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(54) **Title:** REMOTE COMPONENT DEVICES, SYSTEMS, AND METHODS FOR USE WITH LIGHT EMITTING DEVICES

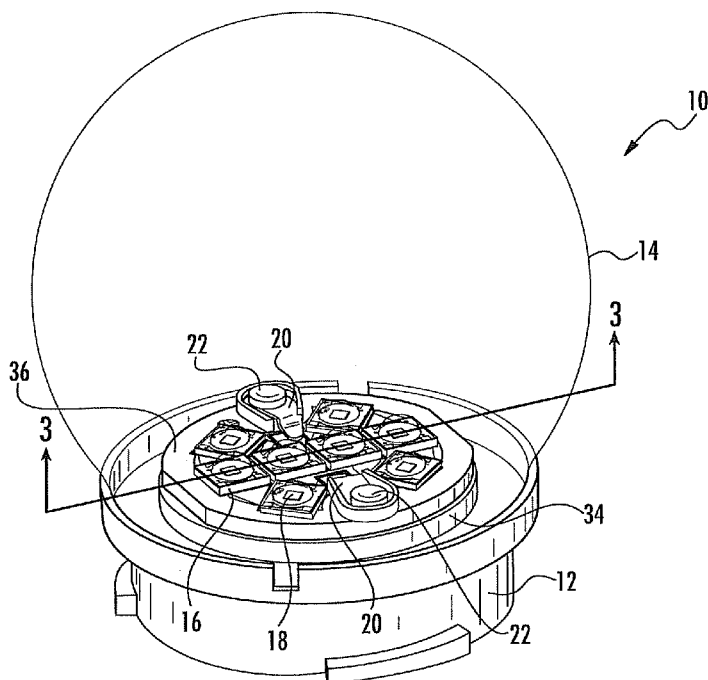


FIG. 1

(57) **Abstract:** Remote component devices, systems, and methods are disclosed. In one aspect, remote component devices, systems, and methods can include a body for lockably securing the remote component to a housing. Devices, systems, and methods can also include one or more light emitting devices disposed over the body. An optical material can be remotely located at least a first distance away from the one or more light emitting devices. Remote component devices, systems, and methods disclosed herein can be used as replacements and/or equivalent light products for standard filament light bulbs and compact fluorescent lamp (CFL) bulbs.



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DESCRIPTION
REMOTE COMPONENT DEVICES, SYSTEMS, AND METHODS FOR USE
WITH LIGHT EMITTING DEVICES

5 CROSS REFERENCE TO RELATED APPLICATIONS

 This application claims the benefit of U.S. Patent Application Serial Number 13/038,109 filed March 1, 2011, the disclosure of which is incorporated herein by reference in its entirety.

10 TECHNICAL FIELD

 The subject matter herein relates generally to remote component devices, systems, and methods for use with light emitting devices. More particularly, the subject matter herein relates to remote phosphor component devices, systems and methods for use with light emitting diodes (LEDs).

15

BACKGROUND

 Solid state light sources, such as light emitting diodes (LEDs) can be used in various lighting products and lighting components for commercial and personal applications. Advantages of using LED lighting products
20 include both increased energy savings and product lifetimes. For example, when LEDs are used as the light source in consumer products such as table and floor lamps, the lamps advantageously consume less energy than lamps using conventional filament light bulbs and even compact fluorescent light (CFL) bulbs. LED lighting products can be manufactured and marketed to
25 consumers for replacing the standard A19 sized filament and CFL light bulbs. The A19 bulb is a standard, $2 \frac{3}{8}$ inch diameter pear-shaped light bulb most commonly used in household lighting products. One problem with current A19 equivalent light bulbs using LEDs is that the light emission is concentrated at top of the bulb. That is, the light is not multi or
30 omnidirectional, but rather, light is mainly emitted from the top of the bulb only. This can make doing normal household activities, such as cleaning, reading, writing, or working at a computer more difficult to perform as surfaces below the bulb may not be illuminated and may be difficult to see.

In addition, such products can require several soldered contacts and/or soldered electrical components which can increase manufacturing times.

Thus, a need remains for remote component devices, systems, and methods that are easy to manufacture, easy to use, and have improved,
5 multidirectional lighting.

SUMMARY

The present subject matter relates to remote component devices, systems, and methods for use with light emitting devices. In one aspect, the
10 subject matter herein relates to remote phosphor component devices, systems, and methods using light emitting diodes (LEDs). In one aspect, remote component devices, systems, and methods disclosed herein can provide energy efficient alternatives to conventional lighting products, such as the standard light bulb of any suitable size and/or shape. Devices,
15 systems, and methods disclosed herein can also improve ease of use and ease of manufacturability of lighting products by using, for example, easy, solder free connections.

It is, therefore, an object of the present disclosure to provide novel remote component devices, systems, and methods and to improve the
20 energy efficiency, usability, and manufacturability of lighting products. This and other objects of the present disclosure as can become apparent from the disclosure herein are achieved, at least in whole or in part, by the subject matter described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view showing a remote component device according to an embodiment of the present subject matter;

Figure 2 is a perspective view showing a body portion of a remote component device according to an embodiment of the present subject
30 matter;

Figure 3 is a cross-sectional view of a remote component device of according to an embodiment of the present subject matter;

Figure 4 is an exploded view of a remote component device according to an embodiment of the present subject matter;

Figure 5 is an exploded view of a remote component system according to an embodiment of the present subject matter;

5 Figure 6 is a perspective view of a remote component system
according to an embodiment of the present subject matter;

Figure 7 is a side view of a remote component system according to an embodiment of the present subject matter;

Figures 8A and 8B are electrical connector devices of remote
10 component devices and systems according to an embodiment of the present
subject matter;

Figure 9 is a schematic illustration of a wire disposed within an electrical connector of remote component devices and systems according to an embodiment of the present subject matter;

15 Figure 10 is a flow chart according to a method for assembling remote component devices according to an embodiment of the present subject matter;

Figure 11 is a cross-sectional view of a lighting device with remote component device according to an embodiment of the present subject matter; and

Figure 12 is a perspective view of a lighting device with remote component device according to an embodiment of the present subject matter.

25 DETAILED DESCRIPTION

The present subject matter now will be described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the subject matter are shown. The present subject matter may, however, be embodied in many different forms and should not be
30 construed as limited to the specific embodiments set forth herein. Rather, these embodiments are provided to convey the scope of the subject matter to those skilled in the art. In the drawings, the size and relative sizes of layers and regions may be exaggerated for clarity.

It will be understood that when an element such as a layer, region or substrate is referred to as being "on" or extending "onto" another element, it can be directly on or extend directly onto the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" or extending "directly onto" another element, no intervening elements are present. It will also be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element or intervening elements may be present. In contrast, when an element is referred to as being "directly connected" or "directly coupled" to another element, no intervening elements are present.

It will be understood that although the terms "first" and "second" are used herein to describe various regions, layers and/or portions, these regions, layers and/or portions should not be limited by these terms. These terms are only used to distinguish one region, layer or portion from another region, layer or portion. Thus, a first region, layer or portion discussed below could be termed a second region, layer or portion, and similarly, a second region, layer or portion may be termed a first region, layer or portion without departing from the teachings of the present subject matter.

Furthermore, relative terms, such as "lower" or "bottom" and "upper" or "top," may be used herein to describe relationship of one or more elements to other elements as illustrated in the Figures. It will be understood that relative terms are intended to encompass different orientations of the device in addition to the orientation depicted in the figures. For example, if a device in the figures is turned over, elements described as being on the "lower" side of other elements would then be oriented on "upper" sides of the other elements. The exemplary term "lower," can therefore, encompasses both an orientation of "lower" and "upper," depending of the particular orientation of the figure. Similarly, if the device in one of the figures is turned over, elements described as "below" or "beneath" other elements would then be oriented "above" the other elements. The terms "below" or "beneath" can therefore encompass both an orientation of above and below.

Unless otherwise defined, terms (including technical and scientific terms) used herein should be construed to have the same meaning as commonly understood by one of ordinary skill in the art to which this subject matter belongs. It will be further understood that terms used herein should
5 be interpreted as having a meaning that is consistent with their meaning in the context of this specification and the relevant art, and should not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

As used herein, the terms solid state light emitter or solid state light
10 emitting device may include a light emitting diode (LED), laser diode and/or other semiconductor device which includes one or more semiconductor layers, which may include silicon, silicon carbide, gallium nitride and/or other semiconductor materials, a substrate which may include sapphire, silicon, silicon carbide and/or other microelectronic substrates, and one or more
15 contact layers which may include metal and/or other conductive materials. Solid state light emitting devices according to embodiments of the subject matter may include III-V nitride (e.g., gallium nitride) based LEDs or lasers fabricated on a silicon carbide substrate, such as those devices manufactured and sold by Cree, Inc. of Durham, N.C. Such LEDs and/or
20 lasers may be configured to operate such that light emission occurs through the substrate in a so-called "flip chip" orientation.

Light emitting devices according to embodiments described herein may comprise group III-V nitride (e.g., gallium nitride) based light emitting diodes (LEDs) or lasers fabricated on a growth substrate, for example,
25 silicon carbide substrate, such as those devices manufactured and sold by Cree, Inc. of Durham, North Carolina. For example, Silicon carbide (SiC) substrates/layers can be 4H polytype silicon carbide substrates/layers. Other silicon carbide candidate polytypes, such as 3C, 6H, and 15R polytypes, however, may be used. Appropriate SiC substrates are available
30 from Cree, Inc., of Durham, N.C., the assignee of the present subject matter, and the methods for producing such substrates are set forth in the scientific literature as well as in a number of commonly assigned U.S. patents, including but not limited to U.S. Patent No. Re. 34,861; U.S. Patent No.

4,946,547; and U.S. Patent No. 5,200,022, the disclosures of which are incorporated by reference herein in their entireties.

As used herein, the term "Group III nitride" refers to those semiconducting compounds formed between nitrogen and one or more elements in Group III of the periodic table, usually aluminum (Al), gallium (Ga), and indium (In). The term also refers to binary, ternary, and quaternary compounds such as GaN, AlGa_N and AlInGa_N. The Group III elements can combine with nitrogen to form binary (e.g., GaN), ternary (e.g., AlGa_N), and quaternary (e.g., AlInGa_N) compounds. These compounds may have empirical formulas in which one mole of nitrogen is combined with a total of one mole of the Group III elements. Accordingly, formulas such as Al_xGa_{1-x}N where 1>x>0 are often used to describe these compounds. Techniques for epitaxial growth of Group III nitrides have become reasonably well developed and reported in the appropriate scientific literature, and in commonly assigned U.S. Patent No. 5,210,051, U.S. Patent No. 5,393,993, and U.S. Patent No. 5,523,589, the disclosures of which are hereby incorporated by reference herein in their entireties.

Although various embodiments of LEDs disclosed herein comprise a growth substrate, it will be understood by those skilled in the art that the crystalline epitaxial growth substrate on which the epitaxial layers comprising an LED are grown may be removed, and the freestanding epitaxial layers may be mounted on a substitute carrier substrate or submount which may have better thermal, electrical, structural and/or optical characteristics than the original substrate. The subject matter described herein is not limited to structures having crystalline epitaxial growth substrates and may be used in connection with structures in which the epitaxial layers have been removed from their original growth substrates and bonded to substitute carrier substrates.

Group III nitride based LEDs according to some embodiments of the present subject matter, for example, may be fabricated on growth substrates (such as a SiC substrates) to provide horizontal devices (with both electrical contacts on a same side of the LED) or vertical devices (with electrical contacts on opposite sides of the LED). Moreover, the growth substrate may

be maintained on the LED after fabrication or removed (e.g., by etching, grinding, polishing, etc.). The growth substrate may be removed, for example, to reduce a thickness of the resulting LED and/or to reduce a forward voltage through a vertical LED. A horizontal device (with or without the growth substrate), for example, may be flip chip bonded to a carrier substrate or printed circuit board (PCB), or wire bonded. A vertical device (without or without the growth substrate) may have a first terminal bonded to a carrier substrate, mounting pad, or PCB and a second terminal wire bonded to the carrier substrate, electrical element, or PCB. Examples of vertical and horizontal LED chip structures are discussed by way of example in U.S. Publication No. 2008/0258130 to Bergmann et al. and in U.S. Publication No. 2006/0186418 to Edmond et al., the disclosures of which are hereby incorporated by reference herein in their entireties.

Phosphors described herein can absorb at least a portion of light emitted by one or more LEDs and emit a different wavelength of light resulting in a combined emission of light from the one or more LEDs and the phosphor. In one embodiment, a white light combination of LED and phosphor light can be emitted. It is understood that LED devices and methods according to the present subject matter can also have multiple LEDs of different colors, one or more of which may be white emitting. Solid state light emitters can be used individually or in combinations, optionally together with one or more luminescent materials (e.g., phosphors, scintillators, lumiphoric inks) and/or filters, to generate light of desired perceived colors (including combinations of colors that may be perceived as white). Inclusion of luminescent (also called 'lumiphoric') materials in LED devices may be accomplished by any suitable method, not limited to adding such materials to encapsulants, adding such materials to lenses, or by direct coating onto LEDs. Other materials, such as dispersers and/or index matching materials may be included in such encapsulants and/or lenses.

