective view, FIG. **10**B shows a top view, FIG. **10**C shows a side view, and FIG. **10**D shows a front view, of an exemplary flexible plate **1000** of the present disclosure.

[0104] Flexible plates **1000** of the present disclosure may further define fastener apertures **808** therein, as shown in FIG. **10**D. Fasteners **902**, as shown in FIGS. **9**A and **20**A, for example, can then be used to secure LED modules **20** to flexible plates **1000** by way of positioning at least part of a fastener **902** through a fastener aperture **808** of a flexible plate **1000** and also through a fastener aperture **808** of a housing **800**.

[0105] A stiffener rail **1010**, such as shown in FIG. **10**A, may also be used to provide some rigidity to an otherwise flexible/compliant flexible plate **1000**. Stiffener rail **1010**, when used, would be coupled to portions of flexible plate **1000** as desired.

[0106] FIGS. **11**A-**11**E show exemplary embodiments of a rigid beam **1100** of the present disclosure. Rigid beams **1100**, as referenced herein, are configured to engage flexible plates **1000**, whereby rigid beams **1100** also become part of exemplary module systems **900** of the present disclosure, as shown in FIG. **9**A. Rigid beams **1100** are configured to be coupled to flexible plates **1000**, allowing flexible plates **1000** to flex as desired, while allowing module system **900** to remain coupled to a desired substrate, such as a vehicle, building, or other substrate. Weld points **1120** are shown in FIG. **11**A on end plates **1102** of rigid beam **1100**, which can be used to identify locations where end pins **1200** (described below) can ultimately be welded to said end plates **1102**. Attachment screws **1130** and washers **1132** can be attached to end plates **1102** as well, such as shown in FIG. **11**E, so to facilitate mounting of rigid plate **1100** to a desired substrate, such as a vehicle, for example. FIG. **11**A shows a perspective view, FIG. **11**B shows a front view, FIG. **11**C shows a side view, and FIG. **11**D shows a top view, of an exemplary rigid beam **1100** of the present disclosure. FIG. **11**E also shows a perspective view of an exemplary rigid beam **1100** of the present disclosure, but with end pins **1200** welded thereto, as noted below. Rigid beams **1100** of the present disclosure may be formed from sheet metal, or comprise another suitable material, such as plastic or wood.

[0107] Rigid beams **1100** can be coupled to flexible plates **1000** of the present disclosure using, for example, one or more end pins **1200**, as shown in FIGS. **12**A and **12**B. End pins **1200**, as shown in FIGS. **12**A and **12**B, can comprise an elongated cylindrical portion **1202** and a flange portion **1204** at a relative end **1206** of pin **1200**, whereby flange portion **1204**, for example, may have a larger diameter or cross-sectional arca than part of cylindrical portion **1202**. End pins **1200** can be welded to, for example, end plates **1102** of rigid beams **1100**, such as whereby end plates **1102** are positioned at relative ends of rigid beams **1100** as shown in FIG. **11**A.

[0108] FIGS. **13**A-**13**D show an exemplary embodiment of a pusher **1300** of the present disclosure. Pushers **1300**, as referenced herein, are configured to push against portions of module systems **900**, such as flexible plates **1000**, so that flexible plate **1000** can flex inward (so to create a concave flexible plate **1000**) or outward (so to create a convex flexible plate **1000**), as may be desired, so

that LED modules **20** of module systems **900** direct light in desired directions. Exemplary pushers **1300** of the present disclosure can comprise a vertical or relatively vertical pusher bar extending from a horizontal or relative horizontal pusher base **1304**, whereby pusher rails **1306** extend downward (vertically or relatively vertically) from pusher base **1304**, as shown in FIG. **13**B. FIG. **13**A shows a perspective view, FIG. **13**B shows a front view, FIG. **13**C shows a side view, and FIG. **13**D shows a bottom view of an exemplary pusher **1300** of the present disclosure.

