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(71) Applicant: **HGCI, INC.** [US/US]; 3993 Howard Hughes Parkway, Suite 250, Las Vegas, NV 89169 (US).

(72) Inventor: **CAI, Dengke**; c/o The Scotts Company LLC, 14111 Scottslawn Road, Marysville, OH 43041 (US).

(74) Agent: **VOIT, Seth, A.** et al.; Ulmer & Berne LLP, 312 Walnut St., Suite 1400, Cincinnati, OH 45202 (US).

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(54) Title: LIGHT FIXTURE INCLUDING A LENS COVER HAVING A PARYLENE COATING

(57) Abstract: A lens cover includes a main body and a parylene coating. The main body includes a base substrate and a plurality of optical lens elements. The base substrate is substantially planar and defines an outer perimeter. The plurality of optical lens elements is that extend from the base substrate and cooperates with the base substrate to provide an exterior surface and an interior surface of the lens cover. Each optical lens element of the plurality of optical lens elements are configured for alignment with a light emitting diode. The parylene coating is provided over the exterior surface and the interior surface. The plurality of optical lens elements protrude from the base substrate at the exterior surface. The lens cover is formed as a unitary one-piece construction such that the exterior surface extends continuously between the base substrate and each optical lens element to form a fluid impervious barrier therebetween.

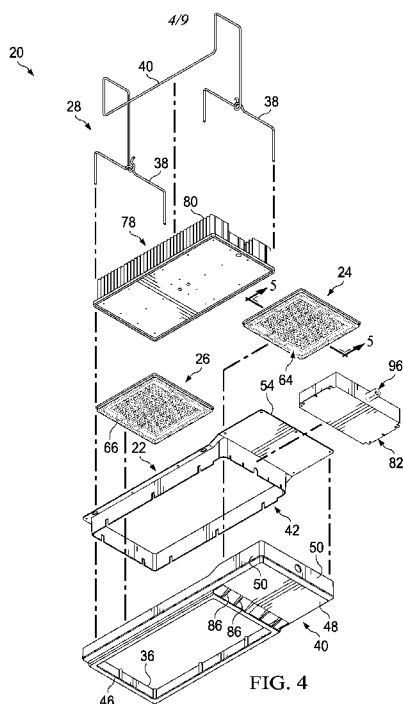


FIG. 4



LIGHT FIXTURE INCLUDING A LENS COVER HAVING A PARYLENE COATING**TECHNICAL FIELD**

[0001] The apparatus described below generally relates to a light fixture that includes an array of light sources for illuminating an indoor grow facility. Each light source includes at least one light emitting diode (LED) and a lens cover that is at least partially coated with a parylene coating.

BACKGROUND

[0002] Indoor grow facilities, such as greenhouses, include light fixtures that provide artificial lighting to plants for encouraging growth. Each of these light fixtures typically includes a plurality of LEDs that generate the artificial light for the plants. The environment inside these indoor grow facilities, however, can include different types of gasses and/or airborne fluid particles that cause the optical quality of the LEDs to degrade (e.g., yellow) over time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Various embodiments will become better understood with regard to the following description, appended claims and accompanying drawings wherein:

[0004] FIG. 1 is an upper isometric view depicting a light fixture, in accordance with one embodiment;

[0005] FIG. 2 is a lower isometric view of the light fixture of FIG. 1, wherein the light fixture is shown to include a pair of lighting modules;

[0006] FIG. 3 is a partially exploded upper isometric view of the LED light fixture of FIG. 1;

[0007] FIG. 4 is a partially exploded lower isometric view of the LED light fixture of FIG. 1, wherein each lighting module is shown to include a lens cover, in accordance with one embodiment;

[0008] FIG. 5 is a cross-sectional view taken along the line 5-5 in FIG. 4;

- [0009] FIG. 6 is a schematic view of various components of the light fixture of FIG. 1;
- [0010] FIG. 7 is an upper isometric view depicting a lens cover for a lighting fixture, in accordance with another embodiment;
- [0011] FIG. 8 is a lower isometric view of the lens cover of FIG. 7; and
- [0012] FIG. 9 is a cross-sectional view taken along the line 9-9 in FIG. 7.

DETAILED DESCRIPTION

[0013] Embodiments are hereinafter described in detail in connection with the views and examples of FIGS. 1-9, wherein like numbers indicate the same or corresponding elements throughout the views. A light fixture 20 for an indoor grow facility (e.g., a greenhouse) is generally depicted in FIGS. 1 and 2 and can include a housing 22, first and second lighting modules 24, 26 (FIG. 2), and a hanger assembly 28. The housing 22 can include a light support portion 30 and a controller support portion 32 adjacent to the light support portion 30. The light support portion 30 can define a lighting receptacle 34 (FIG. 1) and a window 36 (FIG. 2) disposed beneath the lighting receptacle 34. The first and second lighting modules 24, 26 (FIG. 2) can be disposed within the lighting receptacle 34 above the window 36 and can be configured to emit light through the window 36, as will be described in further detail below.

[0014] The hanger assembly 28 can facilitate suspension of the light fixture 20 above one or more plants (not shown) such that light emitted through the window 36 from the first and second lighting modules 24, 26 can be delivered to the underlying plant(s) to stimulate growth. The hanger assembly 28 can include a pair of hanger supports 38 and a hanger bracket 40. The hanger supports 38 can be coupled to the housing 22 on opposing sides of the light fixture 20. The hanger bracket 40 can be coupled with the hanger supports 38 and can extend between the hanger supports 38 to facilitate suspension of the light fixture 20 from a ceiling of the indoor grow facility. In one embodiment, as illustrated in FIGS. 1 and 2, the hanger bracket 40 can have a cross-sectional shape that is substantially J-shaped to facilitate selective hanging of the light fixture 20 from a beam or other elongated support member that is provided along a ceiling of the indoor grow facility.

[0015] Referring now to FIGS. 3 and 4, the housing 22 can include a main frame 42 and a cover member 44 that overlies the main frame 42 and is coupled together with the main frame 42 via welding, adhesives, releasable tabs (not shown), fasteners (not shown), or any of a variety of suitable alternative permanent or releasable fastening arrangements. The main frame 42 can include a bottom lighting wall 46 that defines the window 36. As illustrated in FIG. 3, the main frame 42 can include a bottom controller wall 48, and a plurality of sidewalls 50 that cooperate to define a controller receptacle 52. The cover member 44 can include a lid portion 54 that overlies and covers the controller receptacle 52, as illustrated in FIG. 1. The bottom controller wall 48, the sidewalls 50, and the lid portion 54 can form at least part of the controller support portion 32 of the housing 22.

[0016] As illustrated in FIG. 3, the first and second lighting modules 24, 26 can each include a submount 56, 58, a plurality of light emitting diodes (LEDs) (e.g., 60 in FIG. 5), and a lens cover 64, 66, respectively. Referring to FIG. 5, the first lighting module 24 will now be discussed, but can be understood to be representative of the second lighting module 26. The LEDs 60 can comprise surface mount LEDs that are mounted to the submount 56 via any of a variety of methods or techniques commonly known in the art. The LEDs 60 can be any of a variety of suitable configurations that are mounted directly or indirectly to the submount 56. The LEDs 60 can comprise single color LEDs (e.g., capable of emitting only one color of light such as white, red or blue), multi-color LEDs (e.g., capable of emitting different colors such as white, red, and blue) or a combination of both. The submount 56 can be formed of any of a variety of thermally conductive materials that are suitable for physically and thermally supporting the LEDs 60.