Referring now to Figures 1-12, remote component devices, systems, and methods are illustrated. Figure 1 is a perspective view of a remote component device, generally designated **10**. Remote component **10** can comprise a lighting device which can be used alone or in combination with

other devices and/or within lighting systems. In one aspect, remote component **10** can be fit or be adapted to easily fit into an A19 equivalent bulb. In other aspects, remote component **10** can be easily assembled into other LED products designed to accommodate the component. Remote component **10** can comprise a body **12** and a cover **14** disposed over the body **12**. At least a portion of cover **14** can be configured and sized to fittingly engage a portion of body **12**. In one aspect, body **12** can be adapted to engage an external component, for example, a remote component housing **104** as illustrated in Figure 5. In one aspect, body **12** can lockably engage remote component housing by insertion of a lower protruding portion **98** into an opening **124** of housing **104** (See Figure 5). Body **12** can be moved by twisting and/or rotating to become secured within housing **104** as further described below with respect to Figure 5.

Remote component **10** can further comprise one or more light emitting devices disposed over body **12**. The light emitting devices can be disposed above, on, and/or below and/or over any surface of body **12** either directly or indirectly. Remote component **10** can emit light having a predetermined wavelength upon illumination of the one or more light emitting devices. The light emitting devices can be directly or indirectly attached and/or thermally communicate to a portion of body **12**. In one aspect, light emitting devices can be directly attached to body **12** using a thermal paste or any other suitable attachment materials and methods known in the art. In other aspects, light emitting devices can be indirectly attached to a portion of body **12** when one or more intervening substrates are disposed therebetween. Heat generated by the light emitting devices can dissipate into body **12**. Heat can dissipate through substantially the center of body, in the area below the light emitting devices. If an intervening substrate is present, heat can dissipate through the substrate and into body **12**. Light emitting devices can comprise one or more solid state emitters such as LEDs or LED packages **16**. In one aspect, one or more LED packages **16** can be arranged over a portion of body **12**. LED packages **16** can comprise any suitable package for housing one or more LEDs **18**. Any suitable size, shape, or configuration of LED package **16** is hereby contemplated. Any

suitable color or wavelength of LEDs **18** is hereby contemplated, not limited to blue, green red, and/or combinations thereof. Remote components **10** utilizing non-packaged LEDs **18** are also contemplated herein. That is, LEDs **18** could be directly or indirectly disposed over body **12** without a package, for example, in a chip on board configuration. Remote component can further comprise at least one contact **20** for supplying electrical signal, or current, to the one or more LEDs **18**. One or more contacts **20** can be secured within remote component **10** by at least one rivet **22** which can extend internally within remote component **10** and electrically connect the one or more contacts **20** to a source of electrical signal, or current.

Figure 2 illustrates a perspective view of body **12** of remote component **10** without cover **14** or LED packages **16** disposed thereon. In one aspect, at least a portion of body **12** can comprise a heat transfer material through which heat from the one or more LEDs **18** can dissipate. Body **12** can comprise at least one outer wall **24**. In one aspect, body **12** can comprise a substantially circular body comprising outer wall **24**. In other aspects, body **12** can comprise any suitable shape having more than one wall, for example and not limited to, a square having four outer walls. The at least one outer wall **24** can comprise one or more protrusions **26** configured for locking engagement within an external component, for example, a remote component housing member. The one or more protrusions **26** can be integral with outer wall **14** or separate portions attached thereto. Protrusions **26** can be disposed along a lower or base portion of outer wall **24** and can be spaced apart about the perimeter of outer wall **24** at any suitable distance.

Still referring to Figure 2, body **12** can further comprise an upper portion **28** that can have a greater diameter than outer wall **24**. Upper portion **28** can substantially oppose the portion of outer wall **24** where protrusions **26** are located. In one aspect, outer wall **24** can extend in width between upper portion **28** and protrusions **26**. Upper portion **28** can comprise an inner wall **30** disposed about upper surface **32**. Inner wall **30** can be configured to engage at least a portion of cover **14**. In one aspect, an adhesive can be used to secure cover **14** to upper portion **28** of remote

component **10**. A diameter of inner wall **30** can be substantially the same as a portion of cover **14** such that cover **14** can couple to inner wall **30**. Body **12** can further comprise a platform **34** disposed on upper surface **32**. Platform **34** can comprise a mounting surface over which LEDs **18** maybe
5 directly or indirectly mounted. Platform **34** can elevate the LEDs within body **12** such that light can be emitted from a predetermined distance from body **12**. In one aspect, remote component **10** can comprise a mounting substrate **36** disposed over platform **34**. Any suitable attachment material and/or method can be used to attach mounting substrate **36** to platform **34**
10 where a mounting substrate is used. In one aspect, a thermal paste can be used to secure mounting substrate **36** to platform **34**. A thermal paste can thermally connect mounting substrate **36** to platform **34** such that heat can dissipate from the one or more LEDs **18** into body **12**.

Still referring to Figure 2, platform **34** and mounting substrate **36** can
15 be adapted to receive one or more rivets **22** for passing electrical signal from an electrical power source to the mounting substrate **36** and into the LEDs. For example, rivet **22** can secure contacts **20** to an electrically conductive pad **38** of mounting substrate **36**. Rivet **22** and contact **20** can be housed by an insulating member **40**. Insulating member **40** can comprise any suitable
20 electrically and/or thermally insulating material which can electrically and/or thermally isolate rivet **22** from other components of body **12**. Insulating member **40** can prevent electrical shorting of remote component **10** by preventing electrical current from leaking into the body **12** of remote component. Insulating member **40** can surround rivet **22** and extend through
25 the body **12** of remote component. In one aspect, mounting substrate **36** can comprise a metal core printed circuit board (MCPCB) such as those manufactured by the Bergquist Company of Chanhassen, MN. Any suitable mounting substrate **36** can be used, however. MCPCB substrates typically comprise a core layer and a dielectric layer (not shown). The metal core
30 layer can comprise a conductive metal layer, for example copper (Cu) or aluminum (Al). Dielectric layer can comprise an electrically insulating but thermally conductive material to assist with heat dissipation through mounting substrate **36**. Mounting substrate **36** can comprise any suitable

size, shape, and/or thickness. In one aspect, mounting substrate **36** can comprise a substrate having a diameter of at least approximately 22 millimeter (mm) and a thickness of at least approximately 0.47 mm in thickness. However, as noted, any size and/or thickness can be used. In one aspect, mounting substrate **36** can comprise a 1 mm Cu board having two 2.54 mm openings for receiving 1/16 inch rivets and leaving room for a 0.47 mm thick insulating member **40**. The Cu used in mounting substrate **36** can weigh approximately 3 oz. Mounting substrate **36** can comprise approximately a 3 mil dielectric layer having a thermal conductivity equal to approximately 2.2 W/m-k or greater and approximately 6 kV breakdown voltage or greater.

Mounting substrate **36** can comprise one or more attachment surfaces, generally designated **42**. Attachment surfaces **42** can comprise electrically and/or thermally conductive surfaces to which an LED or LED package can attach. In one aspect, attachment surfaces **42** can comprise an electrically and/or thermally conductive pattern substantially the same as a pattern on the mounting surface, or footprint, of the LED or LED package. That is, the LED or LED package can mount over the mounting surface and electrical and thermal elements of the LED package can substantially align to electrical and thermal elements of the attachment surface. In one aspect, attachment surfaces **42** can comprise thermally conductive surface **44** and one or more electrically conductive surface or surfaces such as surfaces **46**. Electrically conductive surfaces **46** can comprise an anode and cathode for passing electrical current into LED or LED package.

A solder mask layer can be deposited over mounting substrate **36** in areas outside attachment surfaces **42** and conductive pads **38**. Solder mask **48** can prevent the one or more LEDs or LED packages from electrically shorting and/or electrical failure from defects if attachment material, for example, solder, squeezes out during attachment of the LEDs or LED packages to attachment surfaces **42**. In one aspect, solder mask **48** can comprise a material forming white surface for improving brightness of light emitted from LEDs or LED packages. The white surface can reflect more light, thereby increasing the brightness of remote component **10**. In one

aspect, a white PSR-4000 WT03 solder mask can be used, such as those manufactured by Taiyo Holdings Co., Ltd. of Tokyo, Japan, or subsidiaries thereof. The solder mask can maintain its whiteness through heating and/or reflow processes. Conductive pads **38** can electrically communicate to attachment surfaces **42** using conductive traces (not shown) disposed beneath solder mask **48**. Conductive traces can be internal to mounting substrate **36** and can electrically connect attachment surfaces, and therefore the LEDs, in series, in parallel, and/or combinations thereof. Electrical current can pass from rivet **22** to contact **20** and into conductive pads **38**. Conductive pads **38** electrically communicate to each of attachment surfaces **42** and supply current to the LEDs. In one aspect, one or more LED packages **16** can be disposed over mounting substrate **36**. In one aspect, eight LED packages **16** can be disposed over mounting substrate **36**. As mentioned above, LED packages **16** can comprise any suitable package and any suitable LED chip can be disposed within the package. In one aspect, LED package **16** can comprise a square footprint of at least approximately 2 mm or greater length and width. That is, footprint of LED package **16** can comprise an area of approximately 4 mm² or greater in some aspects.

Figure 3 illustrates a cross-sectional view of remote component **10**. In this view, LED packages **16** are shown disposed over platform **34** of body **12**. LEDs **18** are illustrated in LED packages **16**; however, unpackaged LEDs **18** could also be used. LEDs **18** and/or LED packages **16** can be mounted directly over platform **34** of body **12**, or as illustrated, LED packages **16** can be mounted over mounting substrate **36**. LEDs **18** can be attached within LED packages **16** using any suitable die attach materials and/or methods. For example, in one aspect LEDs **18** can be attached within packages **16** using metal-to-metal bonding techniques comprising flux-assisted eutectic die attach, metal-assisted non-eutectic die attach, or thermal compression die. Metal-to-metal die attach comprises a robust die attach resulting in a more reliable die attach during operation of remote component **10**. This can result in fewer LEDs becoming detached during operation. In the alternative, LEDs **18** can be attached using silicone, silver (Ag) epoxy, solder. Any suitable die attach can be used.

As Figure 3 illustrates, cover **14** comprises an outer surface **51** and an inner surface **52**. Outer and inner surfaces **51** and **52** can be coated with one or more layers of optical materials to thereby emit light external from the cover **14** having desired optical properties. For illustration purposes Figure 3 illustrates both outer and inner surfaces **51** and **52** coated with optical material, however, in some aspects only one of the outer or inner surface **51** and **52** is coated. When electrical current is passed through LED packages **16**, LEDs **18** can emit light towards an inner surface **52** of cover **14**. Optical materials coated on either the inner and/or outer surfaces **51** and **52** can interact with light emitted from the one or more LEDs **18** to emit light having a desired wavelength and/or brightness. Optical materials can comprise luminescent materials having an amount of phosphor material **50**. Any suitable phosphor can be used with remote component **10**. Phosphor material **50** can generate light of desired perceived colors when the light emitted from the LEDs **18** interacts with the phosphor. Other materials, such as dispersers and/or index matching materials may be included in the phosphor material **50**. Phosphor material **50** can be applied and/or coated to cover **14** using any suitable method. In one aspect, a predetermined weight of phosphor material **50** can be mixed with an adhesive material and loaded in a syringe. The mixture can then be coated to outer surface **51** and/or inner surface **52** of cover **14** and can optionally be cured. In one aspect, the mixture is spray coated, however, any suitable coating method can be used. For example, phosphor material **50** can coat the inside and/or outside of the cover **14** by spraying, brushing, molding, encapsulating, adhering, dipping, and/or any combinations thereof. Any suitable coating method can be used. The cover can be cleaned, measured, and inspected prior to assembly over body **12** such that defects in the coating can be detected and cured prior to assembly. Adhesive material can comprise any suitable material, not limited to silicone or encapsulants.

Notably, light emitted from remote component **10**, that is, light emitted external from cover **14** can be emitted both above and/or below the LEDs **18**. Conventional lighting products utilizing LEDs emit light mainly from the top of a lighting device only. This can be a problem for lighting devices

used, for example, in table lamps. Ideal table lamps emit light below the light emitting devices to accommodate activities such as reading. The light needs to be emitted below the light emitting devices to illuminate, for example, the pages of a book which most likely will be located below the bulb of table lamp. Remote components herein can be used in lighting products and devices, including products adapted to replace conventional filament and/or compact fluorescent light (CFL) bulbs on the market. Remote components 10 described herein are configured to emit multi-directional or omnidirectional light and can be used to replace conventional bulbs. That is, remote components 10 described herein can emit light in multiple directions from cover 14, including directions below LEDs 18, rather than being limited to emitting light mainly from the top of the device.