[0109] FIGS. **14**A-**14**D show an exemplary embodiment of a mechanism cradle **1400** of the present disclosure. Mechanism cradles **1400**, as referenced herein, are configured to couple to a rigid beam **1100**, as shown in FIG. **20**A, and ultimately receive a pusher **1300**, as shown in FIG. **13**A, so that pusher **1300** can operate to change the configuration/flexation of flexible plate **100**. Exemplary mechanism cradles **1400** of the present disclosure can have a flat (horizontal or relatively horizontal) cradle base **1420** having cradle rails **1422** extending therefrom in a vertical or relatively vertical direction, such as shown in FIG. **14**C. FIG. **14**A shows a perspective view, FIG. **14**B shows a bottom view, FIG. **14**C shows a front view, and FIG. **14**D shows a side view of an exemplary mechanism cradle **1400** of the present disclosure.

[0110] FIGS. **15**A-**15**D show an exemplary embodiment of a rotary push plate **1500** of the present disclosure. Rotary push plates **1500**, as referenced herein, are configured to engage a pusher **1300**, such as shown in FIGS. **16**A and **16**B, to facilitate operation of pusher **1300** along with other components of module systems **900**, as referenced herein. As shown in FIG. **16**A, a flanged pin **1502** of rotary push plate **1500** is configured to be positioned within an elongate groove **1302** defined within a horizontal plate **1304** of pusher **1300**. When pusher **1300** and rotary push plate **1500** are coupled together, as referenced above and as shown in FIG. **16**B and formed as part of module system **900**, rotary movement of rotary push plate **1500** causes pusher **1300** to move, causing flexible plate **100** to move as referenced herein. FIG. **15**A shows a perspective view, FIG. **15**B shows a pack view, FIG. **15**C shows a horizontal side view, and FIG. **15**D shows a vertical side view of an exemplary rotary push plate **1500** of the present disclosure. FIGS. **16**A and **16**B show perspective views of pushers **1300**, with a rotary push plate **1500** not coupled to pusher **1300** in FIG. **16**A and coupled to pusher **1300** in FIG. **16**B.

[0111] FIGS. **17**A-**17**D show an exemplary embodiment of a gear assembly **1700** of the present disclosure. Gear assemblies **1700**, as referenced herein, are configured to engage a worm shaft **1800** (as shown in FIG. **18**A) so to facilitate movement of pusher **1300**, as described herein. Gear assemblies **1700**, as shown in FIGS. **17**A-**17**D, can comprise various elements, such as shown in FIG. **21**C and described in further detail herein. FIG. **17**A shows a perspective view, FIG. **17**B shows a side view, FIG. **17**C shows a top view, and FIG. **17**D shows a bottom view of an exemplary gear assembly **1700** of the present disclosure.

[0112] FIGS. **18**A-**18**D show an exemplary embodiment of a worm shaft **1800** of the present disclosure. Worm shafts **1800**, as referenced herein, are configured to engage gear assemblies **1700** so that rotation of worm shafts **1800** cause rotation of gear assemblies **1700**, as described herein. FIG. **18**A shows a perspective view, FIG. **18**B shows a front view, and FIGS. **18**C and **18**D show side views of an exemplary worm shaft **1800** of the present disclosure.

[0113] FIGS. **19**A-**19**C show an exemplary embodiment of an adjustment knob **1900** of the present disclosure. Adjustment knobs **1900**, as referenced herein, are configured to couple to worm shafts **1800**, as described herein, so that turning adjustment knob **1900** causes worm shaft **1800** to rotate, causing gear assembly **1700** to rotate, and ultimately causing pusher **1300** to move to cause flexible plate **1000** to move. FIG. **19**A shows a perspective view, FIG. **19**B shows a front view, and FIG. **19**C shows a side view of an exemplary adjustment knob **1900** of the present disclosure.

