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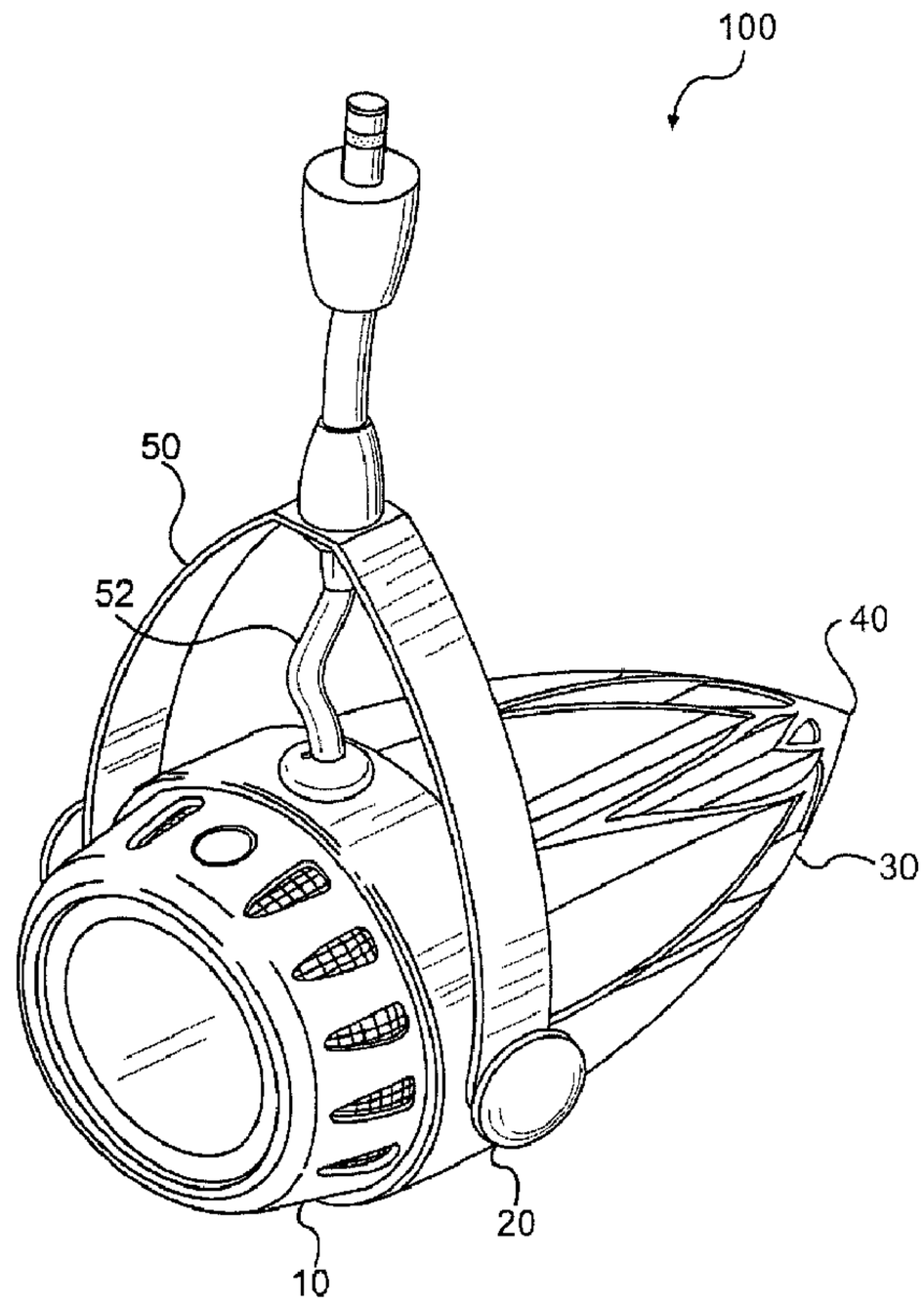

(57) Abrégé/Abstract:
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assembly also includes a thermally conductive core connected to the light module through the enclosure. The lighting assembly further includes a housing mounted in thermal contact with the core and the enclosure, so as to cause the housing to dissipate heat to an ambient atmosphere.

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(57) Abstract: A lighting assembly and a method for manufacturing a lighting assembly are provided. The lighting assembly includes a light module including a lighting element, and an enclosure having a recess for receiving and housing the light module. The lighting assembly also includes a thermally conductive core connected to the light module through the enclosure. The lighting assembly further includes a housing mounted in thermal contact with the core and the enclosure, so as to cause the housing to dissipate heat to an ambient atmosphere.