Still referring to Figure 3, nomenclature for remote component 10 is at least partially derived from the spacing of the LEDs 18 and phosphor material 50. That is, phosphor material 50 is remotely located with respect to the LEDs 18 and LED packages 16. Phosphor material 50 therefore can be excluded from being disposed, for example, directly on and over LEDs 16 or within LED packages 18. Phosphor material 50 can be located any suitable distance from the LEDs, for example, at least approximately 1 mm or greater. As Figure 3 illustrates, LEDs 18 can be mounted a first distance D over upper surface 32 of body 12. This can, in part, allow light to be reflected and emitted below the LEDs 18. First distance D can comprise any suitable distance. Phosphor can be remotely located from the one or more LEDs 18 and/or LED packages 16 a minimum distance of $D2$ from phosphor material 50. Minimum distance $D2$ can comprise any suitable distance, for example, at least approximately 1 mm or greater. In one aspect, minimum distance $D2$ can be equal to approximately 20 mm or greater, depending on the desired size of remote component. Any suitable minimum distance $D2$ is contemplated herein. LEDs 18 and/or LED packages 16 can also be located a maximum distance $D3$ from phosphor material 50. In one aspect, LEDs and/or LED packages 16 can be disposed substantially beneath or below cover 14. Figure 3 illustrates LEDs 18 disposed substantially beneath a substantially circular, domed, and/or rounded cover 14. However, cover 14

can comprise any suitable size and/or shape. In addition, LEDs **18** and/or LED packages **16** can be disposed at any position below cover **14**. As illustrated, LEDs **18** and LED packages **16** can be substantially disposed beneath a center of cover **14**, the center corresponding to maximum distance **D3**. However, LEDs **18** and/or LED packages **16** can be positioned at suitable location below cover **14**, for example, to the left or right of center. Size, number, and positioning of LEDs **18** and LED packages **16** can affect light emission. Any suitable size and number of LEDs **18** and/or LED packages **16** can be used, and the LEDs **18** and/or LED packages **16** can be disposed at any suitable location substantially below cover **14**.

Still referring to Figure 3, cover **14** can further comprise a neck portion **N** for engaging inner wall **30** of body **12**. Neck **N** is adapted to engage inner wall **30** using an adhesive or any suitable material. Neck **N** could also be adapted to frictionally or threadingly engage inner wall **30** of body **12**. Any suitable method can be used to secure neck **N** of cover **14** to inner wall **30** of body. In one aspect, neck **N** can be disposed below the plane on which the LEDs **18** are mounted, and can comprise any suitable size to accommodate sufficient structural strength when connecting and/or engaging to body **12**. In one aspect, neck can comprise an outer diameter **L1** of approximately 40 mm or less. In one aspect, neck **N** can comprise an outer diameter **L1** of approximately 30 mm or less, for example, approximately 25.7 mm or less. However, neck **N** can comprise any suitable outer diameter **L1**. Figure 3 further illustrates neck **N** comprising an inner diameter, **L2**. Inner diameter **L2** can correspond to the thickness of cover **14**, for example, where the cover comprises a thickness of approximately 1 mm or less, neck **N** can comprise an inner diameter of approximately 39 mm or more. Cover **14** can comprise any suitable thickness and any suitable inner diameter **L2**. In one aspects, neck can **N** can comprise an inner diameter **L2** of approximately 30 mm or less, for example, approximately 24.5 mm or less. However, neck **N** can comprise any suitable inner diameter **L2**.

Cover **14** and neck **N** can also comprise any suitable height. In one aspect, cover can comprise a height **H** measured from the base of neck **N** to the furthest point of the outer surface. For example, for spherical shapes,

the height can be measured from the topmost curvature of the cover **14**. In one aspect, cover **14** can comprise a height **H** of approximately 50 mm or less. In one aspect, cover **14** can comprise a height approximately 40 mm or less. In one aspect, cover **14** can comprise a height of approximately 35 mm or less, for example, approximately 33.4 mm or less. However, any suitable height **H** of cover is hereby contemplated. Similarly, neck **N** can comprise a height **H2**. In one aspect, neck **N** height **H2** can comprise approximately 5 mm or less. In one aspect, height **H2** can comprise approximately 3 mm or less. In one aspect, height **H2** comprises approximately 2.8 mm. Neck **N** can comprise any suitable size, shape, height, and/or diameter. Cover **14** can also comprise an inner diameter in which light can be emitted. In one aspect, inner diameter of cover can comprise approximately 40 mm or less. In one aspect, cover **14** can comprise an inner diameter of approximately 35 mm or less, for example, approximately 34.8 mm. Cover can comprise an outer diameter from which light can be emitted. In one aspect, cover can comprise an outer diameter of approximately 45 mm or less. In one aspect, an outer diameter of cover can comprise approximately 36 mm or less. Any suitable size, shape, height, and/or diameter of cover **14** is hereby contemplated.

Remote components **10** described herein can target various colors and wavelengths of light. Light emitted from remote component **10** can comprise a combination of the light from the LEDs **18** and/or LED packages **16** in combination with the light emitted from phosphor material **50**. In one aspect, remote component **10** devices disclosed herein can consume approximately 18 watts (W) of power or less as opposed to conventional bulbs which require at least approximately 40-120 W. For example, remote components **10** described herein can use approximately 12.5 W or less of power. In one aspect, remote components **10** described herein can use approximately 10 W or less of power. Thus, remote component devices and systems described herein can use several times less energy than conventional lighting products and light bulbs, thereby saving energy and reducing energy-related costs. In one aspect, remote components **10** described herein target cool white (CW), outdoor white, neutral white, and

warm white (WW) colors. Remote component **10** devices as described herein can, for example and without limitation, offer light output of approximately 800 lumens (lm) or more at 500 mA (12.5 W) at CW, outdoor white, neutral white, and WW color points. In some aspects, remote component **10** devices as described herein can, for example and without limitation, offer light output of approximately 800 lumens (lm) or more at 10 W or less at CW, outdoor white, neutral white, and WW color points. Remote component **10** devices disclosed herein can be used alone and/or in lighting fixtures offering a minimum CRI for CW color points of 75 CRI which corresponds to a range of 5,000 K to 10,000 K CCT. Remote component **10** devices disclosed herein can also offer, for example, a minimum CRI for WW color points of 80 CRI which corresponds to a range of 2,600K to 3,700K CCT. Remote component **10** devices disclosed herein can also offer, for example, a minimum CRI for color points of 90 CRI which corresponds to a range of 2,600K to 3,200K CCT. Remote component **10** devices can be used for both standard and high voltage configurations. In one aspect, brightness can be improved by using optimized methods and/or procedures described herein. For example, an approximately 6% or more improvement in brightness can be attained using metal-to-metal die attach as previously described herein. An approximately 4% or more improvement in brightness for example can be attained using a white solder mask around the one or more LEDs or LED packages. Approximately 12% brightness can be attained for example by using remote component **10** without an outer bulb **102** (Figure 5). And finally, an approximately 5% or more improvement in brightness can be attained for example when the remote component **10** is used without a housing **104** (Figure 5).

In one aspect, typical performance at 12.5 W can comprise at least approximately 1040 lm and at least approximately 83 lm/W. Typical performance at 12.5 W can also comprise at least as minimum of 80 CRI and 3000 CCT within a 30F bin. Uniformity of light emitted from remote component **10** can be controlled by controlling the uniformity of the phosphor material **50**. In one aspect, uniformity can be controlled by adjusting a spray

pattern of the phosphor material **50** for instances where phosphor material is spray coated to the outer surface **51** or inner surface **52** of cover **14**.

Figure 4 is an expanded view of remote component **10**, and illustrates various devices and/or components thereof. Remote component **10** can comprise a housing for several members within body, for example, internal outer wall **24**. Remote component **10** can comprise cover **14** with an opening **54** sized to fittingly engage inner wall **30** of body **12**. In one aspect, cover **14** can comprise a substantially spherical and/or hemispherical shape. However, cover **14** can comprise any suitable shape. In one aspect, the spherical shape of the cover **14** can maximize light output from the one or more LEDs **18**. For example, the spherical shape can be configured such that the plane of light emission from the one or more LEDs **18** can be directed towards the spherical and/or hemispherical surfaces as opposed to the neck **N** and/or opening **54**.

Figure 4 illustrates rivets **22** having a substantially elongated and rod-shaped body disposed between terminating upper and lower ends. One or more rivets **22** can electrically couple components of body **12** and can serve as electrical conduits, or conductive vias, through which electrical current can flow. Rivets **22** can electrically couple one or more contacts **20** to one or more respective electrical connectors **80**, the electrical connectors receiving electrical signal or current from a power source such as a circuit **106** (Figure 5). Rivet **22** can comprise any suitable electrically conductive material. Rivet **22** can be formed integral with body **12** or as a separate member inserted into body. Rivet **22** can be manufactured by pressing, extruding, machining, layering and/or otherwise depositing material into body, and/or combinations thereof. In the alternative, rivet **22** can be formed using any suitable method. Rivet **22** can be at least partially encased by and extend a length of insulating member **40**. Insulating member **40** can prevent electrical current from transferring to other parts of body **12** and reduces the potential of electrical defects and/or electrical shorting of remote component **10**. Terminating upper and lower ends of rivet **22** can engage and/or otherwise attach to upper and lower conducting members thereby channeling electrical current through body **12**. For example a first upper end of rivet **22** can

engage contact **20** and a second lower end of rivet **22** can engage a lower electrical connector **80**. In one aspect, lower electrical connector **80** can comprise an insulation displacement connector (IDC) type of electrical contact as explained further below. IDC connectors are advantageous in one aspect, as they eliminate the need for manufacturing components with tedious soldered electrical connections which can sometimes fail if inadequately soldered or if heat from the soldering process damages other members of remote component.

One or more rivets **22** can also mechanically couple several members within body **12**. For example, rivets **22** can extend through and mechanically couple mounting substrate **36**, platform **34**, and body **12** with an insulating portion **60** of the body and electrical connector **80**. Notably, rivets **22** in one aspect do not extend through and/or mechanically couple to an electrical connector housing **70** or a locking member **90**. In one aspect, body **12** comprises a rotatable member. Upon rotation of body **12**, each of the other components mechanically coupled thereto can also simultaneously rotate such that remote component **10** can simultaneously electrically, thermally, and mechanically couple to another component, for example, a component housing **104** (Figure 5). Connector housing **70** and locking member **90** can remain stationary upon rotation such that electrical connector **80** can rotate with body **12** about locking member **90** and become disposed within connector housing **70**. Electrical connector **80** can then pierce or otherwise displace insulation from an electrically conductive wire held within openings **78** of connector housing **70**. Electrical connector **80** can therefore electrically communicate with the conductive wire, as illustrated best in Figure 9. Electrical current can be communicated and/or transferred from conductive wire to electrical connector **80**. Electrical connector **80** can then electrically communicate electrical current to rivet **22** which channels the current through body **12** to contact **20**. Contact **20** transfers the electrical current to conductive pads **38** which communicates electrical current to the one or more LEDs **18** and/or LED packages **16**.

As Figure 4 further illustrates, one or more LEDs **18** or LED packages **16** can be disposed over mounting substrate **36**. Any suitable attachment

material and/or method can be used to attach LEDs **18** and/or LED packages **16** to mounting substrate **36**. In one aspect, an electrically and/or thermally conductive solder material, for example, a solder paste can be used to attach LEDs **18** and/or LED packages **16** to mounting substrate **36**.

5 In one aspect, a metallic solder paste, such as a lead (Pb) or Pb-free solder paste can be disposed between LED package **16** and attachment surfaces **42** of mounting substrate **36**. Likewise, a Pb or Pb-free solder paste can be disposed over conductive pads **38**. Rivets **22** can be disposed between openings **56** in each of the contacts **20**, insulating members **40**, and
10 mounting substrate **36**. Contacts **20** can be positioned over conductive pads **38**. LED packages **16** can be picked and placed with a machine. Mounting substrate **36**, LED packages **16**, rivets, contacts, and insulating member **40** can then be heated, for example, by reflowing in a reflow oven to a suitable temperature for securing LED packages **16** to attachment surfaces **42** of
15 mounting substrate **36** and for securing contacts to conductive pads **38**.

Upon reflow, mounting substrate **36** can be secured over platform **34** of body **12** using any suitable material, for example, a thermally conductive paste. Mounting substrate **36** can also be mechanically coupled to platform **34** by the one or more rivets **22**. Rivets **22** can be positioned over one or
20 more holes **58** of body **12** and subsequently lowered or otherwise deposited therein. Insulating members **40** can frictionally engage holes **58** of body **12** thereby fixedly securing rivets **22** within body **12**. Rivets **22** can further extend into insulating portion **60** disposed substantially below body **12**. Insulating portion **60** can comprise one or more holes **66** configured to
25 receive rivets **22**. At least a portion of insulating member **40** can extend into and frictionally engage holes **66** of insulating portion **60** thereby fixedly securing body **12** to insulating portion **60**. Insulating portion **60** can further comprise an upper surface **62** and outer wall **64** which can be substantially shaped the same as inner surfaces of body **12** (not shown). Upper surface
30 **62** and outer wall **64** of insulating portion **60** can matingly engage body **12** when one or more rivets **22** are inserted through each of body **12** and insulating portion **60**. This is illustrated best in Figures 8A and 8B. Insulating portion **60** can comprise a hollowed center **68** which can centrally

surround a portion of the body comprising a heatsink, or heat transfer material.

