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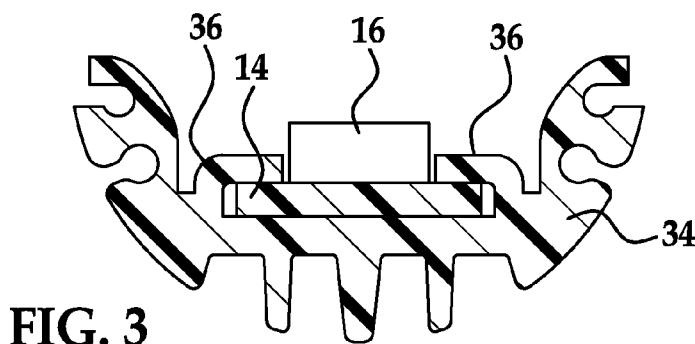


FIG. 3

(57) Abstract: An LED-based light for replacing a conventional fluorescent light in an existing fixture is disclosed. The LED-based light includes an elongated housing, a heat sink extending substantially the length of the housing and having at least one integral retaining portion and a circuit board positioned on the heat sink and having a plurality of LEDs mounted thereon, wherein the at least one integral retaining portion is configured to secure the circuit board to the heat sink.

CIRCUIT BOARD MOUNT FOR LED LIGHT

FIELD OF THE INVENTION

[0001] The present invention relates in general to a light emitting diode (LED) based light, and in particular to a method and apparatus for mounting circuit boards in the LED light.

BACKGROUND

[0002] Fluorescent tube lights are widely used in a variety of locations, such as schools and office buildings. Although conventional fluorescent bulbs have certain advantages over, for example, incandescent lights, they also pose certain disadvantages including, inter alia, disposal problems due to the presence of toxic materials within the glass tube.

[0003] LED-based lights which can be used as one-for-one replacements for fluorescent tube lights have appeared in recent years. LED-based lights can be constructed with LEDs and other circuitry mounted on one or more circuit boards. LED-based lights can include a housing and a heat sink to dissipate heat produced by the LEDs contained therein. In some cases, the circuit board containing the LEDs is functionally attached to the heat sink or housing to prevent the circuit board from moving out of place. In some instances, these attachments may not be adequate.

SUMMARY

[0004] Embodiments of an LED-based light for replacing a conventional fluorescent light in an existing fixture are disclosed herein. In one such embodiment, the LED-based light includes an elongated housing and a heat sink extending substantially the length of the housing. The heat sink has at least one integral retaining portion. The LED-based light also includes a circuit board positioned on the heat sink and having a plurality of LEDs mounted thereon. The at least one integral retaining portion is configured to secure the circuit board to the heat sink.

[0005] Embodiments of a method of manufacturing an LED-based light are also disclosed herein. In one such embodiment, the method includes providing a heat sink having a longitudinally extending flat surface and at least one integral retaining portion extending away from the flat surface in an unengaged position and positioning a circuit board on the flat surface of the heat sink. The method also includes mounting a plurality of LEDs on the

circuit board and engaging at least a portion of the at least one integral retaining portion of the heat sink to the circuit board such that the circuit board is secured to the heat sink.

[0006] These and other embodiments will be described in additional detail hereafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The description herein makes reference to the accompanying drawings wherein like reference numerals refer to like parts throughout the several views, and wherein:

[0008] FIG. 1 is a perspective view of an LED-based light with disengaged heat sink integral retaining portions in accordance with one embodiment;

[0009] FIG. 2 is cross-section view of the LED-based light of FIG. 1 along line A-A;

[0010] FIG. 3 is cross-section view of an LED-based light with engaged heat sink integral retaining portions in accordance with another embodiment along a line similar to line A-A in FIG. 1;

[0011] FIG. 4 is a cross-section view of an LED-based light in accordance with another embodiment along a line similar to line A-A in FIG. 1;

[0012] FIG. 5 is a cross-section view of the LED-based light of FIG. 4 along a line similar to line B-B in FIG. 1; and

[0013] FIG. 6 is a cross-section view of an LED-based light with intermittently engaged heat sink integral retaining portions in accordance with another embodiment along a line similar to line B-B in FIG. 1.

DETAILED DESCRIPTION

[0014] Attaching the circuit board to the heat sink using screws, glue, tape, heat stakes, clips, or other types of fasteners can be both expensive and inadequate over time due to constant temperature changes affecting the attachments. Using one of these various attaching techniques can also reduce the effectiveness of a heat sink or disturb the functioning of the circuit board.