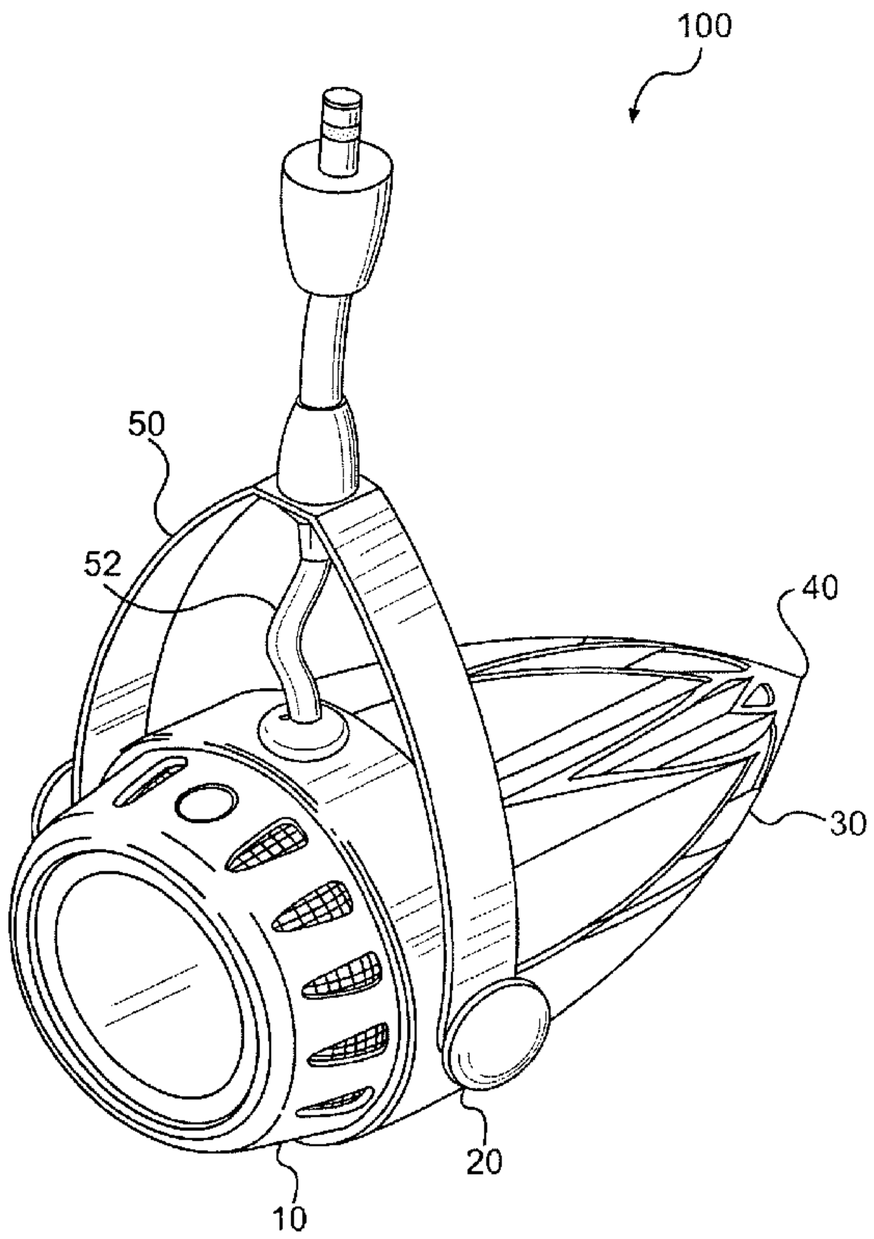

Fig. 1

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LIGHTING ASSEMBLY HAVING A HEAT DISSIPATING HOUSING

BRIEF DESCRIPTION

Technical Field

[001] The present invention is directed to a lighting assembly which may include passive cooling components integrated therein.

Background

[002] Lighting assemblies such as lamps, ceiling lights, and track lights are important fixtures in any home or place of business. Such assemblies are used to not only illuminate an area, but often also to serve as a part of the decor of the area. However, it is often difficult to combine both form and function into a lighting assembly without compromising one or the other.

[003] Traditional lighting assemblies typically use incandescent bulbs. Incandescent bulbs, while inexpensive, are not energy efficient, and have a poor luminous efficiency. To attempt to address the shortcomings of the incandescent bulbs, a move is being made to use more energy efficient and longer lasting sources of illumination, such as fluorescent bulbs and light emitting diodes (LEDs). Fluorescent bulbs require a ballast to regulate the flow of power through the bulb, and thus can be difficult to incorporate into a standard lighting assembly. Accordingly, LEDs, formerly reserved for special applications, are increasingly being considered as a light source for more conventional lighting assemblies.

[004] LEDs offer a number of advantages over incandescent and fluorescent bulbs. For example, LEDs produce more light per watt than incandescent bulbs, LEDs do not change their color of illumination when dimmed, and LEDs can be constructed inside solid cases to provide increased protection and durability. LEDs also have an extremely long life span when conservatively run, sometimes over **100,000** hours, which is twice as long as the best fluorescent bulbs and twenty times longer than the best incandescent bulbs. Moreover, LEDs generally fail by a gradual dimming over

time, rather than abruptly burning out, as do incandescent bulbs. LEDs are also desirable over fluorescent bulbs due to their decreased size and lack of need of a ballast, and can be mass produced to be very small and easily mounted onto printed circuit boards.

[**005**] LEDs, however, have heat-related limitations. The performance of an LED often depends on the ambient temperature of the operating environment, such that operating an LED in an environment having a moderately high ambient temperature can result in overheating the LED, and premature failure of the LED. Moreover, operation of an LED for extended period of time at an intensity sufficient to fully illuminate an area may also cause an LED to overheat and prematurely fail. Accordingly, an important consideration in using an LED in a lighting assembly is to provide adequate passive or active cooling.

[**006**] Active cooling mechanisms, such as fans, may be difficult to implement in a lighting assembly, as they often increase the size and power consumption of the assembly, and drain additional power. Passive cooling structures, such as heat sinks, may also be difficult to incorporate as they increase the size of the lighting assembly. Moreover, traditional heat sinks can be as much of a detriment to incorporation in traditional lighting assignments as a ballast can be in a fluorescent bulb assembly. Accordingly, there is a need for providing adequate cooling in a lighting assembly, such as an LED lighting assembly, without significantly increasing the size, and without taking away from the aesthetics and ambience that a lighting assembly can add to an area.

BRIEF SUMMARY

[**006a**] In accordance with one aspect of the invention there is provided a light module removably mountable to a light fixture. The light module includes an LED lighting element and a mounting base, the LED lighting element mounted to the mounting base. The light module also includes one or more resilient members configured to exert a force on the mounting base to drive the mounting base into resilient contact with the light fixture when the light module is removably coupled to

the light fixture to thereby removably couple at least a portion of the light module to the light fixture so that heat produced by the light module is conducted to the light fixture.

[**006**b] The light module may include a circuit board having a hole therein.

[**006**c] The light module may include a tapered optical element with a plurality of reflective surfaces to direct light emitted from the LED lighting element, a portion of the tapered optical element extending through the hole in the circuit board.

[**006**d] The one or more resilient members may couple the light module to the light fixture by biasing the mounting base against the light fixture with a force exerted substantially evenly on the mounting base of the light module.

[**006**e] The resilient members may include compression springs.

[**006**f] The mounting base may be formed of a thermally conductive material so as to thermally conduct heat from the lighting element to the light fixture.