[0017] The lens cover 64 can overlie the submount 56 and the LEDs 60 and can be coupled with the submount 56 with fasteners 65 (FIG. 3) or any of a variety of suitable alternative coupling arrangements. The lens cover 64 can include a main body 67 that includes a base substrate 68 and a plurality of optical lens elements 70. The base substrate 68 can be substantially planar and the plurality of optical lens elements 70 can extend from the base substrate 68. Each of the optical lens elements 70 can be substantially aligned with respective ones of the LEDs 60 and can be configured to redistribute (e.g., concentrate or disperse) the light emitted from the LEDs 60 towards an area beneath the light fixture 20 (e.g., towards one or more plants). In one embodiment, as illustrated in FIGS. 4 and 5, each of the optical lens elements 70 can have an indented oval

shape. However, the optical lens elements 70 can be any of a variety of suitable alternative shapes or combinations thereof for achieving a desired redistribution of light emitted from the LEDs 60.

[0018] As illustrated in FIG. 5, the LEDs 60 can each be aligned with respective ones of the optical lens elements 70 such that the physical center P and the focal center F are coaxial (i.e., each LED 60 is aligned with a respective one of the optical lens elements 70). In another embodiment, the LEDs 60 can each be slightly offset with respective ones of the optical lens elements 70 such that the physical center P and the focal center F are non-coaxial (i.e., each LED 60 is misaligned with a respective one of the optical lens elements 70). In one embodiment, the lens cover 64 can be a unitary one-piece construction formed of a polycarbonate material and/or polymethyl methacrylate (PMMA). It is to be appreciated, however, that the lens cover 64 can be formed of any of a variety of suitable alternative translucent or transparent materials that can protect underlying LEDs from environmental conditions and can also accommodate a plurality of optical lens elements 70 for redistributing light transmitted from underlying LEDs.

[0019] The lens cover 64 can be spaced from the submount 56 such that the lens cover 64 and the submount 56 cooperate to define an interior 72 therebetween. An encapsulating material 74 can be provided within the interior 72 such that the encapsulating material 74 substantially fills the interior 72 and encapsulates the LEDs 60 therein. The encapsulating material 74 can be formed of an optically neutral (or enhancing) material that reduces optical loss in the interior 72 that might otherwise occur without the encapsulating material 74 (e.g., if there was air in the interior 72). In one embodiment, the interior 72 can be filled with enough of the encapsulating material 74 (e.g., filled entirely) to cause the interior 72 to be substantially devoid of air bubbles or other media that would adversely affect the optical integrity between the LEDs 60 and the lens cover 64. The encapsulating material 74 can also protect the LEDs 60 from environmental conditions that might be able to bypass the lens cover 64 such as a gaseous fluid (e.g., greenhouse gas). In one embodiment, the encapsulating material 74 can be a silicone gel such as a methyl type silicone (e.g., polydimethylsiloxane) or a phenyl-type silicone, for example, that has a refractive index of between about 1.35 and 1.6. It is to be appreciated that any of a variety of suitable alternative materials are contemplated for the encapsulating material 74.

[0020] The encapsulating material 74 can be substantially softer than the lens cover 64 (e.g., the encapsulating material 74 can have a hardness that is less than a hardness of the lens cover 64). In one embodiment, the encapsulating material 74 can be a flowable material, such as a fluid or gel that can be injected or otherwise dispensed into the interior 72 after the lens cover 64 is assembled on the submount 56. In another embodiment, the encapsulating material 74 can be coated onto the lens cover 64 and/or over the submount 56 and LEDs 60 prior to assembling the lens cover 64 on the submount 56.

[0021] Still referring to FIG. 5, the lens cover 64 can include a protective coating 76 that is provided over an exterior surface 77 of the main body 67. The protective coating 76 can be hydrophobic, oleophobic, and/or chemically resistant such that the exterior surface of the main body 67 of the lens cover 64 is protected from harmful environmental conditions that might otherwise adversely affect the optical performance of the optical lens elements 70. The protective coating 76 can additionally or alternatively optically enhance the transmission quality of the optical lens elements 70. In one embodiment, the protective coating 76 can be a thin-film inorganic material that protects against environmental conditions (e.g., chemical etching) and also improves overall transmission quality of the optical lens elements 70. The thin-film inorganic material can be between about 10 nm and about 200 nm thick and can have a refractive index above about 1.49. Some examples of suitable thin-film inorganic materials include MgF_2 , CaF_2 , SiO_2 , Al_2O_3 and/or TiO_2 . Although the protective coating 76 is shown to be a single layer arrangement, it is to be appreciated that the protective coating 76 can alternatively be a multi-layer arrangement that is either homogenous (multiple layers of the same material) or heterogeneous (multiple layers of different material).

[0022] It is to be appreciated that the light emitted by the first lighting module 24 can conform to a lighting profile (e.g., range of color, overall distribution of light, heat profile) that is defined by the physical configuration of the first lighting module 24 (e.g., the types of LEDs 60 that are utilized (e.g., single color or multi-color), the physical layout of the LEDs 60, the optics provided by the optical lens elements (e.g., 70), the encapsulating material (e.g., 74), the protective coating (e.g., 76), and the overall power consumption). Although various examples of the physical configuration of the first lighting module are described above and shown in the figures, it is to be

appreciated that any of a variety of suitable alternative physical configurations of the first lighting module 24 are contemplated for achieving a desired lighting profile.

[0023] Referring now to FIGS. 1 and 3, a heat sink 78 can be disposed over each of the first and second lighting modules 24, 26 and can be configured to dissipate heat away from the first and second lighting modules 24, 26. The heat sink 78 can be formed of any of a variety of a thermally conductive materials, such as aluminum or copper, for example. The heat sink 78 can be in contact with the submounts 56, 58 on an opposite side from the LEDs (e.g., 60). Heat generated by the LEDs (e.g., 60) can be transferred from the submounts 56, 58 to the heat sink 78 and dissipated to the surrounding environment by a plurality of fins 80. In one embodiment, a heat sink compound (not shown), such as thermal paste, for example, can be provided between the submounts 56, 58 and the heat sink 78 to enhance the thermal conductivity therebetween. Although the heat sink 78 is shown to be a unitary component that is provided over the first and second lighting modules 24, 26, it is to be appreciated that dedicated heat sinks can alternatively be provided for each of the first and second lighting modules 24, 26.

[0024] Referring now to FIG. 3, a controller 82 can be disposed in the controller receptacle 52 and can be configured to power and control the first and second lighting modules 24, 26. As illustrated in FIG. 1, the lid portion 54 of the cover member 44 can overlie the controller receptacle 52 and the controller 82. The lid portion 54 can serve as a heat sink for the controller 82 and can include a plurality of fins 84 to facilitate dissipation of heat from the controller 82. A heat sink compound (not shown), such as thermal paste, for example, can be provided between the lid portion 54 and the controller 82 to enhance the thermal conductivity therebetween. The main frame 42 and the cover member 44 can each be formed of a thermally conductive material such as aluminum, for example. Heat from the first and second lighting modules 24, 26 and the controller 82 can be transmitted throughout the housing 22 to effectively supplement the cooling properties of the heat sink 78 and the lid portion 54.