[0015] Embodiments disclosed herein can simplify the design of LED-based lights by combining the heat sink function and the circuit board attachment function which can reduce cost and manufacturing assembly time and increase heat sink effectiveness. By engaging an integral retaining portion on the heat sink to the circuit board or other support, the circuit board can be held in place. Integral retaining portions of the heat sink can be engaged to the circuit board by crimping the integral retaining portions, for example walls or fins, on to the

heat sink to overlap or extend over the circuit board and hold the circuit board in position against the heat sink.

[0016] FIG. 1 illustrates an LED-based light 10 including a housing 12 with open ends, a heat sink 34, a circuit board 14 positioned on the heat sink 34, LEDs 16 mounted on the circuit board 14, and a pair of end caps 23 (only one illustrated in FIG. 1) on opposite ends of the housing 12. At least one of the end caps 23 can carry at least one connector 22 to electrically connect the LEDs 16 to an existing fixture. Each end cap 23 can include two pins, though two of the total four pins can be “dummy pins” that do not provide an electrical connection. Alternatively, other types of end caps can be used, such as single pin end caps. Also, while the end caps 23 is shown as including a cup-shaped body, the end caps can have a different configuration (e.g., the end caps can be shaped to be press fit into the housing 12).

[0017] The heat sink 34 has a flat surface extending longitudinally the length of the heat sink 34 with projections/integral retaining portions 36 such as walls or fins extending away (e.g., vertically) from opposite sides of the flat surface of the heat sink 34 in an unengaged position. The integral retaining portions may also extend in a different direction than vertically (e.g., extend outwardly from the heat sink).

[0018] In the embodiment illustrated in FIG. 1, the integral retaining portions also extend the length of the heat sink. In other embodiments, the integral retaining portions may extend less than the full length of the heat sink. As shown, there are integral retaining portions on each side of the circuit board. In some embodiments, there may only be one integral retaining portion on one side of the circuit board. In other embodiments, there may be multiple distinct integral retaining portions along the length of the heat sink 34. If there are multiple integral retaining portions, each may be distributed evenly along the length of the heat sink. In other embodiments the distribution may be uneven. In some embodiments, there may only be integral retaining portions on each side and each end of the heat sink 34. Any suitable number and configuration of integral retaining portions may be used to suitably secure the circuit board to the heat sink 34.

[0019] In this embodiment of an LED-based light 10, before assembly is completed, the integral retaining portions 36 on the heat sink 34 are not engaged with the circuit board 14 (i.e., in an unengaged position). The heat sink 34 in FIG. 1 shows an example of how the integral retaining portions 36 can be structured before being engaged to the circuit board 14. In addition to engaging the integral retaining portions 36 to the circuit board 14 as described in embodiments herein, the circuit board 14 of FIG. 1 can be fastened to the heat sink 34 with

screws, glue, heat stakes, or other structures so that circuit board 14 does not shift in location on the heat sink 34.

[0020] FIG. 2 shows a cross-section of FIG.1 at line A-A. In one embodiment, the heat sink 34 is a segment of thermally conductive metal of at least the same width as or wider than the circuit board 14 for dissipating heat generated by the LEDs 16 to the ambient environment. The heat sink 34, before assembly, also has integral retaining portions 36 in the form of walls or fins that rise above the thickness of the circuit board 14. The circuit board 14 has an LED-mounting side 14a and a primary heat transferring side 14b opposite the LED-mounting side 14a. The heat sink 34 can be designed so that the space between the integral retaining portions 36 on the heat sink 34 is roughly the width of the circuit board 14 so that the circuit board 14 fits between the integral retaining portions 36 on the heat sink 34 with little room for lateral movement. In another embodiment, the circuit board 14 can be designed so that it fits between the integral retaining portions 36 on the heat sink 34 with ample room for lateral movement. The placement of the circuit board 14 on the heat sink 34 can facilitate the integral retaining portions 36 engaging the circuit board 14.

[0021] Once the circuit board 14 is placed of the top flat surface of the heat sink 34 as shown in FIG. 2, the integral retaining portions 36 on the heat sink 34 can be engaged to the LED-mounting side 14a of the circuit board 14 as shown in FIG. 3. Engaging the integral retaining portions 36 of the heat sink 34 to the circuit board 14 can, for example, be accomplished by crimping the integral retaining portions 36 manually with any suitable artifact, e.g. with pliers, or can be done automatically by any known machine process, for example, pneumatic crimping.