[**006**g] The light module may include at least one electrical contact that is electrically connectable to an electrical contact on the light fixture upon coupling of the light module to the light fixture.

[**006**h] The at least one electrical contact may be rotationally connectable to the electrical contact on the light fixture during coupling of the light module to the light fixture.

[**006**i] The mounting base may be movable axially relative to the light module and may allow heat to be centrally transferred from the LED lighting element to the light fixture.

[**006**j] In accordance with another aspect of the invention there is provided a lighting unit. The lighting unit includes a light module including an LED lighting element, and a light fixture including a recess that removably receives a portion of the light module when removably coupling the light module to the light fixture. The lighting unit further includes one or more resilient members configured to exert a force on at least a portion of the light module to resiliently drive at least a portion of the light module into resilient contact with a surface of the light fixture to thereby removably

couple at least a portion of the light module to the light fixture so that heat produced by the light module is conducted to the light fixture.

[**006**k] The light fixture may further include an electrical contact releasably coupleable to an electrical contact on the light module to define an electrical connection when the light module may be coupled to the light fixture.

[**006**l] The electrical contact on the light module may be rotationally connectable to the electrical contact on the light fixture during coupling of the light module to the light fixture.

[**006**m] The unit may include a thermally conductive material layer disposed between the light module and the light fixture, the thermally conductive material layer configured to minimize a thermal impedance between the light module and the light fixture.

[**006**n] The one or more resilient members may be disposed in the light module.

[**006**o] In accordance with another aspect of the invention there is provided a lighting assembly. The lighting assembly includes a light module including an LED lighting element, and a light fixture including a generally cylindrical recess that removably receives at least a portion of the light module when removably coupling the light module to the light fixture. At least a portion of the light module is axially introduced into the cylindrical recess. The lighting assembly also includes one or more resilient members configured to compress when the light module is removably coupled to the light fixture to exert a generally axial force on at least a portion of the light module to resiliently drive at least a portion of the light module into resilient contact with a surface of the light fixture to thereby thermally couple at least a portion of the light module to the light fixture.

[**006**p] The one or more resilient members may be disposed in the light module.

[**007**] Consistent with the present invention, there is provided a lighting assembly comprising a light module including a lighting element; an enclosure having a recess for receiving and housing the light module; a thermally conductive core

connected to the light module through the enclosure; and a housing mounted in thermal contact with the core and the enclosure, so as to cause the housing to dissipate heat to an ambient atmosphere.

[008] Consistent with the present invention, there is also provided a method for manufacturing a lighting assembly, comprising affixing a top core portion of a thermally conductive core to a bottom enclosure portion of an enclosure using a thermally-conductive adhesive; affixing a housing to a bottom core portion of the thermally-conductive core using a thermally-conductive adhesive; resiliently mounting a light module, including at least one lighting element, on a top enclosure portion in a recess of the enclosure using spring compression; and attaching a protective cover to the enclosure to enclose the light module.

[009] Additional features and advantages consistent with the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The features and advantages consistent with the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

[010] Also consistent with the present invention, a light module is provided for use in a lighting assembly. The light module comprises a mounting base positioned on the lighting assembly, a first thermally conductive material positioned between the lighting assembly and the mounting base, a lighting element mounted on the mounting base, a second thermally conductive material positioned between the lighting element and the mounting base, and a resilient mounting component removably affixing the light module in the lighting assembly.

[011] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

[012] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate one embodiment consistent with the invention and together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[013] Figure **1** is a perspective view of a lighting assembly consistent with the present invention;

[014] Figure **2** is an exploded view of the lighting assembly of Figure **1**;

[015] Figure **3**A is an exploded view of a light module of Figure **2**; and

[016] Figure **3**B is side view of the light module of Figure **3**A.

DETAILED DESCRIPTION

[017] Reference will now be made in detail to the exemplary embodiments consistent with the present invention, an example of which is illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[018] Figure **1** is an illustration of a lighting assembly **100** consistent with the present invention. In one embodiment, lighting assembly **100** includes a protective cover **10**, an enclosure **20**, a housing **30**, and a core **40**. Further consistent with the present invention, lighting assembly may also include a light module **60**, as illustrated in Figures **3**A and **3**B.

[019] In some embodiments consistent with the present invention, lighting assembly may also include a mounting bracket **50**, and a power cable **52**. Mounting bracket **50** may be used to mount lighting assembly **100** to a stationary fixture, such as a wall, a light stand, or a ceiling. In an embodiment consistent with the present invention, mounting bracket **50** may be used to mount lighting assembly **100** to a track used in a track lighting fixture. Power cable **52** may be used as a connector to provide power from an external power source to lighting assembly **100**.

[020] Figure **2** is an exploded view of the lighting assembly of Figure **1**. As shown in Figure **2**, cover **10** may be attached to enclosure **20** enclosing light module

60 therein. Although light module **60** is not fully illustrated in Figure **2**, it is fully illustrated in Figures **3**A and **3**B. The placement of light module **60** in relation to protective cover **10** and enclosure is shown in Figure **2** for illustrative purposes only using dotted lines.

[**021**] Returning to Figure **2**, cover **10** may include a main aperture **12** formed in a center portion of cover **10**, a transparent member, such as a lens **14** formed in aperture **12**, and a plurality of peripheral holes **16** formed on a periphery of cover **10**. Lens **14** allows light emitted from a lighting element to pass through cover **10**, while also protecting the lighting element from the environment. Lens **12** may be made from any transparent material to allow light to flow therethrough with minimal reflection or scattering. Consistent with the present invention, cover **10**, enclosure **20**, housing **30**, and core **40** may be formed from materials having a high thermal conductivity. Cover **10**, enclosure **20**, housing **30**, and core **40**, may be formed from the same material, or from different materials. For example, in one embodiment consistent with the present invention, cover **10**, enclosure **20**, housing **30**, and core **40** are formed from the same material, such as a material having a thermal conductivity greater than **80** W/mK. Consistent with the present invention the material may be aluminum, or anodized aluminum.

