

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
11 December 2003 (11.12.2003)

PCT

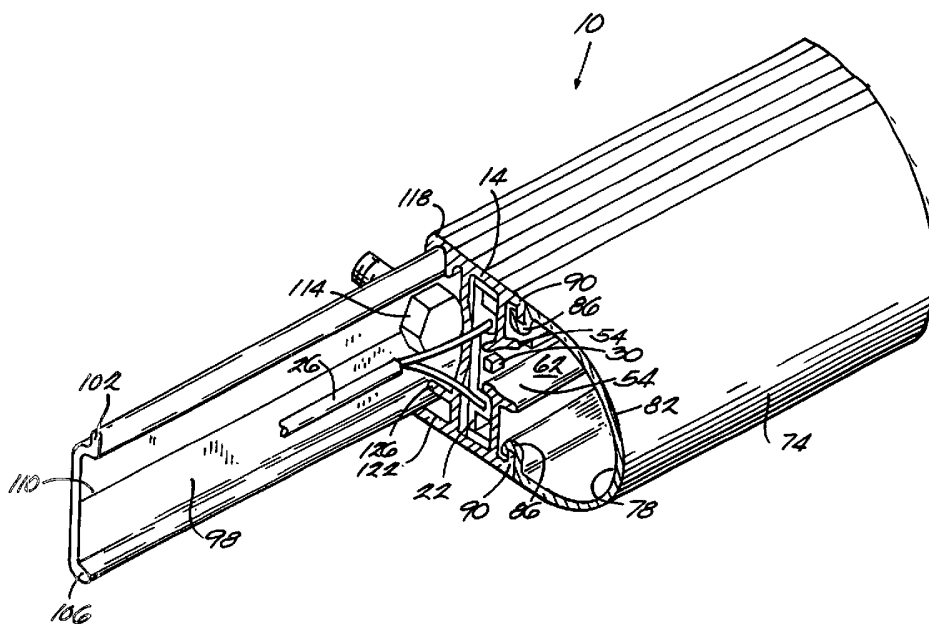
(10) International Publication Number
WO 03/102467 A2

- (51) International Patent Classification⁷: **F21S 4/00**, F21V 23/06, F21Y 101/02
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- (21) International Application Number: PCT/US03/16706
- (81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW.
- (22) International Filing Date: 28 May 2003 (28.05.2003)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 60/385,025 3 June 2002 (03.06.2002) US
- (84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).
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Published:
— without international search report and to be republished upon receipt of that report

[Continued on next page]

(54) Title: LED ACCENT LIGHTING UNITS



(57) Abstract: A lighting unit (10) including at least one elongated substrate (22) having a plurality of light-emitting optoelectronic devices (30) mounted thereon and an elongated housing (14) supporting the elongated substrate (22). The housing (14) includes integrally-formed reflectors (54) positioned adjacent the optoelectronic devices (30). The lighting unit (10) also includes a translucent output panel (74) that transmits light from the optoelectronic devices (30). The light unit (10) has a first wiring harness (26a) for connection to a power source, and a second wiring harness (26b) connectable to an adjacent lighting unit (10).



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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

LED ACCENT LIGHTING UNITS

Related Applications

This is a non-provisional patent application of co-pending U.S. provisional Patent
5 Application Serial Number 60/385,025 filed on June 3, 2002, which is incorporated
herein by reference.

Field of the Invention

This invention relates generally to lighting fixtures, and more particularly to
10 fixtures that provide accent lighting.

Background of the Invention

In commercial applications, accent lighting is typically used to capture the
attention of potential customers. Accent lighting may highlight or supplement a primary
15 display of some sort. Accent lighting may also be used to highlight store information,
such as location, hours of operation, a slogan, etc. Accent lighting may also be used to
advertise product information like the product name, a slogan related to the product,
locations where to find the product, etc.

Commonly, accent lighting includes conventional light sources such as
20 incandescent, fluorescent, or neon lights that provide the desired illumination. However,
these light sources can have several drawbacks. Some of these light sources consume
large amounts of electricity making them expensive to operate; particularly for outdoor
signs that are illuminated for long periods of time. Conventional light sources can also
generate a significant amount of heat that is not easily dissipated. In addition,
25 conventional incandescent light sources can have a short life and/or are susceptible to
damage when compared to some less conventional light sources, and as such must be

inspected and replaced periodically. Neon or fluorescent lights require expensive power supplies, and typically operate at a high voltage.