[0022] Further, the engagement, for example crimping, can be performed along the entire length of the heat sink 34 as shown in FIG. 5 or at selected locations along the length of the heat sink 34 as shown in FIG. 6. It is not necessary to engage the entire length of integral retaining portions 36 to the circuit board 14, only enough engagement to keep the circuit board 14 from shifting. FIGS. 5 and 6 give two examples of how integral retaining portions 36 extending vertically from each side of the top flat surface of the heat sink 34 can be engaged to the LED-mounting side 14a of the circuit board 14. FIG. 5 illustrates that a single integral retaining portion 36 on each side of the heat sink 34 is crimped for the full length of the circuit board 14. FIG. 6 illustrates that a single integral retaining portion 36 on each side of the heat sink 34 is crimped at multiple locations along the circuit board 14, in this case, between the spaced LEDs 16. For example, the integral retaining portions 36 on the heat sink 34 shown in FIGS. 5 and 6 can each be 3mm high making it possible to crimp

the integral retaining portions 36 to the circuit board 14 manually with pliers. Other dimensions of integral retaining portions 36 or number of integral retaining portions 36 can be engaged to the circuit board 14.

[0023] FIG. 4 illustrates a cross-section of an embodiment of an LED-based light 10 similar to the embodiment of FIG. 1 at a line similar to line A-A with a portion of the housing 12 comprised of a lens 20 engaged to the heat sink 34. In this embodiment, the lens 20 includes at two rounded-end integral retaining portions 39a and 39b on an interior surface that each engage a groove 40a and 40b, respectively on an outer surface of the heat sink 34. The lens 20 can be made from polycarbonate, acrylic, glass, or another high-dielectric light transmitting material. The lens 20 can include light diffracting structures, such as dots, bumps, dimples, and other uneven surfaces formed on the interior or exterior of the lens 20. A light diffracting film can be applied to the exterior of the lens 20 or placed between the lens 20 and heat sink 34. The lens 20 can be formed of a material including light diffusing particles. The term “lens” as used herein means a light transmitting structure, and not necessarily a structure for concentrating or diverging light.

[0024] The LED-based light 10 of FIG. 4 also includes a cover 38 engaged to the heat sink 34 and forming a portion of the housing 12. In this embodiment, the cover 38 includes at least one rounded-end integral retaining portion 42a and 42b on an interior surface that each engages a groove 44a and 44b on an outer surface of the heat sink 34. Providing the cover 38 can allow the use of a highly thermally and electrically conductive heat sink 34, e.g., an extruded aluminum heat sink 34, because the dielectric properties of the cover 38 can reduce the shock hazard potential of capacitive coupling between the circuit board 14 and the heat sink 34. Additionally, the cover 38 can provide structural support to the LED-based light 10. Alternative forms of attachment of the lens 20 or cover 38 to the heat sink 34, such as screws, highly thermally conductive adhesive tape, friction fit, or other attachments known to those of skill in the art are alternatively usable.

[0025] Other suitable embodiments of LED-based light 10 including integral retaining portions 36 are also available. For example, although the integral retaining portions 36 are shown to extend the length of the heat sink 34, one or more integral retaining portions may be included in the LED-based light 10 on one or both sides of the heat sink. For example, the LED-based light 10 may include a total of four projections that are a fraction of the length of the tube and are only located at each longitudinal end the heat sink 34. Each projection can be, as discussed previously, structured so that it engages the circuit board to keep it in place.

[0026] In one embodiment, an LED-based light for replacing a conventional fluorescent light in a light fixture includes an elongated housing, a heat sink extending substantially the length of the housing and having at least one integral retaining portion, and a circuit board positioned on the heat sink and having a plurality of LEDs mounted thereon, wherein the at least one integral retaining portion is configured to secure the circuit board to the heat sink.

[0027] In one aspect of this embodiment, the at least one integral retaining portion extends over and engages the circuit board to secure the circuit board to the heat sink.

[0028] In another aspect of this embodiment, the at least one integral retaining portion extends substantially the length of the heat sink.

[0029] In another aspect of this embodiment, the at least one integral retaining portion engages the circuit board along substantially the length of the heat sink or at a plurality of distinct locations along the length of the heat sink.

