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CA 2937642 A1 2015/07/30

(21) **2 937 642**

(12) **DEMANDE DE BREVET CANADIEN**
CANADIAN PATENT APPLICATION

(13) **A1**

(86) **Date de dépôt PCT/PCT Filing Date:** 2015/01/16
(87) **Date publication PCT/PCT Publication Date:** 2015/07/30
(85) **Entrée phase nationale/National Entry:** 2016/07/21
(86) **N° demande PCT/PCT Application No.:** US 2015/011711
(87) **N° publication PCT/PCT Publication No.:** 2015/112437
(30) **Priorité/Priority:** 2014/01/22 (US61/930,170)

(51) **Cl.Int./Int.Cl.** ***H05B 37/02*** (2006.01)
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(54) **Titre : LAMPE A DIODES ELECTROLUMINESCENTES A ADRESSES**
(54) **Title: LED-BASED LIGHT WITH ADDRESSED LEDS**

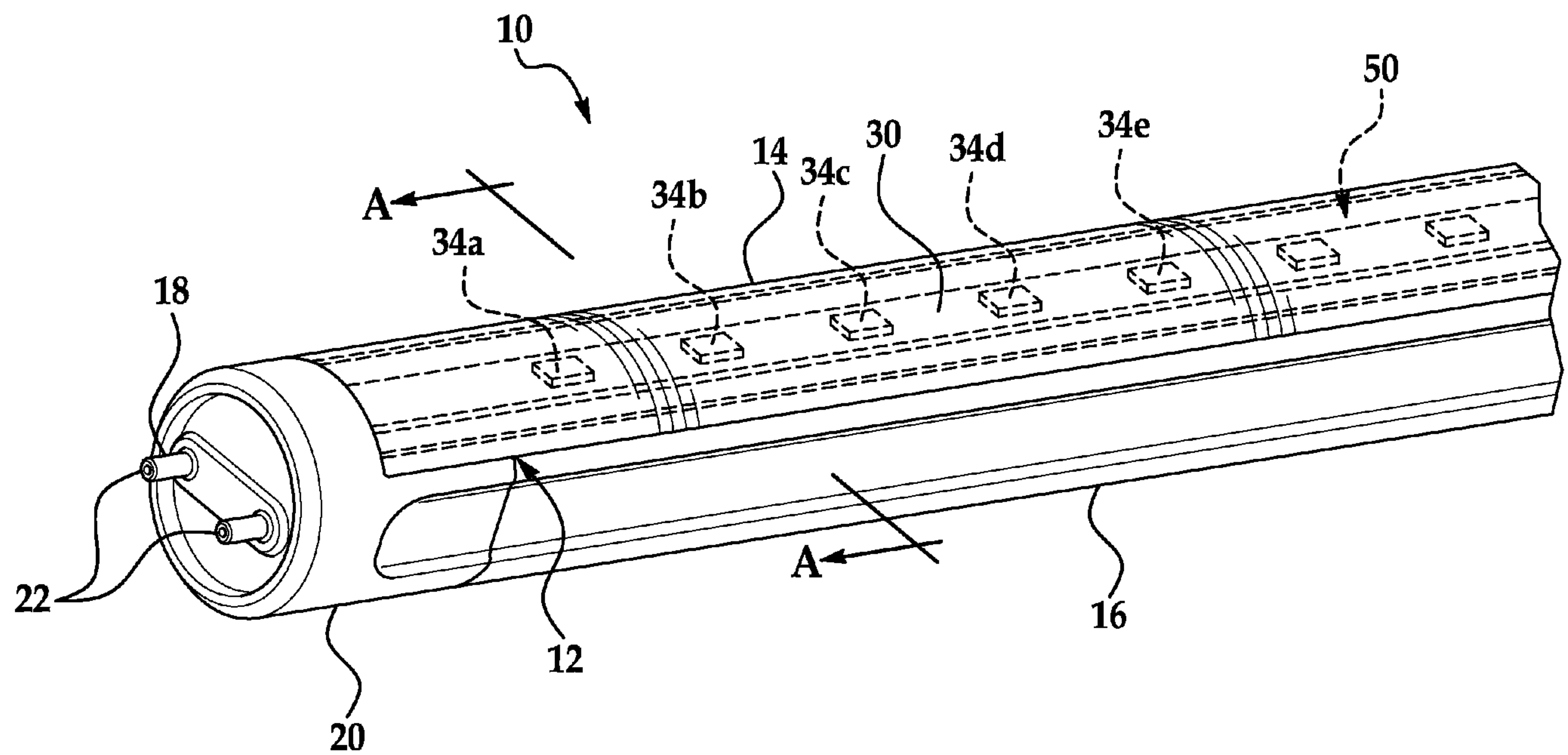

FIG. 1

(57) **Abrégé/Abstract:**
An LED-based replacement light comprises multiple LEDs, the LEDs having different logical control addresses associated among them, with each logical control address subjecting one or more of the LEDs associated therewith to individual control; a controller in communication with the LEDs, the controller configured to generate signals that individually control the operating states of the one or more LEDs associated with each logical control address; a housing for the LEDs; and a connector disposed at an end of the housing, the connector shaped for connection with a light socket.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
30 July 2015 (30.07.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/112437 A1

(51) International Patent Classification:
H05B 37/02 (2006.01)

(21) International Application Number:
PCT/US2015/011711

(22) International Filing Date:
16 January 2015 (16.01.2015)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/930,170 22 January 2014 (22.01.2014) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) **Title**: LED-BASED LIGHT WITH ADDRESSED LEDS