[**022**] Peripheral holes **16** may be formed on the periphery of cover **10** such that they are equally spaced and expose portions along an entire periphery of the cover **10**. Although a plurality of peripheral holes **16** are illustrated, embodiments consistent with the present invention may use one or more peripheral holes **16** or none at all. Consistent with an embodiment of the present invention, peripheral holes **16** are designed to allow air to flow through cover **10** and over light module **60** to dissipate heat. Consistent with another embodiment of the present invention, peripheral holes **16** may be used to allow light emitted from light module **60** to pass through peripheral holes **16** to provide a corona effect on cover **10**.

[**023**] Enclosure **20** may include a recess **21** wherein light module **60** is removably mounted. Enclosure **20** may also include a mounting ring **22** having a plurality of electrical contacts **23** attached thereon using fasteners **24**. A power source opening **25** may be formed on a periphery of enclosure **20**, and a power source

grommet may be attached to power source opening **25** for receiving power source cable **52** and establishing an electrical connection with electrical contacts **23**. In embodiments consistent with the present invention, power source cable **52** may be fixably attached to enclosure **20**, however in other embodiments consistent with the present invention, power source cable **52** may be removably attached to enclosure **20**.

[**024**] Fastening holes **26** may be further formed on a periphery of enclosure **20** for use in fastening mounting bracket **50** to enclosure **20** using fastening screws **27**. Ventilation holes **28** may also be formed on a bottom surface of enclosure **20** for allowing air to flow over light module **60** and out to an ambient atmosphere or through housing **30** and then out to an ambient atmosphere, thereby passively assisting in cooling light module.

[**025**] Consistent with an embodiment of the present invention, electrical contacts **23** provide an electrical connection to light module **60** when light module is mounted therein. Contact pads (not illustrated) may be attached to a bottom surface of light module **60** for establishing an electrical connection with electrical contacts so that when power source cable **52** is plugged into enclosure **20**, power is provided through power source cable **52** to electrical contacts **23** and into light module **60** through the contact pads.

[**026**] Consistent with the present invention, light module **60** may be removable from the enclosure using, for example, plug-in connections. Removable light module **60** may allow a user to safely remove power from light module **60** so that the user can then remove light module **60** and replace, repair, calibrate, or test light module **60**. Specifically, light module **60** may be formed to be replaceable, allowing a user to replace light module **60** without having replace any of the other components of lighting assembly **100**. Moreover, light module **60** may be removed and replaced while lighting assembly **100** remains mounted.

[**027**] Figure **2** further illustrates a thermally-conductive core **40**. Consistent with the present invention, core **40** may have a spike shape, or a "T" shape. Consistent with the present invention, core **40** may be affixed to a bottom surface of enclosure **20** using a thermally-conductive adhesive (not illustrated). In one embodiment consistent with the present invention, the thermally-conductive adhesive may be a SE**4486** CV

Thermally Conductive Adhesive manufactured by Dow Corning Corporation, although other thermally-conductive adhesives may be used.

[028] Consistent with the present invention, core **40** acts as a conduit for conducting heat produced by light module **60** through enclosure **20** and out to an ambient atmosphere through portions of housing **30** and through an end portion of core **40**.

[029] Housing **30** may be made from an extrusion including a plurality of surface-area increasing structures, such as ridges **32**. Ridges **32** may serve multiple purposes. For example, ridges **32** may provide heat dissipating surfaces so as to increase the overall surface area of housing **30**, providing a greater surface area for heat to dissipate to an ambient atmosphere over. That is, ridges **32** may allow housing **30** to act as an effective heat sink for lighting assembly **100**. Moreover, ridges **32** may also be formed into any of a variety of shapes and formations such that housing **30** takes on an aesthetic quality. That is, ridges **32** may be formed such that housing **30** is shaped into an ornamental extrusion having aesthetic appeal. For example, housing **30**, as shown in Figure **2**, has a floral shape, with ridges **32** formed as flutes. However, housing **30** may be formed to have a plurality of other shapes. Accordingly, housing **30** may function not only as a ornamental feature of lighting assembly **100**, but also as a heat sink for cooling light module **60**.

[030] Housing **30** may also include a plurality of housing holes **34**, which are formed to extend from a top portion of housing **30** (to the left in Figure **2**) through a bottom portion of housing **30** (to the right in Figure **2**). Housing holes **34** are formed to not only reduce the weight of housing **30**, but also to further increase the air flow through lighting assembly **100**. Thus, air may flow through periphery holes **16**, over light module **60**, through ventilation holes **28** and through housing holes **34** to be dissipated into an ambient atmosphere through a bottom portion of housing **30**, or to be dissipated through housing **30** into the ambient atmosphere. In one embodiment consistent with the present invention, housing holes **34** are formed such that they are in alignment with ventilation holes **28**.

[031] Consistent with the present invention, housing **30** may further include a core hole **36** which extends from a top portion of housing **30** through a bottom portion thereof (to the right in Figure **2**). Core hole **36** may receive a bottom portion of core **40**

such that housing **30** may be affixed to core **40**. Consistent with an embodiment of the present invention, housing **30** may be affixed to core **40** using a thermally-conductive adhesive. The thermally-conductive adhesive may be a SE**4486** CV Thermally Conductive Adhesive manufactured by Dow Corning Corporation, although other thermally-conductive adhesives may be used.

[032] Housing **30** may be affixed to core **40** such that a top surface of the top portion of housing **30** is flush with a bottom surface of enclosure **20**, thereby establishing secure thermal contact between housing **30** and enclosure **20**. A thermally-conductive adhesive may further be used to resiliently establish the thermal contact between housing **30** and enclosure **20**. Establishing a secure thermal contact between housing **30** and enclosure may aid in cooling light module **60**. For example, a top surface of ridges **32** may be mounted flush against a bottom portion of enclosure **20** such that heat generated by light module **60**, which is resiliently mounted in recess **21** of enclosure **20**, is conducted through the bottom portion of enclosure **20**, into ridges **32**, and then dissipated into the ambient atmosphere.