[0030] In another aspect of this embodiment, the at least one integral retaining portion includes a plurality of integral retaining portions configured to secure the heat sink and the plurality of integral retaining portions are substantially evenly spaced along the length of the heat sink.

[0031] In another aspect of this embodiment, the heat sink includes a first side and a second side opposite the first side, the at least one integral retaining portion includes first and second integral retaining portions and the first integral portion extends substantially the length of the heat sink on the first side and the second integral portion extends substantially the length of the heat sink on the second side the heat sink.

[0032] In another aspect of this embodiment, first and second retaining portions each engage the circuit board along substantially the length of the heat sink.

[0033] In another aspect of this embodiment, first and second retaining portions each engage the circuit board at a plurality of distinct locations along the length of the heat sink.

[0034] In another aspect of this embodiment, wherein the at least one retaining portion is crimped to of the circuit board.

[0035] In another aspect of this embodiment, the LED-based light further includes a pair of end caps disposed on opposite ends of the housing.

[0036] In another aspect of this embodiment, the housing is tubular and substantially all of the heat sink and circuit board are disposed within the housing.

[0037] In another embodiment, a method of manufacturing an LED-based light includes providing a heat sink having a longitudinally extending flat surface and at least one

integral retaining portion extending away from the flat surface in an unengaged position, positioning a circuit board on the flat surface of the heat sink, mounting a plurality of LEDs on the circuit board and engaging at least a portion of the at least one integral retaining portion of the heat sink to the circuit board such that the circuit board is secured to the heat sink.

[0038] In one aspect of this embodiment, the engaged at least one integral retaining portion extends over the circuit board to secure the circuit board to the heat sink.

[0039] In another aspect of this embodiment, the at least one integral retaining portion extends substantially the length of the heat sink.

[0040] In another aspect of this embodiment, engaging at least the portion of the at least one integral retaining portion includes engaging the at least one integral retaining portion to the circuit board along substantially the length of the heat sink.

[0041] In another aspect of this embodiment, engaging at least the portion of the at least one integral retaining portion includes engaging the at least one integral retaining portion to the circuit board at a plurality of distinct locations along the length of the heat sink.

[0042] In another aspect of this embodiment, the at least one integral retaining portion includes a plurality of integral retaining portions substantially evenly spaced along the length of the heat sink, wherein engaging at least the portion of the at least one integral retaining portion includes engaging each of the plurality of integral retaining portions such that the circuit board is secured to the heat sink.

[0043] In another aspect of this embodiment, the heat sink includes a first side and a second side opposite the first side, wherein the at least one integral retaining portion includes first and second integral retaining portions and wherein the first integral portion extends substantially the length of the heat sink on the first side and the second integral portion extends substantially the length of the heat sink on the second side the heat sink, wherein engaging at least the portion of the at least one integral retaining portion includes engaging the first integral retaining portion to the circuit board and engaging the second integral retaining portion to the circuit board such that the circuit board is secured to the heat sink.

[0044] In another aspect of this embodiment, engaging at least the portion of the at least one integral retaining portion includes crimping at least the portion of the at least one integral retaining portion of the heat sink to the circuit board.

[0045] In another aspect of this embodiment, the method further includes enclosing the heat sink and circuit board in an elongated housing and attaching an end cap to each end of the elongated housing.

[0046] The above-described embodiments have been described in order to allow easy understanding of the invention and do not limit the invention. On the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims, which scope is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structure as is permitted under the law.

CLAIMS

What is claimed is:

1. An LED-based light for replacing a conventional fluorescent light in a light fixture comprising:
 - an elongated housing;
 - a heat sink extending substantially the length of the housing and having at least one integral retaining portion; and
 - a circuit board positioned on the heat sink and having a plurality of LEDs mounted thereon, wherein the at least one integral retaining portion is configured to secure the circuit board to the heat sink.
2. The LED-based light of claim 1, wherein the at least one integral retaining portion extends over and engages the circuit board to secure the circuit board to the heat sink.
3. The LED-based light of claim 1, wherein the at least one integral retaining portion extends substantially the length of the heat sink.
4. The LED-based light of claim 3, wherein the at least one integral retaining portion engages the circuit board along substantially the length of the heat sink or at a plurality of distinct locations along the length of the heat sink.
5. The LED-based light of claim 1, wherein the at least one integral retaining portion includes a plurality of integral retaining portions configured to secure the heat sink and wherein the plurality of integral retaining portions are substantially evenly spaced along the length of the heat sink.
6. The LED-based light of claim 1, wherein the heat sink includes a first side and a second side opposite the first side, wherein the at least one integral retaining portion includes first and second integral retaining portions and wherein the first integral retaining portion extends substantially the length of the heat sink on the first side and the second integral retaining portion extends substantially the length of the heat sink on the second side of the heat sink.