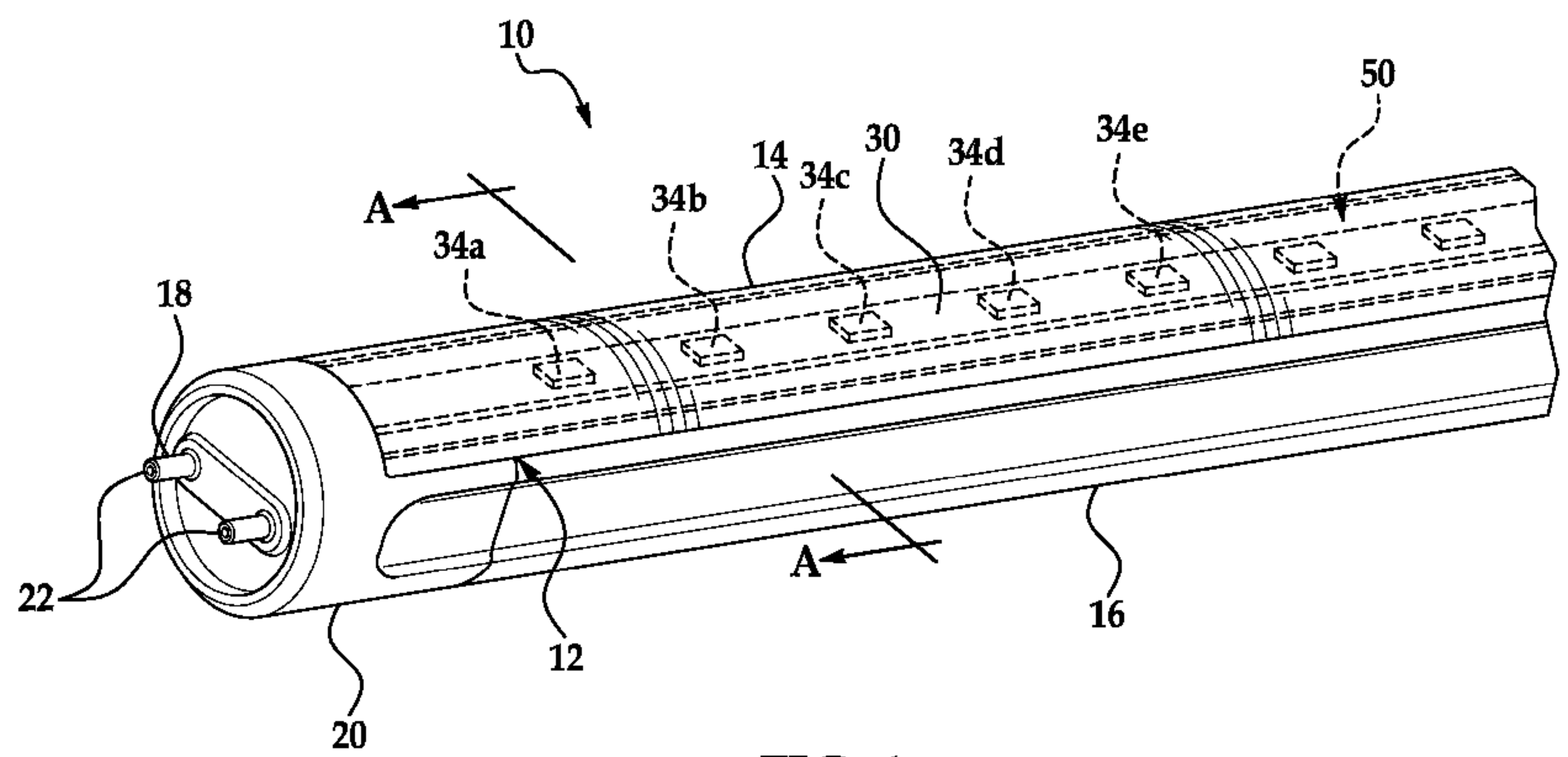

FIG. 1

(57) **Abstract**: An LED-based replacement light comprises multiple LEDs, the LEDs having different logical control addresses associated among them, with each logical control address subjecting one or more of the LEDs associated therewith to individual control; a controller in communication with the LEDs, the controller configured to generate signals that individually control the operating states of the one or more LEDs associated with each logical control address; a housing for the LEDs; and a connector disposed at an end of the housing, the connector shaped for connection with a light socket.

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LED-BASED LIGHT WITH ADDRESSED LEDS

TECHNICAL FIELD

[0001] The embodiments disclosed herein relate to a light emitting diode (LED)-based light for replacing a fluorescent light in a standard fluorescent light fixture.

BACKGROUND

[0002] Fluorescent lights are widely used in a variety of locations, such as schools and office buildings. Although conventional fluorescent lights 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 light.

[0003] LED-based lights designed as one-for-one replacements for fluorescent lights have appeared in recent years. These LED-based lights are often designed to achieve a general lighting outcome compatible with a variety of lighting fixtures and lighting applications. However, it may be desirable to design an LED-based light capable of generate multiple different lighting outcomes.

SUMMARY

[0004] Disclosed herein are embodiments of LED-based light and systems for controlling LED-based lights.

[0005] In one aspect, an LED-based replacement light includes multiple LEDs, a controller in communication with the LEDs, a housing for the LEDs and a connector. The LEDs have different logical control addresses associated among them, with each logical control address subjecting one or more of the LEDs associated therewith to individual control. The controller is configured to generate signals that individually control the operating states of the one or more LEDs associated with each logical control address. The connector is disposed at an end of the housing and is shaped for connection with a light socket.

[0006] In another aspect, an LED-based replacement light includes one or more first LEDs, one or more second LEDs, a housing for the first LEDs and the second LEDs and a connector. The first LEDs are associated with a first logical control address subjecting them to individual control, and have a first spatial distribution profile when controlled to an ON state. The second LEDs are associated with a second logical control address subjecting them to individual control, and are in optical communication with at least one optical device shaped to modify the light emanating therefrom when controlled to an ON state and achieve a second spatial distribution profile different from the first spatial distribution profile. The connector is disposed at an end of the housing, the connector shaped for connection with a light socket.

[0007] In yet another aspect, an LED-based replacement light includes an elongate circuit board, multiple LEDs mounted along the length of the circuit board, a controller in communication with the LEDs, an elongate housing for the circuit board and the LEDs and a pair of end caps disposed at opposing ends of the housing. The LEDs have different logical control addresses associated among them, with each logical control address subjecting one or more LEDs associated therewith to individual control. The controller is configured to generate signals that individually control of the operating states of the one or more LEDs associated with each logical control address. Each end cap includes a connector shaped for connection with a fluorescent light socket.

