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Girolami

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(54) **JUNCTION UNIT FOR USE IN A LIGHTING BALLOON APPARATUS**

(71) Applicant: **Sourcemaker, Inc.**, Valley Cottage, NY (US)

(72) Inventor: **Peter R. Girolami**, Wilmington, NC (US)

(73) Assignee: **Sourcemaker, Inc.**, Valley Cottage, NY (US)

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F21V 3/02	(2006.01)
F21V 21/116	(2006.01)
F21Y 115/10	(2016.01)

(52) **U.S. Cl.**

CPC ***F21V 29/677*** (2015.01); ***F21V 3/026*** (2013.01); ***F21V 21/116*** (2013.01); ***F21V 29/763*** (2015.01); *F21Y 2115/10* (2016.08)

(58) **Field of Classification Search**

CPC F21V 21/116; F21V 29/763; F21V 3/026; F21V 29/677

See application file for complete search history.

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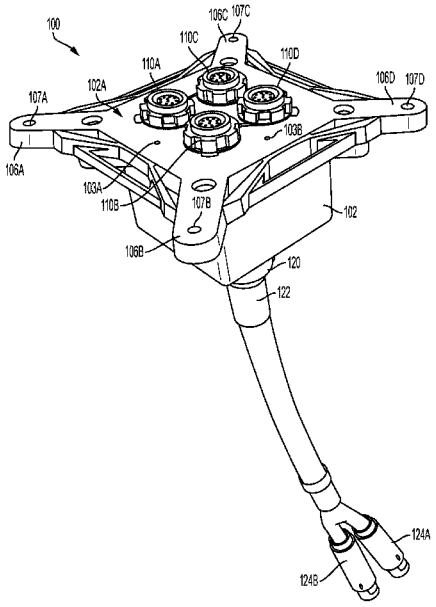
Primary Examiner — Bryon T Gyllstrom
Assistant Examiner — Christopher E Dunay
(74) *Attorney, Agent, or Firm* — Lowenstein Sandler LLP

(57) **ABSTRACT**

A junction unit adapted for use in a lighting balloon apparatus is provided. The junction unit comprises a body, a first attachment region disposed on the body to couple to one or more lighting modules, and a second attachment region disposed on the body to couple to a header cable that provides power to the one or more lighting modules.