[0025] Referring now to FIGS. 1 and 2, the housing 22 can define a passageway 85 that extends between the light support portion 30 and the controller support portion 32 such that the first and second lighting modules 24, 26 and the controller 82 are physically spaced from each other. The passageway 85 can be configured to allow air to flow between the light support portion

30 and the controller support portion 32 to enhance cooling of the first and second lighting modules 24, 26 and the controller 82 during operation. In one embodiment, as illustrated in FIG. 3, the housing 22 can comprise a plurality of rib members 86 that extend between the light support portion 30 and the controller support portion 32 to provide structural rigidity therebetween.

[0026] Referring now to FIG. 6, the controller 82 can include a power supply module 88 and an LED driver module 90. The power supply module 88 can be coupled with the LED driver module 90, and the LED driver module 90 can be coupled with each of the first and second lighting modules 24, 26 (e.g., in parallel). The power supply module 88 can include a power input 92 that is coupled with a power source (not shown), such as an A/C power source, for delivering external power to the power supply module 88 for powering the first and second lighting modules 24, 26. The power supply module 88 can be configured to condition the external power from the power source (e.g., transform AC power to DC power) to facilitate powering of the LEDs (e.g., 60). In one embodiment, the light fixture 20 can be configured to operate at an input power of between about 85 VAC and about 347 VAC (e.g., a 750 Watt load capacity).

[0027] The LED driver module 90 can include a control input 94 that is coupled with a control source (not shown), such as a greenhouse controller, for example, that delivers a control signal to the LED driver module 90 for controlling the first and second lighting modules 24, 26, as will be described in further detail below. The LED driver module 90 can be configured to communicate according to any of a variety of suitable signal protocols, such as BACnet, ModBus, or RS485, for example.

[0028] The power input 92 and the control input 94 can be routed to a socket 96 (FIGS. 2 and 6) that is configured to interface with a plug (not shown) that can deliver the external power and control signals to the power supply module 88 and the LED driver module 90, respectively. In one embodiment, the socket 96 can be a Wieland-type connector, although other connector types are contemplated. It is to be appreciated that although the power and control signals are shown to be delivered through the socket 96 (e.g., via the same cable), the light fixture 20 can alternatively include separate ports for the power and the control signal such that the power and the control signal are transmitted to the power supply module 88 and the LED driver module 90 along different cables.

[0029] The LED driver module 90 can be configured to control one or more of the intensity, color, and spectrum of the light generated by the LEDs (e.g., 60) as a function of time (e.g., a light recipe). The LED driver module 90 can control the light recipe of the first and second lighting modules 24, 26 independently such that the first and second lighting modules 24, 26 define respective first and second lighting zones that are independently controllable within the lighting environment. The light recipes of the first and second lighting zones can accordingly be tailored to accommodate the lighting requirements of plants that are provided within the lighting environment. For example, when the plants provided in each of the first and second lighting zones are the same (or have similar lighting requirements), the respective light recipes for the first and second lighting modules 24, 26 can be the same to provide a substantially uniform lighting environment between the first and second lighting zones. When a group of plants provided in the first lighting zone has a different lighting requirement from a group of plants provided in the second lighting zone, the respective light recipes for the first and second lighting modules 24, 26 can be tailored to accommodate the different lighting requirements between the groups of plants. In one embodiment, the first and second lighting modules 24, 26 can have unique addresses such that the control signal can assign separate lighting recipes to each of the first and second lighting modules 24, 26 (via the LED driver module 90) based upon their unique addresses. It is to be appreciated, that although the LED driver module 90 is described as being configured to control the light recipe of each of the first and second lighting modules 24, 26, the LED driver module 90 can additionally or alternatively be configured to control any of a variety of suitable alternative variable lighting features of the first and second lighting modules 24, 26 (e.g., any lighting feature that can be controlled in real time with a control signal).

[0030] The first and second lighting modules 24, 26 can be self-contained, stand-alone units that are physically separate from each other. As such, the physical configuration and variable lighting features of each of the first and second lighting modules 24, 26 can be individually selected to allow the first and second lighting zones to be customized to achieve a desired lighting environment. In one embodiment, the first and second lighting modules 24, 26 can be exchanged with different lighting modules during the life cycle of a plant to optimize the lighting environment for the plant throughout its life cycle.

[0031] FIGS. 7-9 illustrate an alternative embodiment of a lens cover 164 that is similar to, or the same in many respects as, the lens cover 64 of FIGS. 4 and 5. For example, the lens cover 164 can include a main body 167 that includes a base substrate 168 and a plurality of optical lens elements 170 that extend from the base substrate 168. The base substrate 168 can be substantially planar and can define an outer perimeter P1. The main body 167 can include a gasket channel 175 that is routed along the outer perimeter P1. The gasket channel 175 can house a gasket (not shown) that interfaces with a submount of a lighting module to create an effective seal therebetween.

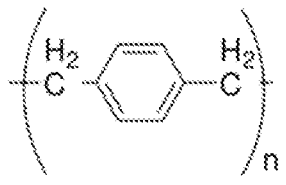
[0032] The main body 167 can include an exterior surface 177 (FIG. 7) and an interior surface 179. Each optical lens element 170 can protrude from the main body 167 at the exterior surface 177 and can define an indentation 181 at the interior surface 179. The main body 167 can be formed as a unitary one-piece construction such that the exterior surface 177 and the interior surface 179 extend continuously along the main body 167 and between the base substrate 168 and each optical lens elements 170 to form a fluid impervious barrier therebetween. The main body 167 can accordingly prevent any fluid that is introduced to the exterior surface 177 from passing through the main body 167 and reaching the interior surface 179.

[0033] Referring now to FIG. 9, the main body 167 can be coated with a parylene coating 176. In certain embodiments, the parylene coating 176 can be applied to the main body 167, as a singular coating, instead of the protective coating 76. However, it will be appreciated that in certain embodiments, one or more additional layers and/or coatings may be applied over a parylene coating. In one embodiment, the parylene coating 176 can fully encapsulate the main body 167 such that the entire main body 167, including the exterior and interior surfaces 177, 179 are covered in parylene. In another embodiment, only a portion of the main body 167, such as only the exterior surface 177 is coated in parylene. In certain embodiments, the parylene coating 176 can be a conformal coating.

[0034] As with the protective coating 76, the parylene coating 176 can provide protection for one or both of the exterior and interior surfaces 177, 179 of the main body 167. The parylene coating can also be transparent. In certain embodiments, the parylene coating 176 can serve as a barrier to shield the lens cover 164 from, among other things, water vapor moisture, various chemicals (e.g., organic solvents), corrosive gases (e.g., ammonia), and free radicals that might

otherwise adversely affect the optical performance of optical lens elements. In one embodiment, the parylene coating 176 can provide a gas barrier for and prevent free radical damage to a polycarbonate lens cover. Additionally, in some embodiments, the parylene coating 176 can provide protection to the lens cover 164 against exposure to extreme temperatures and UV radiation. In certain embodiments, parylene coatings 176 can provide durability, flexibility, high-frequency stability, and a low dielectric constant. The parylene coating 176 can have a thickness of between about 0.5 micrometers and about 10 micrometers, although any of a variety of suitable alternative thicknesses are contemplated for achieving a desired result. In certain embodiments, the parylene coating 176 can have a refractive index between the refractive index for air and the refractive index for the lens cover material (e.g., polycarbonate).