[033] Figure **3**A is an exploded view of a light module consistent with the present invention. As shown in Figure **3**A, light module **60** includes, from top to bottom, a detachable protective shroud **61** , a tapered optical element, or reflector **62**, a first circuit board **63** having a first circuit board hole **64** formed therein, a lighting element **65**, a second circuit board **66** having a second circuit board hole **67** formed therein, resilient mounting components **68**, and a mounting base **69**.

[034] As shown in Figure **3**A, first circuit board **63** may be stacked on second circuit board **66**, and may be formed to have a first circuit board hole **64**, wherein tapered optical element **62** is mounted thereon to extend through first circuit board hole **64**. Consistent with the present invention, tapered optical element **62** may be formed such that it has a top portion which is wider than a bottom portion, such that the bottom portion is able to extend through first circuit board hole **64**. Moreover, tapered optical element **62** may comprise a plurality of reflective surfaces formed on an interior surface to direct light emitted from lighting element **65**, and/or provide additional protection for lighting element **65**.

[035] Second circuit board **66** may be formed such that second circuit board hole **67** receives a top portion **69**A of mounting base **69**. Consistent with the present

invention, mounting base **69** may be formed such that top portion **69**A is narrower than a bottom portion, allowing top portion **69**A to extend through second circuit board hole **67**. Moreover, mounting base **69** may formed from a material having a high thermal conductivity. Consistent with the present invention, mounting base **69** may be formed from copper. Lighting element **65** may then be mounted on top surface **69**A of mounting base **69**.

[036] As shown in Figure **3**A, lighting element **65** includes a light emitting diode (LED) chip **70**. Although the illustrated embodiment uses an LED as a lighting element, consistent with other embodiments of the present invention, other lighting elements may also be used. LED chip **70** may comprise a chip having at least one light emitting diode device mounted thereon. For example, LED chip **70** may comprise an OSTAR **6**-LED chip manufactured by OSRAM GmbH, having an output of **400-650** lumens.

[037] Lighting element **65** may then be mounted on mounting base **69** using fasteners **71** , which may be screws or other well-known fasteners. Positioned between lighting element **65** and mounting base **69** is a first thermally-conductive material **72**, which acts as a void-filler between lighting element **65** and mounting base **69**. Essentially, the machining of both the bottom surface of lighting element **65** and mounting base **69** during the manufacturing process may leave minor imperfections in these surfaces, forming voids. These voids may be microscopic in size, but may act as an impedance to thermal conduction between the bottom surface of lighting element **65** and top surface **69**A of mounting base **69**. First thermally-conductive **72** material then acts to fill in these voids to reduce the thermal impedance between lighting element **65** and mounting base **69**, resulting in improved thermal conduction. Moreover, consistent with the present invention, first thermally-conductive material **72** may be a phase-change material which changes from a solid to a liquid at a predetermined temperature, thereby improving the gap-filling characteristics of first thermally-conductive material **72**. For example, thermally-conductive material **72** may include a Hi-Flow **225**F-AC phase-change material, manufactured by The Bergquist Company, which is designed to change from a solid to a liquid at **55** °C.

[038] Mounting base **69** having lighting element **65** mounted thereon is then resiliently mounted to the stacked first circuit board **63** and second circuit board **66** using resilient mounting components **68**. Consistent with the present invention, mounting base **69** may be mounted to the stacked first circuit board **63** second circuit board **66** using resilient mounting components **68** prior to mounting lighting element **65** on mounting base **69**.

[039] Resilient mounting components **68** may be located so as to mount mounting base **69** to the stacked first and second circuit boards **63** and **66** and provide a substantially even clamping force across the surfaces of lighting element **65** and mounting base **69**. By using resilient mounting components **68**, the thermal impedance caused by voids between lighting element **65** and mounting base **69** are minimized, and thermal conductivity is improved. In the embodiment illustrated in Figure **3**A, resilient mounting components **68** may comprise compression spring members. Other embodiments consistent with the present invention may also be provided, in which resilient mounting components **68** may comprise elastic members, such as, for example, rubber tubing members.

[040] A bottom surface of light module **60** may be mounted in recess **21** of enclosure **20** (Figure **2**). Specifically, light module **60** may be mounted such that a bottom surface of mounting base **69** is in contact with a top surface of enclosure **20** in recess **21**. Consistent with the present invention, a second thermally-conductive material **73** (Figure **3**A) may be positioned between mounting base **69** and enclosure **20** to minimize thermal impedance therebetween, similar to first thermally-conductive material **72**. Second thermally-conductive material **73** may also be a phase-change material, such as a Hi-Flow **225**UF manufactured by The Bergquist Company.

[041] Consistent with the present invention, second circuit board **66** may have at least one secondary LED **74** mounted on a back surface. As shown in Figure **3**A, second circuit board **66** has a plurality of secondary LEDs **74** mounted on a back surface. Consistent with the present invention, secondary LEDs **74** may be attached to the second circuit board **66** such that they are aligned with ventilation holes **28** (Figure **2**). Such an arrangement may allow secondary LEDs **74** to emit secondary light which passes through ventilation holes **28** and illuminates housing **30** and ridges **32**. The secondary light may further cast shadows on an area behind lighting assembly **100** in

the shape of housing **30**, increasing the aesthetic effect provided by lighting assembly **100**.

[**042**] Detachable protective shroud **61** may also be mounted on lighting element **65** to protect tapered optical assembly **62**, and other components on the first and second circuit boards. Consistent with one embodiment of the present invention, detachable protective shroud is made from a synthetic material, and is mounted such that it rests upon a top surface of first circuit board **63**.

[**043**] Figure **3**B is side view of the light module showing a gap **75** between first and second circuit boards, consistent with the present invention. As shown in Figure **3**B, light module **60** is assembled such that there is a predetermined gap having a distance **d** between first circuit board **63** and second circuit board **66**. Although light module **60** is illustrated in Figures **3**A and **3**B as having two circuit boards, in embodiments consistent with the present invention, light module may be formed to have one circuit board, or more than two circuit boards. Moreover, in other embodiments consistent with the present invention, light module **60** may have a micro fan mounted thereon to actively cool lighting element **65**, or a passive heat sink mounted on a circuit board to passively cool lighting element **65**. Furthermore, embodiments consistent with the present invention may use a combination of heat sinks and fans mounted on light element **65**, and other combinations of active and passive cooling components.

