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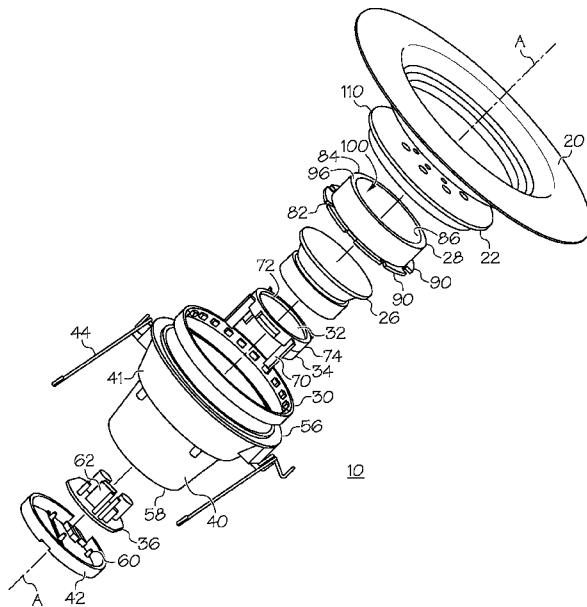


FIG. 2

(57) Abstract: A light fixture is disclosed, and includes a light emitting diode (LED) engine including plurality of LEDs that transmit visible light. The light fixture also includes a waveguide, where the LEDs of the LED engine surround the waveguide and transmit the visible light in a direction towards the waveguide. The light fixture also includes a second element that provides a secondary service. The light fixture also includes a housing that defines a cavity, where the LED engine and waveguide are positioned within the cavity proximate the front of the light fixture, and the a secondary element is positioned within the cavity toward the rear of the light fixture.



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- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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EDGE-LIT LIGHT FIXTURE HAVING CAPABILITIES FOR A SECONDARY SERVICE

Technical Field

[0001] The present disclosure relates generally to a light fixture, and more particularly to a light fixture that includes a light producing element and at least one other element that provides a secondary service that are both contained within a housing of the light fixture.

Background

[0002] Light emitting diode (LED) based lighting systems may offer several energy and reliability advantages over other types of lighting systems such as, for example, incandescent or fluorescent lighting. Thus, LED based lighting systems are increasingly being used to replace other existing lighting technologies. Moreover, it should also be appreciated that LED based lighting systems also being used as components of other systems such as home automation systems.

[0003] Automation systems are used to control various systems that are typically found in homes and office buildings such as lights, heating, security systems, and home appliances. Some examples of appliances that may be controlled by an automation system include washers, dryers, ovens, and refrigerators. Some types of automation systems may also integrate various features and functions into a single device. In fact, sometimes light fixtures include a light producing element like a LED light engine as well as another element that provides another function. For example, the light fixture may include a speaker that produces sound or a microphone that detects a user's voice or other sounds.

[0004] Sometimes difficulties are encountered when attempting to package multiple components that each provide different functions into a single light fixture. This is because light fixtures are usually of a standard size and shape, and therefore only have a limited amount of space available for accommodating various components. Furthermore, sometimes the additional components may interfere with the light fixture's ability to radiate light in a manner that is not only effective, but also aesthetically pleasing. There are also challenges with providing other functions within the light fixture. For example, the sound quality or level of a speaker may be compromised in order to fulfill the light fixture's lumen requirements.

Brief Description of the Drawings

[0005] FIG. 1 is a perspective, cross-sectioned view of the disclosed light fixture;

[0006] FIG. 2 is an exploded view of the light fixture shown in FIG. 1;

[0007] FIG. 3 is an enlarged view of a portion of the light fixture of FIG. 1; and

[0008] FIG. 4 is another perspective view of the disclosed light fixture.

Detailed Description

[0009] The following detailed description will illustrate the general principles of the invention, examples of which are additionally illustrated in the accompanying drawings. In the drawings, like reference numbers indicate identical or functionally similar elements.