[0008] These and other aspects will be described in additional detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The various features, advantages and other uses of the present apparatus and systems will become more apparent by referring to the following detailed description and drawings in which:

[0010] FIG. 1 is a partial perspective view of an example of an LED-based light with individually addressed LEDs;

[0011] FIG. 2 is a perspective view of the LED-based light of FIG. 1;

[0012] FIG. 3 is a schematic block diagram depicting examples of architectures for controlling the operation of one or more of the LED-based lights of FIG. 1;

[0013] FIG. 4 is one representative example of the LED-based light where individually addressed LEDs are controlled to emit light at different intensities;

[0014] FIG. 5 is another representative example of the LED-based light where individually addressed LEDs are configured to emit light at different colors or color temperatures;

[0015] FIG. 6 is another representative example of the LED-based light where different optical structures are associated with respective of the individually addressed LEDs;

[0016] FIG. 7 is an end view of the LED-based light according to FIG. 6; and

[0017] FIG. 8 is a representative example of the LED-based light according to FIG. 6 where the individually addressed LEDs are controlled to emit light at different intensities.

DETAILED DESCRIPTION

[0018] This disclosure relates to LED-based lights with addressed LEDs. In the disclosed LED-based lights, the LEDs are assigned with different logical control addresses. In the example implementations, the operating state of the LEDs assigned with one logical control address can be controlled individually from the operating state of LEDs assigned with another logical control address. By controlling the operating states of the LEDs in different combinations, multiple lighting outcomes can be generated with the LED-based light to suite different lighting applications. Control over the LED-based light can be coordinated with the control of like LED-based lights to generate even more variety in possible lighting outcomes.

[0019] An example of an LED-based light 10 for replacing a conventional light in a standard light fixture is illustrated in FIGS. 1 and 2. As shown in FIGS. 1 and 2 and explained in greater detail below, the LED-based light includes a plurality of light producing LEDs 34. In the following description, the identifier "34" is used to reference one or more of the LEDs 34 generally, while a specific identifier (e.g., "34A") is used to reference a specific individual LED 34 or a specific group of LEDs 34 as needed to facilitate discussion. The LED-based light 10 includes a housing 12 and has a pair of end caps 20 positioned at the ends of the housing 12. An LED circuit board 30 including the LEDs 34 and a power supply circuit board 32 are arranged within the housing 12.

[0020] The housing 12 of the LED-based light 10 can generally define a single package sized for use in a standard fluorescent light fixture. In the illustrated example, the pair of end caps 20 is attached at opposing longitudinal ends of the housing 12 for physically connecting the LED-based light 10 to a light fixture. As shown, each end cap 20 carries an electrical connector 18 configured to physically connect to the light fixture. The electrical connectors 18 can be the sole physical connection between the LED-based light 10 and the light fixture. One example of a light fixture for the LED-based light 10 is a troffer designed to accept conventional fluorescent lights, such as T5, T8 or T12 fluorescent tube lights. These and other light fixtures for the LED-based light 10 can include one or more sockets adapted for physical engagement with the electrical connectors 18. Each of the illustrated electrical connectors 18 is a bi-pin connector including two pins 22. Bi-pin electrical connectors 18 are compatible with many fluorescent light fixtures and sockets, although other types of electrical connectors can be used, such as a single pin connector or a screw type connector.

[0021] The light fixture can connect to a power source, and at least one of the electrical connectors 18 can additionally electrically connect the LED-based light 10 to the light fixture to provide power to the LED-based light 10. In this example, each electrical connector 18 can include two pins 22, although two of the total four pins can be "dummy pins" that provide physical but not electrical connection to the light fixture. The light fixture can optionally include a ballast for electrically connecting between the power source and the LED-based light 10.

[0022] While the illustrated housing 12 is cylindrical, a housing having a square, triangular, polygonal, or other cross sectional shape can alternatively be used. Similarly, while the illustrated housing 12 is linear, housings having an alternative shape, e.g., a U-shape or a circular shape can alternatively be used. The LED-based light 10 can have any suitable length. For example, the LED-based light 10 may be approximately 48" long, and the housing 12 can have a 0.625", 1.0" or 1.5" diameter for engagement with a standard fluorescent light fixture.

[0023] The housing 12 can be formed by attaching multiple individual parts, not all of which need be light transmitting. For example, illustrated example of the housing 12 is formed in part by attaching a lens 14 at least partially defining the housing 12 to an opaque lower portion 16. The illustrated housing 12 has a generally bipartite configuration defining a first cavity 50 between the lower portion 16 and the lens 14 sized and shaped for housing the LED circuit board 30 and a second cavity 60 defined by the lower portion 16 sized and shaped for housing the power supply circuit board 32.

[0024] As shown, the lower portion 16 defines an LED mounting surface 52 for supporting the LED circuit board 30. The LED mounting surface 52 can be substantially flat, so as to support a flat underside of the LED circuit board 30 opposite the LEDs 34. After attachment of the lens 14 to the lower portion 16 during assembly of the LED-based light 10, the LED circuit board 30 is positioned within the first cavity 50 and adjacent the lens 14, such that the LEDs 34 of the LED circuit board 30 are oriented to illuminate the lens 14.

[0025] The illustrated lower portion 16 has a tubular construction to define the second cavity 60, although the lower portion 16 could be otherwise configured to define a cavity configured for housing the power supply circuit board 32. The LED-based light 10 can include features for supporting the power supply circuit board 32 within the second cavity 60. For example, as shown, an end cap 20 may include channels 62 configured to slidably receive outboard portions of an end 32a of the power supply circuit board 32. It will be understood that the channels 62 are provided as a non-limiting example and that the power supply circuit board 32 may be otherwise and/or additionally supported within the second cavity 60.

[0026] The lower portion 16 may be constructed from a thermally conductive material and configured as a heat sink to enhance dissipation of heat generated by the LEDs 34 during operation to an ambient environment surrounding the LED-based light 10. In the exemplary LED-based light 10, an LED mounting surface 52 of the lower portion 16 is thermally coupled to the LEDs 34 through the LED circuit board 30, and the remainder of the lower portion 16 defines a heat transfer path from the LED mounting surface 52 to the ambient environment.