[**044**] Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A light module removably mountable to a light fixture, comprising:

an LED lighting element;

a mounting base, the LED lighting element mounted to the mounting base; and

one or more resilient members configured to exert a force on the mounting base to drive the mounting base into resilient contact with the light fixture when the light module is removably coupled to the light fixture to thereby removably couple at least a portion of the light module to the light fixture so that heat produced by the light module is conducted to the light fixture.

2. The light module according to claim **1**, further comprising a circuit board having a hole therein.

3. The light module according to claim **2**, further comprising a tapered optical element with a plurality of reflective surfaces to direct light emitted from the LED lighting element, wherein a portion of the tapered optical element extends through the hole in the circuit board.

4. The light module according to claim **1**, wherein the one or more resilient members couple the light module to the light fixture by biasing the mounting base against the light fixture with a force exerted substantially evenly on the mounting base of the light module.

5. The light module according to claim **1**, wherein the resilient members comprise compression springs.

6. The light module according to claim **1**, wherein the mounting base is formed of a thermally conductive material so as to thermally conduct heat from the lighting element to the light fixture.

7. The light module according to claim **1**, further comprising at least one electrical contact that is electrically connectable to an electrical contact on the light fixture upon coupling of the light module to the light fixture.

8. The light module according to claim **7**, wherein the at least one electrical contact is rotationally connectable to the electrical contact on the light fixture during coupling of the light module to the light fixture.

9. The system of claim **1**, wherein the mounting base is movable axially relative to the light module and allows heat to be centrally transferred from the LED lighting element to the light fixture.

10. A lighting unit comprising:

a light module comprising an LED lighting element;

a light fixture comprising a recess that removably receives a portion of the light module when removably coupling the light module to the light fixture; and

one or more resilient members configured to exert a force on at least a portion of the light module to resiliently drive at least a

portion of the light module into resilient contact with a surface of the light fixture to thereby removably couple at least a portion of the light module to the light fixture so that heat produced by the light module is conducted to the light fixture.

11. The unit of claim **10**, wherein the light fixture further comprises an electrical contact releasably coupleable to an electrical contact on the light module to define an electrical connection when the light module is coupled to the light fixture.

12. The unit of claim **11**, wherein the electrical contact on the light module is rotationally connectable to the electrical contact on the light fixture during coupling of the light module to the light fixture.

13. The unit of claim **10**, further comprising a thermally conductive material layer disposed between the light module and the light fixture, the thermally conductive material layer configured to minimize a thermal impedance between the light module and the light fixture.

14. The unit of claim **10**, wherein the one or more resilient members are disposed in the light module.

15. A lighting assembly, comprising:

a light module comprising an LED lighting element;

a light fixture comprising a generally cylindrical recess that removably receives at least a portion of the light module when removably coupling the light module to the light fixture, wherein at

least a portion of the light module is axially introduced into the cylindrical recess; and

one or more resilient members configured to compress when the light module is removably coupled to the light fixture to exert a generally axial force on at least a portion of the light module to resiliently drive at least a portion of the light module into resilient contact with a surface of the light fixture to thereby thermally couple at least a portion of the light module to the light fixture.