[0035] In certain embodiments, the parylene coating 176 may comprise one or more of parylene N, parylene C, parylene D, parylene F (e.g., parylene AT-4 and/or parylene VT-4), parylene E, parylene M, and parylene AM-2, and copolymers thereof. Parylene, obtained through the polymerization of *para*-xylylene, can have repeating units of the formula:



Parylene N, specifically, is represented by the unsubstituted polymer unit shown above. Other types of parylene, however, can be provided through substitution of the hydrogen atoms on the phenyl ring or aliphatic bridge. For example, parylene C includes a chlorine atom in place of a hydrogen atom in the ring of each unit, while parylene D includes two chlorine atoms in place of hydrogen atoms in the ring of each unit. Each of parylene AT-4 and parylene VT-4, both of which are types of parylene F, includes four fluorine atoms in each unit. Parylene AT-4 includes the fluorine atoms in the bridge, while parylene VT-4 includes the fluorine atoms in the ring.

[0036] In one embodiment, the parylene coating 176 comprises a copolymer of parylene C and parylene N, which has a high temperature rating, for example. Each of the different types of parylene can provide various benefits, however, and the type or types of parylene employed in the parylene coating 176 can depend on characteristics desired for a specific application, considering

a variety of factors, such as, for example, the type of lens cover 164, the material from which it is constructed, its intended use and the environment in which the lens cover 164 is used.

[0037] The surfaces 177, 179 of the lens cover 164 can be prepared before application of the parylene coating 176. In certain embodiments, for example, one or both of the exterior and interior surfaces 177, 179 of the main body 167 can undergo treatment and/or cleaning to prime such surfaces 177, 179 to facilitate effective coating of the same. Treatment and cleaning methods used for preparation of the surfaces 177, 179 of the lens cover 164 can include any suitable methods known in the art.

[0038] The parylene coating 176 can be applied to the main body 167 of the lens cover 164 in several ways. In certain embodiments, the parylene coating 176 can be applied to the main body 167 by vacuum deposition, such as chemical vapor deposition (“CVD”); dip coating; spin coating; spray coating, e.g., via one or more spray guns; or any of a variety of other suitable, known coating methods.

[0039] In one embodiment, the parylene coating is applied via a CVD process. The main body 167 is placed into a deposition chamber. Then, parylene gas is introduced into the chamber as a precursor and is deposited on the main body 167. In some embodiments, a solid raw material dimer may be heated and vaporized to provide the parylene gas. The CVD process may be a low-pressure CVD (“LPCVD”); however, it will be appreciated that any of a variety of other suitable, known CVD methods may be employed to coat a main body 167 of a lens cover 164. The application of a conformal coating can be facilitated by the CVD process. In certain embodiments, the CVD process can effect an even parylene coating 176 on the surfaces 177, 179 of the lens cover 164, including oddly-shaped portions and small crevices. In some embodiments, the parylene coating may be pinhole-free. Further, the CVD process can allow for the application of a relatively thin parylene coating 176 with a consistent thickness.

[0040] The foregoing description of embodiments and examples has been presented for purposes of illustration and description. It is not intended to be exhaustive or limiting to the forms described. Numerous modifications are possible in light of the above teachings. Some of those modifications have been discussed and others will be understood by those skilled in the art. The embodiments were chosen and described for illustration of various embodiments. The scope is, of

course, not limited to the examples or embodiments set forth herein, but can be employed in any number of applications and equivalent devices by those of ordinary skill in the art. Rather, it is hereby intended that the scope be defined by the claims appended hereto. Also, for any methods claimed and/or described, regardless of whether the method is described in conjunction with a flow diagram, it should be understood that unless otherwise specified or required by context, any explicit or implicit ordering of steps performed in the execution of a method does not imply that those steps must be performed in the order presented and may be performed in a different order or in parallel.

WHAT IS CLAIMED IS:

1. A lens cover for a light fixture for an indoor growing facility, the lens cover comprising:
 - a main body comprising:
 - a base substrate that is substantially planar and defines an outer perimeter; and
 - a plurality of optical lens elements extending from the base substrate and cooperating with the base substrate to define an exterior surface and an interior surface of the lens cover, each optical lens element of the plurality of optical lens elements being configured for alignment with a light emitting diode; and
 - a parylene coating provided over at least one of the exterior surface and the interior surface of the main body, wherein:
 - the plurality of optical lens elements protrudes from the base substrate at the exterior surface; and
 - the main body is formed as a unitary one-piece construction such that the exterior surface extends continuously between the base substrate and each optical lens element of the plurality of optical lens elements to form a fluid impervious barrier therebetween.
2. The lens cover of claim 1 wherein each optical lens element of the plurality of optical lens elements defines an indentation at the interior surface.
3. The lens cover of claim 1 wherein the parylene coating entirely encapsulates the main body.
4. The lens cover of claim 1 wherein the main body is formed entirely of polycarbonate or polymethyl methacrylate.
5. The lens cover of claim 1 wherein the parylene coating has a thickness of between about 0.5 micrometers and about 10 micrometers.
6. The lens cover of claim 1 wherein the parylene coating comprises parylene N, parylene C, parylene D, parylene F, or copolymers thereof.
7. The lens cover of claim 6, wherein the parylene coating comprises a copolymer of parylene N and parylene C.

8. The lens cover of claim 1 wherein the main body comprises a gasket channel that is routed along the outer perimeter.

9. The lens cover of claim 1, wherein the parylene coating is a conformal coating.

10. A light fixture for an indoor growing facility, the light fixture comprising:

- a housing defining a first portion and a second portion, the second portion defining a window;

- a controller at least partially disposed within the first portion;

- a first lighting module at least partially disposed in the second portion;

- a second lighting module at least partially disposed in the second portion adjacent to the first lighting module, each of the first lighting module and the second lighting module comprising:

- a submount; and

- a plurality of light emitting diodes coupled with the submount and configured to project light through the window; and

- a lens cover overlying the plurality of light emitting diodes and comprising:

- a main body comprising:

- a base substrate that is substantially planar and defines an outer perimeter;
- and

- a plurality of optical lens elements extending from the base substrate and cooperating with the base substrate to provide an exterior surface and an interior surface, each optical lens element of the plurality of optical lens elements are aligned with respective light emitting diodes of the plurality of light emitting diodes; and

- a parylene coating provided over at least one of the exterior surface and the interior surface, wherein:

- the first lighting module and the second lighting module are physically independent from each other;

the plurality of optical lens elements protrudes from the base substrate at the exterior surface; and

the main body is formed as a unitary one-piece construction such that the exterior surface extends continuously between the base substrate and each optical lens element of the plurality of optical lens elements to form a fluid impervious barrier therebetween.

11. The light fixture of claim 10 wherein:

the lens cover and the submount cooperate to define an interior therebetween; and

the light fixture further comprises an encapsulating material that substantially fills the interior and encapsulates the plurality of light emitting diodes; and

the lens cover has a first hardness and the encapsulating material has a second hardness that is less than the first hardness.