7. The LED-based light of claim 7, wherein first and second retaining portions each engage the circuit board along substantially the length of the heat sink.

8. The LED-based light of claim 7, wherein first and second retaining portions each engage the circuit board at a plurality of distinct locations along the length of the heat sink.

9. The LED-based light of claim 1, wherein the at least one retaining portion is crimped to of the circuit board.

10. The LED-based light of claim 1, further comprising:
a pair of end caps disposed on opposite ends of the housing,

11. The LED-based light of claim 1 wherein the housing is tubular and substantially all of the heat sink and circuit board are disposed within the housing.

12. A method of manufacturing an LED-based light comprising:
providing a heat sink having a longitudinally extending flat surface and at least one integral retaining portion extending away from the flat surface in an unengaged position;
positioning a circuit board on the flat surface of the heat sink;
mounting a plurality of LEDs on the circuit board; and
engaging at least a portion of the at least one integral retaining portion of the heat sink to the circuit board such that the circuit board is secured to the heat sink.

13. The method of claim 12, wherein the engaged at least one integral retaining portion extends over the circuit board to secure the circuit board to the heat sink.

14. The method of claim 12, wherein the at least one integral retaining portion extends substantially the length of the heat sink.

15. The method of claim 14, wherein engaging at least the portion of the at least one integral retaining portion comprises:

engaging the at least one integral retaining portion to the circuit board along substantially the length of the heat sink.

16. The method of claim 14, wherein engaging at least the portion of the at least one integral retaining portion comprises:

engaging the at least one integral retaining portion to the circuit board at a plurality of distinct locations along the length of the heat sink.

17. The method of claim 12, wherein the at least one integral retaining portion includes a plurality of integral retaining portions substantially evenly spaced along the length of the heat sink, wherein engaging at least the portion of the at least one integral retaining portion comprises:

engaging each of the plurality of integral retaining portions such that the circuit board is secured to the heat sink.

18. The method of claim 12, wherein the heat sink includes a first side and a second side opposite the first side, wherein the at least one integral retaining portion includes first and second integral retaining portions and wherein the first integral portion extends substantially the length of the heat sink on the first side and the second integral portion extends substantially the length of the heat sink on the second side the heat sink, wherein engaging at least the portion of the at least one integral retaining portion comprises:

engaging the first integral retaining portion to the circuit board and engaging the second integral retaining portion to the circuit board such that the circuit board is secured to the heat sink.