[0010] FIG. 1 is a perspective, cross-sectioned view of an exemplary light fixture 10. The light fixture 10 includes a bezel 20, a waveguide 22, a secondary element 26, a secondary element holder 28, a light emitting diode (LED) engine 30, a first driver board 32, a driver board holder 34, a second driver board 36, a housing 40, an end cap or cover 42, and one or more installation features 44 such as installation springs. Although the light fixture 10 shown in FIG. 1 illustrates a downlight, it is to be appreciated that the embodiment in FIG. 1 is merely exemplary in nature. For example, in other embodiments the light fixture 10 may be a parabolic aluminized reflector (PAR) type light fixture or a bulged reflector (BR) type light fixture.

[0011] In addition to generating light, the light fixture 10 also includes the secondary element 26, which is used to provide another, secondary service in addition to generating light. In the non-limiting embodiment as described, the secondary element 26 is a speaker for generating sound. However, it is to be understood that the light fixture 10 is not limited to a speaker. For example, in other embodiments the secondary element 26 may be a microphone or a motion detector.

[0012] The housing 40 defines a cavity 50 that is shaped to contain the secondary element 26, the secondary element holder 28, the LED engine 30, the first driver board 32, the driver board holder 34, and the second driver board 36. In the non-limiting

embodiment as shown in FIG. 1, the housing 40 includes a heat sink 46 that is constructed of a heat-conducting metal. The heat sink 46 coincides with an inner surface 48 of the housing 40. In another embodiment, the housing 40 is constructed of a material that is an electrical insulator that allows for radio frequency (RF) signals to pass through such as, but not limited to, a thermally conductive plastic. The housing 40 defines a first end portion 52 and a second end portion 54. The first end portion 52 of the housing 40 defines a first opening 56 and the second end portion 54 defines a second opening 58 of the housing 40. As seen in FIG. 1, a portion 41 of the housing 40 may have a generally frustoconical profile, and the first opening 56 of the housing 40 is larger in size when compared to the second opening 58.

[0013] In the non-limiting embodiment as shown, the first end portion 52 of the housing 40 is secured to the bezel 20, and the second end portion 54 of the housing 40 is secured to the cover 42. The bezel 20 may be secured to the first end portion 52 of the housing 40 by a snap-fit engagement. However, it is to be appreciated that the bezel 20 and the housing 40 are not limited to a snap-fit engagement, and that other fastening techniques may be used as well to secure the bezel 20 to the housing 40. Furthermore, in an alternative embodiment, the bezel 20 and the housing 40 may be integrated together into a single piece. The cover 42 may be used to close off or seal the second opening 58 of the housing 40.

[0014] FIG. 2 is an exploded view of the light fixture 10 shown in FIG. 1. Referring now to both FIGS. 1 and 2, the cover 42 may include one or more locating features 60 for engaging and locating the second driver board 36. The second driver board 36 may include various power electronics 62 required for electrical operation of the LED engine 30 and the light fixture 10. The driver board holder 34 may include one or more legs 70 that project in a direction towards the second end portion 54 and cover 42 of the light fixture 10 when assembled. The legs 70 of the driver board holder 34 may act as locator pins or features that are used to engage and secure the driver board 36 in place within the cavity 50 of the housing 40.

[0015] The driver board holder 34 may also define a ledge 72, where the ledge 72 defines a recessed surface 74 (corresponding position exterior of the holder 34 is indicated in FIG. 2) that the first driver board 32 may be seated upon. The first driver board 32 may be a

printed circuit board (PCB) and may include an antenna (not shown), such as a trace antenna. However, those skilled in the art will appreciate that the disclosure should not be limited to a trace antenna and PCB. In one embodiment, the antenna may be configured to receive a short-range RF signal such as, for example, a Bluetooth® signal conforming to the Institute of Electrical and Electronics Engineers (IEEE) Standard 802.15. Furthermore, in one embodiment, the antenna may be a multi-band antenna that operates at different RF frequency bands.