Summary of the Invention

5 The present invention provides a lighting unit including at least one elongated substrate including a plurality of light-emitting optoelectronic devices mounted thereon and an elongated housing supporting the elongated substrate. The housing also includes integrally-formed reflectors positioned adjacent the optoelectronic devices, and a translucent output panel that transmits light from the optoelectronic devices.

10 The present invention also provides a lighting unit including an elongated substrate having a plurality of optoelectronic devices mounted thereon and a first wiring harness extending from one end of the substrate and terminating with a first connector. The first wiring harness has two wires that electrically connect the plurality of optoelectronic devices with a power source. The lighting unit also includes a second
15 wiring harness that electrically connect to the first wiring harness and the power source. The second wiring harness also has two wires that terminate with a second connector engageable with the first connector. The second wiring harness extends in a cavity or recess in the lighting unit to electrically connect an adjacent substrate or lighting unit module to the power source.

20 The present invention also provides a lighting unit including an elongated substrate having a plurality of optoelectronic devices mounted thereon, and a first wiring harness extending from one end of the substrate and terminating with a first connector. The first wiring harness electrically connects the plurality of optoelectronic devices with a power source. In one embodiment, the lighting unit also includes a second wiring
25 harness extending from the same end of the substrate as the first wiring harness and terminating with a second connector engageable with the first connector. In another

embodiment, the second wiring harness extends from an end of the substrate that is opposite to the end from which the first wiring harness extends. In both embodiments, the second wiring harness is electrically connected with the power source. The second wiring harness preferably extends along in a cavity or recess in the lighting unit to electrically connect an adjacent substrate or lighting unit module to the power source.

Further, the present invention provides a lighting assembly including a first lighting unit having an elongated substrate including a plurality of optoelectronic devices mounted thereon and a first wiring harness having a first connector. The first wiring harness is coupled to one end of the substrate to electrically connect the plurality of optoelectronic devices with a power source. The first lighting unit also has a second wiring harness including a second connector. The first wiring harness has either a male or female connector, and the second wiring harness has the other of the male or female connector. The second wiring harness may be coupled to the same end of the substrate as the first wiring harness to receive power from the power source, and is extendable along the substrate in a cavity of the lighting unit. The lighting assembly also includes a second lighting unit similar to the first lighting unit. The second lighting unit is positioned adjacent the first lighting unit such that the second connector of the first lighting unit engages the first connector of the second lighting unit to electrically connect the second wiring harness of the first lighting unit with the first wiring harness of the second lighting unit.

Brief Description of the Drawings

In the drawings, wherein like reference numerals indicate like parts:

FIG. 1a is a cross-sectional view of a LED accent lighting unit embodying the present invention;

FIG. 1b is an enlarged, cross-sectional view of an integrally-formed reflector of the LED accent lighting unit of FIG. 1a;

FIG. 2a is a perspective view of multiple interconnected substrates, illustrating multiple LEDs on each substrate and insulated electrical connectors interconnecting the
5 substrates;

FIG. 2b is an enlarged, perspective view of the electrical connector of FIG. 2a;

FIG. 3 is a perspective view of the LED accent lighting unit of FIG. 1a, illustrating a housing attached to a mounting strip;

10 FIG. 4a is a perspective view of multiple LED accent lighting units of FIG. 1a, illustrating multiple housings connected to a mounting strip; and

FIG. 4b is a perspective view of multiple, electrically connected LED accent lighting units of an alternate configuration.

Before at least one embodiment of the invention is explained in detail, it is to be
15 understood that the invention is not limited in its application to the details of construction and the arrangements of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded
20 as limited.

Detailed Description

FIG. 1a illustrates a cross-sectional view of an LED accent lighting unit 10. The unit 10 includes a housing 14 extruded from plastic and cut to a pre-determined length.
25 The housing 14 includes a slot portion 18 to insert and constrain multiple substrates 22 (see FIG. 2a). One of the multiple substrates 22 is electrically connected at one end to a

power source that provides DC voltage through a wiring harness 26. Typically, either of the substrates 22 positioned at opposite ends of the unit 10 may be electrically connected to the power source via the wiring harness 26. Each substrate 22 includes multiple wide-beam LEDs 30 that emit light over an angle of about 120 degrees. The LEDs 30 are energy efficient and as a result, large amounts of heat need not be dissipated. Each substrate 22 also includes at least one resistor 34 that provides the desired level of DC current to the LEDs 30, which is about 20 mA. The LEDs 30 can thus be configured to operate at a low voltage, typically in the 12 to 60 volt range.