Figure 4 further illustrates connector housing **70** disposed over locking member **90**. At least one electrical connector **80** can be disposed therebetween, and also positioned over locking member **90**. Connector housing **70** and locking member **90** can in one aspect not be mechanically coupled by one or more rivets **22** to body **12** or various components thereof. Rather, connector housing **70** can comprise one or more housing portions **74** with bottom surfaces **71** fixedly held within notches, or stepped portions **92** of locking member. Upper surfaces of housing portions **74** can comprise one or more apertures **76** which may align with a surface of insulating portion **60** (not shown) for further alignment and positioning of connector housing **70** above locking member **90** and below insulating portion **60**. Upon rotation of body **12**, connector housing **70** can remain engaged within stepped portions of **92** of locking member **90**, and rotation can induce one or more electrical connectors **80** to move into the one or more housing portions **74** of connector housing **70**. As illustrated, rivets **22** can extend through each of holes **58** of body **12** and holes **66** of insulating portion **60** and can bypass connector housing **70**. Rivets **22** can extend through openings **82** of the at least one electrical connector **80** and can mechanically couple electrical connector **80** to insulating portion **60**. Connector housing **70** can comprise a hollowed center **72** substantially aligned with hollowed center **68** of insulating portion **60**. Each of the hollowed centers can be disposed about a thick, central portion of body **12** configured to dissipate heat from the one or more LEDs **18** and/or LED packages **16**.

Locking member **90** can further comprise a lower protruding portion **98** which can engage a portion of an external housing, for example, housing **104** in Figure 5. Locking member **90** can engage housing **104**, and by rotation, or twisting body **12**, protruding portions **26** of body **12** can lockably engage with housing **104** thereby securing remote component **10** within housing **104**. An electrically conductive wire (not shown) can be fed through openings **124** of housing **104** (Figure 5) and through protruding portion **98** of locking member and then through openings **94** of locking member **90**. Wire

can further be fed into openings **78** of connector housing **70**. An insulated covering can be disposed over the conductive wire, and the insulated covering can be pierced when electrical connector **80** is moved into connector housing **74**. Electrical connector **80** can comprise one or more centrally aligned apertures **84** for piercing the insulated portion of a conductive wire. Together, electrical connector **80** and connector housing **70** can comprise an IDC which is notably a solder-free electrically conductive connector to electrically couple the conductive wire and rivet **22**. For example, the insulated conductive wire can be fed and held between openings **94** of locking member **90** and connector housing **70**, respectively. Upon rotation, the IDC can pierce or otherwise displace the insulated covering of the conductive wire and allow current to flow from the wire, into the electrical connector **80** and into rivet **22**. Rivet **22** can then transfer the electrical current to contact **30** and conductive pad **38**. Conductive pads **38** can electrically connect to each of the one or more LEDs **18** and/or LED packages **16** thereby illuminating the LEDs **18** and/or LED packages **16**. The IDC can facilitate an electrical connection within remote component **10** that does not require soldering the conductive wire to various components within remote component **10**. The solder free IDC connection can be more robust and less tedious than soldering connections within remote component **10**. In addition, the IDC can significantly improve the ease of use and manufacturability of lighting fixtures and systems utilizing remote components **10**, as the component can be placed and simply twist-locked within a remote component housing, such as housing **104** (Figure 5) without requiring tedious, messy, and cumbersome soldering processes.

Figure 5 illustrates an exploded view of a remote component system, generally designated **100**. Remote component system **100** can comprise a bulb **102** substantially surrounding remote component **10**. Remote component **10** can be lockably secured within a remote component housing **104**. A circuit **106** can be disposed within housing **104** above a base **108**. Circuit **106** can receive power when a switch, for example, a lamp switch is turned on. Current can flow from circuit **106** through one or more wires (not shown) inserted into one or more openings **124** of housing **104**. In one

aspect, housing **104** can comprise two openings **124** at any suitable location for connecting two wires to circuit **106**. One wire can electrically connect to an anode and the other wire can electrically connect to a cathode of circuit **106** for supplying electrical current to the one or more LEDs **18**. The
5 openings **124** in housing can receive two wires fed up from circuit **106** and the wires and/or holes can comprise any suitable diameter. In one aspect, wires can comprise two 22 AWG wires. Wires can be fed into locking member **90** and connector housing **70**. In one aspect, locking member **90** can be polarized (i.e., fitting only one way within housing **104**) such that the
10 electrical polarity of the wires should be considered when introducing the wires into each of housing **104**, locking member **90**, and connector housing **70**. Locking member **90** can be optional to remote component devices, systems, and methods disclosed herein. That is, customers and/or consumers could use any suitable locking member **90** for securing remote
15 component within housing **104**. Upon rotation of remote component **10** in the direction indicated by the arrow R, remote component **10** can be simultaneously with one motion thermally, electrically, and mechanically coupled to housing **104**.

As Figure 5 illustrates, housing **104** can comprise an outer surface
20 having one or more outer fins **110** disposed thereon. Remote component **10** can simultaneously mechanically, electrically, and thermally couple to housing **104** by any suitable configuration or structure dictating a prescribed motion, and this coupling is shown for illustration purposes as coupling from rotational movement but is by no means limited to such movement or
25 structure dictating such movement. Fins **110** can increase the surface area from which heat can dissipate when remote component **10** thermally couples to housing **104**. Housing **104** can further comprise an upper portion **112** for mechanically connecting to bulb **102**. Upper portion **112** can comprise an upper surface **114** at least partially surrounded by an inner wall **115**. A lower
30 portion **101** of bulb **102** can engage with inner wall **115** of housing. In one aspect, an adhesive material can be applied to inner wall **115** and lower portion **101** of bulb **102** can be secured thereto after mechanically coupling remote component **10** to housing **104**. Housing **104** can further comprise an

elevated portion **116** extending from upper surface **114**. In one aspect, elevated portion is substantially disposed at a center of upper surface **114** of housing **104**. Elevated portion **116** can comprise an elevated surface **118** substantially parallel upper surface **114**. Elevated surface **118** can be disposed on a plane above upper surface **114**. Upper surface **28** of remote component **10** can substantially engage elevated surface **118** when remote component **10** is positioned within housing **104**. For example, elevated portion **116** of housing **104** can comprise a centrally disposed hollow center having a floor **120** at least partially surrounded by an inner wall **122** of elevated portion **116**. One or more openings **124** can be disposed in floor **120**. Openings **124** can be adapted to receive a conductive wire from circuit **106** and adapted to feed the conductive wire into remote component **10** through openings **94** of locking member **90**. Openings **124** can also be adapted to engage lower protruding portion **98** of locking member **90**. Elevated portion **116** of housing **104** can be adapted to receive at least a portion of remote component **10** therein. At least a portion of remote component **10** can be disposed over floor **120** and at least a portion of protruding portions **26** of remote component can frictionally engage inner wall **122** of elevated portion **116**.

As Figure 5 illustrates, inner wall **122** of housing **104** can comprise one or more expanded portions **126**. Expanded portions **126** can be spaced apart inner wall **122**. In one aspect, expanded portions **126** of inner wall **122** correspond to a shape and number of protruding portions **26** of remote component **10**. Expanded portions **126** can be wider than a thickness of protruding portions **26** such that protruding portions **26** can easily align and fit therein. Inner wall **122** can be configured for frictionally engaging the exterior of remote component **10** when remote component is rotated such as for example as indicated by arrow R. In addition, remote component **10** can frictionally engage floor **120** of housing **104**. That is, remote component **10** can be disposed over and/or attached to locking member **90**. Each of remote component **10** and locking member **90** can be inserted into the hollowed center of elevated portion **116** of housing **104**. Lower protruding portion **98** of locking member **90** can be positioned at least partially within

opening **124** of floor. Protruding portions **26** of remote component **10** can be positioned in expanded portions **126** and rotated to grip and/or frictionally engage inner wall **122**. Upon rotation in direction R, body **12** with protruding portions **26** can rotate over locking member **90** to frictionally engage inner wall **122** of housing **104**. In one aspect, a spanner tool can be used to twist remote component **10** clockwise by approximately $\frac{1}{4}$ turn within housing **104**. Thus, rotation of remote component **10** can mechanically couple remote component **10** to housing **104**. This design can be advantageous to consumers and/or manufacturers of remote component devices, systems, and methods described herein, as such devices and systems can be easy to use. Simply insert remote component, twist, and the component and/or system is ready to use. A thermal paste or adhesive can optionally be disposed between locking member **90** and floor **120** of housing **104**. In one aspect, a thermal pad can optionally be disposed between locking member **90** and floor **120** of housing **104**. Once remote component **10** is rotated to lock it within housing **104**, the remote component and housing **104** are also thermally coupled. Heat can dissipate from one or more LEDs **18** to body **12** and housing **104**. Notably, customers and/or consumers can design their own locking member **90** for twist-locking remote component **10** to housing **104**.

Figures 6 and 7 illustrate side and perspective side views of an assembled remote component system, generally designated **100**. That is, remote component **10** has been inserted and rotated to lock it within housing **104**. Remote component **10** can mechanically, electrically, and thermally communicate with housing **104** upon rotation. Bulb **102** can then be positioned over housing **104** and secured to inner wall **115** thereof. Bulb **102** can be transparent, semitransparent, opaque, and/or any combination thereof. For illustration purposes, bulb **102** is illustrated as transparent such that remote component **10** can be visibly seen therein. Figure 7 illustrates remote component **10** centrally disposed with respect to bulb **102**. However, any configuration is contemplated. In some embodiments, remote component **10** can be to the left or right of center. In other embodiments, bulb **102** can comprise any suitable shape than the pear shape (A19

size/shape) as illustrated. Any size and/or shape of bulb **102** and remote component system **100** are hereby contemplated. In one aspect, remote component system **102** can comprise an A19 equivalent bulb. That is, remote component system can be adapted to replace standard filament and CFL size A19 light bulbs. As Figure 7 illustrates, light can be emitted from remote component and illuminate the inside of bulb **102** as the lines indicate. The light can then be emitted through bulb **102** as the lines external of bulb **102** indicate. In some aspects it may be desirable to use remote component **10** in a housing **104** without a bulb **102**. In other aspects, a bulb **102** is advantageous. Notably, the remote component system can emit omnidirectional light both above and/or below remote component. Base **108** of lamp can comprise an electrical connector **130** adapted to engage and fit within standard sockets for lighting fixtures. Electrical current can be communicated into remote component system **100** when activated by turning a lamp switch "on." Electrical current can flow into circuit **106** (Figure 5) which can comprise one or more wires (Figure 9) for feeding up through housing **104** and held between openings **78** of connector housing **70** and openings **94** of locking member **90**. Insulation about one or more wires can then be displaced using electrical connector **80**, for example, an IDC which can electrically communicate current to rivet **22** and cause the electrical current to illuminate the one or more LEDs **18**. Electrical connector **130** can be adapted to fit within sockets of table lamps, floor lamps, and/or any other suitable lighting product, fixture, or system. In optional designs, base **108** can be threaded such that it can threadingly engage with a lamp socket and be secured thereto. In one aspect, base **108**, circuit **106**, and housing **104** can be pre-designed and/or pre-assembled using any suitable method. The pre-designed and/or pre-assembled housing **104** can be configured for receiving remote components **10** described herein.

Figures 8A and 8B illustrate an unexploded portion of a cross-sectional view of housing **104** with remote component **10** disposed therein. Figure 8A illustrates a first embodiment of an IDC connector as described earlier. Figure 8B illustrates another embodiment of an IDC connector. For illustration purposes, only two embodiments are shown, however, any

embodiment of a connector adapted for piercing and/or otherwise displacing insulation from a conductive wire is hereby contemplated. Figures 8A and 8B illustrate body **12** of remote component disposed within housing **104**. One or more rivets **22** can electrically communicate with one or more contacts **20** and one or more electrical connectors **80**. At least a portion of rivet **22** can be positioned through opening **82** of electrical connectors **80**. Rivet **22** can mechanically couple body **12** to each of insulating portion **60** and electrical connector **80**. An insulating member **40** can be at least partially disposed about a portion of rivet **22**. Insulating member **40** and rivet **22** can at least partially extend vertically within body **12**. Upon rotation in the direction indicated by the arrow **R**, each of body **12**, insulating member **60**, and electrical connector **80** can simultaneously rotate about locking member **90** and electrical connector housing. An insulated wire (Figure 9) can be fed up through housing **104** and can supply electrical current for illuminating remote component **10**. Electrical connector **80** can be electrically coupled to the wire upon rotation. Thus, rotation simultaneously thermally, mechanically, and electrically couples remote component **10** to housing **104**.

Figure 8A illustrates electrical connector housing, generally designated **70**. Figure 8B illustrates a second embodiment of electrical connector housing, generally designated **140**. In one aspect, electrical connectors illustrated in Figures 8A and 8B can comprise solder-free IDC connectors of a custom design or designs available on the market can be used. Electrical connector housing **70** comprises an opening **78** of housing portion **74**. A portion of body **12** can be disposed within hollowed center **72** of connector housing **70**. This thicker body portion can advantageously comprise an effective heat transfer material, or heatsink, which can thermally couple over housing **104** to readily dissipate heat through body to one or more fins **110** (Figure 5) of housing. Opening **78** can substantially align with opening **94** of locking member **90**. A wire can be disposed within each of openings **78** and **94**. The wire can be fixedly held between each of the openings and trimmed off flush at the top of electrical connector housing **70**. Upon rotation, an aperture **86** of electrical connector **80** can slidably move over locking member **90** and engage the wire. Upper surfaces **86** of

aperture **84** can displace insulation from and upper portion of wire. Lower surfaces **88** of aperture **84** can displace the insulation from a bottom portion of wire. Upper and lower surfaces **86** and **88**, respectively, can make electrical contact with the conductive portion of wire, and electrically communicate with wire and rivet **22**. In one aspect, the rotation force causes upper and lower surfaces **86** and **88** to cut into the insulation and electrically communicate with the exposed conductive wire. During rotation, housing portion **72** can fixedly engage stepped portion **92** of locking member **90** such that it can hold the wire stationary allowing electrical connector **80** to make electrical contact with the wire.