[0016] Referring to FIG. 1, the secondary element 26 includes a first end portion 76 and a second end portion 78. The first end portion 76 of the secondary element 26, which is illustrated as a speaker, is seated against a front face 80 of the driver board holder 34. Referring now to both FIGS. 1 and 2, the secondary element holder 28 defines a first end portion 82, a second end portion 84, and a cavity 86 that extends in an axial direction along a central axis A-A of the light fixture 10. The first end portion 82 of the secondary element holder 28 includes one or more retaining flanges 90. As seen in FIG. 1, the flanges 90 of the secondary element holder 28 may engage the holder 28 to a retaining feature 92 located along the inner surface 48 of the housing 40.

[0017] The second end portion 84 of the holder 28 defines a flange 96 that extends in an inward direction with respect to the axis A-A of the light fixture 10. As seen in FIG. 1, the flange 96 defines an opening 100 that is smaller in size than the second end portion 78 of the secondary element 26. Thus, a rear face 98 of the flange 96 of the secondary element holder 28 retains the secondary element 26 in place within the housing 40 of the light fixture 10. For example, in the embodiment as shown the light fixture 10 is a downlight. Therefore, when the downlight is installed in a building, the end cap 42 is positioned so as to be on top or at the upper end of the light fixture 10. When the downlight is installed, the flange 96 of the secondary element holder 28 prevents the secondary element 26 from migrating downwards and contacting the waveguide 22.

[0018] The light fixture 10 is an edge-lit device. That is, the LED light engine 30 surrounds the waveguide 22 in the plane of the waveguide, i.e., surrounds the lateral edges of the waveguide 22 with respect to the central axis A-A of the light fixture. The waveguide 22 is constructed of the material including properties that illuminate an entire face 102 (FIGS. 1 and 4) of the waveguide 22 using the light generated by the LED engine

30. One advantage of using an edge-lit device is cost reduction, since fewer LEDs are typically required to produce the same lumen output. Referring to FIGS. 1 and 3, the LED light engine 30 includes a backing material 104 and a plurality of LEDs 106 that are mounted upon the backing material 104. The backing material 104 may be a relatively flexible material. Specifically, the backing material 104 may be formed as a strip, and the strip may be bent into the annular or ring-shaped configuration as seen in FIG. 3. Thus, the LED light engine 30 may completely extend around a circumference 110 (FIG. 2) of the waveguide 22. That is, in other words, the LEDs 106 surround the waveguide 22, and transmit visible light in a direction towards the waveguide 22.

[0019] Referring now to FIG. 4, the waveguide 22 may also be referred to as a lens or a light guide. The waveguide 22 is used to collect the light generated by the LEDs 106, and directs the light to the front face 102 of the waveguide 22 to provide illumination. The waveguide 22 may include a plurality of light deflecting elements (not illustrated), which are also referred to as microstructures or three-dimensional elements. In one embodiment, the light deflecting elements are prismatic cavities formed in a longitudinal direction of the waveguide 22, and are used to illuminate the entire front face 102 of the waveguide 22. The light deflecting elements are distributed along the front face 102 of the waveguide 22.

[0020] The waveguide 22 may define a plurality of apertures 112, which are distributed in a predefined pattern along the front face 102 of the waveguide 22. In the embodiment as shown, the apertures 112 allow sound generated by the secondary element 26 (FIGS. 1 and 2), which is illustrated as a speaker, to be transmitted to the environment. The apertures 112 may be arranged into a starburst pattern where the apertures 112 are arranged to radiate outwardly from a central point along the front face 102 of the waveguide 22. However, it is to be appreciated that the embodiment as shown in FIG. 4 is merely exemplary in nature, and that the apertures 112 may be arranged into a variety of other patterns and configurations as well.

[0021] It is to be appreciated that the apertures 112 are arranged so as to provide acceptable sound quality, and to also provide light that is not only aesthetically pleasing, but also meets any light output or lumen requirements. In other words, the apertures 112 are arranged so as to create a light pattern that may be considered visually appealing to a consumer.