In one configuration of the substrate 22, as shown in FIG. 2a, the resistor 34 is located toward the middle of each substrate 22. Alternatively, the resistor 34 can be positioned toward either end of the substrate 22. Also in the illustrated embodiment, four LEDs 30 are wired in series with the resistor 34. This configuration provides a voltage of about 12-40 (preferably 12-24) VDC to each group of four LEDs 30. Alternatively, more or fewer than four LEDs 30 may be wired in series with the resistor 34.

As shown in FIGS. 2a and 2b, multiple substrates 22 are electrically connected to the power source by connector pins 38 that are soldered to adjacent substrates 22. The substrates 22 include buses 40 extending along the length of the substrates 22 that electrically connect the LEDs 30 and resistors 34 to the power source when adjacent substrates 22 are electrically connected by the connector pins 38. Insulating clips 42 support and substantially surround the connector pins 38, and provide a mechanical connection between adjacent substrates 22 in addition to insulating the connector pins 38. The clips 42 have nubs 43 that snap into existing apertures 46 located on the adjacent substrates 22 to interlock the adjacent substrates 22. The clips 42 also have ramped or chamfered surfaces 45 and 47, particularly in the region between pins 38, to avoid interference with the LED wires and thereby aid in assembly to substrates 22.

Upon interlocking two adjacent substrates 22 with an insulating clip 42 having the connector pins 38, the connector pins 38 come into electrical and physical contact with contact plates 48, which are exposed portions of the buses 40. As a result, the substrate 22 that is directly electrically connected with the power source provides power to other interconnected substrates via the electrical contact between the buses 40 and the connector pins 38. Also, the connector pins 38 may include chamfered ends to aid in the interconnection of two adjacent substrates 22.

In the embodiment depicted in Figure 2a, the substrates 22 are not designed to be cuttable, unlike the substrates 22a discussed below in connection with the second embodiment. As a result, a lighting unit comprising of several substrates 22 preferably has a first wiring harness 26 disposed at one end of the lighting unit, and a second wiring harness 27 disposed at an opposite end of the lighting unit. The first wiring harness 26 has a connector that is either a male or female connector like either connector 140 or 144 (Figure 4b). The second wiring harness will have a connector that is the other of a male or female connector like either connector 144 or 140. Both wiring harnesses are connected to bus 40. The first wiring harness of the end lighting unit in the assembly is connected to a power source. The second wiring harness of that same lighting unit is connected to the first wiring harness of an adjacent lighting unit in the assembly. In this way, a lighting assembly comprising multiple lighting units or modules may receive power from the power source via the bus and their respective first and second wiring harnesses.

Another configuration of the substrates, indicated by reference numeral 22a, is partially illustrated in FIG. 4b being utilized in lighting units 10a. The substrates 22a are substantially similar to the substrates 22 of FIG. 2a, with like components having like reference numerals. Each substrate 22a is divided into multiple sections 49, with each section 49 including two LEDs 30 wired in series with a resistor 34. Each substrate 22a

is cuttable, such that any number of sections 49 may be cut from the substrate 22a to shorten the substrate 22a. This allows a user to custom-fit the substrate 22a to a user-specific application.

In each lighting unit 10a, multiple substrates 22a may be interconnected using the same connector pins and clips (not shown in FIG. 4b) as the substrates 22 of FIG. 2a, and power may be transferred to interconnected substrates via the buses 40 and connector pins. One of the multiple substrates 22a in each lighting unit 10a is directly electrically connected to the power source by a first wiring harness 26a. The first wiring harness 26a includes two wires that are soldered or otherwise connected to the contact plates 48 of the buses 40 at one end of the substrate 22a to provide power to all the interconnected substrates 22a. The first wiring harness 26a connects to the power source via an input connector 140 having a first configuration. The substrate 22a having the first wiring harness 26a also includes a second wiring harness 26b having two wires soldered or otherwise connected to the same contact plates 48 as the wires of the first wiring harness 26a. The second wiring harness 26b includes an output connector 144. This is either a male or female connector engageable with the first connector 140. The length of the second wiring harness 26b allows the second wiring harness 26b to extend along the multiple interconnected substrates 22a and away from the end of the substrate 22a connected to the second wiring harness 26b, in cavity 130 (Fig. 1a).