[0114] FIG. **20**A shows an exemplary embodiment of a portion of a rigid beam **1100** (a portion of a module system **900** of the present disclosure) in the process of having an exemplary mechanism cradle **1400** fastened thereto. One or more fasteners **902** can be used to secure mechanism cradle **1400** to rigid beam **1100**, and/or another mechanism of fastening can be used, such as by way of

welding, an adhesive, a clip, and the like. In at least one embodiment, fasteners **902** comprise M3 screws. Fasteners **902** would be at least partially inserted into fastener apertures **808** defined within mechanism cradle **1400** and rigid beam **1100** (such as in the direction of the downward pointing arrows in the figure), noting that should a fastener aperture **808** not be defined within rigid beam **1100** (such as when the hole is not defined all the way through rigid beam **1100**), a fastener hole **2000** can be defined at least partially within rigid beam **1100** so to receive at least part of fastener **808**. A boss **2002**, such as shown in FIG. **20**A, having a clearance hole **2004** defined therethrough, can be welded or otherwise attached to mechanism cradle **1400** so to ultimately receive at least part of gear assembly **1700**, as referenced in further detail herein.

[0115] FIG. **20**B shows portions of a module system **900** whereby mechanism cradle **1400** is fastened to rigid beam **1100**, such as by way of using fasteners **902** as referenced in FIG. **20**A. As shown in FIG. **20**B, a worm shaft **1800** is being installed into module system **900** in the direction of the arrow following an elongated axis of worm shaft **1800** shown therein), whereby a distal portion **1802** of worm shaft **1800** is inserted into an aperture **1402**, as shown in FIG. **20**A, defined within a first vertical element **1404** of mechanism cradle **1400**, as shown in FIGS. **20**A and **20**B.

[0116] FIG. **21**A shows a gear assembly **1700** of the present disclosure being installed into module system **900**. As shown therein, gear assembly **1700** is installed into module system **900** such that a central projection **1702** extending from gear assembly **1700** fits within a clearance hole **2004** of boss **2002** to allow gear assembly **1700** to rotate as desired. Once installed, such as shown in FIG. **21**B, teeth **1704** positioned around gear assembly **1700** can engage spiral grooves **1804** of worm shaft **1800**, such that rotation of worm shaft **1800** and rotation of gear assembly **1700** occur at the same time.

[0117] FIG. **21**C shows portions of an exemplary gear assembly **1700** of the present disclosure, whereby gear assembly **1700** can comprise an upper portion **1750** and a lower portion **1752**. Lower portion **1752** of gear assembly **1700**, in at least one embodiment, can comprise the central projection **1702** extending from a first cylindrical element **1710**, whereby teeth **1704** are defined around a circumference of first cylindrical element **1710**. Upper portion **1750** of gear assembly **1700**, in at least one embodiment, can comprise a second cylindrical element **1760**, having gear protrusions **1700** extending therefrom, as shown in FIG. **21**C.

[0118] FIG. **22**A shows portions of an exemplary module system **900** of the present disclosure having a worm shaft retainer **2200** in the process of being fastened thereto. As shown therein, worm gear retainer comprises an arched plate **2202** having fastener apertures **808** defined therein, whereby fasteners **902** can be positioned at least partially within fastener apertures **808** of arched plate **2202** and into fastener apertures **808** and/or fastener holes **2000** defined within mechanism cradle **1400**, as referenced herein. Once worm shaft retainer **2200** is fastened or otherwise coupled to mechanism cradle, worm shaft **1800** is prevented from disengaging mechanism cradle **1400**. As shown in FIG. **22**A, a portion of worm shaft **1800** are positioned within first vertical element **1402** of mechanism cradle **1400**, and another portion of worm shaft **1800** is positioned within a groove **1410** defined within a second vertical element **1412** of mechanism cradle **1400**, so that worm shaft **1800** can readily rotate about/within aperture **1402** and groove **1410**.

[0119] FIG. **22**B shows portions of an exemplary module system **900** of the present disclosure having a worm shaft retainer **2200** fastened thereto. An adjuster support **2250** is also shown in FIG. **22**B, whereby adjuster support **2250** is also configured to be fastened to mechanism cradle **1400** so to maintain a proper position of worm shaft **1800**.

[0120] FIG. **23**A shows portions of an exemplary module system **900** of the present disclosure, whereby adjuster support **2250** is fastened to mechanism cradle **1400**, such as by use of one or more fasteners **902** positioned within fastener apertures **808** defined within adjuster support **2250** and into fastener apertures **808** or fastener holes **2000** defined within mechanism cradle **1400**.