[0022] Referring generally to the figures, the disclosed light assembly provides at least one other or secondary service to a consumer. For example, in the embodiments as shown, the secondary service is a speaker for transmitting sound. The LED light engine is positioned around and directs light towards the waveguide. The edge-lit LEDs require less packaging space when compared to conventional board-type LED light engines, which are usually mounted along a central portion of a light. Therefore, the edge-lit LEDs allow for sufficient packaging space for the elements associated with the secondary service. In other words, the edge-lit LED configuration results in increased packaging space to accommodate the speaker. Furthermore, the sound quality or level of a speaker is not compromised in order to fulfill the light fixture's lumen requirements.

[0023] While the forms of apparatus and methods herein described constitute preferred embodiments of this invention, it is to be understood that the invention is not limited to these precise forms of apparatus and methods, and the changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. A light fixture, comprising:
 - a light emitting diode (LED) engine including plurality of LEDs that transmit visible light;
 - a waveguide, wherein the plurality of LEDs of the LED engine surround the waveguide and transmit the visible light in a direction towards the waveguide;
 - a housing that defines a cavity, wherein the LED engine and waveguide are positioned within the cavity within a first end portion of the housing comprising the front of the light fixture; and
 - a secondary element that provides a secondary service, wherein the secondary element is positioned within the cavity between the first end portion and a second end portion of the housing comprising the rear of the light fixture.
2. The light fixture of claim 1, wherein the secondary element includes a speaker.
3. The light fixture of claim 1, wherein the secondary element includes a microphone.
4. The light fixture of claim 2, wherein the waveguide defines a plurality of apertures that allow sound generated by the speaker to be transmitted to the environment.
5. The light fixture of claim 1, wherein the light fixture is a downlight.

6. The light fixture of claim 1, wherein the plurality of LEDs of the LED engine are mounted upon a backing material, and the backing material is shaped as an annular ring extending around a circumference of the waveguide.
7. The light fixture of claim 1, wherein the first end portion of the housing includes a heat sink, constructed of a heat-conducting metal, that coincides with an inner surface of the housing.
8. The light fixture of claim 1, wherein the light fixture further comprises:
 - first and second driver boards positioned with the cavity between the second end portion and the secondary element; and
 - a driver board holder interposed between the first and second driver boards and the secondary element, wherein the secondary element seats against a front face of the driver board holder; and
 - a secondary element holder interposed between the secondary element and the waveguide.
9. The light fixture of claim 8, wherein the front face of the driver board holder defines a ledge, and the ledge defines a recessed surface that the first driver board is seated upon.
10. The light fixture of claim 9, wherein the first driver board includes an antenna configured to receive a short-range RF signal.

11. The light fixture of claim 9, wherein the driver board holder includes one or more legs that project in a direction towards the second end of the housing, and the one or more legs engage the second driver board to secure the second driver board within the cavity.