At least one transient suppressor 50 is included in the units 10, 10a and electrically connected to one of the substrates 22, 22a within the units 10, 10a. The transient suppressor 50 substantially prevents voltage spikes from damaging the LEDs 30 due to static electricity resulting from handling and other situations. As shown in FIGS. 2a and 4b, the transient suppressor 50 is shown toward the end of the substrate 22, 22a connected to the power source. Alternatively, the transient suppressor 50 can be located anywhere on any of the substrates 22, 22a.

The substrates 22, 22a are also coated by a flexible waterproof transparent sealer for protection against the outside environment. The sealer protects the substrates 22, 22a and the LEDs 30 from the environment, while allowing the substrates 22, 22a to expand and contract with varying temperatures.

5 Since the substrates 22, 22a are also made of a fiberglass material and are relatively thin, the substrates 22, 22a include some degree of flexibility. This allows the substrates 22, 22a to be used in applications demanding the substrates 22, 22a to bend around some curved surfaces.

As shown in FIGS. 1a and 3, the housing 14 includes integrally-formed reflectors
10 54. The reflectors 54 define the upper part of the slot portion 18 and help constrain the substrates 22, 22a within the slot portion 18. The reflectors 54 include stems 58 projecting from opposing sides of the housing 14 that are integrally formed with opposing reflective surfaces 62. Each reflective surface 62 includes a curved portion 66 and a straight portion 70 (most clearly shown in FIG. 1b). The LEDs 30 are positioned at
15 substantially the same level as the straight portion 70 such that the light emitted by the LEDs 30 is substantially incident on the reflective surfaces 62 above the straight portion 70. The curved portion 66 is positioned above the straight portion 70 and reflects the light emitted by the LEDs 30. The reflective surfaces 62 additionally diffuse the incident light.

20 As shown in FIG. 1a, a lens 74 including an inner surface 78 and outer surface 82 is positioned above the LEDs 30 and connected to the housing 14 via a hook and slot arrangement. The hooks 86 are integrally formed with the lens 74 of an impact-resistant acrylic. The slots 90 are integrally formed with the housing 14 and engage the hooks 86 to interconnect the lens 74 and housing 14. The lens 74 is translucent and also acts as a
25 diffuser for the light incident on the inner surface 78 so that the light transmitted from the

outer surface 82 is diffused. As a result, a substantially uniform light is emitted from the outer surface 82 of the lens 74.

As shown in FIG. 4a, translucent end caps 94 are coupled to the ends of the units 10. The end caps 94 substantially cover the ends of the units 10 such that light emitted from the LEDs 30 is incident on the end caps 94 as well as the lens 74. Since the end caps 94 are translucent, there are no dark spots shown on the surfaces of the lens 74 and end caps 94.

As shown in FIGS. 1a and 3, a mounting strip 98 is fastened to a surface where the unit 10 is to be located and includes a ball-pivoting end 102 and a first locking tab 106 to interconnect to the housing 14. The mounting strip 98 further includes a v-notch 110 disposed between the ball-pivoting end 102 and the first locking tab 106 wherein the v-notch 110 provides a guide to position the mounting strip fasteners 114 that support the unit 10. The housing 14 has a socket end 118 to receive the ball-pivoting end 102 of the mounting strip 98 and a second locking tab 122 and guide tab 126 to engage the first locking tab 106 of the mounting strip 98. To mount the housing 14 to the strip 98, the socket end 118 of the housing 14 first engages the ball-pivoting end 102 of the strip 98. The housing 14 is then pivoted such that the second locking tab 122 and guide tab 126 engage and interconnect with the first locking tab 106. As shown in FIGS. 3 and 4, the mounting strip 98 can be bolted to a surface with the ball-pivoting end 102 facing upwards. Using this configuration, the weight of the housing 14 and lens 74 is supported by the ball-pivoting end 102 of the strip 98. It should also be known that FIG. 1a is also a representative cross-section of the lighting unit 10a and substrate 22a.

As shown in FIG. 4a, several LED accent lighting units 10 may be positioned adjacent to each other to hide the individual wiring harnesses 26 attached to the individual units 10. As shown in FIGS. 1a and 3, a cavity 130 is formed between the housing 14 and mounting strip 98 upon their interconnection. Wiring harnesses 26 from

adjacent units 10 can be disposed in the cavity 130 to keep them hidden from view. The height of the cavity 130 may be increased as needed to accommodate the wiring harnesses 26. The individual wiring harnesses 26 of the individual units 10 must then be electrically connected to the power source for operation.