[0027] The lower portion 16 and the lens 14 may each include complementary structures permitting for attachment of the lens 14 to the lower portion 16 to define the first cavity 50. For example, as shown, the lower portion 16 may include a pair of hooked projections 54 for retaining a corresponding pair of projections 56 of the lens 14. The projections 56 of the lens 14 can be slidably engaged with the hooked projections 54 of the lower portion 16, or can be snap fit to the hooked projections 54. The hooked projections 54 can be formed integrally with the lower portion 16 by, for example, extruding the lower portion 16 to include the hooked projections 54. Similarly, the projections 56 can be formed integrally with the lens 14 by, for example, extruding the lens 14 to include the projections 56. The hooked projections 54 and projections 56 can extend the longitudinal lengths of the lower portion 16 and the lens 14, respectively, although a number of discrete hooked projections 54 and/or projections 56 could be used to couple the lens 14 to the lower portion 16. Alternatively, the lower portion 16 could be otherwise configured for attachment with the lens 14. For example, the lens 14 could be clipped, adhered, snap- or friction-fit, screwed or otherwise attached to the lower portion 16.

[0028] Alternatively to the illustrated housing 12, the housing 12 can include a light transmitting tube at least partially defined by the lens 14. The lens 14 can be made from polycarbonate, acrylic, glass or other light transmitting material (i.e., the lens 14 can be transparent or translucent). The term “lens” as used herein means a light transmitting structure, and not necessarily a structure for concentrating or diverging light.

[0029] The LED-based light 10 can include features for distributing the light produced by the LEDs 34 to, for example, emulate in full or in part the uniform light distribution of a conventional fluorescent light. For instance, the lens 14 can be manufactured to include light diffusing structures, such as ridges, dots, bumps, dimples or other uneven surfaces formed on an interior or exterior of the lens 14. The light diffusing structures can be formed integrally with the lens 14, for example, by molding or extruding, or the structures can be formed in a separate manufacturing step such as surface roughening. Alternatively, the material from which the lens 14 is formed can include light refracting particles. For example, the lens 14 can be made from a composite, such as polycarbonate, with particles of a light refracting material interspersed in the polycarbonate. In addition to or as an alternative to these light diffusing structures, a light diffusing film can be applied to the exterior of the lens 14 or placed in the housing 12.

[0030] The LED-based light 10 can include other features for distributing light produced by the LEDs 34. For example, the lens 14 can be manufactured with structures to collimate light produced by the LEDs 34. The light collimating structures can be formed integrally with the lens 14, for example, or can be formed in a separate manufacturing step. In addition to or as an alternative to manufacturing the lens 14 to include light collimating structures, a light collimating film can be applied to the exterior of the lens 14 or placed in the housing 12.

[0031] In yet other embodiments, the LEDs 34 can be over molded or otherwise encapsulated with light transmitting material configured to distribute light produced by the LEDs 34. For example, the light transmitting material can be configured to diffuse, refract, collimate and/or otherwise distribute the light produced by the LEDs 34. The over molded LEDs 34 can be used alone to achieve a desired light distribution for the LED-based light 10, or can be implemented in combination with the lens 14 and/or films described above.

[0032] The above described or other light distributing features can be implemented uniformly or non-uniformly along a length and/or circumference of the LED-based light 10. These features are provided as non-limiting examples, and in other embodiments, the LED-based light 10 may not include any light distributing features.

[0033] The LED circuit board 30 can include at least one LED 34, a plurality of series-connected or parallel-connected LEDs 34, an array of LEDs 34 or any other arrangement of LEDs 34. Each of the illustrated LEDs 34 can include a single diode or multiple diodes, such as a package of diodes producing light that appears to an ordinary observer as coming from a single source. The LEDs 34 can be surface-mount devices of a type available from Nichia, although other types of LEDs can alternatively be used. For example, the LED-based light 10 can include high-brightness semiconductor LEDs, organic light emitting diodes (OLEDs), semiconductor dies that produce light in response to current, light emitting polymers, electro-luminescent strips (EL) or the like. The LEDs 34 can emit white light. However, LEDs that emit blue light, ultra-violet light or other wavelengths of light can be used in place of or in combination with white light emitting LEDs 34.

[0034] The orientation, number and spacing of the LEDs 34 can be a function of a length of the LED-based light 10, a desired lumen output of the LED-based light 10, the wattage of the LEDs 34, a desired light distribution for the LED-based light 10 and/or the viewing angle of the LEDs 34.

[0035] The LEDs 34 can be fixedly or variably oriented in the LED-based light 10 for facing or partially facing an environment to be illuminated when the LED-based light 10 is installed in a light fixture. Alternatively, the LEDs 34 can be oriented to partially or fully face away from the environment to be illuminated. In this alternative example, the LED-based light 10 and/or a light fixture for the LED-based light 10 may include features for reflecting or otherwise redirecting the light produced by the LEDs into the environment to be illuminated.

[0036] For a 48" LED-based light 10, the number of LEDs 34 may vary from about thirty to three hundred such that the LED-based light 10 outputs between 1,500 and 3,000 lumens. However, a different number of LEDs 34 can alternatively be used, and the LED-based light 10 can output any other amount of lumens.

[0037] The LEDs 34 can be arranged in a single longitudinally extending row along a central portion of the LED circuit board 30 as shown, or can be arranged in a plurality of rows or arranged in groups. The LEDs 34 can be spaced along the LED circuit board 30 and arranged on the LED circuit board 30 to substantially fill a space along a length of the lens 14 between end caps 20 positioned at opposing longitudinal ends of the housing 12. The spacing of the LEDs 34 can be determined based on, for example, the light distribution of each LED 34 and the number of LEDs 34. The spacing of the LEDs 34 can be chosen so that light output by the LEDs 34 is uniform or non-uniform along a length of the lens 14. In one implementation, one or more additional LEDs 34 can be located at one or both ends of the

LED-based light 10 so that an intensity of light output at the lens 14 is relatively greater at the one or more ends of the LED-based light 10. Alternatively, or in addition to spacing the LEDs 34 as described above, the LEDs 34 nearer one or both ends of the LED-based light 10 can be configured to output relatively more light than the other LEDs 34. For instance, LEDs 34 nearer one or both ends of the LED-based light 10 can have a higher light output capacity and/or can be provided with more power during operation.

[0038] The LED-based light 10 may be configured for permitting individual control over the operating states of the LEDs 34. For example, different LEDs 34 of the LED-based light 10 may be assigned with different respective logical control addresses. According to a non-limiting example indicated in FIG. 1, for instance, different logical control addresses may be assigned among the LEDs 34A, B, C, D, E, etc. With the LEDs 34 of the LED-based light 10 assigned with different logical control addresses, individual control can be exercised over the operating states of those of the LEDs 34 assigned with a respective logical control address.