Similarly, electrical connector housing **140** of Figure 8B can comprise a housing portion **142**. Housing portion **142** can comprise a groove **144** substantially aligned over opening **94** of locking member **90**. Groove **144** can fixedly hold a wire between opening **94**. A portion of body **12** can be disposed within a hollowed center **146** of connector housing **140**. This thicker body portion can advantageously comprise an effective heat transfer material, or heatsink, which can thermally couple over housing **104** to readily dissipate heat through body **12** to one or more fins **110** (Figure 5) of housing. Similar to Figure 8A, electrical connector **80** can slidably move over locking member **90** and engage the wire. Upper surfaces **86** of aperture **84** can displace insulation from and upper portion of wire. Lower surfaces **88** of aperture **84** can displace the insulation from a bottom portion of wire. In one aspect, upper and lower surfaces **86** and **88**, respectively bite or otherwise cut into the insulation surrounding the conductive wire to expose and electrically communicate with wire. Upper and lower surfaces **86** and **88**, respectively, can make electrical contact with the conductive portion of wire, and electrically communicate with wire and rivet **22**. During rotation, housing portion **142** can fixedly engage stepped portion **92** of locking member **90** such that it can hold the wire stationary allowing electrical connector **80** to make electrical contact with the wire.

Figure 9 illustrates a cross-sectional view of electrical connector **80** along line **9-9** of Figures 8A and 8B. Electrical connector **80** can comprise an IDC contact. In Figure 9 a cross-section of conductive wire **150** is as fixedly

held vertical with respect to electrical connector **80**. Conductive wire **150** can be covered with an insulating covering **152**. When remote component **10** rotates, electrical connector **80** can slide over locking member **90** and pierce conductive wire **150**. Electrical connector **80** makes electrical contact with the conductive wire **150** when rotation causes it to displace insulating covering **152**. For example, conductive wire **150** can be directly contacted by upper and lower surfaces **86** and **88**, respectively, of electrical connector **80** upon rotation. When rotated, electrical connector **80** can electrically communicate with conductive wire **150** and transfer electrical current to the LEDs **18** using rivet **22**. Rotation can electrically link remote component **10** to circuit **106** of housing **104**. As noted earlier, electrical conductor can comprise any suitable electrically conductive material. Notably, an IDC contact is solder-free which improves handling and ease of use and manufacturing of devices and/or components as described herein. In addition, no manual stripping of wires prior to soldering is necessary, as the IDC contact strips the wires upon rotation.

Figure 10 is a flow chart illustrating a method of assembling light emitting devices **10** described herein. As Figure 10 illustrates, the method can comprise three different sub-methods designated I, II, and III each of which can comprise one or more steps performed before and/or simultaneous with the steps of the preceding sub-method. That is, steps **168** and **170** of sub-method II can be performed before and/or simultaneous with the steps of sub-method I. Similarly, steps **182-194** of sub-method III can be performed before and/or simultaneous with the steps of sub-methods I and/or II.

First sub-method I can comprise preparing the optical material located remotely from the one or more LEDs. For example, a first step in preparing the optical material can comprise step **162** which can be to weigh the mixture used for the optical material. The mixture can be mixed at step **164** and loaded in a syringe at step **166**. Sub-method II can comprise preparing the cover, for example cover **14** (Figure 1) to which the optical material can adhere and/or attach to. For example, the cover can be cleaned at step **168** and inspected at step **170**. At step **172** the optical material prepared

according to sub-method I can be applied to the prepared cover. For example, in one aspect the optical material prepared in sub-method I can be coated at step **172** onto the cover. In one aspect, the optical material can be spray coated to an inner and/or outer surface of the cover **14**. However, any coating method can be used, for example not limited to brushing, molding, dipping, adhering, encapsulating, or any other suitable method. The cover can be optionally cured according to step **174** and the opening of cover can be lightly grinded in step **176**. The cover can be cleaned at step **178** and measured and/or inspected at step **180**. In one aspect, optical properties of the cover can be measured, and the cover can be inspected for optical and/or physical defects.

Still referring to Figure 10, sub-method III can include steps of preparing the body **12** prior to attaching cover **14** (Figure 1). For example, the body can be inspected at step **182** and screen printed at step **184**. In one aspect, the solder mask can be screen printed over the mounting substrate for improved light reflection and/or other improved optical properties. LEDs and/or LED packages can be picked and placed at step **186**. The body, including the connector, insulating portion and LEDs or LED packages can be heated for example, by reflowing at step **188**. The body can be assembled at step **190** to locking member. Rivets can be formed at step **192**. In one aspect, rivets can be pressed. An adhesive ring can be dispensed at step **194** about inner wall of body, for example, inner wall **30** (Figure 1) for securely attaching to cover. The cover can be assembled to the body at step **196** by positing the cover over inner wall with the adhesive disposed therebetween. The cover can be wet cured to the body at step **198**. The remote component is now assembled and can be measured at step **200**. Optical, physical and/or electrical properties can be measured at step **200**. The remote component can be binned according to its optical properties and/or packaged at step **202**. In one aspect, remote component can be packaged as is for shipping to customers to use in customer-specific component designs. Or remote component can be packaged for shipping to be used alone or in other lighting products. In other aspects, remote component can be packaged within a housing, for example, housing **104** for

use in an A19 equivalent light bulb system as described herein. Remote component devices can be used alone and/or in combination with any other suitable components forming remote component systems thereof.

Figures 11 and 12 illustrate lighting products, or devices utilizing remote component devices **10**. For example, remote component devices **10** as described herein can be used alone in lighting products or used as a system in lighting products. Such systems can comprise, for example, A19 equivalent light bulb and systems previously described. Remote component systems are not limited to A19 equivalent bulbs, but can comprise any suitable system. Figure 11 illustrates a remote component **10** used in a lighting device **210**. Lighting device **210** can comprise a decorative lamp for use in down lighting applications. Lighting device **210** can comprise a decorative cover **212** and a thermal element **216**. Thermal element can be thermally coupled to remote component **10** and can dissipate heat from remote component **10** into the ambient air. Thermal element **216** can comprise a housing for mechanically coupling to remote component **10**. Notably, remote component can be used alone, and not contained within another bulb, such as bulb **102** (Figure 5). Remote component **10** can be secured within thermal element, for example, lockably secured as described earlier. Remote component **10** can electrically, thermally, and mechanically couple within device **210** to thermal element **216**, as electrical current can at least partially be transferred through thermal element **216** to remote component **10** using electrical wire **218**. Remote component **10** can comprise omnidirectional light emission, which in turn, can produce omnidirectional lighting from lighting device **210**.

Figure 12 illustrates another example of a lighting product using remote component **10**. Figure 12 illustrates a recessed light, generally designated **220**. Recessed light **220** can be installed, for example, from a ceiling **222**. Recessed light **220** can comprise a recess **R** in which remote component **10** can be lockably secured, and from which remote component **10** can emit light. Remote component **10** can be used alone, or as a system within recessed light **220**. At least a portion of recessed light **220** can comprise a housing for receiving remote component **10**. Remote component

10 can electrically, thermally, and mechanically couple within recess **R** to other components (not shown) of recessed light **220**. Remote component **10** can emit omnidirectional light which can be reflected and directed down at least partially, for example, by reflective inner wall **224**. Remote component

5 **10** can be used either alone and/or in combination within a system in any suitable lighting device, or product. Embodiments herein have been used for illustration purposes. Any lighting product device or system is hereby contemplated.

In sum, remote component devices can be used as a lighting product

10 to illuminate lighting devices either alone or in combination within systems targeted at replacing standard filament and CFL bulbs. Remote component devices and systems can comprise easy to use twist-lock lighting products having omnidirectional light emission. Customers and/or consumers can simply insert remote components and twist, and the devices and/or systems

15 are ready to use. Customers and/or consumers can easily fit remote components described herein into A19 equivalent bulbs and/or easily design and assemble A19 lamps, or other LED products using components described herein. Tedious stripping and soldering of electrical components can be eliminated. In one aspect, the remote component devices, systems,

20 and methods herein can thermally, electrically, and mechanically couple with one simple rotation or twisting motion. Additional optics or components can be installed and/or used with remote component devices, systems, and methods as specified by the manufacturer and/or consumer. While the subject matter has been described herein in reference to specific

25 aspects, features and illustrative embodiments of the subject matter, it will be appreciated that the utility of the subject matter is not thus limited, but rather extends to and encompasses numerous other variations, modifications and alternative embodiments, as will suggest themselves to those of ordinary skill in the field of the present subject matter, based on the disclosure herein.

30 Correspondingly, the subject matter as hereinafter claimed is intended to be broadly construed and interpreted, as including all such variations, modifications and alternative embodiments, within the scope of this disclosure.

CLAIMSWhat is claimed is:

1. A remote component for providing light, the remote component comprising:
 - 5 a body attachable to a housing for attaching the remote component to the housing;
 - one or more light emitting devices disposed over the body; and
 - an optical material remotely located at least a first distance away from the one or more light emitting devices for affecting light
 - 10 emitted from the one or more light emitting devices.
2. The remote component of claim 1 wherein the one or more light emitting devices comprise one or more light emitting diodes (LEDs).
- 15 3. The remote component of claim 1 wherein the optical material comprises a phosphor material.
4. The remote component of claim 3 further comprising a cover disposed over the one or more LEDs, and wherein the phosphor material is disposed
- 20 on the cover.
5. The remote component of claim 4 wherein the phosphor material is coated on an inner or outer surface of the cover.
- 25 6. The remote component of claim 1 comprising light emitting devices adapted for a light emission having a minimum of approximately 80 CRI for white color points.
7. The remote component of claim 1 comprising light emitting devices
- 30 adapted for a light emission having a minimum of approximately 90 CRI for white color points.

8. The remote component of claim 1 comprising light emitting devices adapted for a light emission of at least approximately 800 lumens (lm) or more at approximately 12.5 W of power or less.
- 5 9. The remote component of claim 1 wherein the housing is a housing adapted for receiving an A19 equivalent light bulb.
10. The remote component of claim 1 wherein the one or more light emitting devices receive electrical signal transferred at least partially from a
10 lower connector upon rotation of the body.
11. The remote component of claim 10 wherein the lower connector comprises an insulation displacement connector (IDC).
- 15 12. The remote component of claim 11 wherein the IDC is adapted for simultaneously mechanically and thermally coupling the body to the housing upon rotation.
13. The remote component of claim 1 wherein the first distance is 1 or
20 more millimeters (mm).
14. The remote component of claim 4 wherein the remote component is adapted for emitting light from the cover omnidirectionally.
- 25 15. A remote component for providing light, the remote component comprising:
- a body attachable to a housing for attaching the remote component to the housing;
 - one or more light emitting devices disposed over the body, the
30 one or more light emitting devices configured for receiving electrical signal transferred at least partially from a lower connector upon rotation of the body; and

an optical material remotely located at least a first distance away from the one or more light emitting devices.

16. The remote component of claim 15 wherein the one or more light
5 emitting devices comprise one or more light emitting diodes (LEDs).

17. The remote component of claim 16 wherein the optical material
comprises a phosphor material.

10 18. The remote component of claim 17 further comprising a cover
disposed over the one or more LEDs, and wherein the phosphor material is
disposed on the cover.

15 19. The remote component of claim 18 wherein the phosphor material is
coated on an inner or outer surface of the cover.

20 20. The remote component of claim 15 comprising light emitting devices
adapted for a light emission having a minimum of approximately 80 CRI for
white color points.

21. The remote component of claim 15 comprising light emitting devices
adapted for a light emission of at least approximately 800 lumens (lm) or
more at approximately 12.5 W of power or less.

25 22. The remote component of claim 15 wherein the housing is for an A19
equivalent light bulb.

23. The remote component of claim 15 wherein the lower connector
comprises an insulation displacement connector (IDC).

30 24. The remote component of claim 23 wherein the IDC is adapted for
simultaneously mechanically and thermally coupling the body to the housing
upon rotation.

25. The remote component of claim 15 wherein the first distance is 1 or more millimeters (mm).
- 5 26. The remote component of claim 18 wherein the remote component is adapted for emitting light from the cover omnidirectionally.
27. A remote component system for providing light, comprising:
a remote component comprising:
10 a body;
one or more light emitting devices disposed over the body; and
an optical material remotely located at least a first distance away from the one or more light emitting devices;
15 a housing for receiving the body; and
wherein the remote component thermally, electrically, and mechanically connects to the housing upon rotation of the body.
28. The remote component system of claim 26 wherein the system
20 comprises an A19 equivalent light bulb.
29. The remote component system of claim 27 comprising light emitting devices adapted for a light emission of at least approximately 800 lumens (lm) or more at approximately 12.5 W of power or less.
25
30. The remote component system of claim 27 wherein the one or more light emitting devices comprise one or more light emitting diodes (LEDs).
31. The remote component system of claim 30 wherein the optical
30 material comprises a phosphor material.