14 Claims, 8 Drawing Sheets



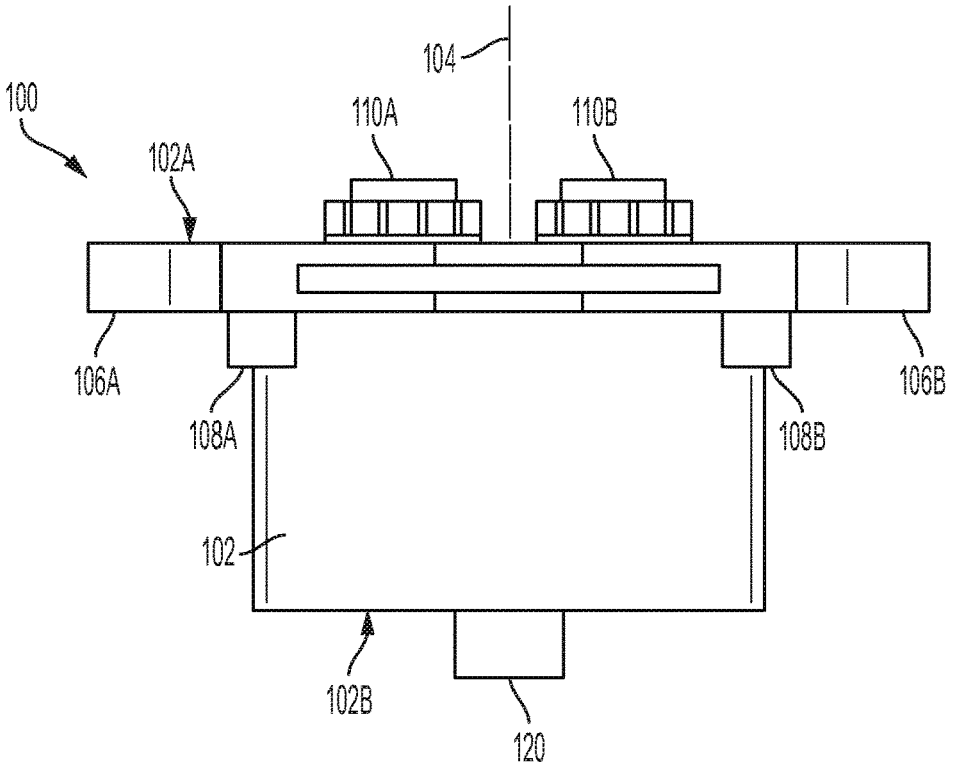

104
100
110A
110B
102A
106A
106B
108A
108B
102
102B
120

FIG. 1A

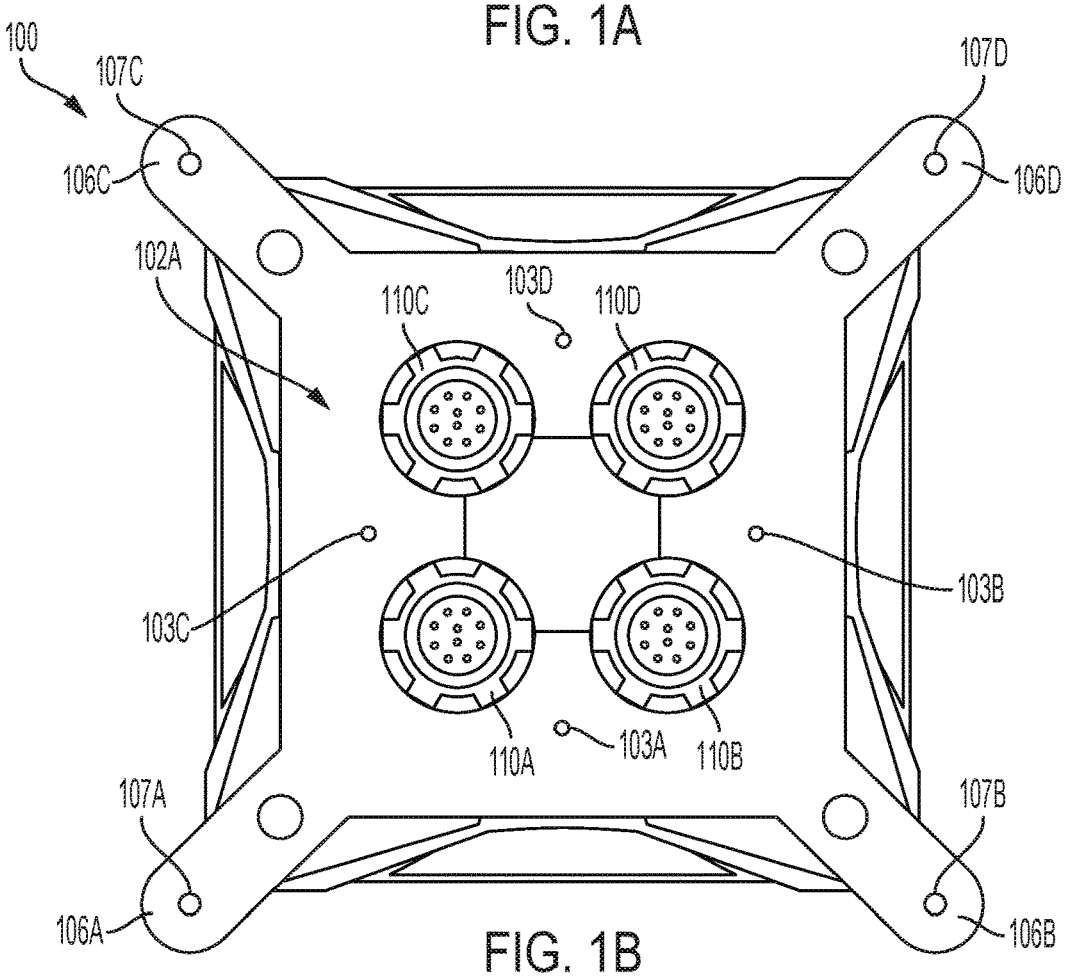

100
107C
107D
106C
106D
102A
110C
103D
110D
103C
103B
110A
103A
110B
107A
107B
106A
106B

FIG. 1B

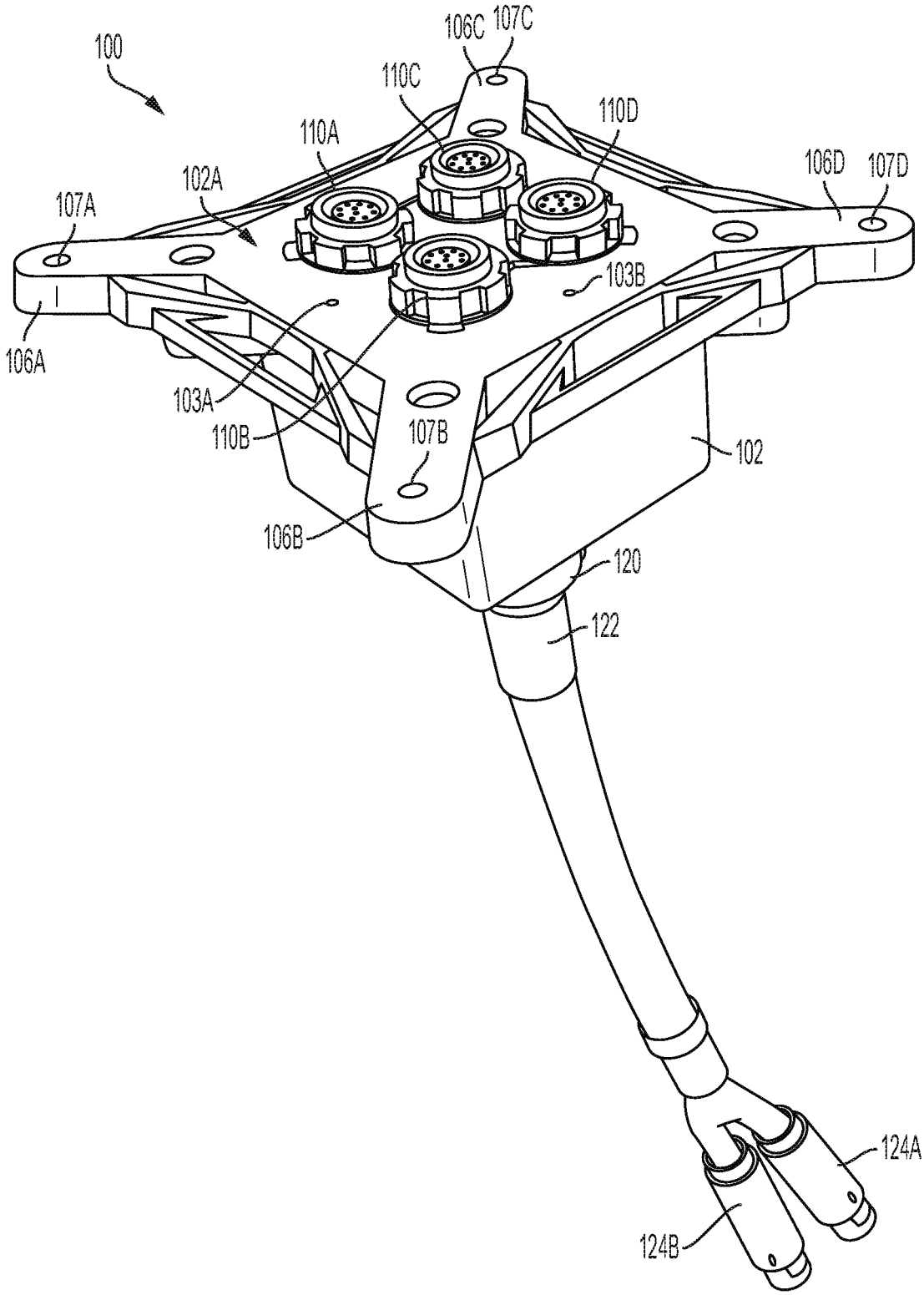

100
106C
107C
110C
110D
110A
102A
106D
107D
107A
103B
106A
103A
110B
107B
102
106B
120
122
124A
124B

FIG. 1C

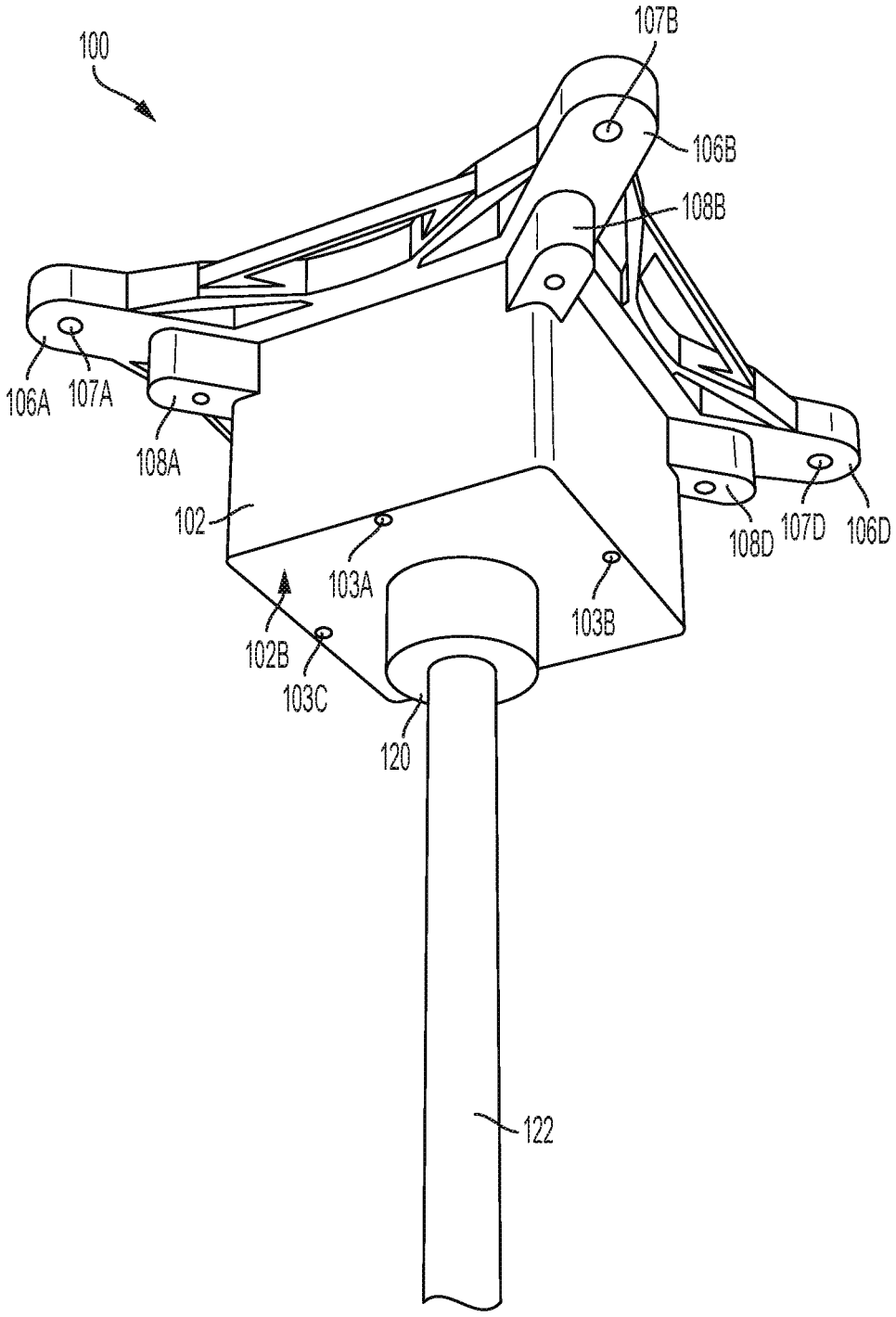

100
107B
106B
108B
106A
107A
108A
102
103A
102B
103C
120
103B
108D
107D
106D
122

FIG. 1D

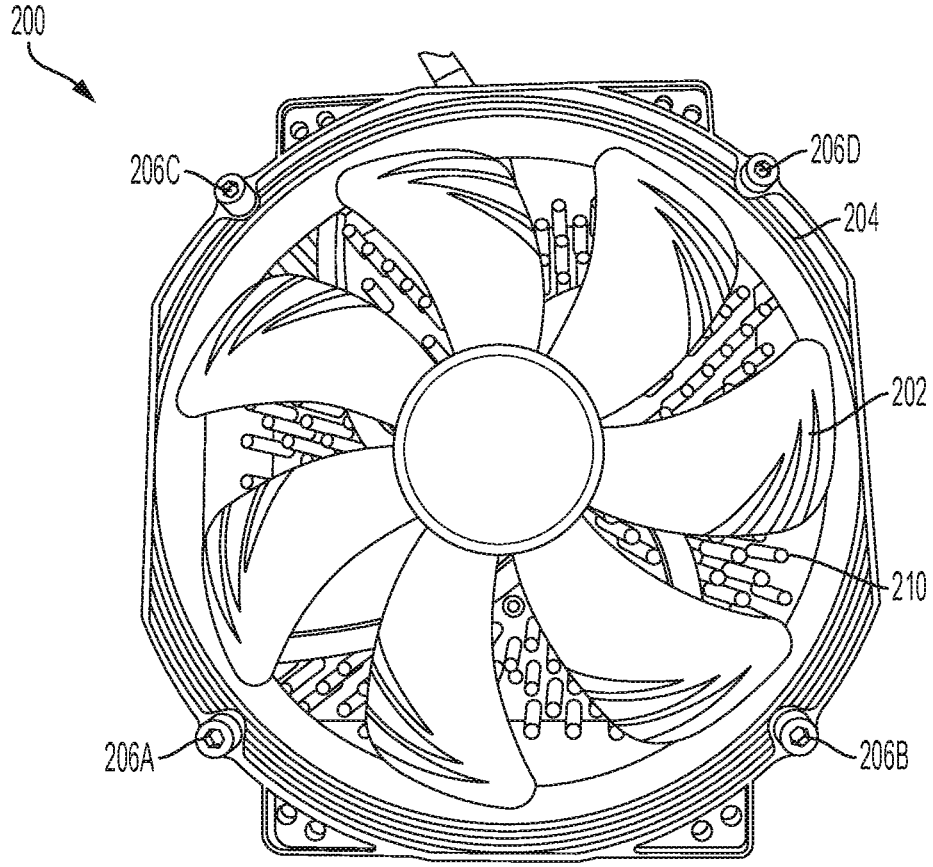

200
206C
206D
204
202
210
206A
206B

FIG. 2A

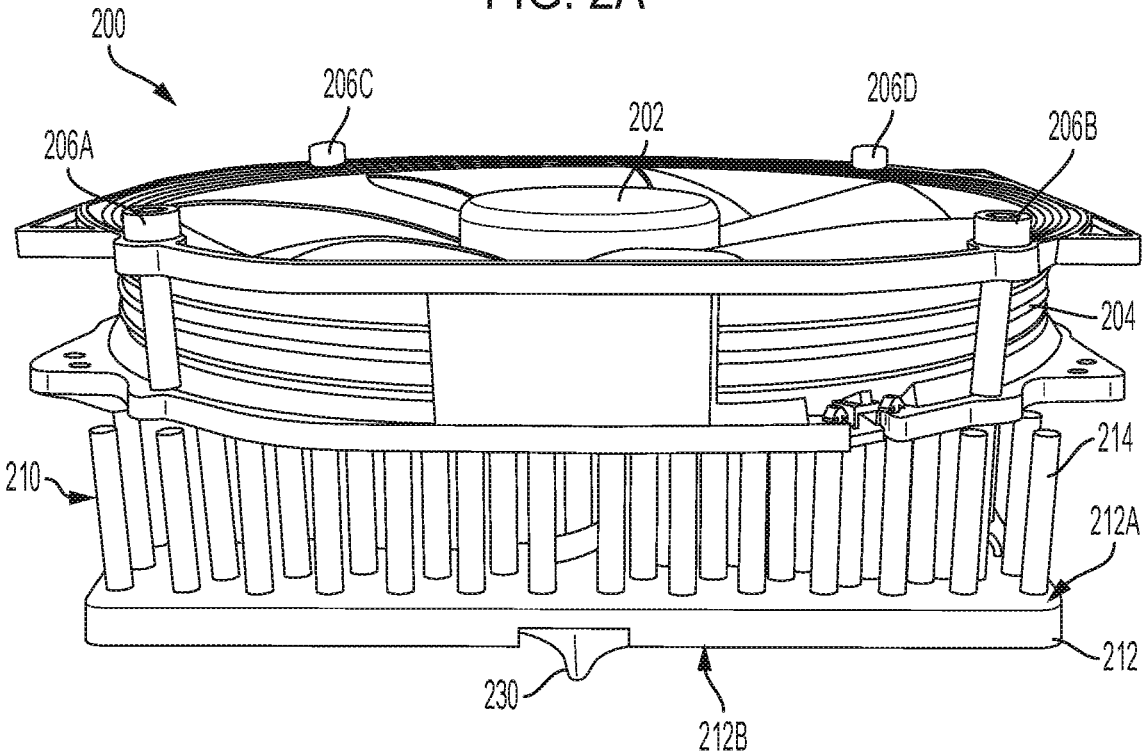

200
206C
206D
202
206A
206B
204
214
210
212A
212
230
212B

FIG. 2B

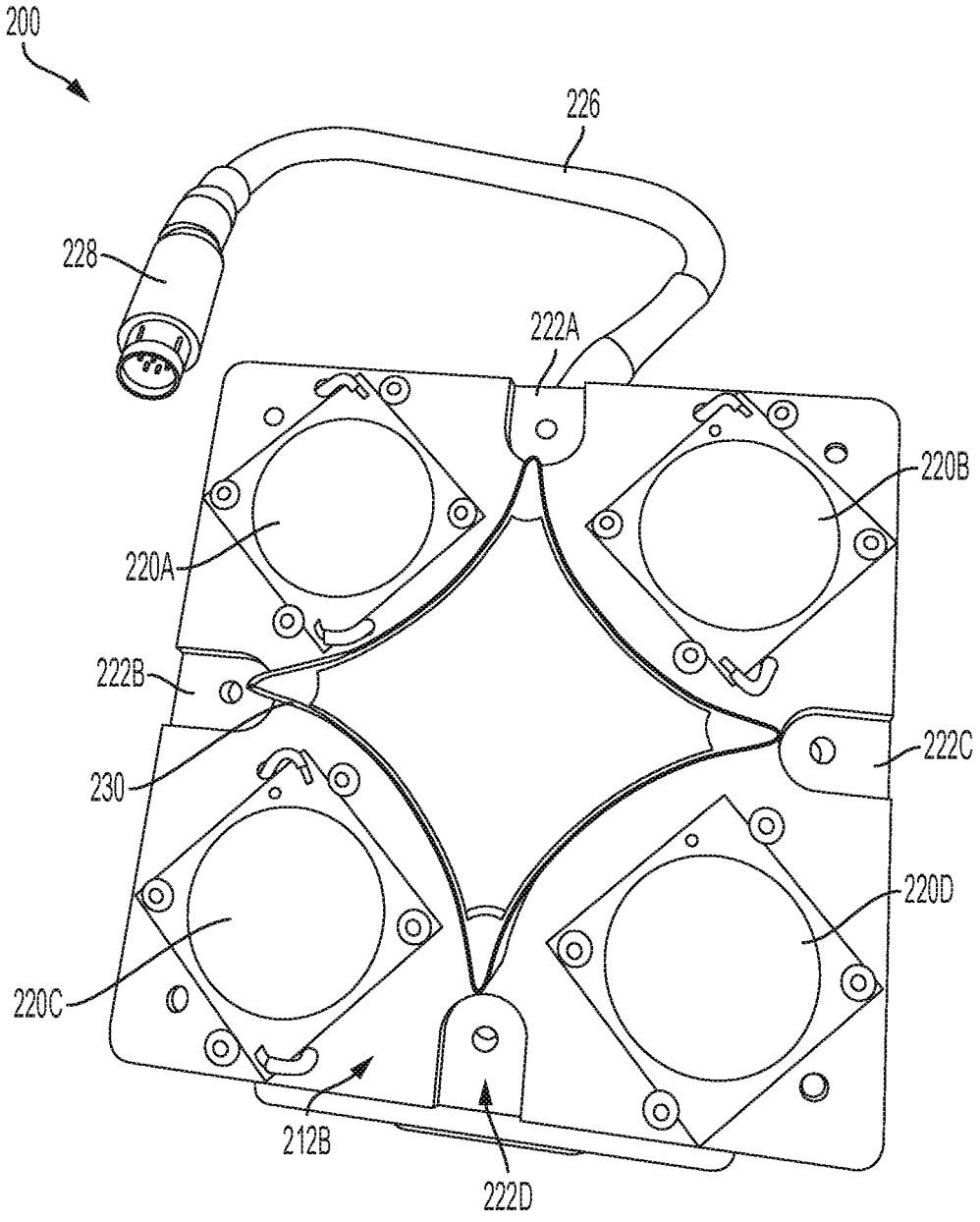


FIG. 2C

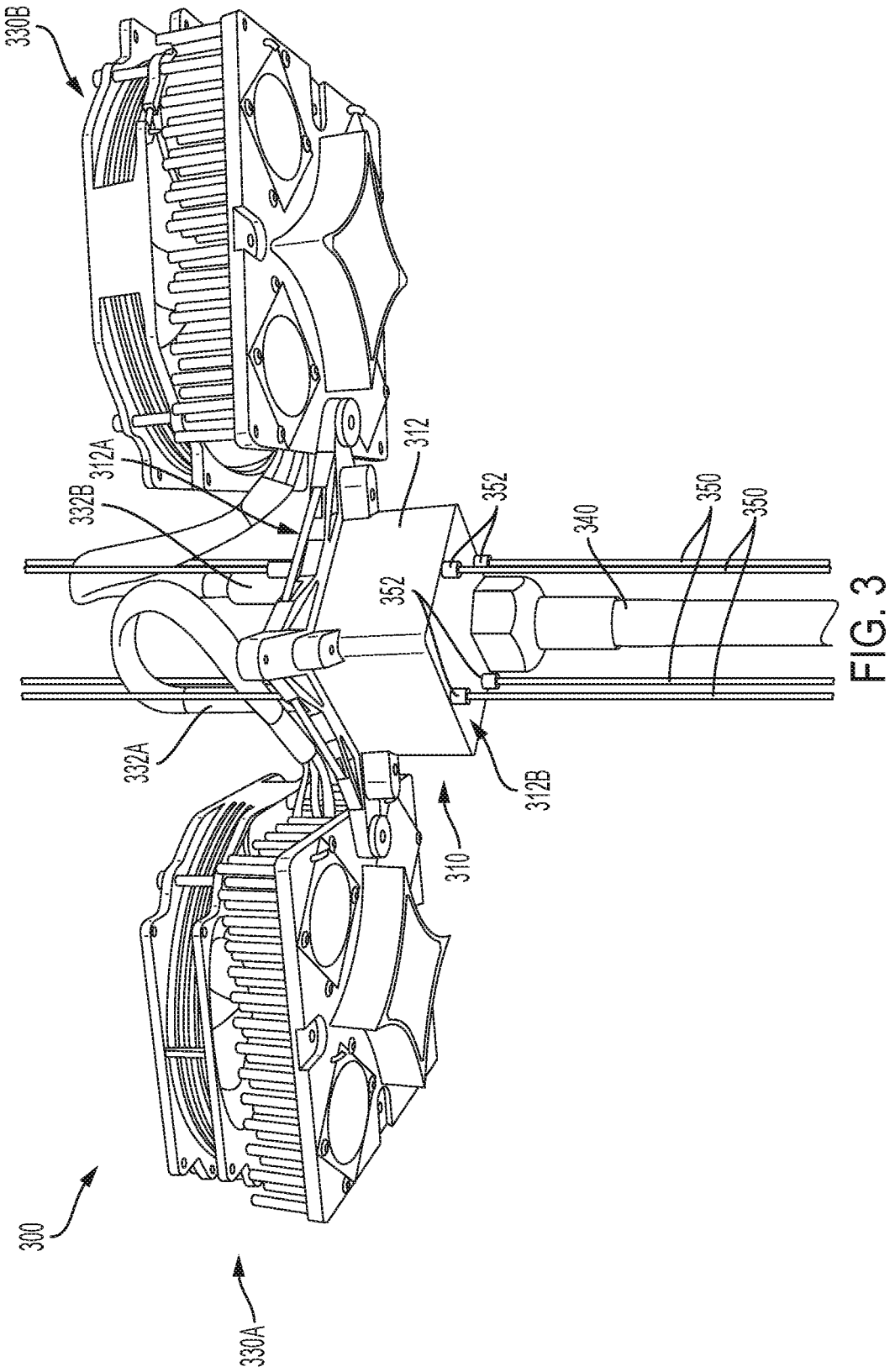


FIG. 3

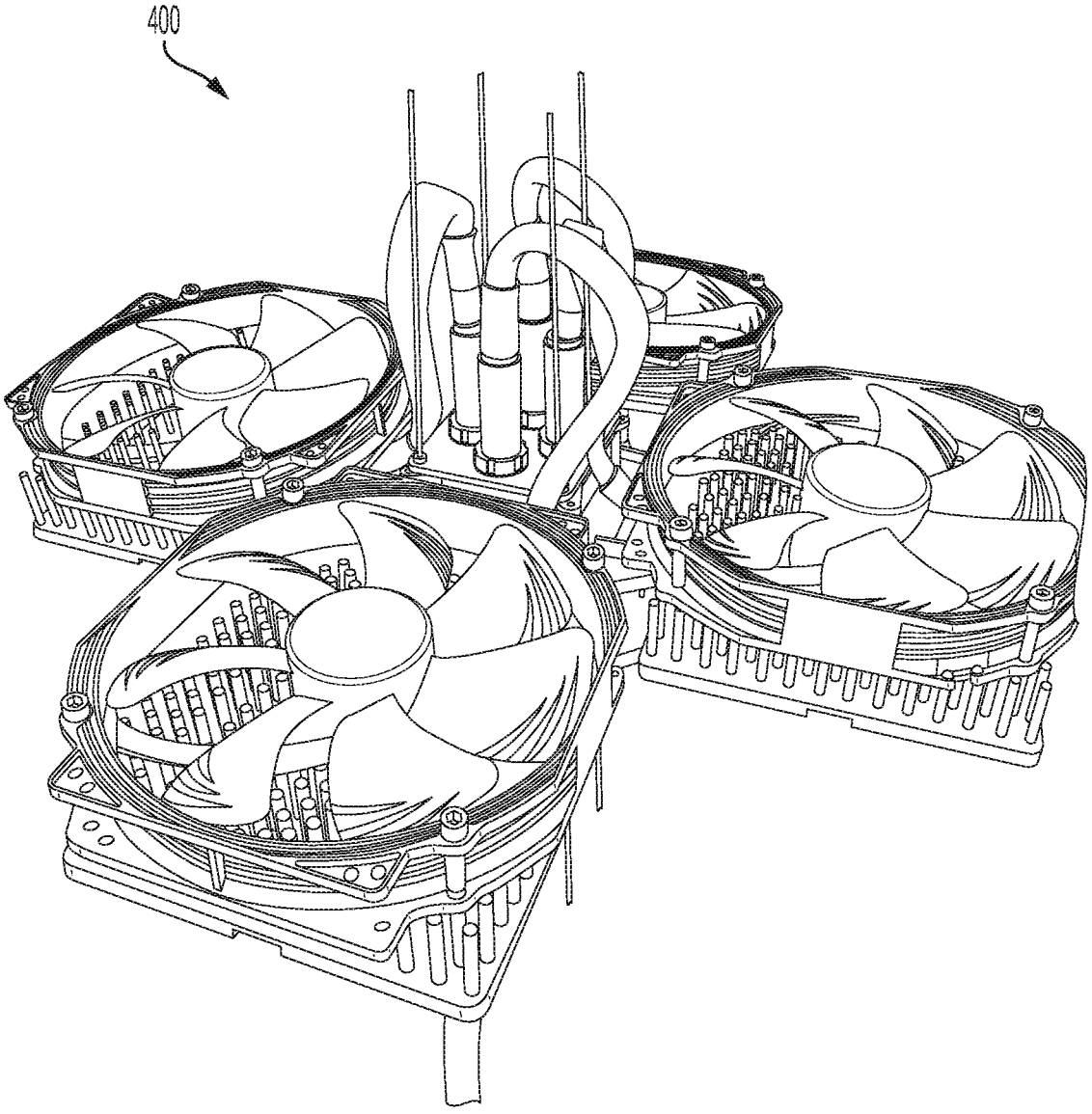


FIG. 4

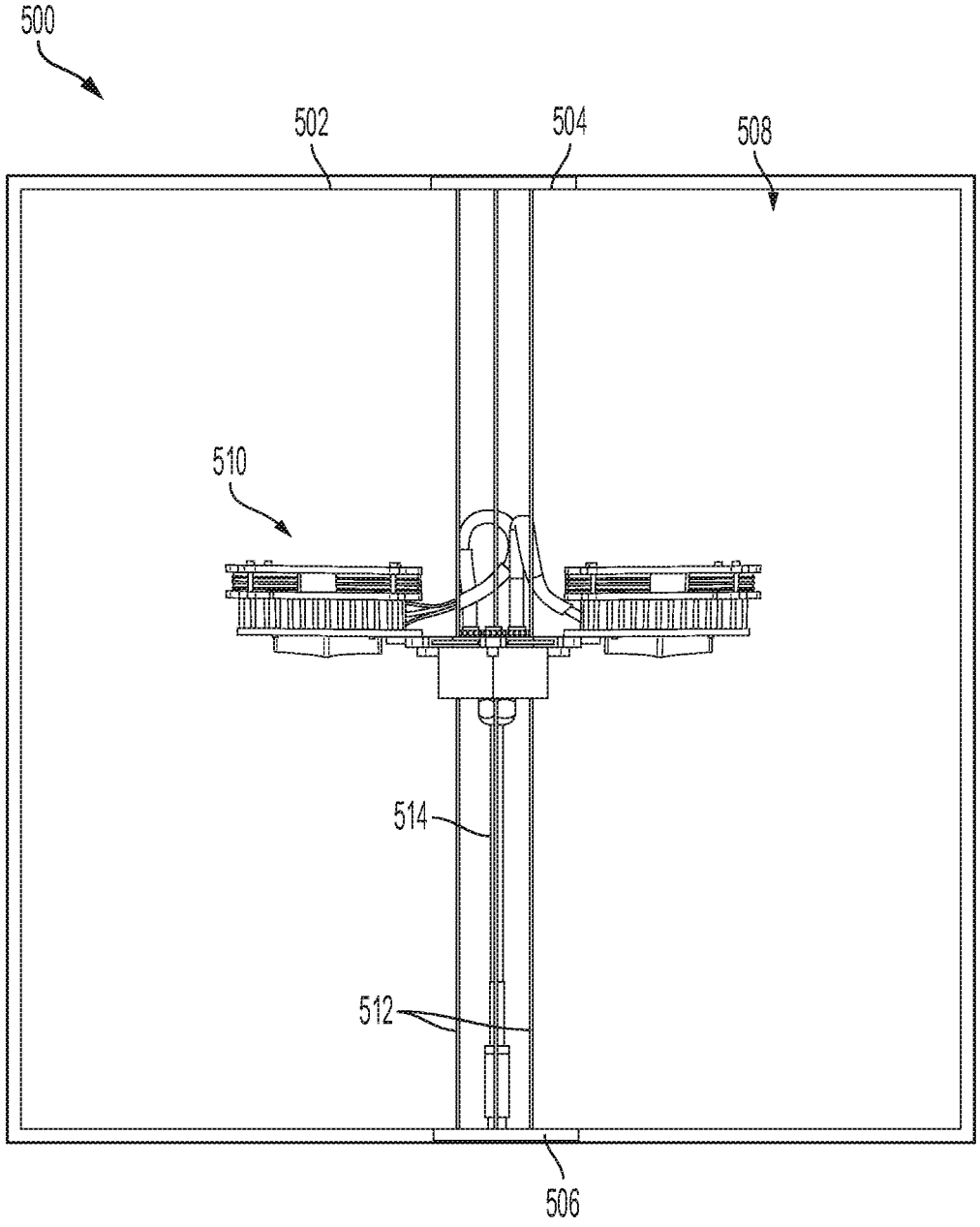


FIG. 5

JUNCTION UNIT FOR USE IN A LIGHTING BALLOON APPARATUS

TECHNICAL FIELD

Embodiments of the present invention relate generally to a lighting apparatus and, more particularly, to a junction unit and lighting harness assembly to be incorporated into a lighting balloon apparatus.

BACKGROUND

Proper lighting is essential in the filming and photography industry. However, many of the traditional lighting solutions offered in the industry are limited by their ability to accommodate multiple applications. This is often the case, for example, when there are frequent changes in lighting requirements or placement position. Moreover, many lighting solutions that incorporate high output light-emitting diodes (LEDs) are difficult to use due to their high weight and substantial heat generation.