5 As shown in FIG. 4b, several lighting units 10a utilizing the sectioned substrates 22a may also be positioned adjacent to each other to hide the wiring harnesses 26a, 26b attached to the individual units 10a. However, rather than requiring each lighting unit 10a to directly electrically connect to the power source, the output connector 144 of the second wiring harness 26b of one unit 10a may engage the input connector 140 of the
10 first wiring harness 26a of an adjacent unit 10a to provide power to the adjacent unit 10a. Additional lighting units 10a may be electrically connected in the same way.

When positioned adjacent each other, the adjacent units 10, 10a will have the appearance of a continuous length rather than individual units 10, 10a. To allow for expansion and contraction of the individual units 10, 10a about $\frac{1}{4}$ inch gap should exist
15 between individual units 10, 10a. The individual units 10, 10a can be manufactured between about 2 inches to typically 10 feet in length. In addition, the lighting units 10a utilizing the sectioned substrates 22a are field-cutable such that the units 10a may be cut to a desired length during installation. The units 10, 10a also include a low profile such that they do not protrude high above the surface to which they are mounted.

20 In one embodiment of the present invention, the housing 14 (including the reflectors 54 and reflective surfaces 62), mounting strip 98, and lens 74 are extruded of a plastic material that is dyed to match the color of the LED 30. For example, a unit 10, 10a that emits green accent lighting can utilize green LEDs 30 in combination with a green housing 14 having green reflectors 54. This configuration would minimize any
25 losses during light transmission due to the surfaces 62 of the reflectors 54 having a color of the same wavelength of the incident light. If, however, the color of the surfaces 62 of

the reflectors 54 does not have a wavelength similar to the incident light, then absorption occurs at the surfaces 62 of the reflectors 54.

In another embodiment, the housing 14 is extruded of a plastic material with the reflectors 54 integrally formed within the housing 14. The mounting strip 98 is also
5 extruded from a plastic material similar in color and substance to the housing 14. The lens 74 is extruded of a plastic material having a color of the desired accent lighting. The reflective surfaces 62 each include a white coating 134 to help maximize reflection and minimize absorption of the incident light. The coating 134 may be applied by a spinning fiber roller or by a spray nozzle. Using this configuration, white or any other color LEDs
10 30 can be used in combination with the colored lens 74 to achieve a desired color of accent lighting.

Claims

We claim:

- 5 1. A lighting unit, comprising:
 at least one elongated substrate including a plurality of light-emitting
 optoelectronic devices mounted thereon;
 an elongated housing supporting the elongated substrate, the housing
 including integrally-formed reflectors positioned adjacent the optoelectronic devices; and
10 a translucent output panel that transmits light from the optoelectronic
 devices.
2. The lighting unit of Claim 1, wherein the substrate is divided into multiple
 sections.
- 15 3. The lighting unit of Claim 2, wherein at least one section from the
 substrate is permanently removable from the substrate to shorten the substrate.
4. The lighting unit of Claim 2, wherein at least one section includes at least
20 two optoelectronic devices and a resistor.
5. The lighting unit of Claim 1, wherein the substrate includes at least four
 optoelectronic devices and a resistor.

6. The lighting unit of Claim 1, further comprising a transient suppressor mounted to the substrate and electrically connected with the plurality of optoelectronic devices.
- 5 7. The lighting unit of Claim 1, wherein the at least one elongated substrate includes two elongated substrates, and wherein the lighting unit further comprises a connector configured for physically and electrically connecting the two substrates.
- 10 8. The lighting unit of Claim 7, wherein the connector includes at least two pins electrically connecting the two substrates.
9. The lighting unit of Claim 8, wherein the pins are spaced apart and are partially encapsulated by an insulating clip.
- 15 10. The lighting unit of Claim 9, wherein the clip includes first and second chamfered edges.
11. The lighting unit of Claim 7, wherein the connector includes at least two opposed resilient tabs configured for physically connecting the two substrates, and
20 wherein each of the two substrates includes an aperture that receives a respective tab.
12. The lighting unit of Claim 7, wherein the connector includes
an insulated clip having two spaced tabs on each end thereon that are received in respective apertures in the substrates; and
25 two spaced pins that are at least partially enclosed by the insulated clip and that electrically connect the two substrates.