12. The light fixture of claim 11 wherein the second hardness is a Shore A of less than 70.

13. The light fixture of claim 11 wherein the encapsulating material comprises a silicone gel.

14. The light fixture of claim 10 wherein the main body is formed entirely of polycarbonate or polymethyl methacrylate.

15. The light fixture of claim 10 wherein each optical lens element of the plurality of optical lens elements defines an indentation at the interior surface.

16. The light fixture of claim 10 wherein the housing defines a passageway between the first portion and the second portion.

17. The light fixture of claim 16 further comprising a plurality of rib members that extend between the first portion and the second portion and are at least partially disposed in the passageway.

18. A lens cover for a light fixture for an indoor growing facility, the lens cover consisting of:

a main body comprising:

a base substrate that is substantially planar and defines an outer perimeter; and

a plurality of optical lens elements extending from the base substrate and cooperating with the base substrate to define an exterior surface and an interior surface of the lens cover, each optical lens element of the plurality of optical lens elements being configured for alignment with a light emitting diode; and

a parylene coating provided over at least one of the exterior surface and the interior surface of the main body, wherein:

the plurality of optical lens elements protrudes from the base substrate at the exterior surface; and

the main body is formed as a unitary one-piece construction such that the exterior surface extends continuously between the base substrate and each optical lens element of the plurality of optical lens elements to form a fluid impervious barrier therebetween.

19. The lens cover of claim 18 wherein each optical lens element of the plurality of optical lens elements defines an indentation at the interior surface.

20. The lens cover of claim 18 wherein the parylene coating entirely encapsulates the base substrate and the plurality of optical lens elements.

21. The lens cover of claim 18 wherein the main body is formed entirely of polycarbonate or polymethyl methacrylate.

22. The lens cover of claim 18 wherein the parylene coating has a thickness of between about 0.5 micrometers and about 10 micrometers.