[0039] In the examples that follow, each of the LEDs 34 of the LED-based light 10 is assigned with a logical control address. However, it will be understood that, consistently with these examples, some of the LEDs 34 of the LED-based light 10 need not be assigned with a logical control address. Such LEDs 34, if any, may be controlled in a conventional manner.

[0040] According to one non-limiting example of the LED-based light 10, each of the LEDs 34A, 34B, 34C, 34D, 34E, etc. of the LED-based light 10 may be assigned with a respective logical control address. In other examples of the LED-based light 10, one, some or all of the different logical control addresses could be assigned to a group of multiple of the LEDs 34. For example, some of the LEDs 34 may be grouped for assignment with a single logical control address according to the location of the LEDs 34 with respect to one another or with respect to the LED-based light 10, differences between the configurations of the LEDs 34, or both. For instance, one or more groups of LEDs 34 assigned with respective logical control addresses can correspond to zones of the LED-based light 10 and/or to sequential patterns within the LEDs 34 of the LED-based light 10. Moreover, one or more groups of LEDs 34 assigned with respective logical control addresses can additionally or alternatively correspond to the properties of the light emitted from the LEDs 34 or of the light emanating from the LED-based light 10 upon operation of the LEDs 34. In these or other examples of the LED-based light 10, a group of LEDs 34 assigned with a logical control address may, for instance, be or include two or more adjacent or non-adjacent LEDs 34.

[0041] The power supply circuit board 32 can be positioned within the housing 12 adjacent the electrical connector 18. The power supply circuit board 32 can also be positioned in other suitable locations (e.g., external to the LED-based light 10, within one or both of the end caps 20, etc.). The power supply circuit board 32 has power supply circuitry configured to condition an input power received from, for example, the light fixture through the electrical connector 18, to a power usable by and suitable for the LEDs 34. In some implementations, the power supply circuit board 32 can include one or more of an inrush protection circuit, a surge suppressor circuit, a noise filter circuit, a rectifier circuit, a main filter circuit, a current regulator circuit and a shunt voltage regulator circuit. The power supply circuit board 32 can be suitably designed to receive a wide range of currents and/or voltages from a power source and convert them to a power usable by the LEDs 34.

[0042] The LED-based light 10 may require a number of electrical connections to convey power between the various illustrated spatially distributed electrical assemblies included in the LED-based light 10, such as the LED circuit board 30, the power supply circuit board 32 and the electrical connector 18. These connections can be made using a circuit connector header 40 and a pin connector header 42, as shown in FIG. 2. In particular, when the LED-based light 10 is assembled, the circuit connector header 40 may be arranged to electrically couple the LED circuit board 30 to the power supply circuit board 32, and the pin connector header 42 may be arranged to electrically couple the power supply circuit board 32 to the pins 22 of an end cap 20.

[0043] As shown, the LED circuit board 30 and the power supply circuit board 32 are vertically opposed and spaced with respect to one another within the housing 12. The LED circuit board 30 and the power supply circuit board 32 can extend a length or a partial length of the housing 12, and the LED circuit board 30 can have a length different from a length of the power supply circuit board 32. For example, the LED circuit board 30 can generally extend a substantial length of the housing 12, and the power supply circuit board 32 can extend a partial length of the housing. However, it will be understood that the LED circuit board 30 and/or the power supply circuit board 32 could be alternatively arranged within the housing 12, and that the LED circuit board 30 and the power supply circuit board 32 could be alternatively spaced and/or sized with respect to one another.

[0044] The LED circuit board 30 and the power supply circuit board 32 are illustrated as elongate printed circuit boards. Multiple circuit board sections can be joined by bridge connectors to create the LED circuit board 30 and/or power supply circuit board 32. Also, other types of circuit boards may be used, such as a metal core circuit board. Further, the components of the LED circuit board 30 and the power supply circuit board 32 could be in a single circuit board or more than two circuit boards.

[0045] In the LED-based light 10, the operating states of the LEDs 34 assigned with each logical control address can be controlled individually from the operating states of the LEDs 34 assigned with other logical control addresses. For example, each of the one or more LEDs 34 assigned with a given logical control address can be selectively driven to an OFF state, where the LEDs 34 do not emit light, or to an ON state. The LEDs 34 may be driven in the ON state to emit light at a full operational intensity, for example. The full operational intensity of light can correspond to the absolute light output capacity for the LEDs 34, for instance, or to the light output capacity for the LEDs 34 under nominal operating conditions. Optionally, in the ON state, the LEDs 34 may be driven to emit light at one or more intermediate intensities. The LEDs 34 according to these examples may also, for example, be intermittently driven between an OFF state and an ON state.

[0046] One or more controllers may be provided in communication with the LEDs 34 for controlling the operating states of the LEDs 34 assigned with each logical control address. As shown in FIG. 3, for instance, the LED-based light 10 may include a controller 100 in communication with the LEDs 34A, 34B, 34C, 34D, 34E, etc. In one implementation of the LED-based light 10, the controller 100 may be configured to generate respective control signals for controlling the operating states of the LEDs 34 assigned with each logical control address. In an alternative implementation including multiple of the LED-based lights 10, respective controllers 100 may act as slaves to a central controller 150 configured to generate control signals to coordinate the operations of the LED-based lights 10.

[0047] The ability to control the operating states of the LEDs 34 assigned with a logical control address individually from the operating states of the LEDs 34 assigned with other logical control addresses creates the opportunity to generate a variety of different lighting outcomes with the LED-based light 10. Differences between lighting outcomes can be defined, for example, with respect to the spatial, spectral and/or temporal aspects of the light emanating from the LED-based light 10 upon operation of the LEDs 34. Differences between lighting outcomes can be generated with examples of the LED-based light 10 where each of the LEDs 34 are similarly configured, or where there are variations among the configurations of the LEDs 34. Optionally, in furtherance of creating the opportunity to generate a variety of different lighting outcomes, the LED-based light 10 may incorporate optical structures to alter the properties of the light emitted from one, some or all of the LEDs 34, or of the light emanating from the LED-based light 10 upon operation of the LEDs 34.