13. The lighting unit of Claim 1, wherein the optoelectronic devices include light-emitting diodes.
14. The lighting unit of Claim 1, wherein the housing includes a slot that
5 receives the substrate therein.
15. The lighting unit of Claim 1, wherein the reflectors extend from opposing side walls of the housing.
- 10 16. The lighting unit of Claim 1, wherein the reflectors are disposed on opposite sides of the optoelectronic devices, and wherein each reflector forms an acute angle with the substrate.
- 15 17. The lighting unit of Claim 1, wherein at least some of the reflectors include a reflective surface that diffuses light emitted by the optoelectronic devices.
18. The lighting unit of Claim 1, wherein the reflectors each include a substantially curved reflective surface.
- 20 19. The lighting unit of Claim 1, wherein the reflectors each include a coated reflective surface.
20. The lighting unit of Claim 19, wherein the reflective surfaces have a white colored coating.

21. The lighting unit of Claim 1, wherein the housing is molded from a plastic material, and wherein the plastic material is selected to match the color of light emitted by the optoelectronic devices.

5 22. The lighting unit of Claim 1, wherein the output panel includes a diffuser that is removably coupled to the housing.

23. The lighting unit of Claim 22, wherein one of the output panel and the housing includes a hook portion and the other of the output panel and the housing
10 includes a slot portion engageable with the hook portion to couple the output panel and the housing.

24. The lighting unit of Claim 22, wherein the output panel is molded from a plastic material, and wherein the plastic material is selected to match the color of light
15 emitted by the optoelectronic devices.

25. The lighting unit of Claim 1, further comprising a mounting strip fixed to a support surface, wherein the housing is coupled to the mounting strip to secure the housing to the support surface.

20

26. The lighting unit of Claim 25, wherein one of the mounting strip and the housing includes a ball portion, and the other of the mounting strip and the housing includes a socket portion engageable with the ball portion to couple the mounting strip and the housing.

25

27. The lighting unit of Claim 25, wherein one of the mounting strip and the housing includes a substantially rigid tab, and the other of the mounting strip and the housing includes a resilient tab engageable with the substantially rigid tab to couple to mounting strip and the housing.

5

28. The lighting unit of Claim 1, further comprising:

a first power input for the first substrate, including

an input connector, and

first and second power wires each having an input end and an

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output end, the input ends of the first and second wires being electrically connected to the input connector and the output ends of the first and second wires being electrically connected to the first substrate; and

a power output adapted to provide power to a second substrate, including

third and fourth power wires each having an input end and an

15

output end, the input ends of the third and fourth wires connected in circuit to the input connector, and the output ends of the third and fourth wires electrically connected to an output connector.

29. The lighting unit of Claim 28, wherein the input connector is one of a mating male and a female connector, and wherein the output connector is the other of the male and female connector.

30. The lighting unit of Claim 28, wherein the second substrate is disposed in a distinct second lighting unit.

25

31. The lighting unit of Claim 28, wherein the input ends of the third and fourth wires are electrically connected to the output ends of the first and second wires.

32. The lighting unit of Claim 28, wherein the housing includes a recess that receives the third and fourth wires.

5 33. The lighting unit of Claim 1, wherein the substrate includes at least two buses that electrically connect the plurality of optoelectronic devices with a power source.

10 34. The lighting unit of Claim 33, further comprising:
a first wiring harness extending from a first end of the substrate and terminating with a first connector that is one of a male and female connector, the first wiring harness electrically connecting the plurality of optoelectronic devices with a power source; and
a second wiring harness extending from a second end of the substrate and terminating with a second connector that is the other of a male and female connector.

35. A lighting unit comprising:
an elongated first substrate including a plurality of optoelectronic devices
mounted thereon;
a first wiring harness extending from one end of the first substrate and
5 terminating with a first connector, the first wiring harness electrically connecting the
plurality of optoelectronic devices with a power source; and
a second wiring harness extending from the same end of the first substrate
as the first wiring harness and terminating with a second connector engageable with the
first connector, the second wiring harness being electrically connected with the power
10 source, the second wiring harness electrically connecting a second substrate to the power
source.

36. The lighting unit of Claim 35, wherein the first substrate is divided into
multiple sections.

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37. The lighting unit of Claim 36, wherein at least one section of the first
substrate is permanently removable from the first substrate to shorten the first substrate.

38. The lighting unit of Claim 37, wherein the at least one permanently
20 removable section is removed from an end of the first substrate opposite the end
electrically connected with the first and second wiring harnesses.