[0121] FIG. **23**B shows portions of an exemplary module system **900** of the present disclosure, whereby an exemplary flexible plate **1000** is shown coupled to an exemplary rigid beam **1100** of

the present disclosure. As shown therein, end pins **1200** of rigid beam **1100**, such as shown in FIG. **11**E for example, are positioned within pin apertures **1020** defined within anchoring tabs **1022** extending from front portion **1024** of flexible plate **1000**, such as shown in FIG. **10**A. So to fit flexible plate **1000** onto rigid beam **1100** to fit about end pins **1200**, flexible plate **1000** must flex/bend during placement. Mechanism cradle **1400**, having various components coupled thereto and/or positioned thereon as shown in FIG. **23**A, properly fits within module system **900** when flexible plate **1000** is coupled to rigid beam **1100** having mechanism cradle **1400** coupled thereto.

[0122] Housings **800** of LED modules **20** can be coupled to flexible plate **1000** by way of fasteners **902** positioned through fastener apertures **808** or fastener holes **2000** defined within housings **800**, as shown in FIG. **24**A. Once fastened to flexible plate **1000**, some or all of lens **26** would be visible through lens aperture **1002** of flexible plate **1000**.

[0123] A mechanism cradle **1300** can be positioned relative to mechanism cradle **1400**, such as shown in FIG. **24**B, so that pusher bar **1302** of pusher **1300** can ultimately be coupled to flexible plate **1000**. LED modules **20** can be coupled to flexible plate **1000** before or after flexible plate **1000** is coupled to rigid beam **1100**, such as shown in FIG. **24**A. To fasten an exemplary pusher **1300** of the present disclosure to flexible plate **1000**, for example, fasteners **902** can be positioned within fastener apertures **808** defined within pusher **1300** and flexible plate **1000** and further positioned into fastener apertures **808** or fastener holes **2000** defined within housing **800**, such as shown in FIG. **25**B. Pusher **1300**, as shown in FIG. **24**B, can be inserted so to slide along portions of mechanism cradle **1400**. In various embodiments, pusher rails **1306**, as shown in FIG. **13**B, can be positioned next to cradle rails **1422**, as shown in FIG. **14**C, so that pusher **1300** cannot move side to side relative to cradle **1400** when positioned relative thereto and fastened to flexible plate **1000**.

[0124] FIG. **25**A shows a front perspective view of a portion of a module system **900** of the present disclosure. As shown therein, a rotary push plate **1500** is depicted, whereby proper positioning of rotary push plate **1500** relative to gear assembly **1700** would allow gear protrusions **1770** of gear assembly **1700**, as shown in FIG. **21**C, to fit within protrusion apertures **1510** defined within rotary push plate **1500**, as shown in FIG. **15**B.

[0125] FIG. **26**A shows an exemplary adjustment knob **1900** in the process of being fastened to an exemplary worm shaft **1800** of the present disclosure. As shown therein, a notched end **1810** of worm shaft **1800**, also as shown in FIG. **18**D, is shown extending from adjuster support **2250**, and is configured to be received by a knob aperture **1902** of adjustment knob **1900**, also as shown in FIG. **19**B. Adjustment knob **1900** can then be fastened to worm shaft **1800** by way of tightening a grub screw **2600** within a threaded aperture **1904** defined within adjustment knob **1900**, also as shown in FIG. **19**A, so that grub screw **2600** can tightly contact worm shaft **1800** at notched end **1810**. FIG. **26**B shows a rear portion of an exemplary module system **900** of the present disclosure having adjustment knob **1900** coupled thereto.

[0126] Once assembled, turning adjustment knob **1900** in a first direction causes worm shaft **1800** to rotate in a first direction, causing gear assembly **1700** to rotate in a first direction, and ultimately causing pusher **1300** to move flexible plate **1000** in a first direction, such as from convex to less convex, convex to flat, flat to concave, or concave to more concave. Turning adjustment knob **1900** in an opposite second direction causes worm shaft **1800** to rotate in a second direction, causing gear assembly **1700** to rotate in a second direction, and ultimately causing pusher **1300** to move flexible plate **1000** in a second direction, such as from concave to less concave, concave to flat, flat to convex, or convex to more convex.