16. The lighting assembly of claim **15**, wherein the one or more resilient members are disposed in the light module.

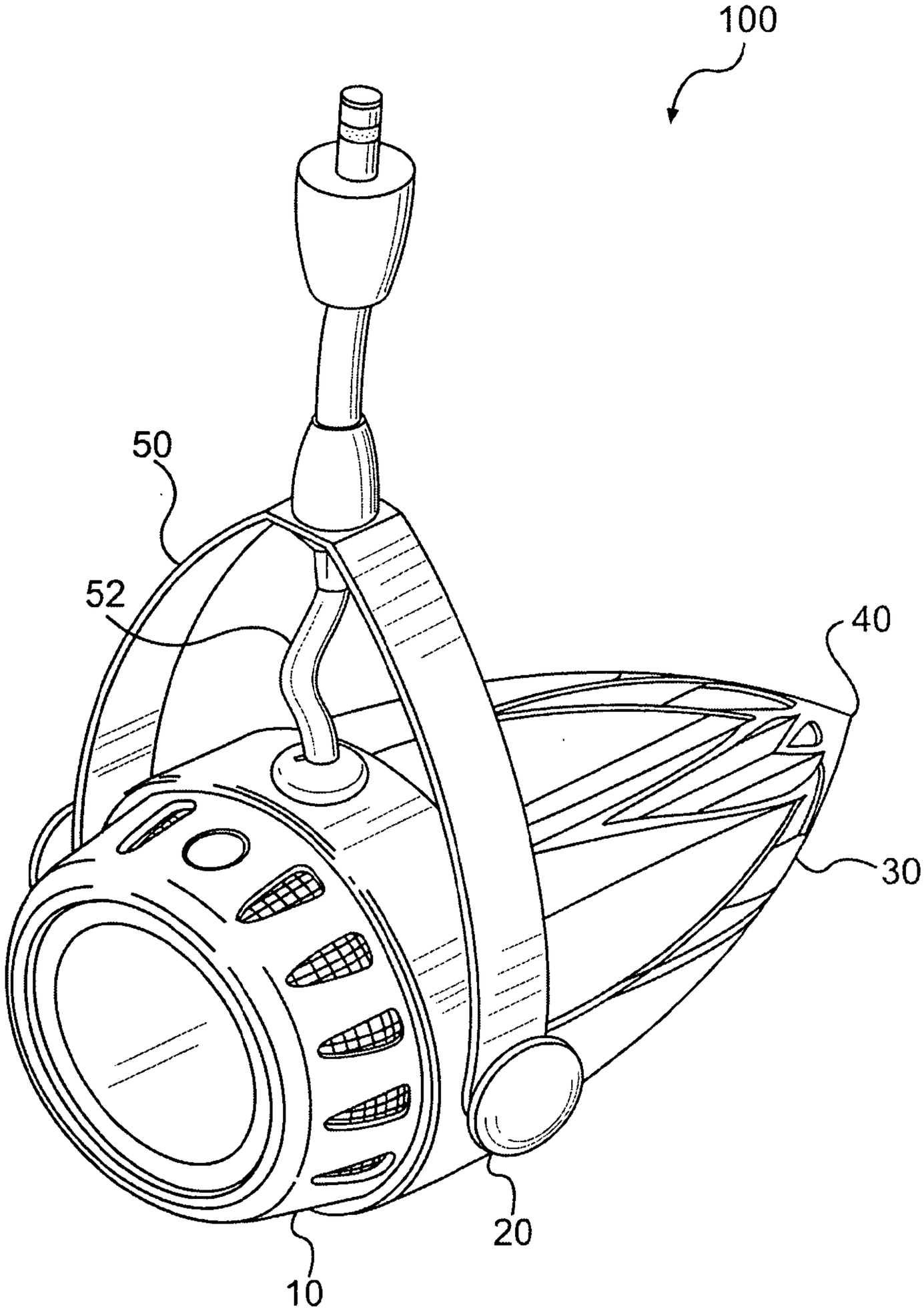
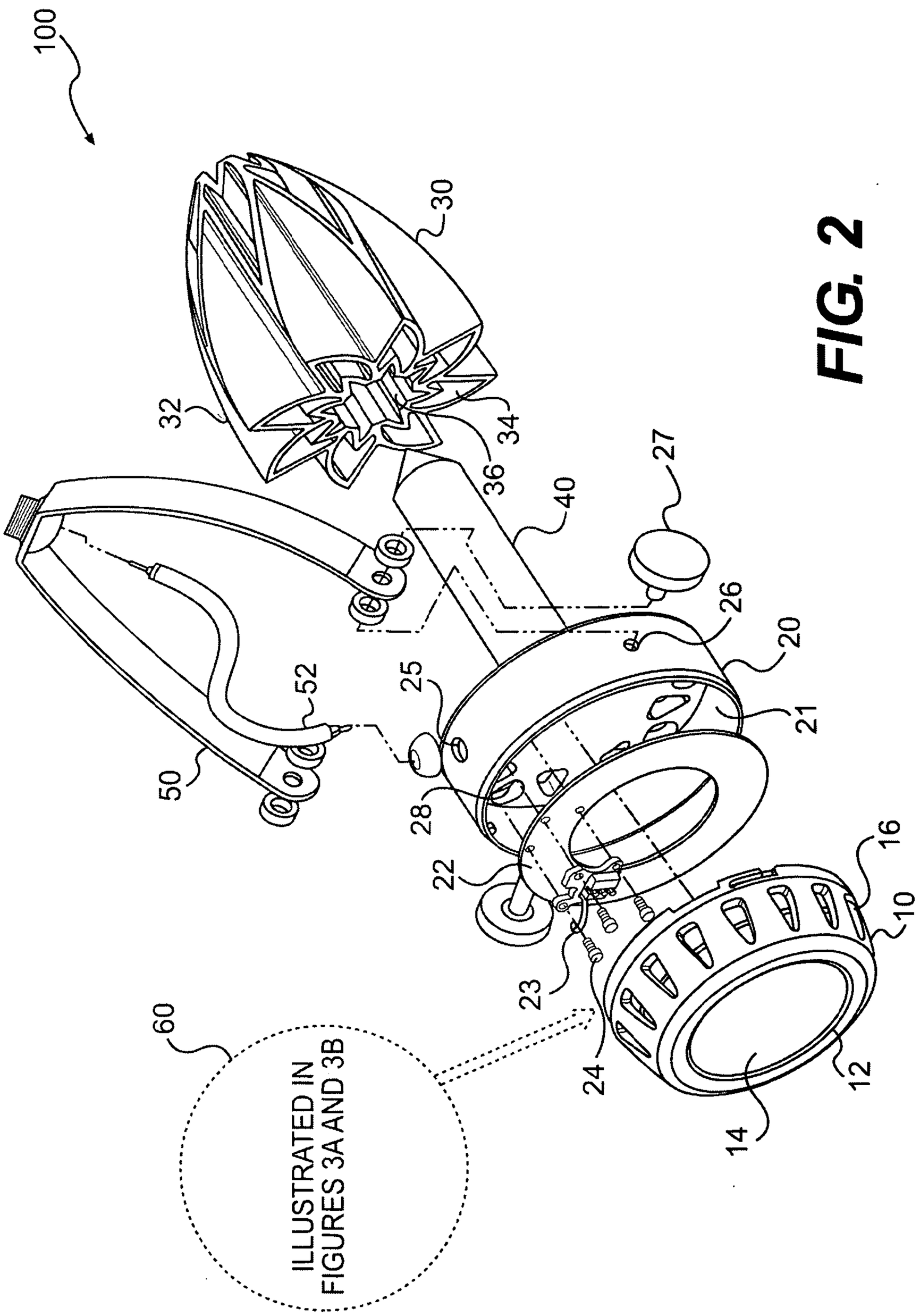


FIG. 1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ILLUSTRATED IN
FIGURES 3A AND 3B