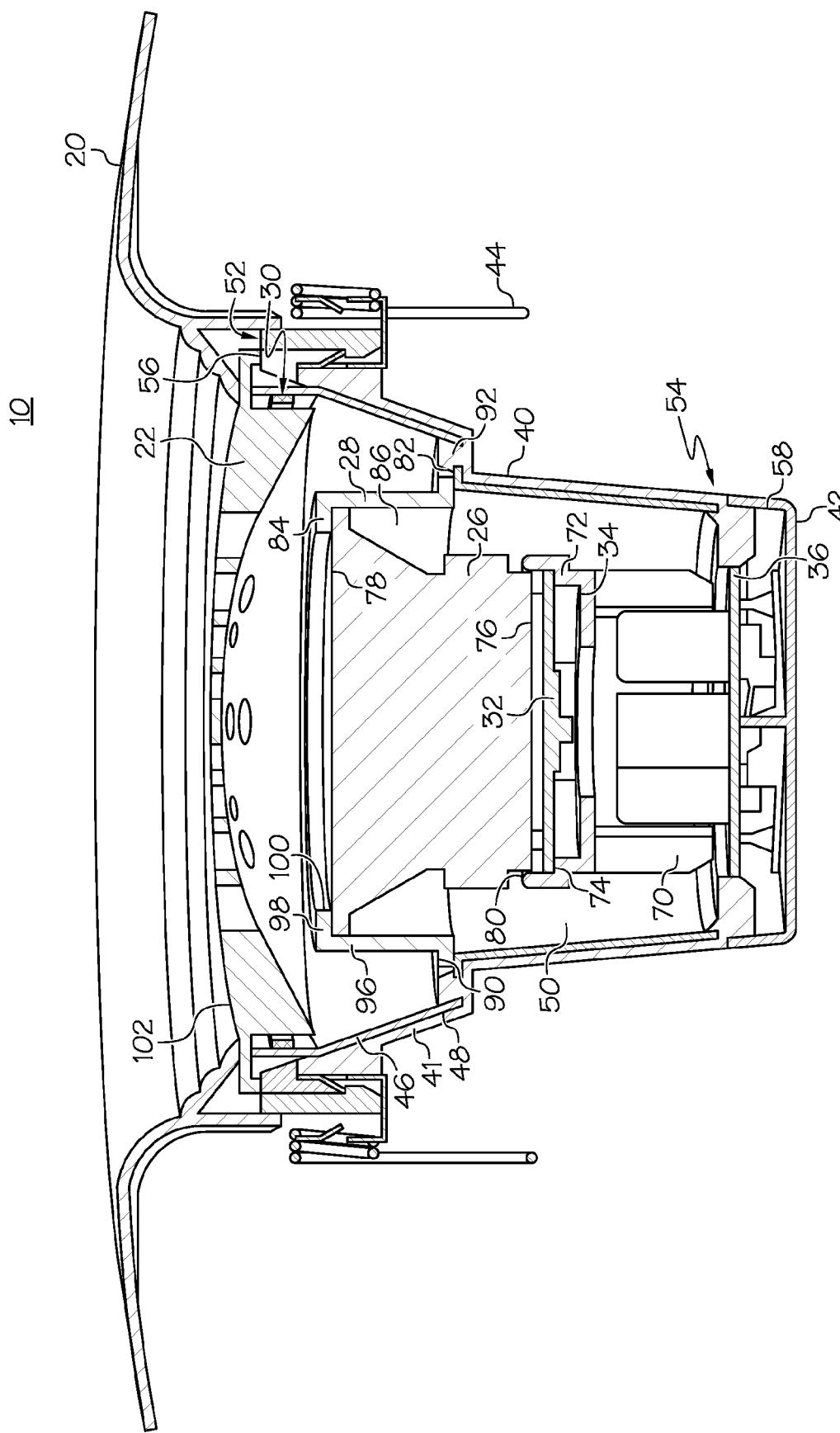
12. The light fixture of claim 11, further comprising an end cap secured to the second end portion of the housing, wherein the end cap includes a locator feature engaging the second driver board.

13. The light figure of claim 8, wherein the secondary element includes a first end portion, and the first end portion includes one or more retaining flanges that engage a retaining feature located along an inner surface of the housing.

14. The light fixture of claim 13, wherein the secondary element includes a second end portion, wherein the second end portion is positioned frontward of the first end portion and the second end portion includes an inwardly extending flange that defines an opening that is smaller than the second end portion.

15. The light fixture of claim 14, wherein the secondary element is seated between the front face of the driver board holder and a rear face of the inwardly extending flange.