[0127] As generally referenced herein, exemplary module systems **900** of the present disclosure can comprise several LED modules **20**, and can be adjusted so that modules **20** direct light in a general perpendicular direction relative to an elongate axis of flexible plate **1000**, or to direct light relatively inward (at least using LED modules **20** on the relative ends of flexible plate **1000**) when flexible plate **1000** is flexed to form a concave shape, or to direct light relatively outward (at least

using LED modules **20** on the relative ends of flexible plate **1000**) when flexible plate is flexed to form a convex shape. In view of the same, exemplary module systems **900** of the present disclosure have the ability to overlap light patterns emitted by LED modules **20** (pods) arranged on a beam (coupled to flexible plate **1000**), and have ability to adjust the arc radius in order to give the user the ability to focus or spread the light out. Each LED module **20** could also be interchanged to produce different colors, intensity or light output patterns, as may be desired, which is easily accomplished by removing one LED module **20** and replacing it with another LED module.
[0128] Prior art LEDs positioned on a flat surface or a surface that is bent in only one direction causes the LEDs perform independently. An LED functioning alone is not bright enough to produce the intensity and result that many situations call for. At least one fundamental concept within the present disclosure includes disclosure of a system that can have 100% of the LED modules **20** of the system to emit overlapping light. If one imagines an LED emits light in a cone shape when used with an optic (reflector or lens), and if those cones are put in a straight line pointing in the same direction, some with overlap to a small degree but the majority of the surface that is being lit ends up being lit by only a small number of LED cones. If that line is bent and point all those LEDs to the same center point, all the cones overlap and the performance of that space is now all the LEDs. The latter is accomplished using the novel devices and systems of the present disclosure, as a single row of LED modules **20** can overlap 100% of the LED output onto one space evenly without spilling light. Some benefits include the following: [0129] a. Even color output: If devices and systems of the present disclosure are used in photography, for example, one can mix and match any number (unlimited) of LED modules **20** and create custom colors of light output. If the photographer wants to add more white or more blue to the mix, he or she can simply change one or more LED modules **20** of a module system **900**. [0130] b. Light pattern and coverage: If this is used in a street light and the city wants to only have the light hit the sidewalk without the cars or the houses being exposed to light, they can adjust to focus to cover exactly the area they want. Then if they want the color of the street lights to be different (white instead of yellow) or they want to shape the output in a square instead of a circle, they can change the LED modules **20** for different optics.
[0131] Various module systems **900** of the present disclosure can be used for various purposes, such as those described herein, including but not limited to use on trucks, boats and other off-road areas or vehicles. Users of said trucks and boats, for example, would want the light output to be just what they need it for. Sometimes that may be racing which requires extreme spot light with distance and focus being important. Others want wide angled flood patterns for spotting animals that may run in front of them. Boaters want light output that is flood patterned with some focus in the center and no light pointing down to hit the bow and cause glare. Various devices and systems of the present disclosure are configured to allows these customers to interchange LED modules **20** for optics and colors but also bend the beam to focus or spread the light by, for example, turning adjustment knob **1900** to flex flexible plate **1000**. The modular choices for optics in view of the adjustable flexing of all LED modules **20** result in total control of light emitted by module systems **900**. Any number of components referenced herein in connection with one or more light fixtures **100** or module systems **900** of the present disclosure may be used with the other, such as a component of a light fixture **100** being used with a module system **900**, as applicable/desired.
[0132] As referenced herein exemplary module systems **900** comprise a flexible plate **1000** configured (having the ability) create any convex, concave or planar surface, namely configured to bend in a convex or concave fashion or have a planar (straight) configuration, with any a range of degrees determined/desired by the user, such as part of or a full circumference (360° curvature). Exemplary flexible plates **1000** of the present disclosure can be adjusted manually/mechanically, as referenced herein (such as by way of pusher **1300** and/or other componentry), or remotely, such as by way of a motor **2700** coupled to one or more portions of an exemplary module system **900** of the present disclosure. Motors **2700**, as referenced herein and as shown in the block component