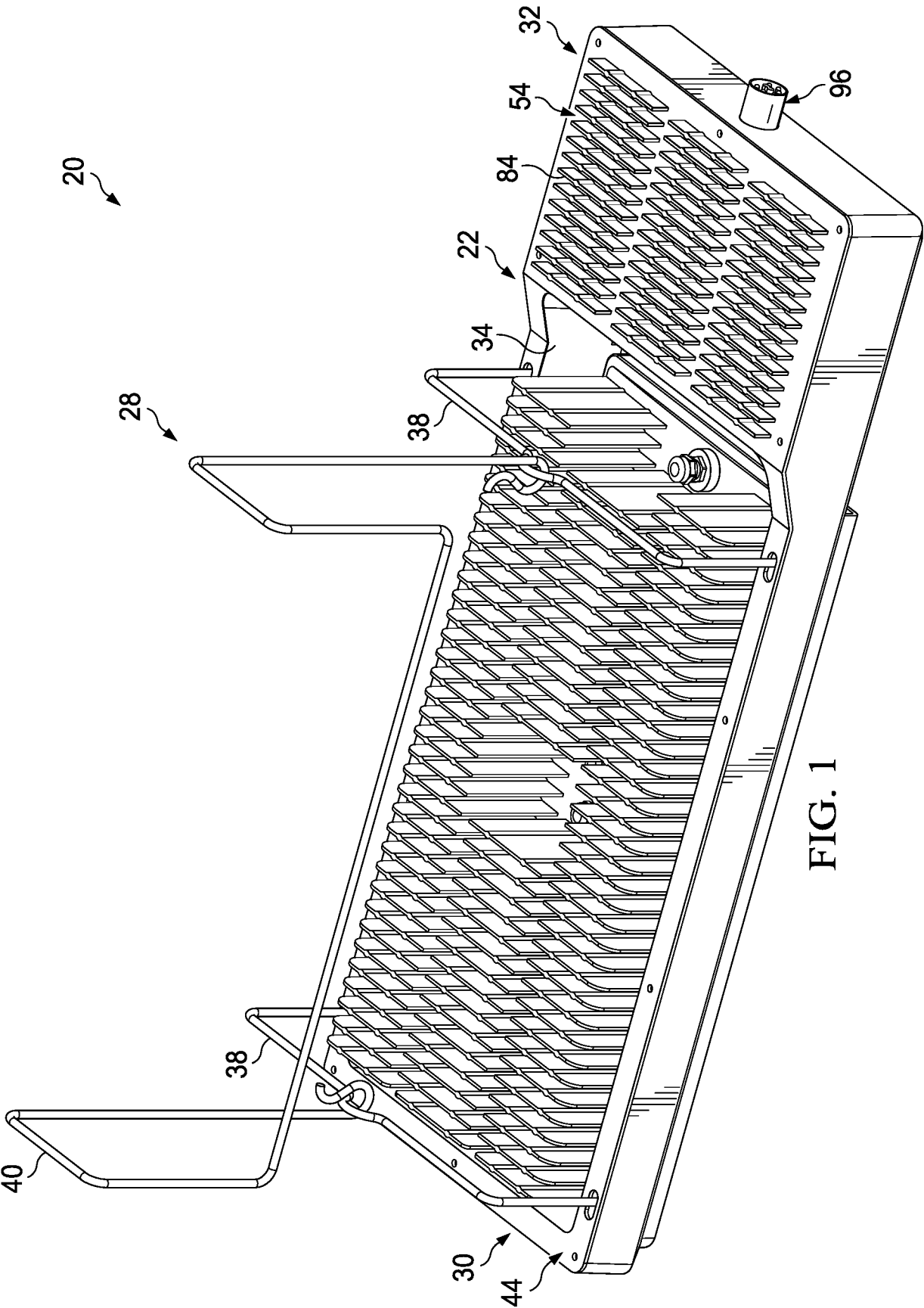
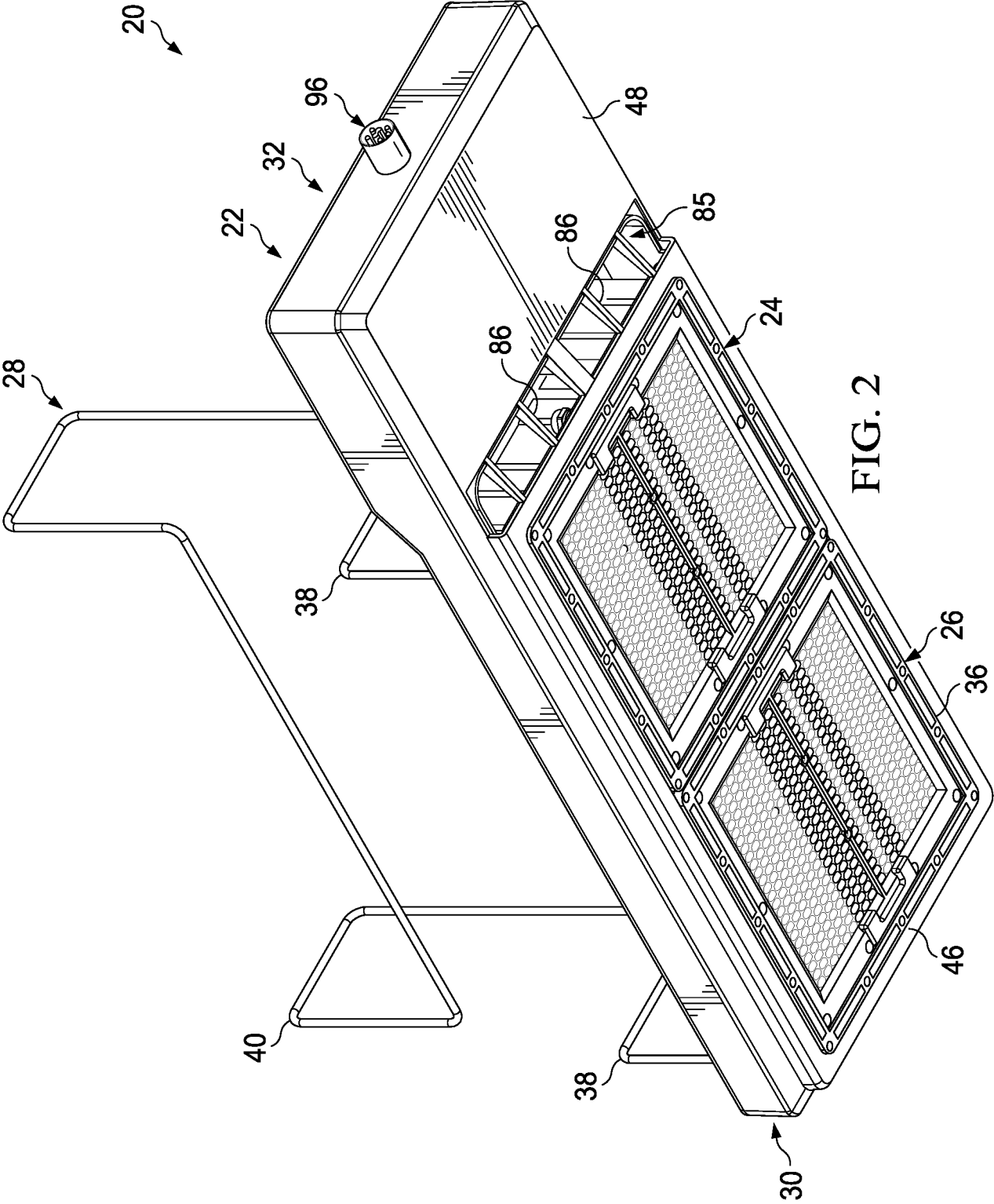