[0048] FIGS. 4-8 depict specific non-limiting examples of LED-based lights 10 configured, implemented and/or controlled according to the foregoing general description.

[0049] In some example implementations of the LED-based light 10, differences between lighting outcomes can be generated in whole or in part through the selective and individual control over the intensity of light emitted from the LEDs 34.

[0050] The LEDs 34, for example, may be selectively driven to vary the intensity of light emanating along the length of the LED-based light 10. For instance, the LEDs 34 along one half of the LED-based light 10 could be driven in an ON state to emit light, and the LEDs 34 along the other half of the LED-based light 10 could be driven in an OFF state, resulting in light being emanating from only half of the LED-based light 10.

[0051] The LEDs 34 may also, for instance, be selectively driven to generate different gradients of light emanating from the LED-based light 10 upon operation of the LEDs 34. In the example according to FIG. 4, each of the LEDs 34 is driven in an ON state to emit light, with the LEDs 34 nearer the ends of the LED-based light 10 (only one end is shown) emitting light at a relatively higher intensity than the remaining LEDs 34 toward a center of the LED-based light 10. As shown, a resulting gradient of light 200 emanating from the LED-based light 10 is generally dog boned shaped in a plane including the axes of the LEDs 34. The dog bone shaped gradient of light 200 could be useful, for instance, in a lighting application where the LED-based light 10 is installed across an aisle and it is desirable not only to illuminate the aisle generally but also to wash the walls of the aisle with light. In other implementations, multiple LED-based lights 10 could be installed across a larger aisle, and the operations of the multiple of the LED-based lights 10 could be coordinated to generate the dog bone shaped gradient of light 200. This implementation could be useful, for instance, in a parking garage in order to provide relatively more light along the sides of the aisles above parked cars, and relatively less light along a main passageway receiving light from the headlamps of passing cars. Although the dog bone shaped gradient of light 200 is depicted and described in accordance with certain non-limiting examples, it will be understood that other implementations of one or more LED-based lights 10 could be used, and other control schemes could be applied, to support the generation of many other lighting outcomes exhibiting alternative gradients of light.

[0052] In some example implementations of the LED-based light 10, differences between lighting outcomes can be generated in whole or in part by exploiting variations among the configurations of the LEDs 34. Where the LED-based light 10 includes LEDs 34 with different configurations, it will be understood that multiple LEDs 34 with a common configuration could be assigned with respective logical control addresses, for example, or could be grouped for assignment with a single logical control address.

[0053] The LED-based light 10 of FIG. 5 includes one or more LEDs 34A, one or more LEDs 34B and one or more LEDs 34C, which as generally indicated are each configured to emit light with different properties. The differences among the properties could correspond to the color, the color temperature and/or any other properties of the emitted light. Where the differences among the properties corresponds in whole or in part to the color of the emitted light, it will be understood that the LEDs 34 could emit light of a same general color but at different respective hues (e.g., the LEDs 34A, 34B and LEDs 34C could emit different hues of white light).

[0054] In the example of the LED-based light 10 of FIG. 5, the LEDs 34A, 34B and 34C may be selectively driven to vary the color or the color temperature, for example, of the light emanating from the LED-based light 10. For instance, in one example implementation, one of the LEDs 34A, 34B or 34C may be selectively driven in an ON state to emit light, with the others of the LEDs 34A, 34B and 34C driven in an OFF state, to generate a lighting outcome where the LED-based light 10 emanates light according the properties of the LEDs 34A, 34B or 34C driven in an ON state. In other example implementations, any combination of the LEDs 34A, 34B and 34C may be selectively driven in an ON state to emit light to support the generation of many other lighting outcomes exhibiting different colors, color temperatures and/or other properties with respect to the light emanating from the LED-based light 10.

[0055] In some example implementations of the LED-based light 10, differences between lighting outcomes can be generated in whole or in part by outfitting the LED-based light 10 with optical structures to alter the properties of the light emitted from one, some or all of the LEDs 34, or of the light emanating from the LED-based light 10.

[0056] For instance, as shown in FIGS. 6 and 7, the LED-based light 10 may include optical structures 210A associated with one or more LEDs 34A and optical structures 210B associated with one or more LEDs 34B. Optionally, one or more LEDs 34C can operate without an optical structure altering the properties of the light emitted from the LEDs 34C. As generally indicated, the optical structures 210A are configured to direct light emitted from respective LEDs 34A in a first direction to the side of the LED-based light 10, while the optical structures 210B are configured to direct light emitted from respective LEDs 34B in a second direction to an opposing side of the LED-based light 10. Although the description follows with general reference to alteration of the spatial aspects of the light emitted from the LEDs 34A and 34B, it will be understood that the optical structures 210A and 210B could be additionally configured to modify, for instance, the spectral aspects of the emitted light.

[0057] As shown, each of the optical structures 210A and 210B is over-molded onto respective LEDs 34A and 34B, although the optical structures 210A and 210B could be otherwise arranged within the LED-based light 10, either as standalone structures or incorporated into another structure of the LED-based light 10, such as the lens 12. In a non-limiting example, each of the optical structures 210A and 210B could be, or include, a lens, for instance. In another non-limiting example, each of the optical structures 210A and 210B could be, or include, a light pipe, for instance. According to these or other examples, an optical structure 210A or 210B could alternatively be associated with more than one respective LED 34A or 34B. It will be understood that multiple LEDs 34 associated with a common type of optical structure, or multiple LEDS 34 not associated with an optical structure, could be assigned with respective logical control addresses, for example, or could be grouped for assignment with a single logical control address.

[0058] In example implementations of the LED-based light 10 according to FIGS. 6 and 7, one or more of the LEDs 34A, 34B and 34C may be selectively driven in an ON state to emit light to generate lighting outcomes where the LED-based light 10 emanates light in on or more of the first direction to one side of the LED-based light 10, the second direction to an opposing side of the LED-based light 10 or radially from the LED-based light 10. The ability to selectively drive the LEDs 34A and/or LEDs 34B could be useful, for instance, in a lighting application where the LED-based light 10 is installed in a cove or other structure to wash a wall to the side of the LED-based light 10 with light.