diagram shown in FIG. **27**, are configured to operate by way of a control module **2702** and a power source (controller **50**) so that operation of control module **2702** causes motor **2700**, powered by power source (controller **50**) or another source of power, to operate as desired to cause flexible plate **1000** to move in a desired direction (so to become concave, more concave, convex, more convex, or straight). In at least one embodiment, motor **2700** is in contact with at least one of pusher **1300**, a mechanism cradle **1400**, a rotary push plate **1500**, a gear assembly **1700**, a worm shaft **1800**, and/or an adjustment knob **1900**, so to cause movement of the same to cause flexible plate **1000** to move as desired. Controller **2702** can be operated directly or remotely, such as by way of remote **2704**, as shown in FIG. **27**, in wired or wireless communication with controller **2702**.

[0133] Flexible plates **1000** can be made from many types of materials to provide different performance for different environments, such as various metals and/or plastics. Flexible plates **1000** can also be positioned in various locations relative to LED modules **20** depending on the desired use, such as being above, below, in front, or behind said LED modules **20**. Flexible plates **1000**, as referenced herein, are configured to retain a plurality of LED modules **20**, each of which can be mounted and/or powered independently from the other. Flexible plates **1000** can allow for the attachment of each LED module **20** with the ability to remove, exchange or replace each LED module **20** without removing or affecting any other LED module on the flexible plate **1000** (meaning that LED modules **20** can be hot-swappable, in various embodiments).

[0134] Flexible plates **1000** of the present disclosure can be built in different patterns to allow for different shapes and sizes of LED modules **20**, as referenced herein. LED modules **20**, in various embodiments, can be independently connected to a power source, such as one or more controllers **50** configured to provide electrical power to LED modules **20**. LED modules **20** can be connected to controller(s) **50** independently, and can comprise/utilize a power connector **60**, such as referenced herein, at or as part of each LED module **20** for connecting/disconnecting each LED module **20** with a waterproof connection. In various embodiments, each LED module **20** is completely sealed, waterproof, and independently powered.

[0135] In various embodiments, LED modules **20** can be considered as having other light sources aside from LEDs therein. As such, LED module **20** can also be referenced to herein as being a light module **20**, with said light modules **20** having one or more characteristics, components, and/or features as LED modules **20** referenced herein, but with a different light source (instead of LED source **22**, it would be considered as a light source **22**, which would be different than a LED). In view of the same, each light module **20** can comprise any type of light source, optic or power such as to be allowed by the module system **900** with the limitation of engineering restrictions to size, weight and thermal. The modular systems **900** of the present disclosure can also utilize any number of other light sources as can be sourced to be a suitable fit to the flexible plate **1000** so that module systems **900** operate as desired. This allows for the flexible plate **1000**, for example, to be considered an editable platform for the control of many different independent modular illumination systems in order to achieve any range of illumination output results due to the vast options available in the form of independent illumination system sources, optics, power inputs (such as variations as different optics angles, different optics, different colors, different wattages, different LEDs, or even have infrared LEDs, etc., to produce/facilitate night vision, as may be desired).

[0136] Each module system **900** can be independently controlled to affect operation of each (such as powering on and off, adjusting light intensity from light modules **20**, turning on and off components of each light module **20**, and the like. The ability to control each light module **20** of a module system **900** would then only be limited by the ability or options of that individual unit. Each light module **20** can be independently controlled through a control module **2702**, as referenced herein, via a wired or wireless remote interface (a remote **2704**).