Accordingly, there is a need for improved lighting solutions with particular applicability in the filming and photography industry.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example, and not by way of limitation, and will become apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

FIG. **1**A illustrates a side view of a junction unit in accordance with an exemplary embodiment of the present invention;

FIG. **1**B illustrates a top view of the junction unit in accordance with an exemplary embodiment of the present invention;

FIG. **1**C illustrates a top perspective view of the junction unit in accordance with an exemplary embodiment of the present invention;

FIG. **1**D illustrates a bottom perspective view of the junction unit in accordance with an exemplary embodiment of the present invention;

FIG. **2**A illustrates a top view of a lighting module in accordance with an exemplary embodiment of the present invention;

FIG. **2**B illustrates a side view of the lighting module in accordance with an exemplary embodiment of the present invention;

FIG. **2**C illustrates a bottom view of the lighting module in accordance with an exemplary embodiment of the present invention;

FIG. **3** illustrates a bottom perspective view of a lighting harness assembly including two lighting modules coupled to a junction unit in accordance with an exemplary embodiment of the present invention;

FIG. **4** illustrates a top perspective view of a lighting harness assembly including four lighting modules coupled to a junction unit in accordance with an exemplary embodiment of the present invention; and

FIG. **5** illustrates a side view of a lighting balloon apparatus including a lighting harness assembly in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION

Embodiments of the present invention include a junction unit for insertion into a lighting balloon, a junction unit operably coupled to one or more lighting modules, a lighting assembly including a junction unit, and a lighting balloon apparatus incorporating a junction unit. The embodiments described herein allow for the assembly of high output LED lighting balloons while mitigating issues associated with weight and heat generation.

In certain embodiments, a junction unit serves as a hub for one or more lighting modules and routes power and signals to the one or more lighting modules. The lighting modules include light sources, such as LEDs, and may be actively or passively cooled. In embodiments that utilize active cooling, a lighting module may include a fan and optionally a heat sink. The fan circulates air to dissipate heat generated by the light sources when in operation. In embodiments that utilize passive cooling, a lighting module may include a heat sink without a fan. In certain embodiments, actively cooled modules may be powered by direct current (DC). In certain embodiments, passively cooled modules may be powered by alternating current (AC).

Active or passive cooling may be implemented during operation while the junction unit and lighting modules are suspended in a lighting harness assembly within a sealed balloon. In certain embodiments, the lighting harness assembly is disposed at the center of the balloon envelope to evenly distribute its weight. While the embodiments illustrated and described herein correspond to two-module and four-module