32. The remote component system of claim 31 wherein the remote component further comprises a cover disposed over the one or more LEDs, and wherein the phosphor material is disposed on the cover.
- 5 33. The remote component system of claim 32 wherein the phosphor material is coated on an inner or outer surface of the cover.
34. The remote component system of claim 27 comprising a light emission having a minimum of approximately 80 CRI for white color points.
- 10 35. The remote component system of claim 27 wherein a lower connector is adapted for thermally, electrically, and mechanically connecting to the housing upon rotation of the body.
- 15 36. The remote component system of claim 33 wherein the lower connector comprises an insulation displacement connector (IDC).
37. The remote component system of claim 27 wherein the first distance is 1 or more millimeters (mm).
- 20 38. The remote component system of claim 27 further comprising a bulb disposed over the cover of remote component.
39. The remote component system of claim 32 wherein the light emitting
25 devices are configured for emitting light from the cover omnidirectionally.
40. The remote component system of claim 38 wherein the remote component system is configured for emitting light from the bulb omnidirectionally.
- 30 41. A method of providing a lighting device, comprising
providing a remote component comprising:

a body attachable to a housing for attaching the remote component to the housing;

one or more light emitting devices disposed over the body;

5 an optical material remotely located at least a first distance away from the one or more light emitting devices; and attaching the body of the remote component to the housing.

42. The method of claim 41 wherein locking the body of the remote
10 component comprises rotating the body within at least a portion of the housing.

43. The method of claim 41 wherein providing one or more light emitting
15 devices comprises providing one or more light emitting diodes (LEDs) disposed over the body.

44. The method of claim 43 wherein the optical material comprises a phosphor material.

20 45. The method of claim 44 further comprising providing a cover disposed over the one or more LEDs, and wherein the phosphor material is disposed on the cover.

46. The method of claim 45 wherein the method further comprises coating
25 the phosphor material on an inner or outer surface of the cover.

47. The method of claim 41 further comprising illuminating the one or
more light emitting devices, whereby a light emission of the one or more light
emitting devices comprises a minimum of approximately 80 CRI for white
30 color points.

48. The method of claim 41 further comprising illuminating the one or
more light emitting devices, whereby a light emission of the one or more light

emitting devices comprises a minimum of approximately 90 CRI for white color points.

49. The method of claim 48 whereby the light emission comprises at least
5 approximately 800 lumens (lm) or more at approximately 12.5 W of power or less.

50. The method of claim 48 whereby the light emission is omnidirectional.

10 51. The method of claim 42 wherein rotating the body comprises moving a lower connector to electrically connect to the one or more light emitting devices.

52. The method of claim 51 wherein the lower connector comprises an
15 insulation displacement connector (IDC).

53. The method of claim 52 wherein moving the IDC mechanically and thermally couples the body to the housing upon rotation.

20 54. A method of providing a remote component system comprising:
providing a remote component comprising:
a body;
one or more light emitting devices disposed over the
body;
25 an optical material remotely located at least a first
distance away from the one or more light emitting devices;
providing a housing for receiving the body; and
attaching the remote component to the housing whereby the
remote component is mechanically and electrically coupled to the
30 housing.

55. The method of claim 54 wherein attaching the remote component comprises rotating the remote component with respect to the housing.

56. The method of claim 54 whereby the remote component thermally couples to the housing upon attachment.

5 57. The method of claim 54 wherein providing the remote component comprises positioning the optical material at least the first distance away from one or more light emitting diodes (LEDs), the first distance comprising 1 or more millimeters (mm).

10 58. The method of claim 54 further comprising attaching a bulb over the remote component.

59. An A19 equivalent light bulb provided using the method of claim 54.

15 60. The method of claim 54 further comprising illuminating the one or more light emitting devices, whereby a light emission of the one or more light emitting devices comprises a minimum of approximately 80 CRI for white color points.

20 61. The method of claim 60 whereby the light emission comprises at least approximately 800 lumens (lm) or more at approximately 12.5 W of power or less.

62. The method of claim 60 whereby the light emission is omnidirectional.

1/9

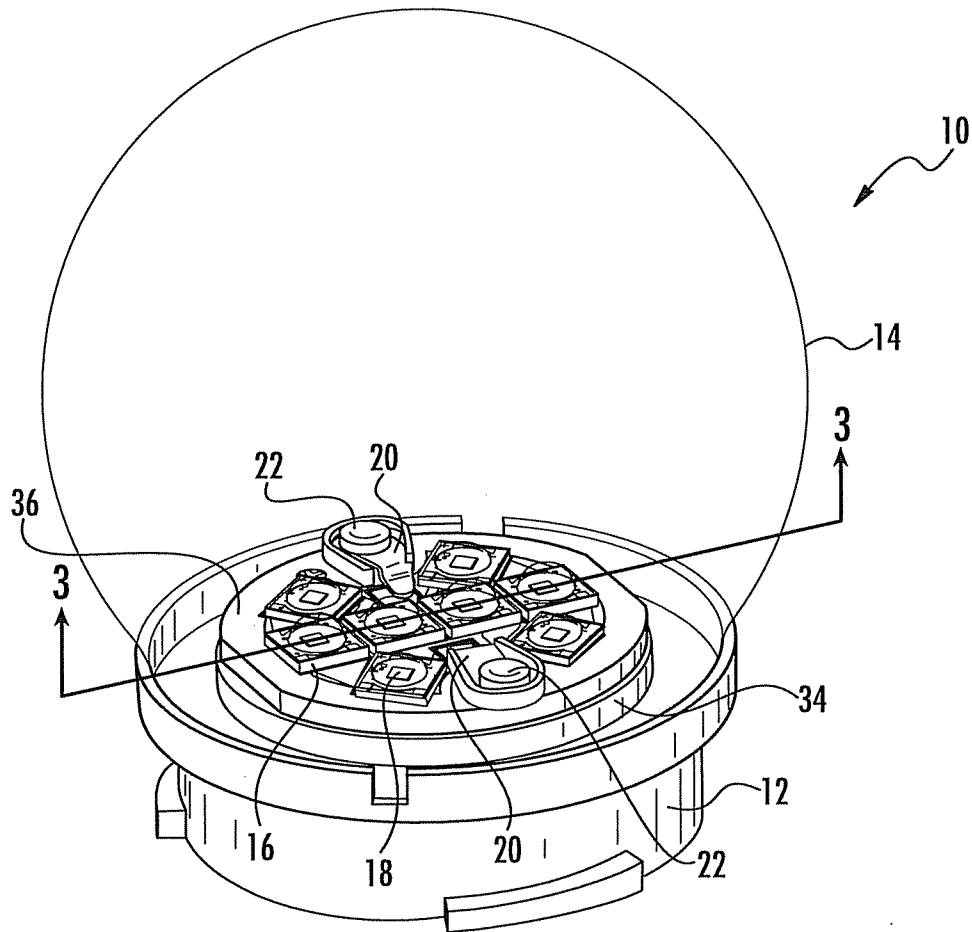


FIG. 1

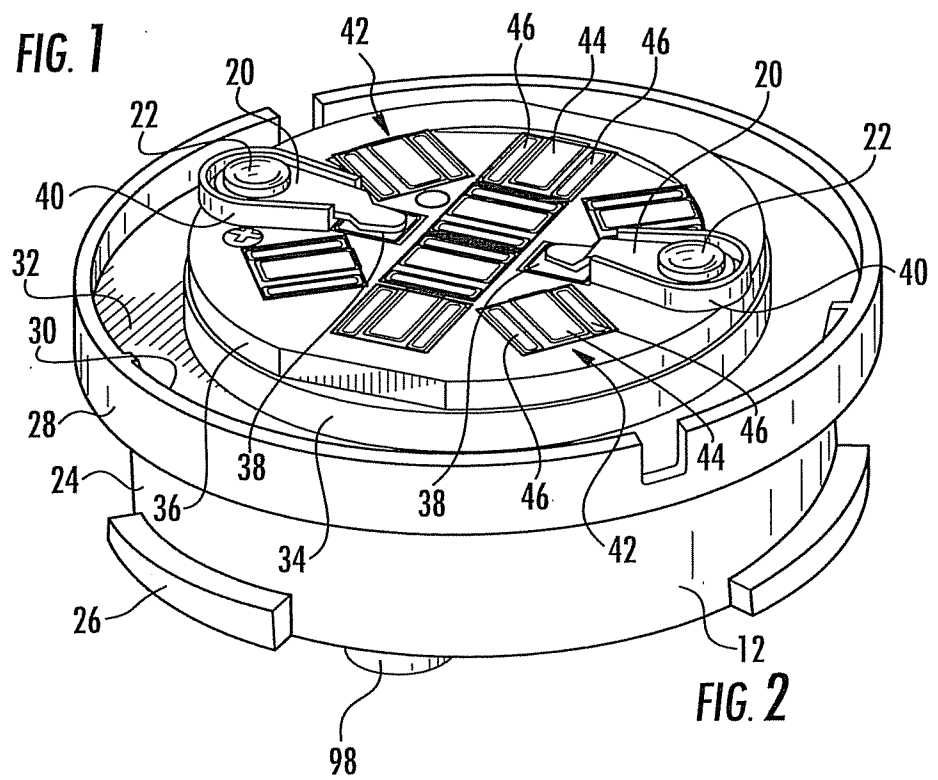


FIG. 2

2/9

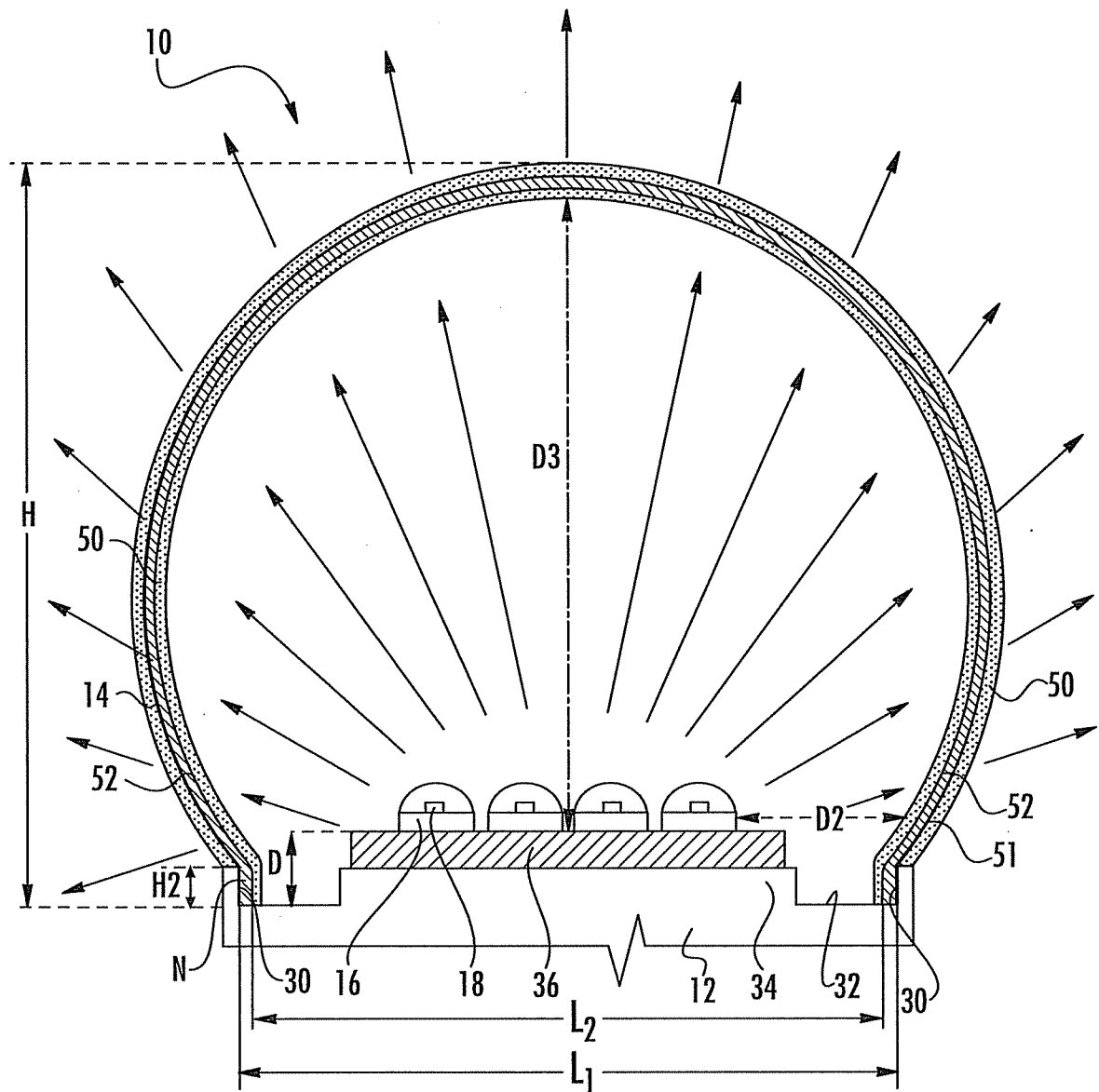
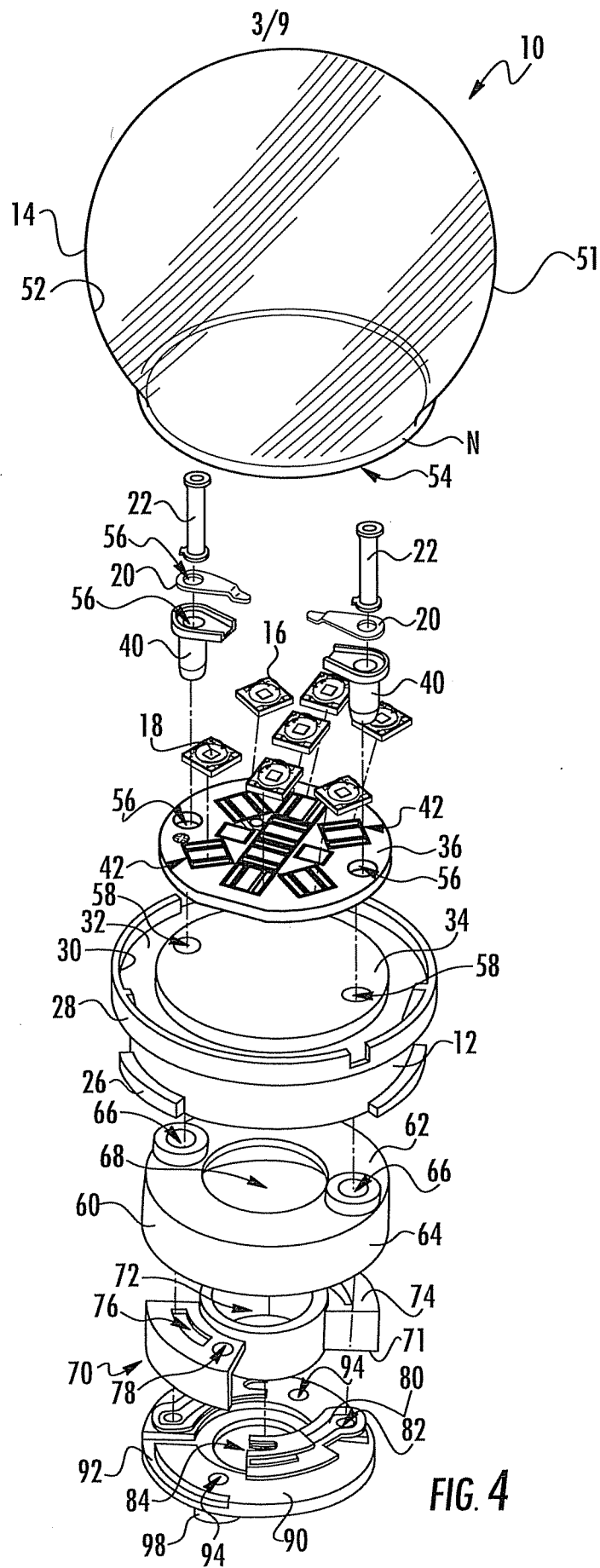