[0137] Exemplary module systems **900** of the present disclosure can be mounted to many different structures in varying ways, including, but not limited to, vehicles, buildings, towers, handles, or

any other structures/substrates or means of mounting to provide a stable operation of the module system **900**.
[0138] Flexible plates **1000** can be configured to operate in tandem with one or more additional flexible plates **1000** in a stacked or tiered fashion as may be desired, which is only dependent on the number of flexible plates **1000** the user prefers. Each flexible plate **1000** can operate (move, illuminate, etc.) independent of all other flexible plates **1000**, but may also act in unison with any other flexible plate via operation of one or more control modules **2702**, such as via a wired or wireless interface (using a remote **2704**).
[0139] While various embodiments of an arc modular LED light fixture and methods for using and constructing the same have been described in considerable detail herein, the embodiments are merely offered by way of non-limiting examples of the disclosure described herein. It will therefore be understood that various changes and modifications may be made, and equivalents may be substituted for elements thereof, without departing from the scope of the disclosure. Indeed, this disclosure is not intended to be exhaustive or to limit the scope of the disclosure.
[0140] Further, in describing representative embodiments, the disclosure may have presented a method and/or process as a particular sequence of steps. However, to the extent that the method or process does not rely on the particular order of steps set forth herein, the method or process should not be limited to the particular sequence of steps described. Other sequences of steps may be possible. Therefore, the particular order of steps disclosed herein should not be construed as limitations of the present disclosure. In addition, disclosure directed to a method and/or process should not be limited to the performance of their steps in the order written. Such sequences may be varied and still remain within the scope of the present disclosure.

Claims

1. A modular light system, comprising: a plurality of light emitting diode (LED) modules, each LED module comprising a housing with a light source therein, said housing comprising a front portion, a back portion, and one or more side portions; wherein each LED module of the plurality of LED modules is adjacent one another in a side-by-side configuration.
2. The modular light system of claim 1, each light source directs light outward in the same direction.
3. The modular light system of claim 1, wherein each LED module defines a screw hole therein so that an exemplary fastener can be used to couple each housing to a desired substrate.
4. The modular light system of claim 1, wherein the light source comprises at least three LED light sources.
5. The modular light system of claim 1, wherein each LED module of the plurality of LED modules has at least four light sources therein.
6. The modular light system of claim 1, configured so to permit an LED module of the plurality of LED modules to be removed and replaced with another LED module while the remaining LED modules of the plurality of LED modules are operable to emit light therefrom.
7. The modular light system of claim 1, further comprising: a flexible plate substrate coupled to each housing.
8. The modular light system of claim 7, wherein the flexible plate substrate is configured to couple to a vehicle.
9. The modular light system of claim 7, wherein when the flexible plate substrate is relatively long, a greater number of LED modules can be coupled thereto, and wherein when the flexible plate substrate is relatively short, a smaller number of LED modules can be coupled thereto.
10. The modular light system of claim 1, wherein each LED module has a spot light output.
11. The modular light system of claim 1, wherein each LED module has a flood light output.
12. The modular light system of claim 1, wherein the plurality of LED modules comprises eight

LED modules.
13. The modular light system of claim 1, wherein the plurality of LED modules comprises sixteen LED modules.
14. The modular light system of claim 1, wherein each LED module of the plurality of LED modules comprises a heat sink including a plurality of cooling fins.
15. A modular light system, comprising: a first light emitting diode (LED) module comprising a housing with a light source therein; a second LED module comprising a housing with a light source therein, the second LED module positioned next to the first LED module; wherein each housing comprises a front portion, a back portion, and one or more side portions; and wherein each LED module is adjacent one another in a side-by-side configuration.
16. The modular light system of claim 15, further comprising: a third LED module comprising a housing with a light source therein, the third LED module positioned next to the second LED module; and a fourth LED module comprising a housing with a light source therein, the fourth LED module positioned next to the third LED module; wherein the first LED module, the second LED module, the third LED module, and the fourth LED module are adjacent one another in a side-by-side configuration.
17. The modular light system of claim 16, wherein each LED module comprises a heat sink including a plurality of cooling fins.
18. The modular light system of claim 16, wherein each LED module directs light outward in the same direction.
19. The modular light system of claim 16, wherein each LED module defines a screw hole therein so that an exemplary fastener can be used to couple each housing to a desired substrate.