assemblies, it is to be understood that the junction unit may be adapted to couple to any number of lighting modules, such as one, two, three, four, five, six, or more lighting modules. Moreover, it is to be understood that a lighting balloon apparatus may incorporate multiple lighting harness assemblies, which may be arranged in a manner that evenly distributes the overall weight of the lighting balloon apparatus (i.e., a centrally located center of mass).

In certain embodiments, the lighting harness assembly is arranged such that the light sources (e.g., LEDs) cast light in a downward direction (i.e., substantially along the direction of the earth's gravitational force) through the balloon envelope creating a diffused light effect. In certain embodiments, the LEDs may include one or more high color rendering index (CRI) LEDs, which may include daylight, tungsten, a "hybrid" of both color temperatures, and/or RGB-A (red, green, blue, amber).

FIGS. **1**A-**1**D illustrate an embodiment of a junction unit **100** in accordance with an exemplary embodiment of the present invention. The junction unit **100** comprises a body **102**, which may be solid or hollow. In certain embodiments, the body **102** is constructed from a durable material, such as a metal or a high-density plastic (e.g., polyvinyl chloride, polyethylene terephthalate, high density polyethylene, polypropylene, and polyurethane). The junction unit includes a first attachment region **102**A and a second attachment region **102**B which may, for example, be disposed on opposite surfaces of the body **102**. Each of the first attachment region **102**A and **102**B may include mechanical adapters for physically securing