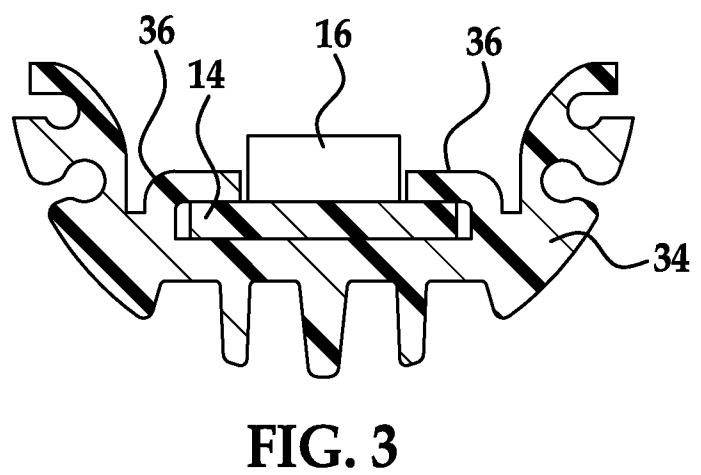
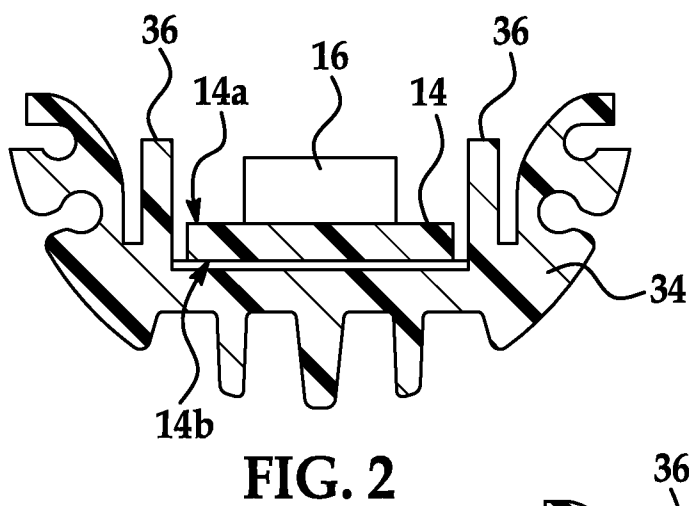
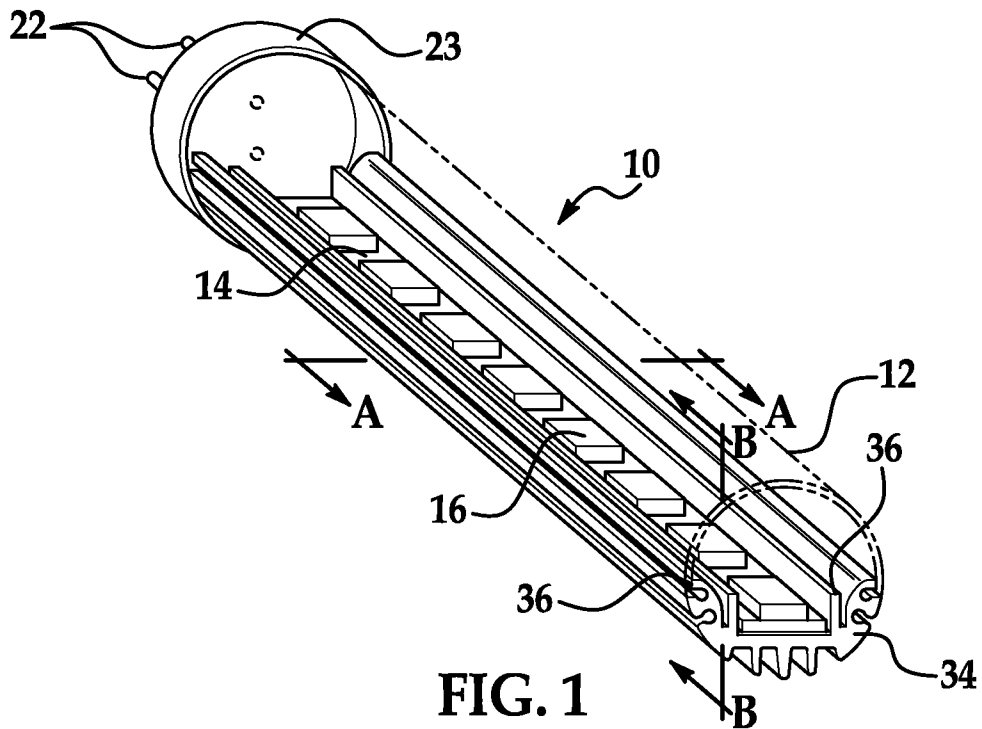
19. The method of claim 12, wherein engaging at least the portion of the at least one integral retaining portion comprises:

crimping at least the portion of the at least one integral retaining portion of the heat sink to the circuit board.

20. The method of claim 12, further comprising:

enclosing the heat sink and circuit board in an elongated housing; and
attaching an end cap to each end of the elongated housing.