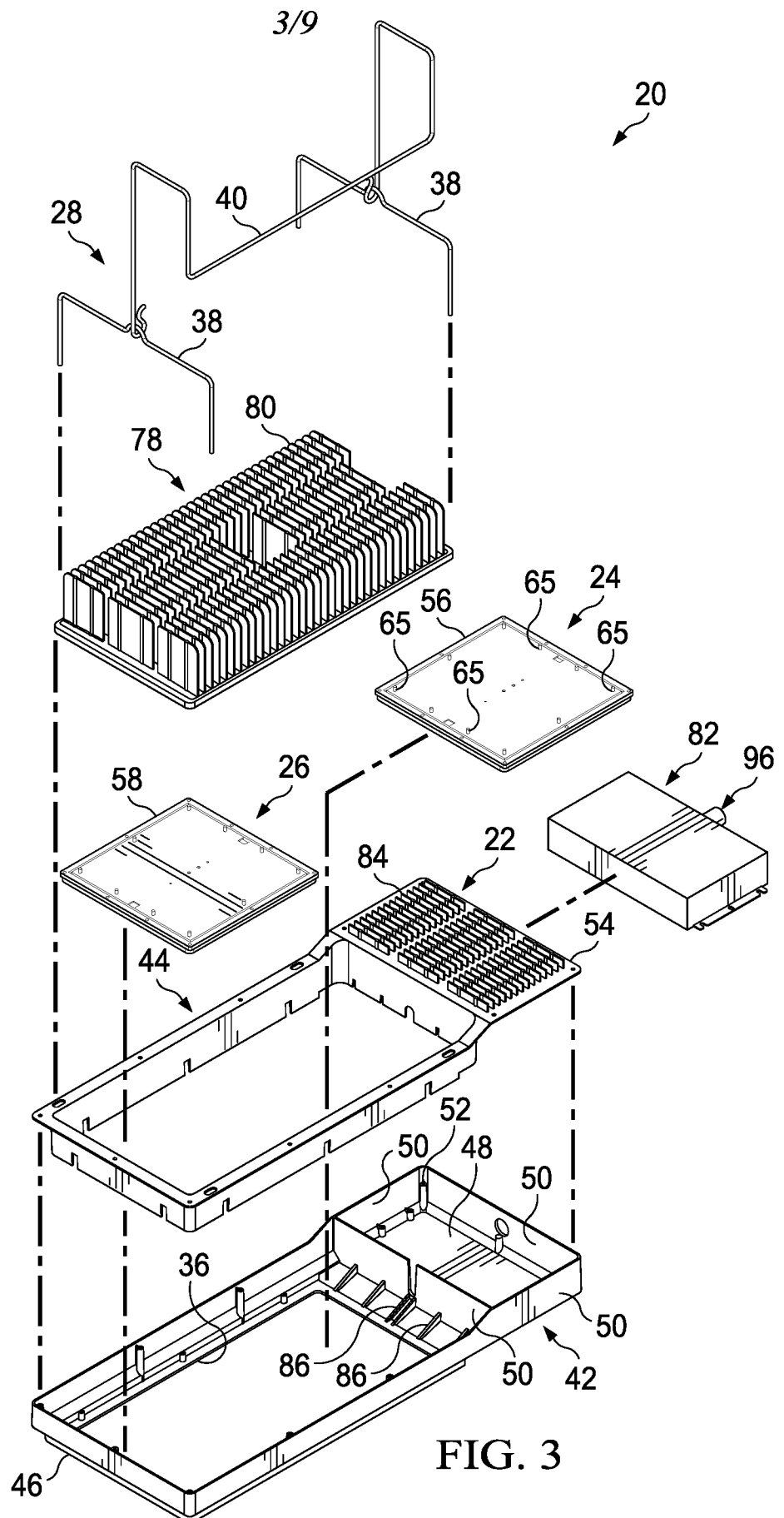
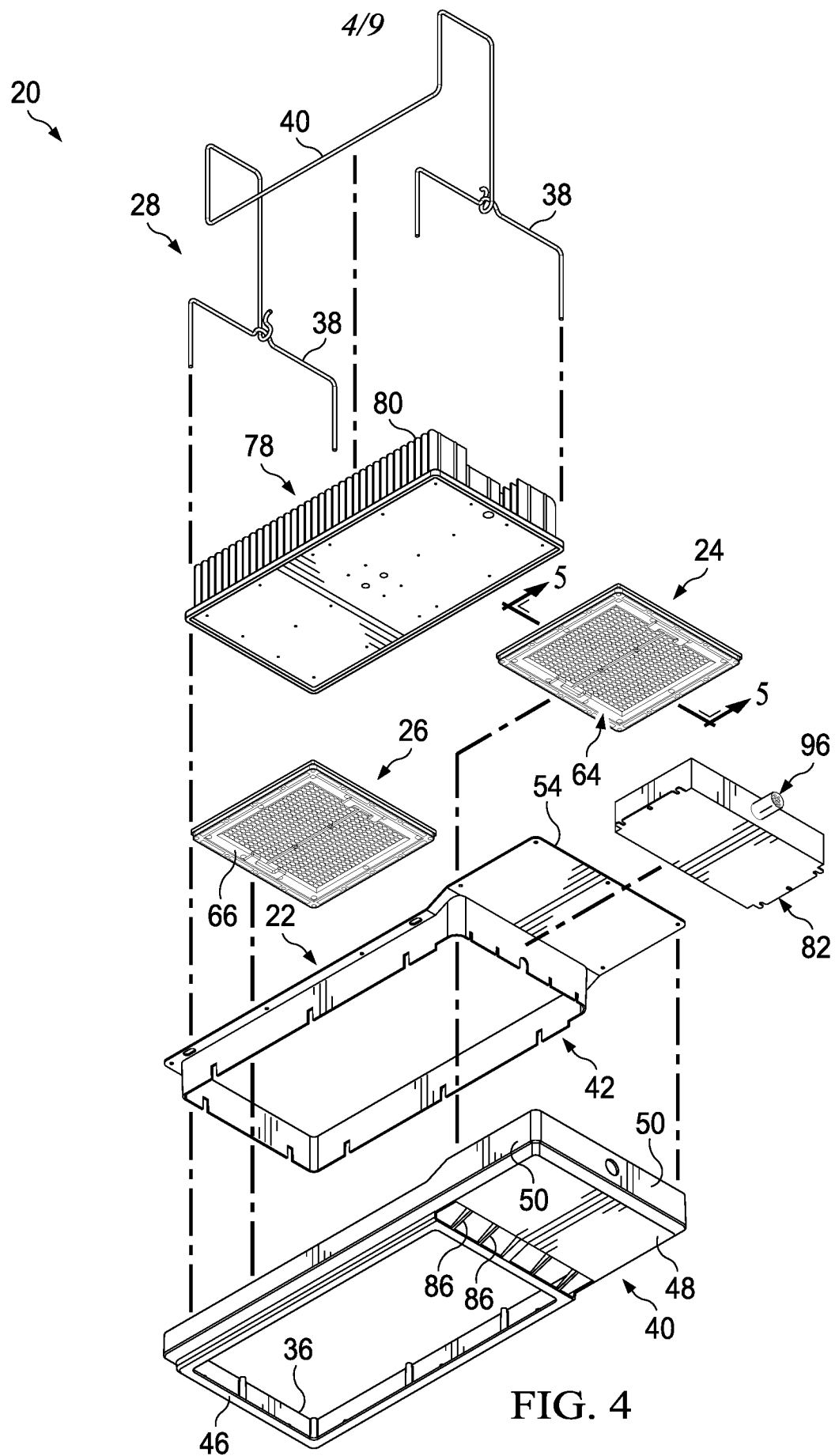