39. The lighting unit of Claim 36, wherein at least one each section includes at
least two optoelectronic devices and a resistor.

25

40. The lighting unit of Claim 35, further comprising a transient suppressor mounted to the first substrate and electrically connected with the plurality of optoelectronic devices.

5 41. The lighting unit of Claim 35, wherein the optoelectronic devices include light-emitting diodes.

42. The lighting unit of Claim 35, wherein the first substrate includes at least two buses, that electrically connect the plurality of optoelectronic devices with the power
10 source.

43. The lighting unit of Claim 42, wherein the first wiring harness is electrically connected to the buses at the one end of the first substrate, and wherein the first connector is electrically connected to the power source to provide power to the
15 plurality of optoelectronic devices.

44. The lighting unit of Claim 43, wherein the second wiring harness is electrically connected to the buses at the same end of the first substrate as the first wiring harness, and wherein the second connector is electrically connected to the first connector
20 of the second substrate.

45. The lighting unit of Claim 35, further comprising a housing supporting the first substrate, the housing being configured for diffusing light emitted by the optoelectronic devices.

25

46. The lighting unit of Claim 35, wherein the housing includes a recess that receives at least a portion of the second wiring harness.

47. A lighting assembly comprising:

a first lighting unit including

an elongated substrate having a plurality of optoelectronic devices
mounted thereon,

5 a first wiring harness having a first connector that is one of a male
and female connector, the first wiring harness being coupled to one end of the
substrate to electrically connect the plurality of optoelectronic devices with a
power source, and

a second wiring harness having a second connector that is the other
10 of a male and female connector, the second wiring harness being electrically
connected to the substrate to receive power from the power source; and

a second lighting unit, similar to the first lighting unit, positioned adjacent
the first lighting unit such that the second connector of the first lighting unit engages the
first connector of the second lighting unit to electrically connect the second wiring
15 harness of the first lighting unit with the first wiring harness of the second lighting unit.

48. The lighting assembly of Claim 47, wherein said second wiring harness is
connected to the same end of the substrate as the first wiring harness.

20 49. The lighting assembly of Claim 47, wherein the second wiring harness is
connected to the opposite end of the substrate as the first wiring harness.