[0059] It will be understood that the principles described with reference to the foregoing example implementations of the LED-based light 10 are not mutually exclusive. That is, an LED-based light 10 may embody any combination of variations among the configurations of the LEDs 34, optical structures to alter the properties of the light emitted from one, some or all of the LEDs 34, the ability to selectively and individually control the intensity of light emitted from the LEDs 34, and other features supporting the generation of a variety of different lighting outcomes.

[0060] FIG. 8, for instance, depicts an implementation of the LED-based light 10 according to FIGS. 6 and 7 where the LEDs 34A and 34B, and optionally the LEDs 34C, are selectively driven in an ON state to emit light, and where in addition, the LEDs 34 nearer the ends of the LED-based light 10 (only one end is shown) are driven to emit light at a relatively higher intensity than the remaining LEDs 34 toward a center of the LED-based light 10. As shown, a resulting gradient of light 220 emanating from the LED-based light 10 is generally dog boned shaped in a plane normal to axes of the LEDs 34.

[0061] The following are examples of embodiments disclosed herein. In one embodiment, an LED-based replacement light, comprises: multiple LEDs, the LEDs having different logical control addresses associated among them, with each logical control address subjecting one or more of the LEDs associated therewith to individual control; a controller in communication with the LEDs, the controller configured to generate signals that individually control the operating states of the one or more LEDs associated with each logical control address; a housing for the LEDs; and a connector disposed at an end of the housing, the connector shaped for connection with a light socket.

[0062] In one aspect of this embodiment, the generated signals individually control of the operating states of the one or more LEDs associated with each logical control address in multiple combinations, each combination resulting in a different lighting outcome for the LED-based light.

[0063] In another aspect of this embodiment, the generated signals individually control of the one or more LEDs associated with each logical control address to one of an OFF state or an ON state.

[0064] In another aspect of this embodiment, the generated signals individually control of the one or more LEDs associated with each logical control address to one of an OFF state or one of a plurality of intensities in an ON state.

[0065] In another aspect of this embodiment, each of the multiple LEDs is configured to emit the same color of light when controlled to an ON state.

[0066] In another aspect of this embodiment, the multiple LEDs include: one or more first LEDs associated with a first logical control address and configured to emit light of a first color when controlled to an ON state, and one or more second LEDs associated with a second logical control address and configured to emit light of a second color different from the first color when controlled to an ON state.

[0067] In another aspect of this embodiment, the multiple LEDs include: one or more first LEDs associated with a first logical control address and configured to emit light of a first color temperature when controlled to an ON state, and one or more second LEDs associated with a second logical control address and configured to emit light of a second color temperature different from the first color temperature when controlled to an ON state.

[0068] In another aspect of this embodiment, the multiple LEDs include: one or more first LEDs associated with a first logical control address and having a first spatial distribution profile when controlled to an ON state, and one or more second LEDs associated with a second logical control address and in optical communication with at least one optical device shaped to modify the light emanating from the second LEDs when controlled to an ON state and achieve a second spatial distribution profile different from the first spatial distribution profile.

[0069] In another embodiment, an LED-based replacement light, comprises: one or more first LEDs, the first LEDs associated with a first logical control address subjecting them to individual control, and having a first spatial distribution profile when controlled to an ON state; one or more second LEDs, the second LEDs associated with a second logical control address subjecting them to individual control, and in optical communication with at least one optical device shaped to modify the light emanating therefrom when controlled to an ON state and achieve a second spatial distribution profile different from the first spatial distribution profile; a housing for the first LEDs and the second LEDs; and a connector disposed at an end of the housing, the connector shaped for connection with a light socket.

[0070] In one aspect of this embodiment, the LED-based light further comprises: a controller in communication with the first LEDs and the second LEDs, the controller configured to generate signals that control of the first LEDs to an ON state and the second LEDs to an OFF state to achieve the first spatial distribution profile.

[0071] In another aspect of this embodiment, the LED-based light further compries: a controller in communication with the first LEDs and the second LEDs, the controller configured to generate signals that control of the first LEDs to an OFF state and the second LEDs to an ON state to achieve the second spatial distribution profile.

[0072] In another aspect of this embodiment, the first spatial distribution profile is centered on an axis, and the second spatial distribution profile is off-center from the axis.

[0073] In another aspect of this embodiment, the at least one optical device is at least one over mold for the second LEDs.

[0074] In another aspect of this embodiment, the at least one optical device is included in a lens defined by the housing and opposing the second LEDs.

[0075] In another aspect of this embodiment, the first LEDs are in optical communication with at least one optical device shaped to modify the light emanating therefrom when controlled to an ON state and achieve the first spatial distribution profile.

[0076] In another aspect of this embodiment, the first LEDs and the second LEDs are configured to emit the same color of light when controlled to an ON state.

[0077] In another embodiment, an LED-based replacement light, comprises: an elongate circuit board; multiple LEDs mounted along the length of the circuit board, the LEDs having different logical control addresses associated among them, with each logical control address subjecting one or more LEDs associated therewith to individual control; a controller in communication with the LEDs, the controller configured to generate signals that individually control of the operating states of the one or more LEDs associated with each logical control address; an elongate housing for the circuit board and the LEDs; and a pair of end caps disposed at opposing ends of the housing, each including a connector shaped for connection with a fluorescent light socket.

[0078] In another aspect of this embodiment, the controller is configured to generate signals that individually control of the operating states of the one or more LEDs associated with each logical control address in multiple combinations, each combination resulting in a different lighting gradient from the LED-based light in a plane parallel to the axes of the one or more LEDs.

[0079] In another aspect of this embodiment, the multiple LEDs include one or more first LEDs associated with a first logical control address and positioned toward the middle of the LED-based light in a direction of its length, and one or more second LEDs associated with a second logical control address and positioned toward one or both of the ends of LED-based light in the direction of its length; and the controller is configured to generate signals that control of the first LEDs to an ON state at a first intensity and the second LEDs to an ON state at a second intensity higher than the first intensity, resulting in at least a partial dog-boned shaped lighting gradient from the LED-based light in a plane normal to the circuit board.