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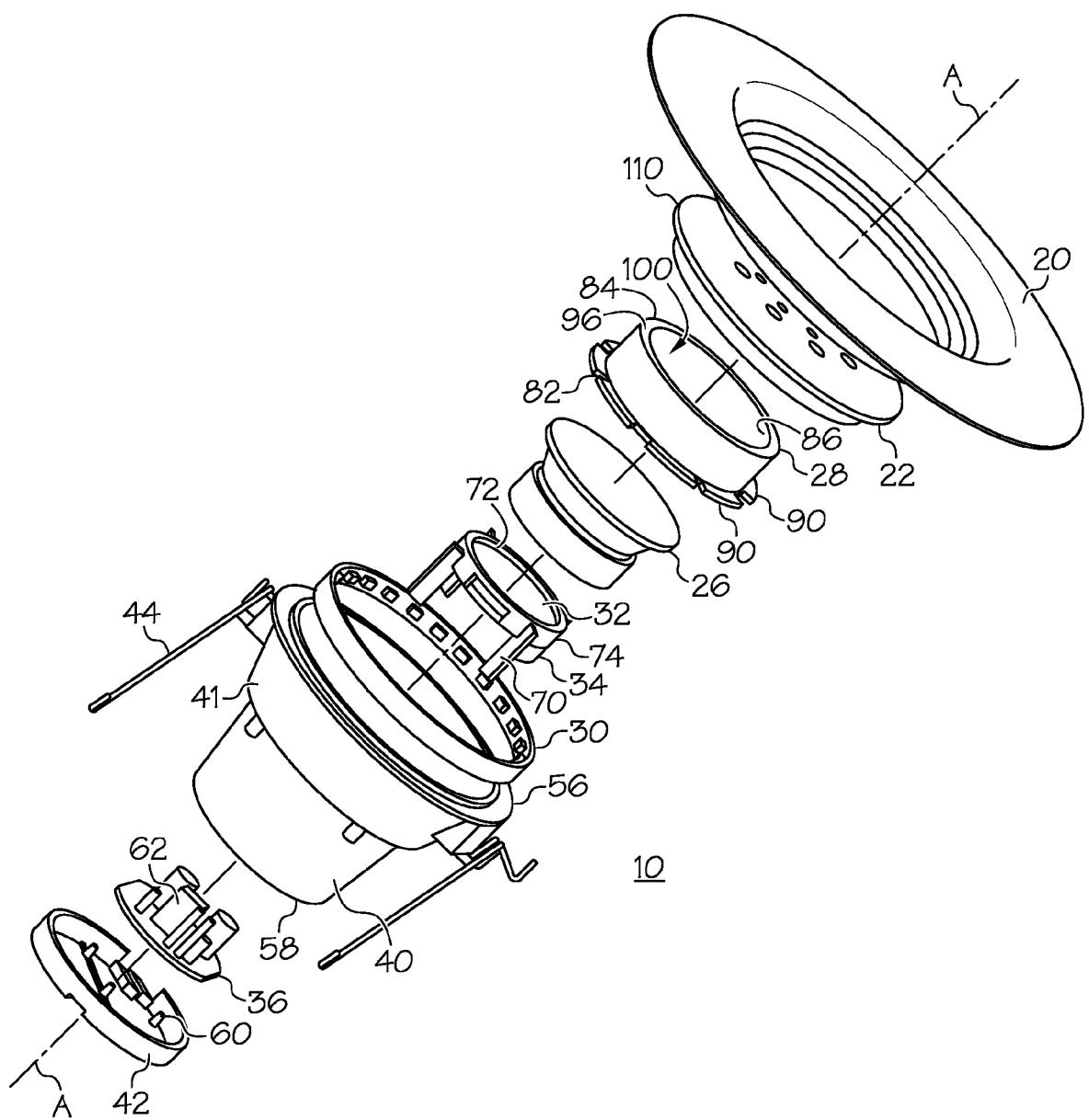
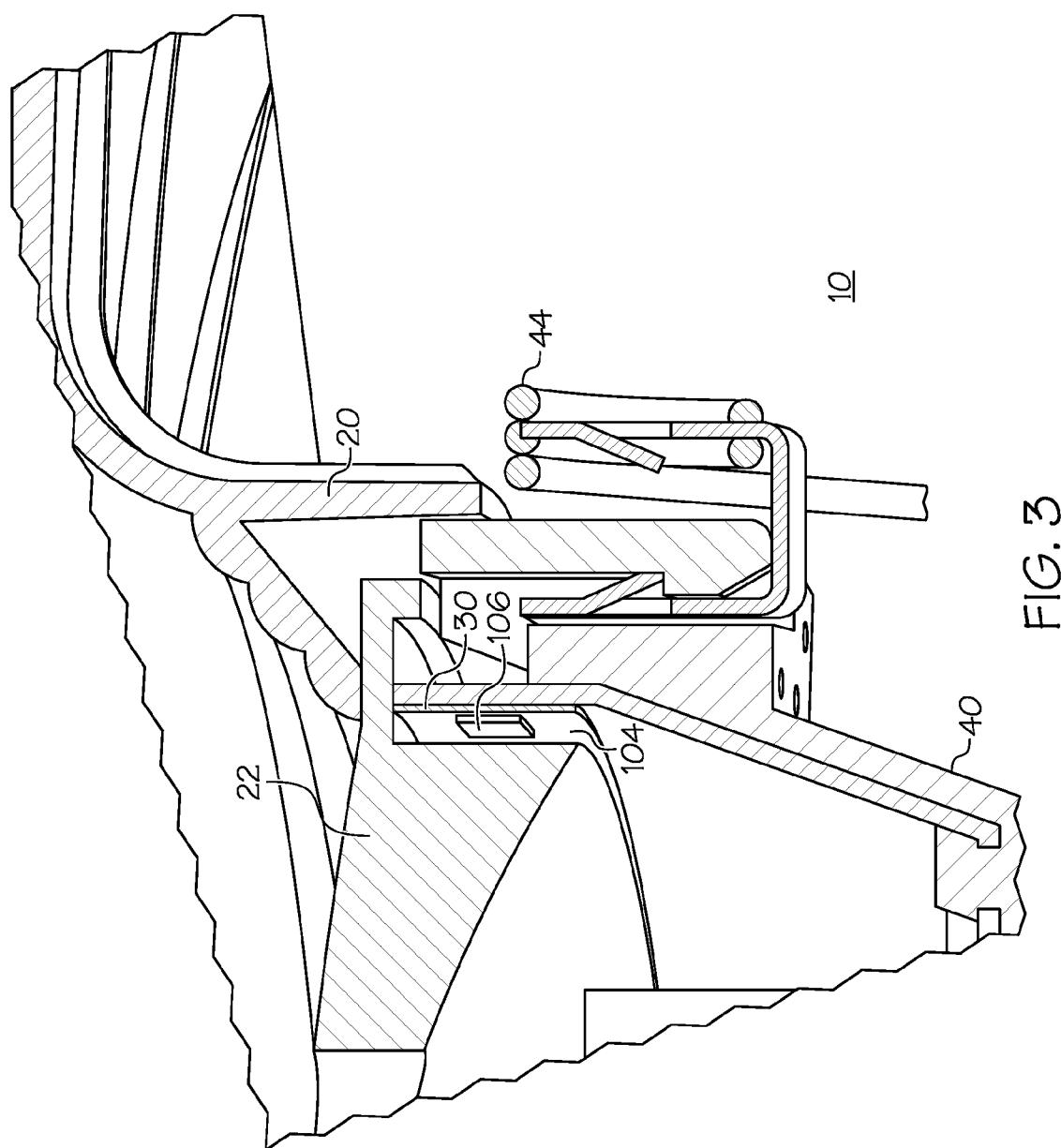