one or more objects to the body **102**, as well as ports for electrically coupling to one or more electronic components. The first attachment region **102**A includes arms **106**A-**106**D, which are depicted as being distributed symmetrically about the central axis **104** and extending radially outward from the body **102**. Slots **107**A-**107**D are formed in the arms **106**A-**106**D, respectively, which are adapted to receive and secure lighting modules, as will be discussed

later with respect to FIGS. **2**A-**2**C. The slots **107**A-**107**D may be in a form of apertures, for example, or other mechanical structures to facilitate mechanical coupling to their respective lighting modules, as would be appreciated by one of ordinary skill in the art. The body **102** may further include struts **108**A-**108**D to provide structural support to the arms **106**A-**106**D, respectively (strut **108**C is obscured in FIGS. **1**A-**1**D, but would be located behind strut **108**A in FIG. **1**A and below arm **106**C in FIG. **1**B).

The first attachment region **102**A further includes module power ports **110**A-**110**D, which are depicted as being distributed symmetrically about a central axis **104** of the body **102**. It is to be understood that any suitable number of module power ports may be present, and need not be coplanar or distributed symmetrically as shown. Each of the module power ports **110**A-**110**D is arranged to be adjacent to respective arms **106**A-**106**D (e.g., module power port **110**A is adjacent to arm **106**A, module power port **110**B is adjacent to arm **106**B, etc.), though other suitable arrangements and configurations are possible.