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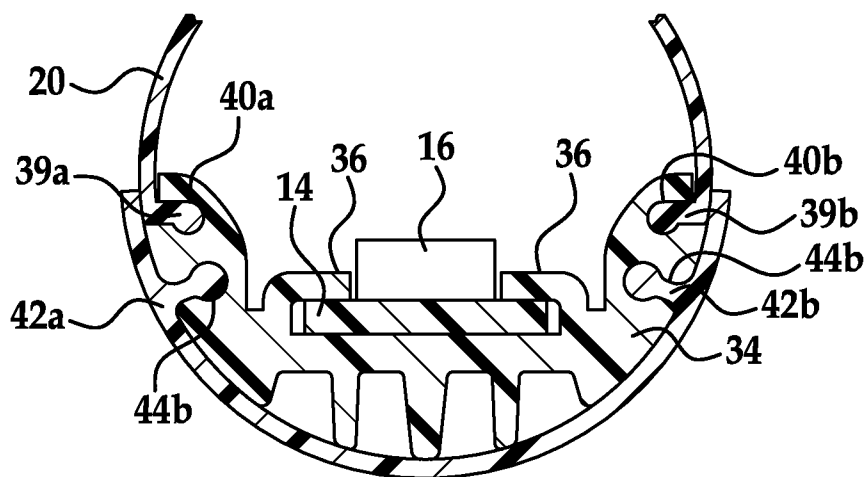


FIG. 4

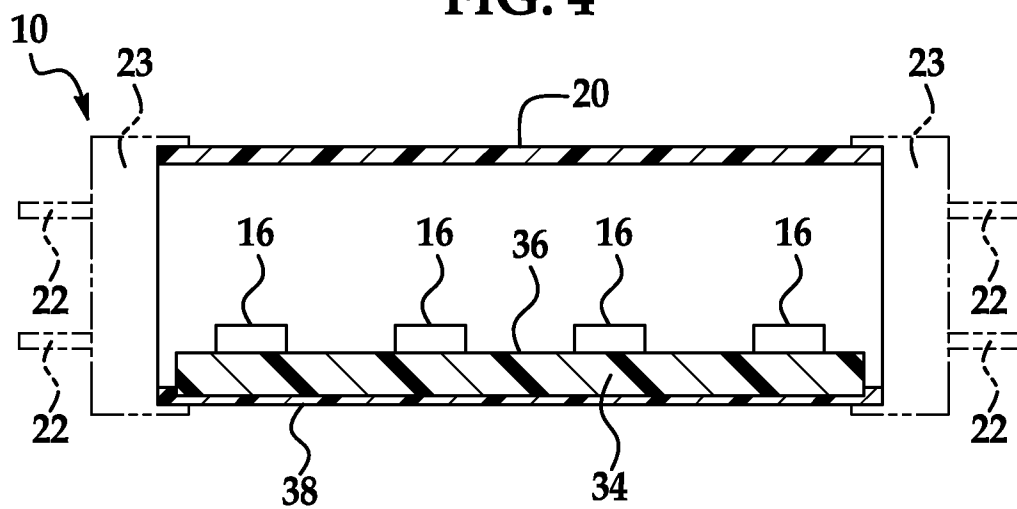


FIG. 5

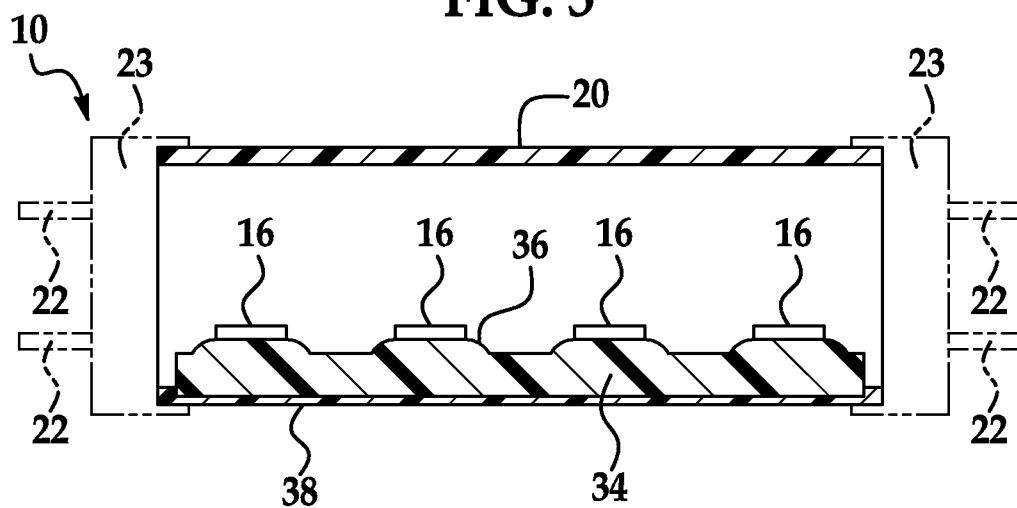


FIG. 6