FIG. 2

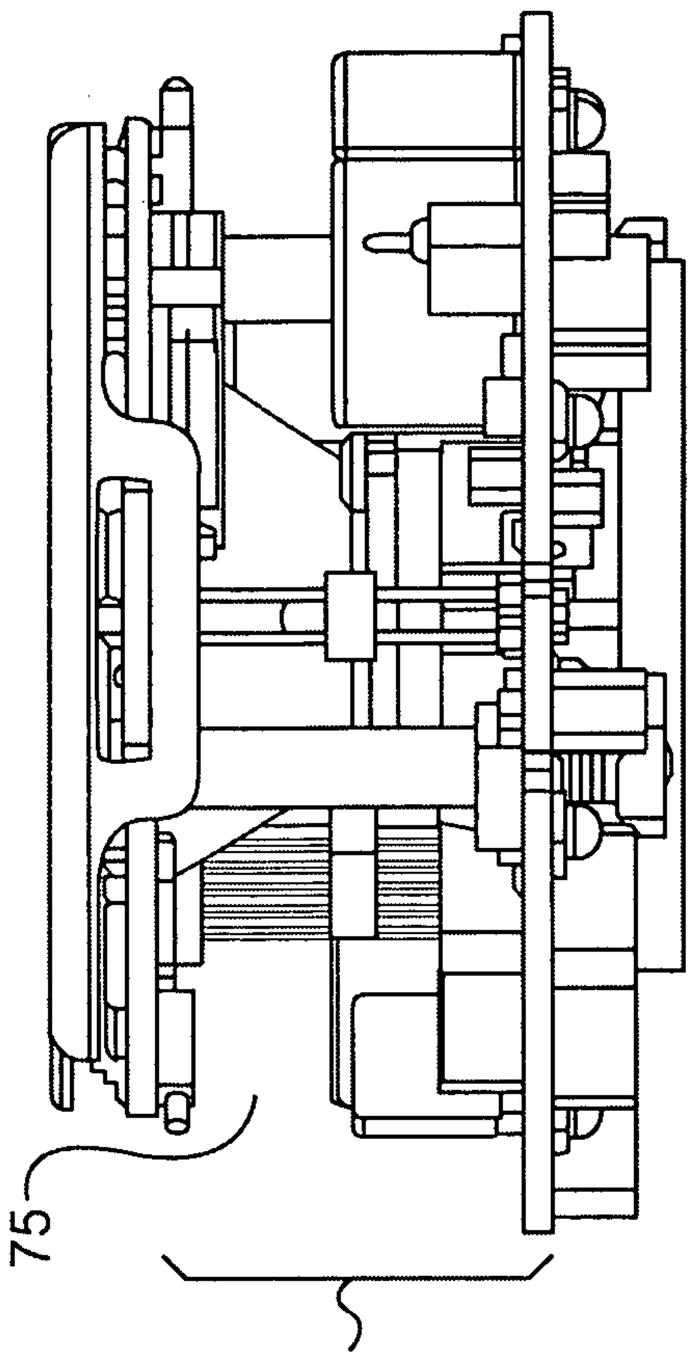
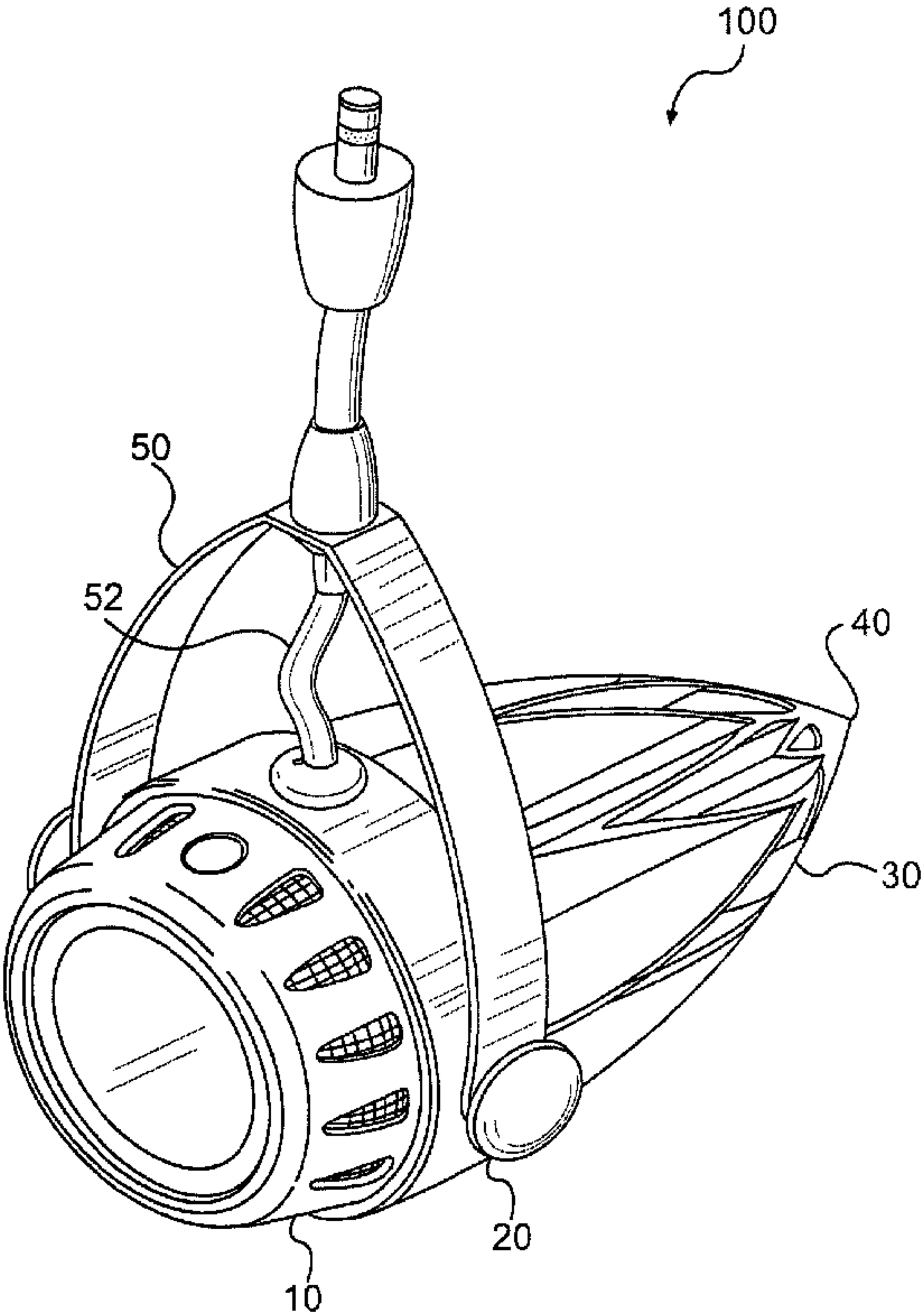


FIG. 3B

FIG. 3A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