The second attachment region **102**B includes a source power port **120** which may be adapted to couple to a header cable **122**, and may be a threaded connector that the header cable **122** can screw onto. In certain embodiments, the header cable **122** houses a plurality of electrically isolated channels to provide power to light sources (e.g., LEDs) of lighting modules coupled to the junction unit **100**. In certain embodiments, when the header cable **122** is attached to the source power port **120**, the channels within the header cable **122** are electrically coupled to channels housed within the body **102**, which extend through the body **102** to establish electric coupling with respective module power ports **110**A-**110**D. The header cable **122** terminates at connectors **124**A and **124**B, for example, which may be coupled to a power supply through one or more intermediate junctions. In certain embodiments, the power supply may comprise one or more power supplies connected together in series or in parallel. In certain embodiments, one or more solar panels may be utilized as a power source or in combination with one or more power sources.

The body **102** further includes apertures **103**A-**103**D for receiving suspension cables that may be used to suspend the junction unit **100** in a harness arrangement, as will be discussed later with respect to FIGS. **3**-**5**. In certain embodiments, the apertures **103**A-**103**D pass through the body **102** from the first attachment region **102**A to the second attachment region **102**B.

Although the body **102** is depicted as box-shaped, it is to be understood that the body **102** may have other shapes, such as triangular, hexagonal, circular, or any other suitable shape to accommodate a substantially radial distribution of arms **106**A-**106**D. Moreover, various dimensions of body **102** may be provided to accommodate different lighting applications. In certain embodiments, the body **102** may be omitted entirely resulting in a more compact form of the junction unit **100**.

FIGS. **2**A-**2**C illustrates a lighting module **200** in accordance with an exemplary embodiment of the present invention. The lighting module **200** includes a fan **202**, a heat sink **210**, and a plurality of light sources **220**A-**220**C. Active cooling (i.e., where the heat sink **210** is exposed to a continuous or semi-continuous flow of air) may be achieved in embodiments that include the fan **202**, though the fan may **202** may be omitted in other embodiments. In embodiments where the lighting module **200** does not include the fan **202**, such embodiments may be said to utilize passive cooling (i.e., where the heat sink **210** is exposed to a stationary air). The fan **202** includes a surrounding frame **204** which may couple to the heat sink **210** through connectors **206**A-**206**D. For example, the connectors **206**A-**206**D may be screws or fasteners that couple to, for example, a support plate **212** of the heat sink **210**.

The heat sink **210** includes the support plate **212**, which has an upper surface **212**A having a plurality of columns **214** formed thereon. The columns **214** facilitate heat dissipation by providing high surface area for contacting the surrounding air. In embodiments that utilize the fan **202**, the structure of the heat sink **210** allows for air flow to be circulated directly through the columns **214**. In certain embodiments, the support plate **212** and the columns **214** are collectively formed from a single unitary metallic material.

Reference is now made to FIG. **2**C, which illustrates a bottom view of the lighting module **200**, and specifically the components disposed on a lower surface **212**B of the support plate **212**. Light sources **220**A-**220**D are coupled directly to the lower surface **212**B, which allows the light sources **220**A-**220**D to be in direct contact with the heat sink. Power and control signals may be provided to the light sources **220**A-**220**D through a power cable **226**, which may include an adapter **228** that can be coupled to a module power port on a junction unit (e.g., one of the module power ports **110**A-**110**B of the junction unit **100** described with respect to FIGS. **1**A-**1**D). In certain embodiments, and as illustrated in FIG. **2**C, the light sources **220**A-**220**D may be chip on board (COB) LEDs. One or more of the light sources **220**A-**220**D may be high color rendering index (CRI) LEDs adapted for daylight or tungsten color temperatures, for example. In certain embodiments, the high CRI LEDs may be adapted for a CRI of 87+, 90+, or 95+. In certain embodiments, one or more of the light sources **220**A-**220**D may be an RGB-A LED. In certain embodiments, the light sources **220**A-**220**D may be blended collectively as a hybrid of color temperatures (e.g., light source **220**A may be a tungsten LED, light source **220**B may be a daylight LED, etc.). In certain embodiments, the light sources **220**A-**220**D may be controlled individually or together as a group. In embodiments where the light sources **220**A-**220**D are individually controlled, the power cable **226** may include individual electrically isolated channels that power each of the light sources **220**A-**220**D individually. In certain embodiments, one or more of the light sources **220**A-**220**D may include a lens that is coupled directly or indirectly thereto or is integrally formed thereon.

The lower surface **212**B of the support plate **212** further includes a spacer **230**, which protects the light sources **220**A-**220**D from damage when the lighting module is placed on a surface. In certain embodiments, the surfaces of the spacer **230** are reflective to reflect light generated by the light sources **220**A-**220**D. The lower surface **212**B of the support plate **212** may further comprise coupling regions **222**A-**222**D which are adapted to facilitate coupling of the lighting module **200** to an arm of a junction unit (e.g., one of the arms **106**A-**106**D of the junction unit **100** described with respect to FIGS. **1**A-**1**D). It is to be understood that any of the light sources **220**A-**220**D, the heat sink **210**, the support plate **212**, or the fan **202** may have other shapes, such as such as triangular, hexagonal, circular, or any other suitable shape.

FIG. **3** illustrates a bottom perspective view of a lighting harness assembly **300** including two lighting modules **330**A and **330**B coupled to a junction unit **310** in accordance with an exemplary embodiment of the present invention. The lighting modules **330**A and **330**B and junction unit **310** may be the same as or similar to the aforementioned components

that were identically named. The lighting modules **330**A and **330**B are illustrated as being coupled to arms of a first attachment region **312**A of a body **312** of the junction unit **310**, and a header cable **340** is illustrated as being coupled to a second attachment region **312**B of the body **312**. The lighting modules **330**A and **330**B are electrically coupled to module power ports (not visible) of the first attachment region **312**A via their respective power cables **322**A and **322**B.

The lighting harness assembly **300** further includes suspension cables **350** which pass through apertures of the body **312** (e.g., the apertures **103**A-**103**D). The body **320** may be oriented such that the second attachment region **312**B faces direction of gravitational force. In this configuration, the suspension cables include stationary stops **352** that are each wider than the diameters of the apertures of the body **312**. The stationary stops **352** which allow the body to rest thereon so that the position of the junction unit **310** and the lighting modules **330**A and **330**B may be adjusted when suspended within a lighting balloon apparatus simply by adjusting the suspension cables **350**. In certain embodiments, the suspension cables **350** may be aluminum cables or any other material suitable for supporting the weight of the lighting harness assembly **300**.

FIG. **4** illustrates a top perspective view of a lighting harness assembly **400** which includes four lighting modules coupled to a junction unit in accordance with an exemplary embodiment of the present invention. The lighting harness assembly **400** may utilize the same or similar components as illustrated in FIG. **3**.

FIG. **5** illustrates a side view of a lighting balloon apparatus **500** including a lighting harness assembly **510** in accordance with an exemplary embodiment of the present invention. The lighting harness assembly **510** may be the same as or similar to the lighting harness assembly **300**, and includes suspension cables **512**.

The lighting balloon apparatus **500** includes a balloon envelope **502** that serves as an illuminating body through which light produced by the light sources of the lighting harness assembly **510** passes. The balloon envelope **502** may be constructed as a rectangular-shaped body having six orthogonally-fixated sides, though it is to be understood that other suitable shapes may be utilized, such as a cylinder, cuboid, octagon, etc. In certain embodiments, the lighting balloon apparatus **500** may have one or more physical dimensions (e.g., height, width, length, diameter) independently selected from 2 feet to 20 feet or larger.