FIG. 3



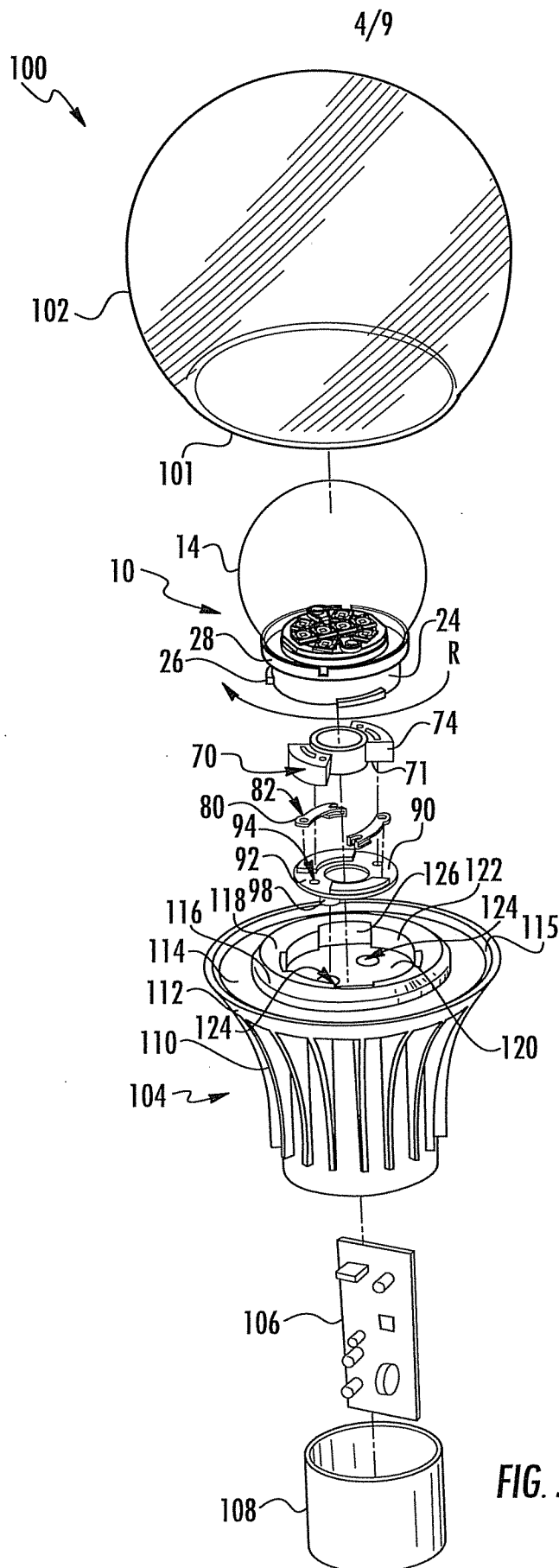
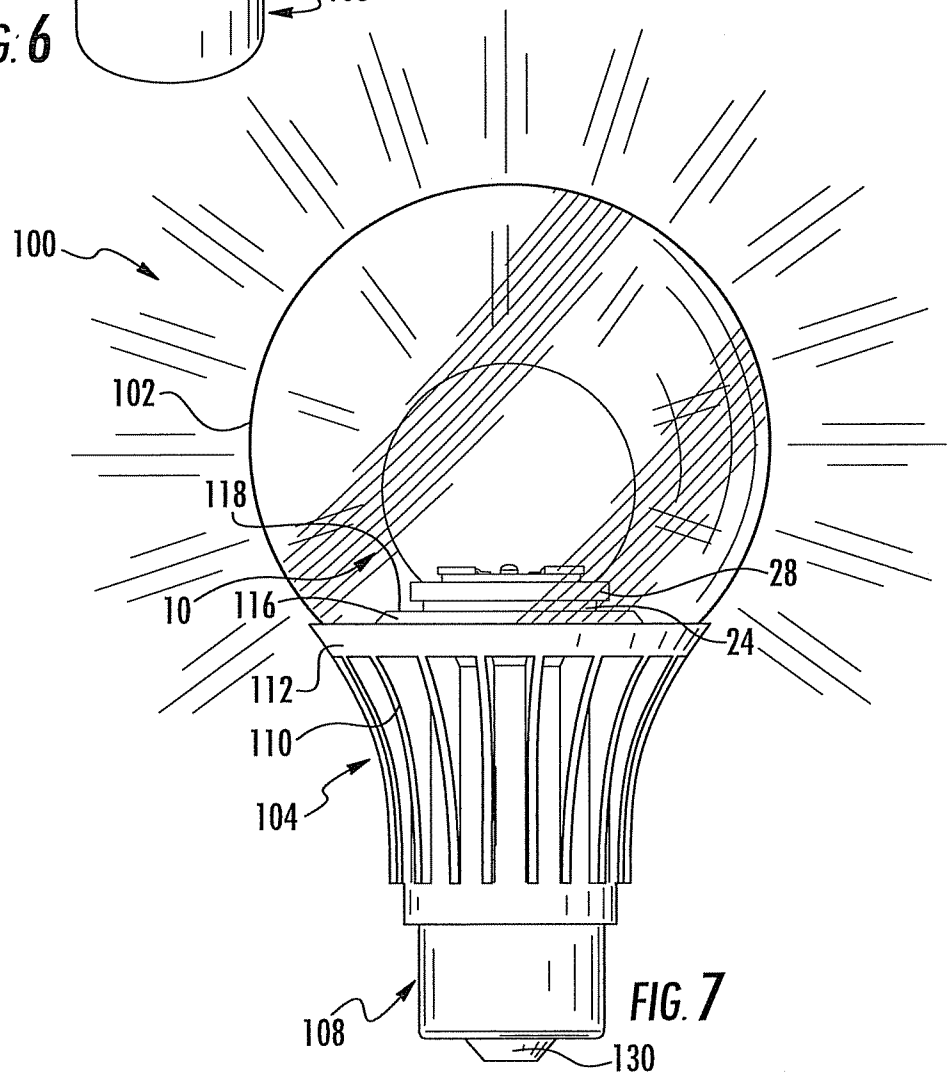
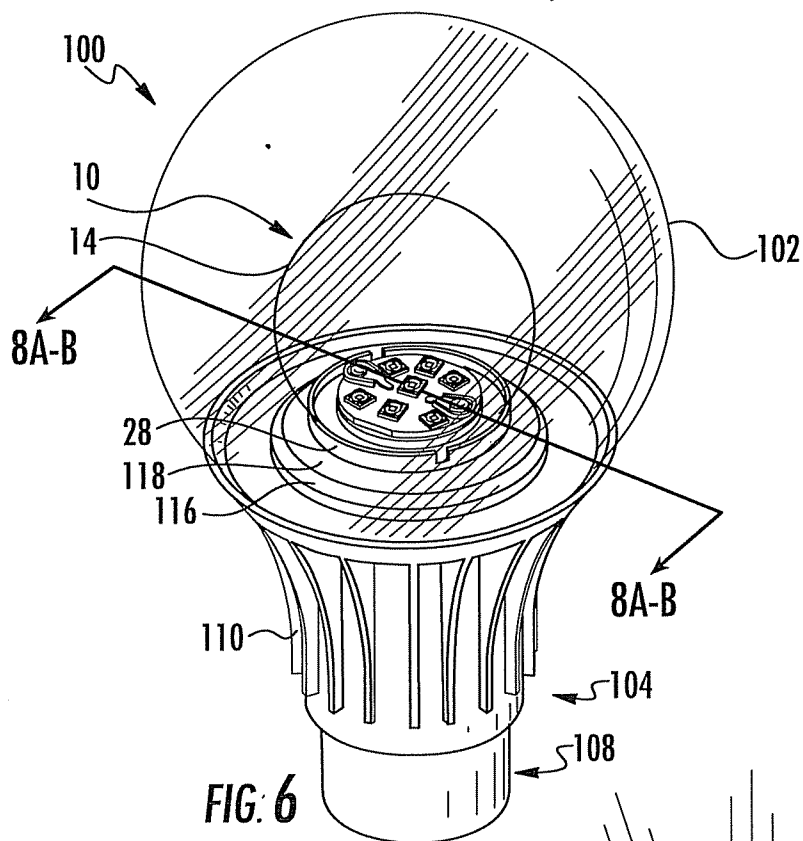
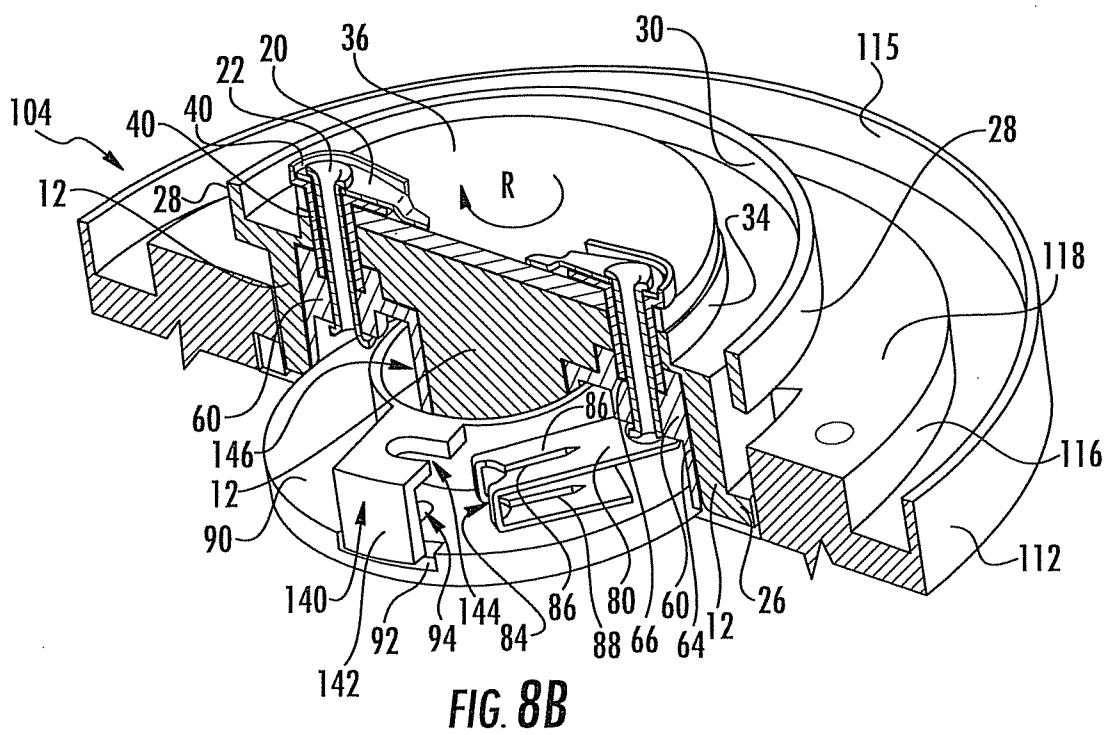
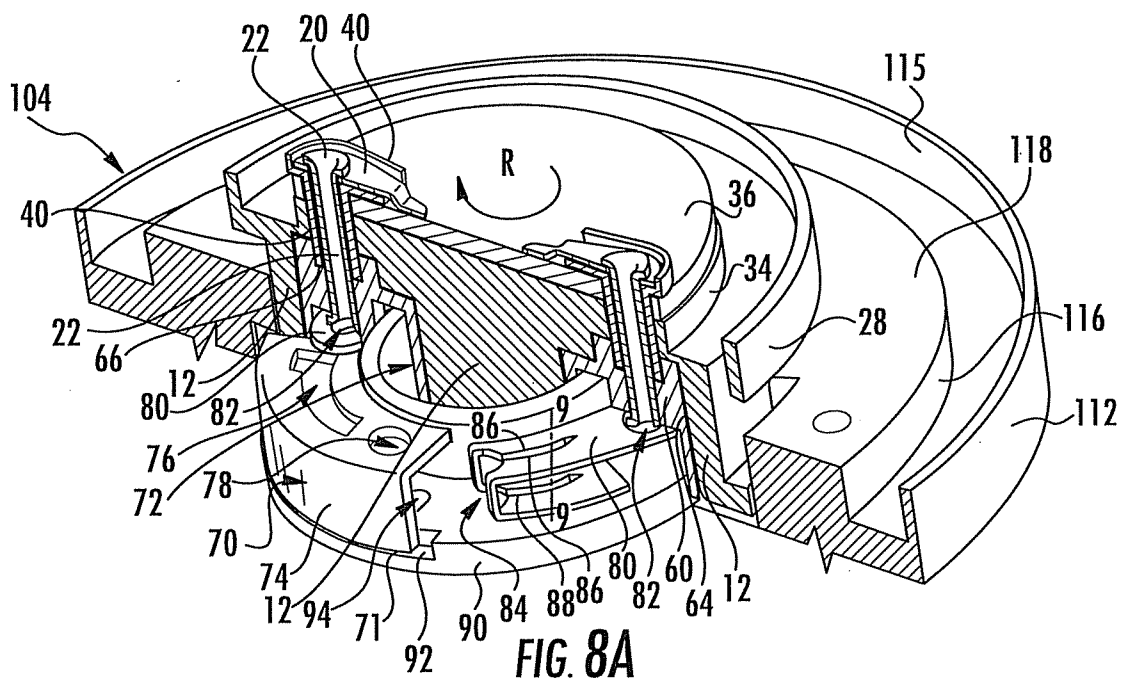