FIG. 2

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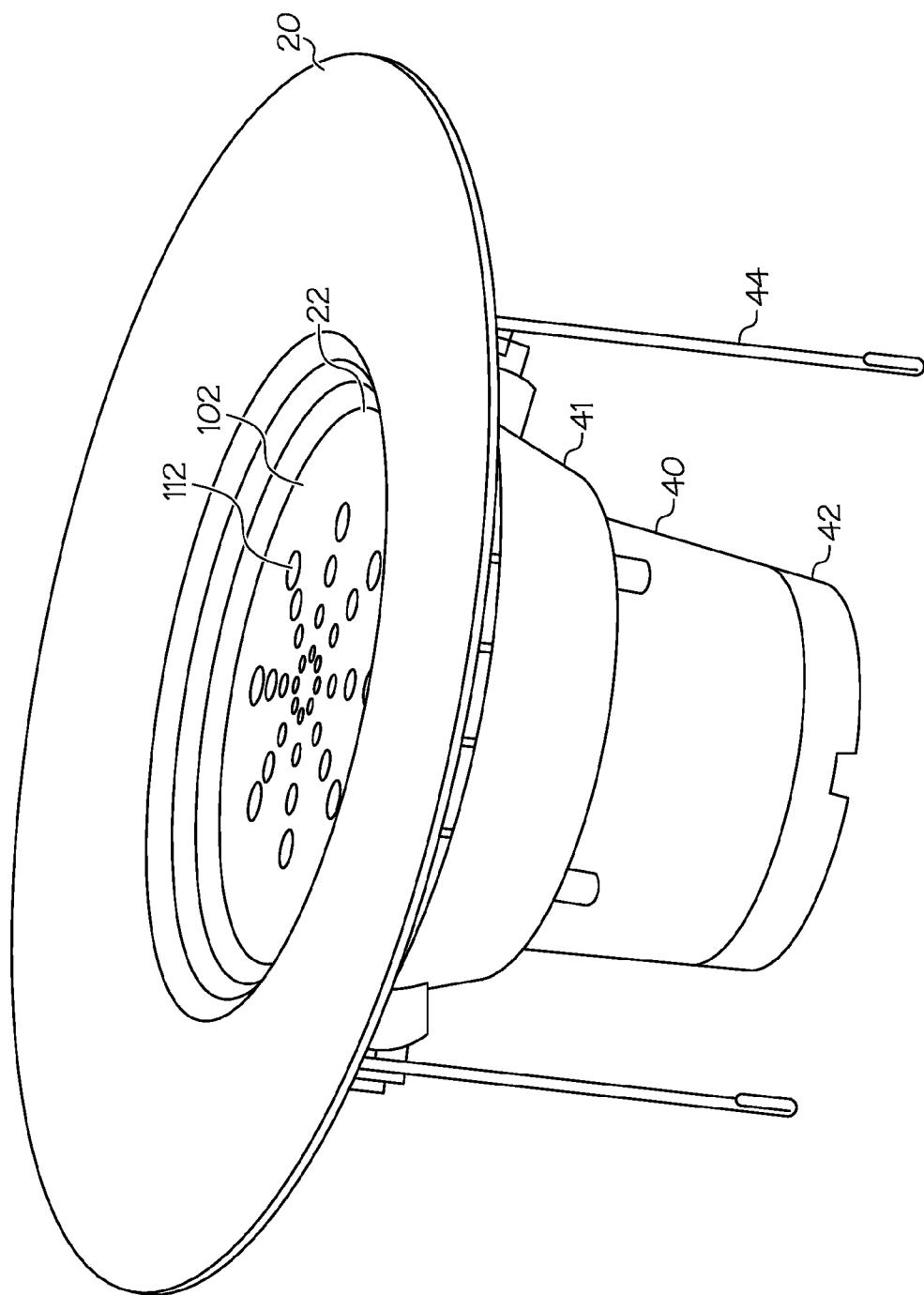


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US18/44810

A. CLASSIFICATION OF SUBJECT MATTER

IPC - F21V 33/00, 23/00, 29/70, 29/89; F21S 8/02; G02B 6/00; F21K 9/61 (2018.01)

CPC - F21V 33/0056, 23/009, 23/006, 29/70, 29/89; F21S 8/02; G02B 6/0091; F21K 9/61

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

See Search History document

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

See Search History document

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

See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/317846 A1 (YUAN, X et al.) 29 December 2011; abstract, figures 2-3, paragraphs [0044]-[0051], [0055]	1-2, 4-6
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Y		12, 14-15
X	US 9,651,243 B1 (ASTRO, INC.) 16 May 2017; figures 7I-K, 9E-F, column 16, lines 46-62, column 17, lines 4-20, line 62 to column 19, line 36, lines 51-63, column 22, lines 8-31	1, 3, 7-11, 13
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Y		12, 14-15
P, X	CN 207094410 U (DONGGUAN YOUPIN ELECTRONIC MAKING CO LTD) 13 March 2018; entire document	1

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents:

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