In certain embodiments, the balloon envelope **502** comprises a material having a medium weight laminate of polyester film weaved into polyester fabric using an adhesive containing an antimicrobial additive, to reduce the incidence of mildew, and an ultraviolet (UV) inhibitor. This material may be cut into various sized templates and affixed together using double sided adhesive tape. The material may also be treated with a UV inhibitor. In certain embodiments, a reflective material may be affixed or deposited onto an interior surface area of an upper surface of the balloon envelope **502** to direct, as well as increase, the illuminating output of the light sources enclosed within. In certain embodiments, one or more portions of the balloon envelope **502** may be opaque, partially opaque, translucent, or transparent. For example, in certain embodiments, a lower portion of the balloon envelope **502** may be transparent or partially opaque. In certain embodiments, the balloon envelope **502** is the same as or similar to the balloon envelope illustrated and described in U.S. Pat. No. 7,641,351 B2, the disclosure of which is hereby incorporated by reference herein in its entirety.

The balloon envelope **502** includes an upper cap **504** and a lower cap **506**, which anchor the suspension cables **512** therebetween. The upper cap **504** and lower cap **506** may each include, for example, a receiver ring containing stainless steel shackles to provide a stable core for suspending the lighting harness assembly **510**. The lower cap **506** may further include a port that a header cable **514** may pass through or interface with in order to provide power from an external power source to the lighting harness assembly **510**. Additionally, the upper cap **504** and lower cap **506** may include o-rings in order to completely seal an interior volume **508** defined by the balloon envelope **502** to allow balloon envelope **502** to maintain a volume of helium gas. The suspension cables **512** may be rigid enough to maintain a level of rigidity of the balloon envelope **502** during inflation of the lighting balloon apparatus **500**.

In certain embodiments, the balloon envelope **502** includes a zipper to allow access to the interior volume **508**, for example, to insert the lighting harness assembly **510** prior to inflating the lighting balloon apparatus **500**. In certain embodiments, the zipper is an air-tight and/or water-tight zipper, such as a TIZIP® zipper.

In certain embodiments, a power supply may be onboard the lighting balloon apparatus **500**, such as a battery. In certain embodiments, the lighting balloon apparatus **500** may include a solar panel located on an upper surface of the balloon envelope **502**.

In certain embodiments, the junction harness assembly is suspended within the interior volume **508** such that the center of mass of the lighting balloon apparatus is substantially located at a geometric center of the interior volume **508** enclosed by the sealed balloon envelope **502**. It is to be understood that the single lighting harness assembly **510** in FIG. **5** is merely illustrative, as additional lighting harness assemblies may be enclosed within the balloon envelope **502**.

In the foregoing description, numerous details are set forth. It will be apparent, however, to one of ordinary skill in the art having the benefit of this disclosure, that the present disclosure may be practiced without these specific details. In some instances, well-known structures and devices are shown in block diagram form, rather than in detail, in order to avoid obscuring the present disclosure.

The words "example" or "exemplary" are used herein to mean serving as an example, instance, or illustration. Any aspect or design described herein as "example" or "exemplary" is not necessarily to be construed as preferred or advantageous over other aspects or designs. Rather, use of the words "example" or "exemplary" is intended to present concepts in a concrete fashion. As used in this application, the term "or" is intended to mean an inclusive "or" rather than an exclusive "or." That is, unless specified otherwise, or clear from context, "X includes A or B" is intended to mean any of the natural inclusive permutations. That is, if X includes A; X includes B; or X includes both A and B, then "X includes A or B" is satisfied under any of the foregoing instances. In addition, the articles "a" and "an" as used in this application and the appended claims should generally be construed to mean "one or more" unless specified otherwise or clear from context to be directed to a singular form. Reference throughout this specification to "an embodiment" or "one embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus,

the appearances of the phrase "an embodiment" or "one embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment.

The present disclosure is not to be limited in scope by the specific embodiments described herein. Indeed, other various embodiments of and modifications to the present disclosure, in addition to those described herein, will be apparent to those of ordinary skill in the art from the preceding description and accompanying drawings. Thus, such other embodiments and modifications are intended to fall within the scope of the present disclosure. Further, although the present disclosure has been described herein in the context of a particular embodiment in a particular environment for a particular purpose, those of ordinary skill in the art will recognize that its usefulness is not limited thereto and that the present disclosure may be beneficially implemented in any number of environments for any number of purposes. Accordingly, the claims set forth below should be construed in view of the full breadth and spirit of the present disclosure as described herein, along with the full scope of equivalents to which such claims are entitled.

What is claimed is:

1. A junction unit adapted for use in a lighting balloon apparatus, the junction unit comprising:

a body;

a first attachment region disposed on the body, the first attachment region comprising:

a plurality of arms that extend radially outward from the body and are each adapted to couple to and secure a lighting module away from the body; and

a plurality of module power ports;

a second attachment region disposed on the body, the second attachment region comprising a source power port adapted to couple to a header cable comprising a plurality of electrically isolated source channels; and

a plurality of power channels disposed within the body that are adapted to transmit power from the source power port to each of the plurality of module power ports in a one-to-one correspondence with the plurality of electrically isolated source channels of the header cable when coupled thereto.

2. The junction unit of claim **1**, wherein the body further comprises two or more apertures formed therethrough.

3. The junction unit of claim **1**, wherein there is a one-to-one correspondence of the plurality of arms to the plurality of module power ports, and wherein each module power port is disposed adjacent to its respective arm.

4. The junction unit of claim **1**, wherein the body is radially symmetric about a central axis, and wherein the plurality of arms is distributed symmetrically about the central axis.

5. The junction unit of claim **4**, wherein the first attachment region and the second attachment region are disposed on opposite facing surfaces of the body.

6. The junction unit of claim **5**, wherein the plurality of arms are disposed on the body in coplanar fashion.

7. The junction unit of claim **1**, further comprising the header cable.

8. The junction unit of claim **1**, wherein a first arm of the plurality of arms is coupled to a lighting module, wherein a first module power port of the plurality of module power ports is coupled to a power cable of the lighting module, and wherein the lighting module comprises a light source and a heat sink.

9. A lighting balloon apparatus comprising:

a sealed balloon envelope;

a junction unit suspended within the sealed balloon envelope; and

a plurality of lighting modules coupled to the junction unit, the plurality of lighting modules each comprising a light source, a heat sink, and a power cable electrically coupled to the junction unit, wherein the junction unit is configured to couple each of the plurality of lighting modules in a one-to-one correspondence with a plurality of electrically isolated source channels of a header cable when coupled thereto.

10. The lighting balloon apparatus of claim **9**, further comprising a plurality of suspension cables received through apertures formed through the junction unit and coupled to opposing harness couples within the sealed balloon envelope.

11. The lighting balloon apparatus of claim **10**, wherein the junction unit is suspended by the suspension cables such that the center of mass of the lighting balloon apparatus is substantially located at a geometric center of a volume enclosed by the sealed balloon envelope.

12. The lighting balloon apparatus of claim **9**, wherein the plurality of lighting modules is distributed symmetrically around the junction unit.

13. The lighting balloon apparatus of claim **9**, wherein at least one of the plurality of lighting modules comprises a light source that comprises a chip on board (COB) light emitting diode (LED).

14. The lighting balloon apparatus of claim **9**, wherein at least one of the plurality of lighting modules comprises a fan adapted to circulate air flow away from the heat sink.

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