FIG. 5

5/9



6/9



7/9

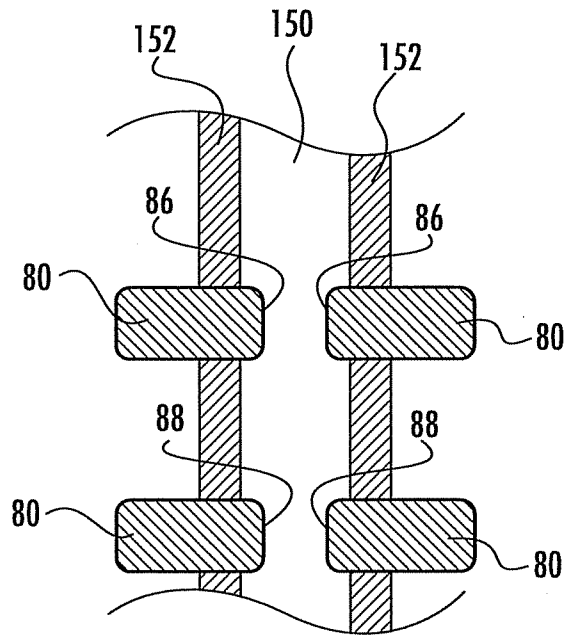


FIG. 9

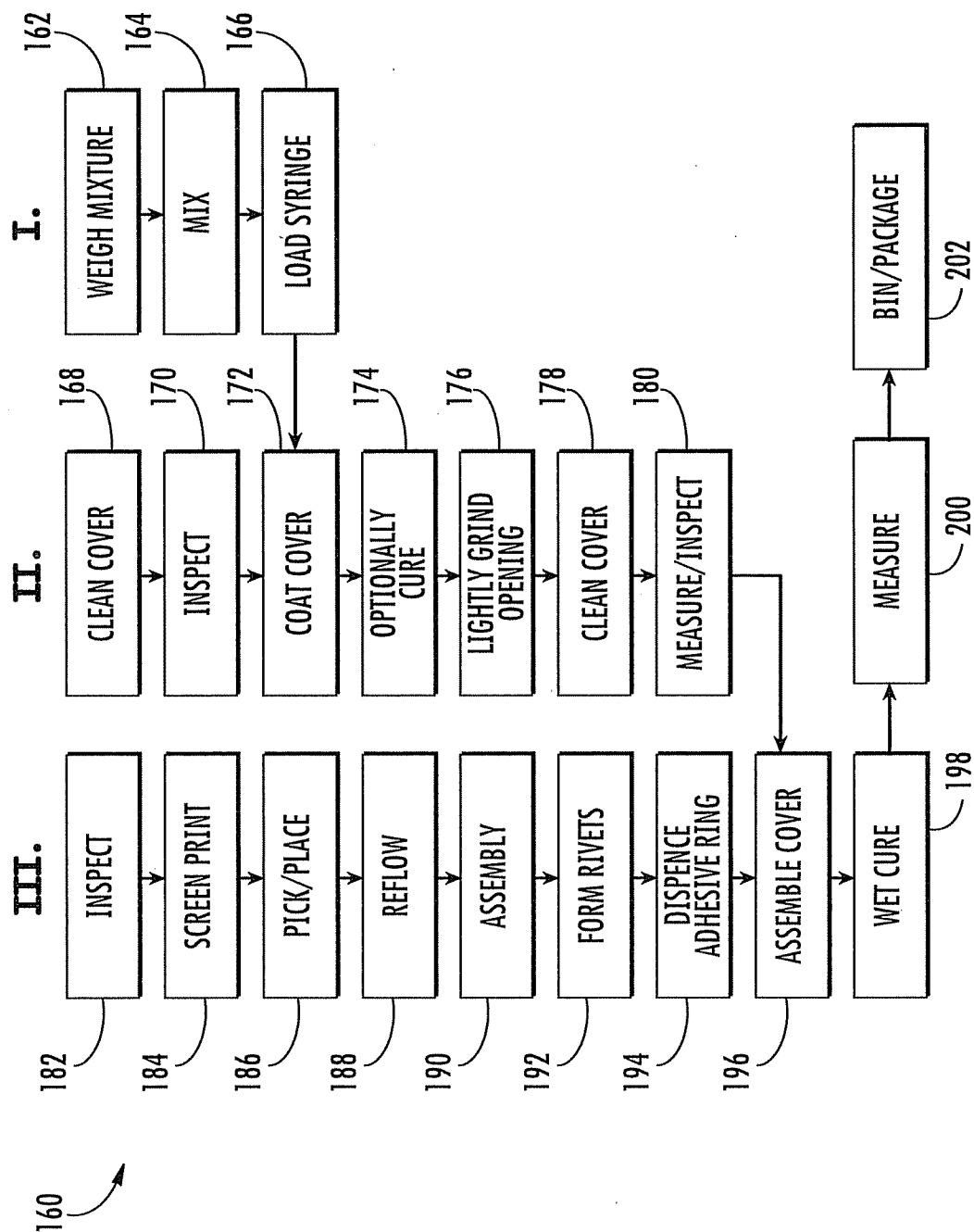


FIG. 10

9/9

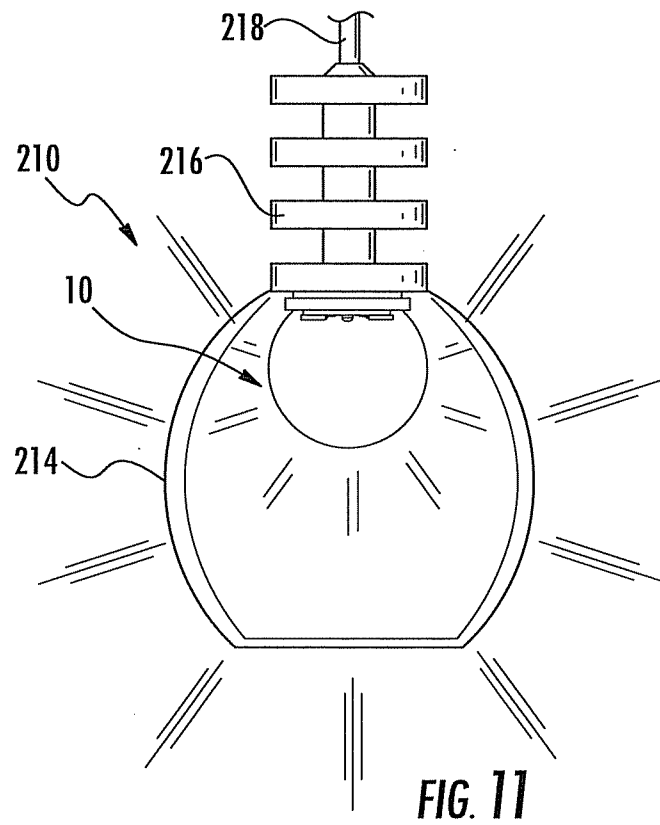


FIG. 11

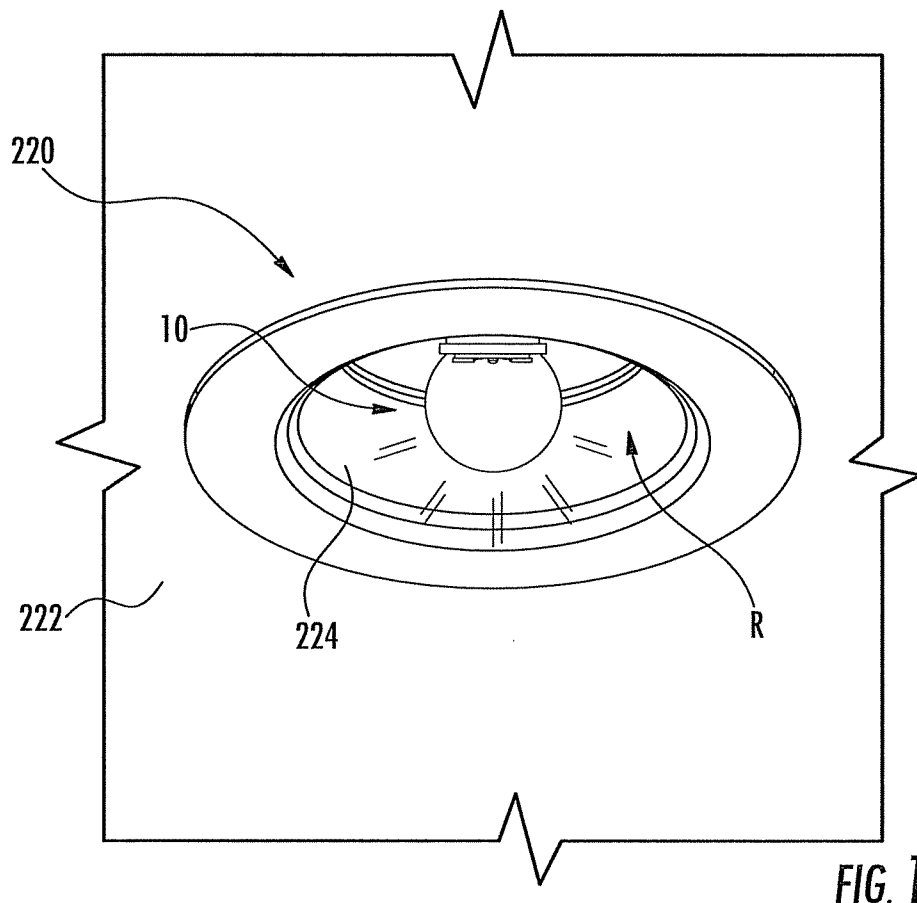


FIG. 12