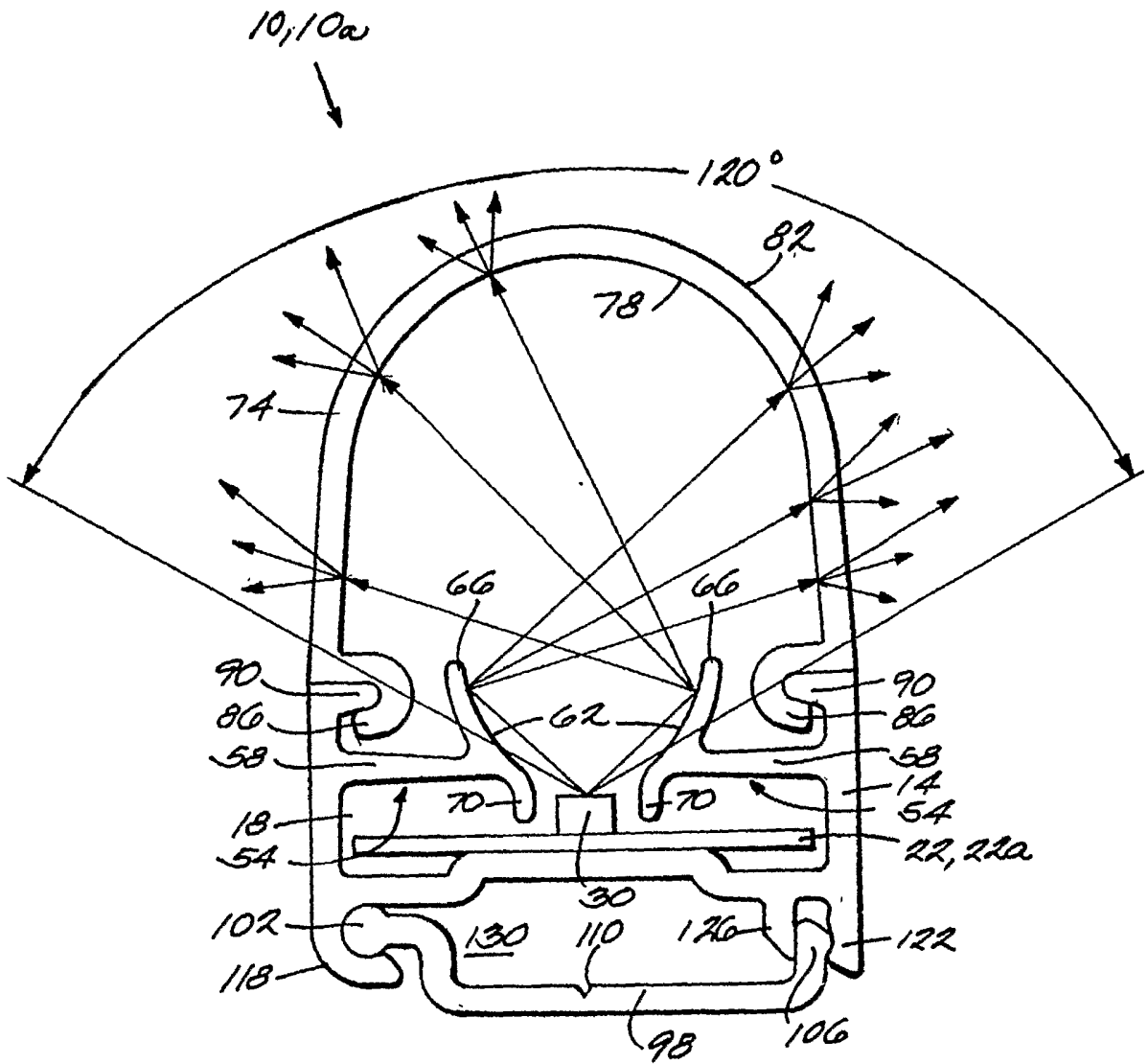


Fig. 1a

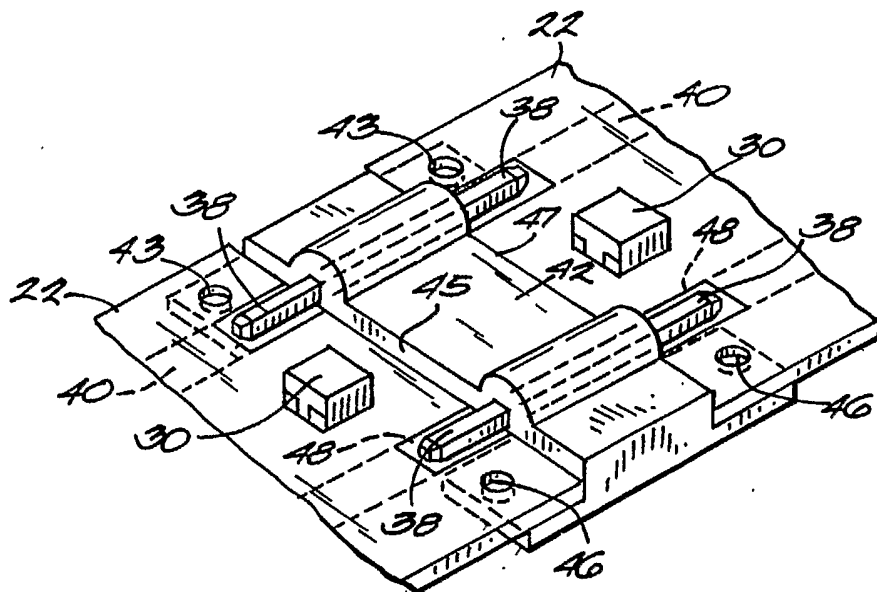


Fig. 21

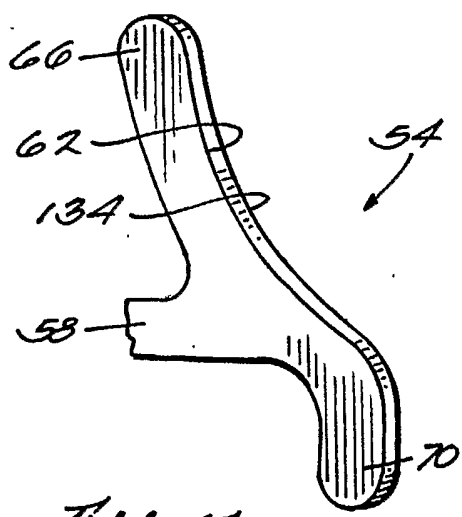


Fig. 22