FIG. 1







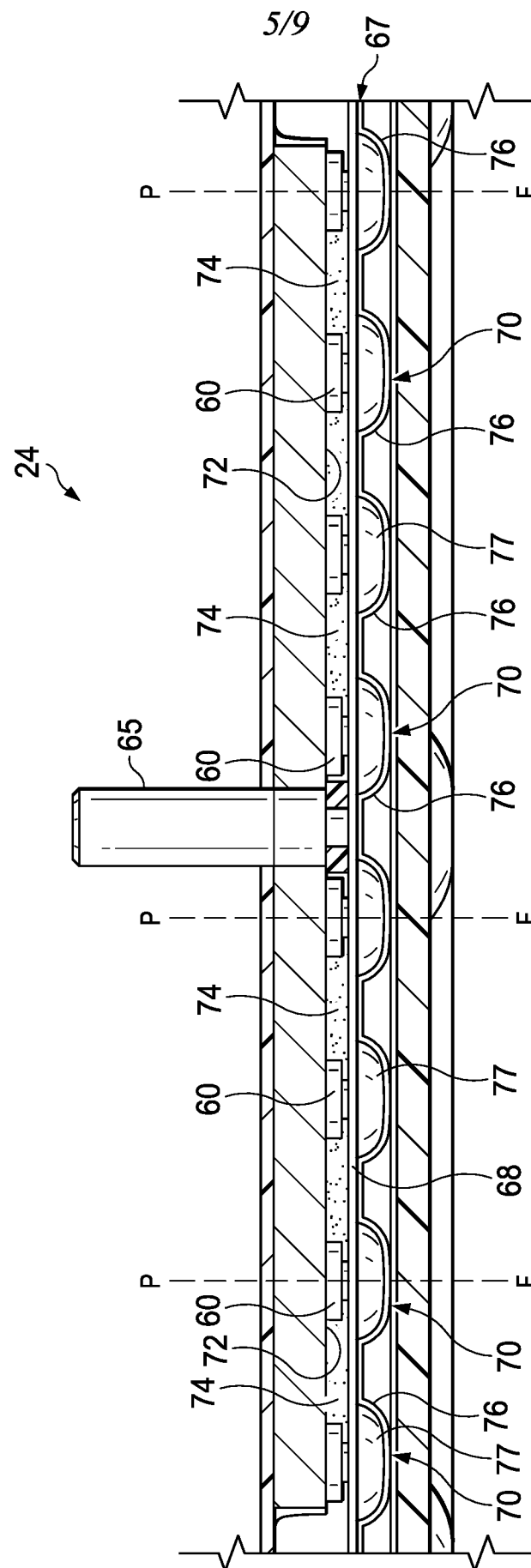


FIG. 5

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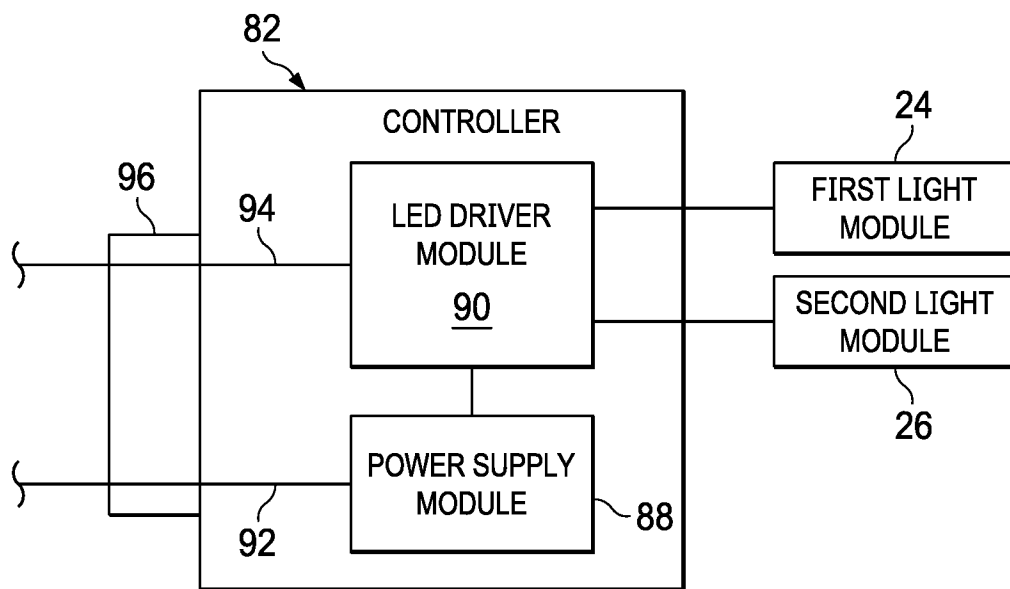
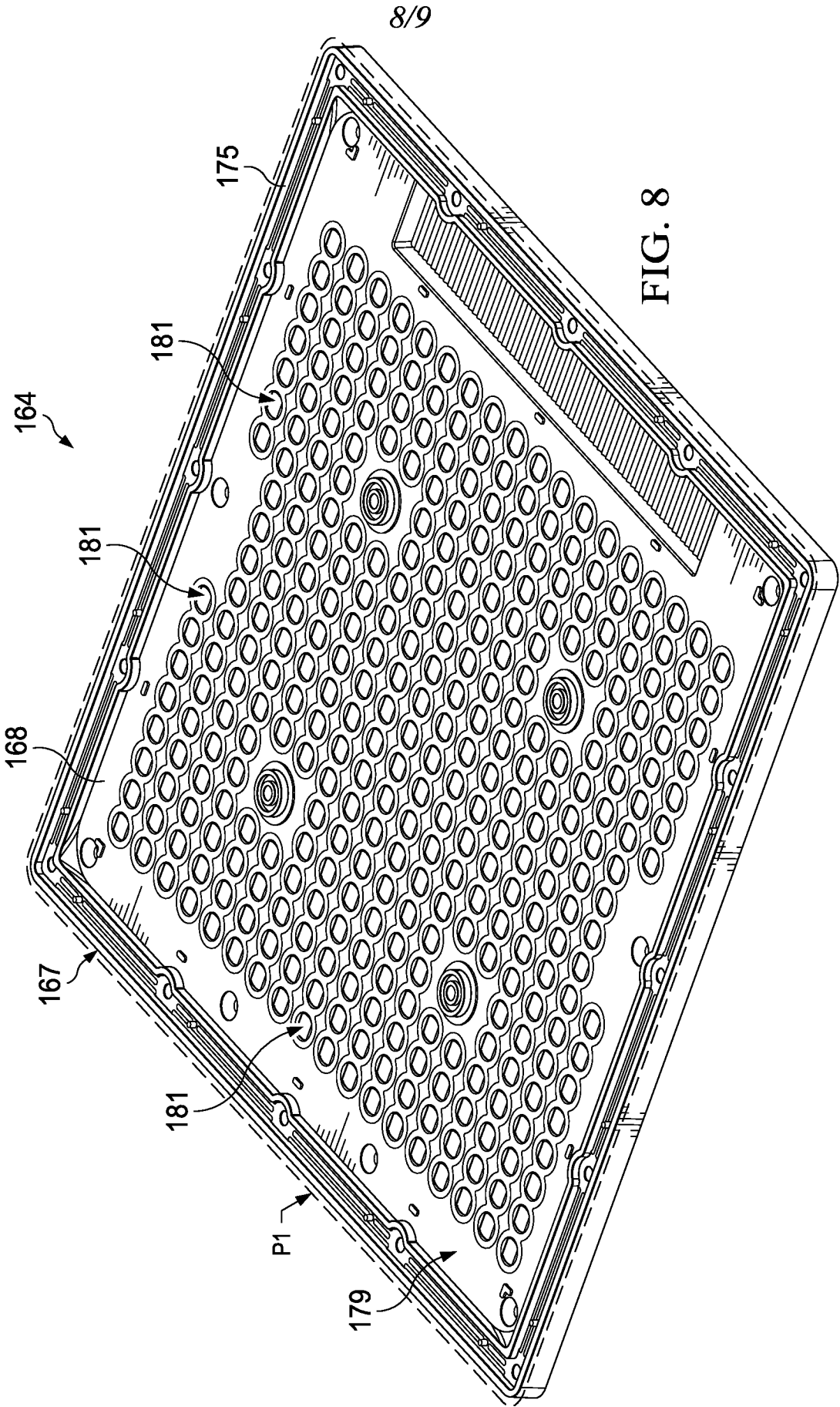
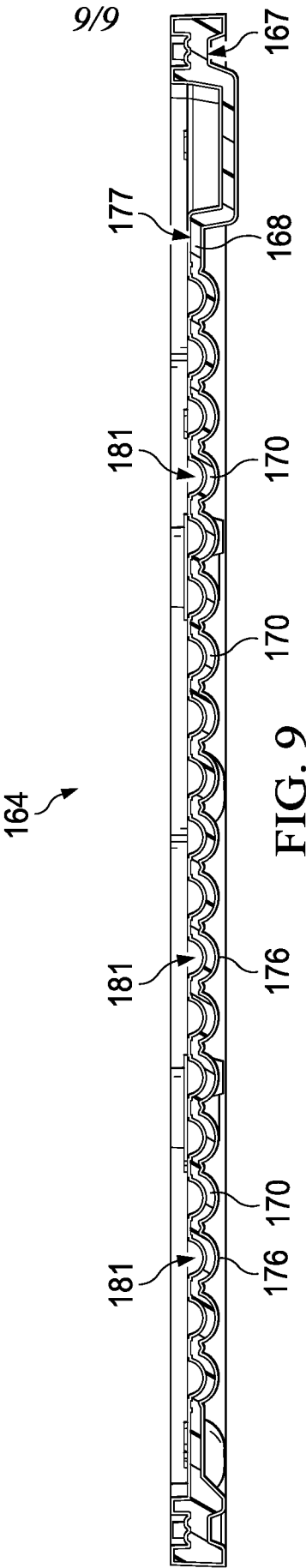


FIG. 6





INTERNATIONAL SEARCH REPORT

International application No.

PCT/US22/34692

A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. F21Y 115/10; A01G 9/20; F21V 3/10; F21V 31/04 (2022.01)

ADD.

CPC - INV. F21Y 2115/10; F21S 8/00; F21V 3/10; F21V 31/04

ADD. A01G 7/04; A01G 7/045; A01G 9/249; F21S 8/063; F21V 5/007; F21V 5/04; F21V 15/00; F21V 29/763; F21Y 2105/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

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

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2022/0170610 A1 (HGCI, INC.) 02 June 2022; paragraphs 0002, 0004, 0005, 0022, 0024, 0025, 0026, 0027, 0028, 0029, 0030, 0034, 0040, 0041	1-22
Y	US 2017/0362703 A1 (HZO, INC.) 21 December 2017; paragraphs 0046, 0062	1-22
Y	US 8,142,047 B2 (ACAMPORA ET AL) 27 March 2012; column 1, lines 53-60	8
Y	KIM et al. "Enhancement of the thermo-mechanical properties of PDMS molds for the hot embossing of PMMA microfluidic devices" 1-10. JOURNAL OF MICROMECHANICS AND MICROENGINEERING.[retrieved 02 September 2022]; Retrieved from the Internet: https://www.researchgate.net/publication/258297348_Enhancement_of_the_thermo-mechanical_properties_of_PDMS_molds_for_the_hot_embossing_of_PMMA_microfluidic_devices . 28 August 2013; Entire Document	12

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Further documents are listed in the continuation of Box C.

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*

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document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"

document member of the same patent family

Date of the actual completion of the international search

02 September 2022 (02.09.2022)

Date of mailing of the international search report

OCT 06 2022

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Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-8300

Authorized officer

Shane Thomas

Telephone No. PCT Helpdesk: 571-272-4300