[0080] In another aspect of this embodiment, the multiple LEDs include one or more first LEDs associated with a first logical control address and having a first spatial distribution profile when controlled to an ON state, and one or more second LEDs associated with a second logical control address and in optical communication with at least one optical device shaped to modify the light emanating from the second LEDs when controlled to an ON state and achieve a second spatial distribution profile different from the first spatial distribution profile; and the controller is configured to generate signals that control of the first LEDs to an ON state and the second LEDs to an OFF state to achieve the first spatial distribution profile, or, to generate signals that control of the first LEDs to an OFF state and the second LEDs to an ON state to achieve the second spatial distribution profile.

[0081] While recited characteristics and conditions of the invention have been described in connection with certain embodiments, it is to be understood that the invention is not to be limited to the disclosed embodiments but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims, which scope is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures as is permitted under the law.1.

What is claimed is:

1. An LED-based replacement light, comprising:

multiple LEDs, the LEDs having different logical control addresses associated among them, with each logical control address subjecting one or more of the LEDs associated therewith to individual control;

a controller in communication with the LEDs, the controller configured to generate signals that individually control the operating states of the one or more LEDs associated with each logical control address;

a housing for the LEDs; and

a connector disposed at an end of the housing, the connector shaped for connection with a light socket.

2. The LED-based light of claim 1, wherein the generated signals individually control of the operating states of the one or more LEDs associated with each logical control address in multiple combinations, each combination resulting in a different lighting outcome for the LED-based light.

3. The LED-based light of claim 1, wherein the generated signals individually control of the one or more LEDs associated with each logical control address to one of an OFF state or an ON state.

4. The LED-based light of claim 1, wherein the generated signals individually control of the one or more LEDs associated with each logical control address to one of an OFF state or one of a plurality of intensities in an ON state.

5. The LED-based light of claim 1, wherein each of the multiple LEDs is configured to emit the same color of light when controlled to an ON state.

6. The LED-based light of claim 1, wherein the multiple LEDs include:

one or more first LEDs associated with a first logical control address and configured to emit light of a first color when controlled to an ON state, and

one or more second LEDs associated with a second logical control address and configured to emit light of a second color different from the first color when controlled to an ON state.

7. The LED-based light of claim 1, wherein the multiple LEDs include:

one or more first LEDs associated with a first logical control address and configured to emit light of a first color temperature when controlled to an ON state, and

one or more second LEDs associated with a second logical control address and configured to emit light of a second color temperature different from the first color temperature when controlled to an ON state.

8. The LED-based light of claim 1, wherein the multiple LEDs include:

one or more first LEDs associated with a first logical control address and having a first spatial distribution profile when controlled to an ON state, and

one or more second LEDs associated with a second logical control address and in optical communication with at least one optical device shaped to modify the light emanating from the second LEDs when controlled to an ON state and achieve a second spatial distribution profile different from the first spatial distribution profile.

9. An LED-based replacement light, comprising:

one or more first LEDs, the first LEDs associated with a first logical control address subjecting them to individual control, and having a first spatial distribution profile when controlled to an ON state;

one or more second LEDs, the second LEDs associated with a second logical control address subjecting them to individual control, and in optical communication with at least one optical device shaped to modify the light emanating therefrom when controlled to an ON state and achieve a second spatial distribution profile different from the first spatial distribution profile;

a housing for the first LEDs and the second LEDs; and

a connector disposed at an end of the housing, the connector shaped for connection with a light socket.

10. The LED-based light of claim 9, further comprising:

a controller in communication with the first LEDs and the second LEDs, the controller configured to generate signals that control of the first LEDs to an ON state and the second LEDs to an OFF state to achieve the first spatial distribution profile.

11. The LED-based light of claim 9, further comprising:

a controller in communication with the first LEDs and the second LEDs, the controller configured to generate signals that control of the first LEDs to an OFF state and the second LEDs to an ON state to achieve the second spatial distribution profile.

12. The LED-based light of claim 9, wherein the first spatial distribution

profile is centered on an axis, and the second spatial distribution profile is off-center from the axis.

13. The LED-based light of claim 9, wherein the at least one optical device is at least one over mold for the second LEDs.

14. The LED-based light of claim 9, wherein the at least one optical device is included in a lens defined by the housing and opposing the second LEDs.

15. The LED-based light of claim 9, wherein the first LEDs are in optical communication with at least one optical device shaped to modify the light emanating therefrom when controlled to an ON state and achieve the first spatial distribution profile.

16. The LED-based light of claim 9, wherein the first LEDs and the second LEDs are configured to emit the same color of light when controlled to an ON state.

17. An LED-based replacement light, comprising:

an elongate circuit board;

multiple LEDs mounted along the length of the circuit board, the LEDs having different logical control addresses associated among them, with each logical control address subjecting one or more LEDs associated therewith to individual control;

a controller in communication with the LEDs, the controller configured to generate signals that individually control of the operating states of the one or more LEDs associated with each logical control address;

an elongate housing for the circuit board and the LEDs; and

a pair of end caps disposed at opposing ends of the housing, each including a connector shaped for connection with a fluorescent light socket.

18. The LED-based light of claim 17, wherein the controller is configured to generate signals that individually control of the operating states of the one or more LEDs associated with each logical control address in multiple combinations, each combination resulting in a different lighting gradient from the LED-based light in a plane parallel to the axes of the one or more LEDs.

19. The LED-based light of claim 17, wherein:

the multiple LEDs include one or more first LEDs associated with a first logical control address and positioned toward the middle of the LED-based light in a direction of its length, and one or more second LEDs associated with a second logical control address and positioned toward one or both of the ends of LED-based light in the direction of its length; and

the controller is configured to generate signals that control of the first LEDs to an ON state at a first intensity and the second LEDs to an ON state at a second intensity higher than the first intensity, resulting in at least a partial dog-boned shaped lighting gradient from the LED-based light in a plane normal to the circuit board.

20. The LED-based light of claim 1, wherein:

the multiple LEDs include one or more first LEDs associated with a first logical control address and having a first spatial distribution profile when controlled to an ON state, and one or more second LEDs associated with a second logical control address and in optical communication with at least one optical device shaped to modify the light emanating from the second LEDs when controlled to an ON state and achieve a second spatial distribution profile different from the first spatial distribution profile; and

the controller is configured to generate signals that control of the first LEDs to an ON state and the second LEDs to an OFF state to achieve the first spatial distribution profile, or, to generate signals that control of the first LEDs to an OFF state and the second LEDs to an ON state to achieve the second spatial distribution profile.

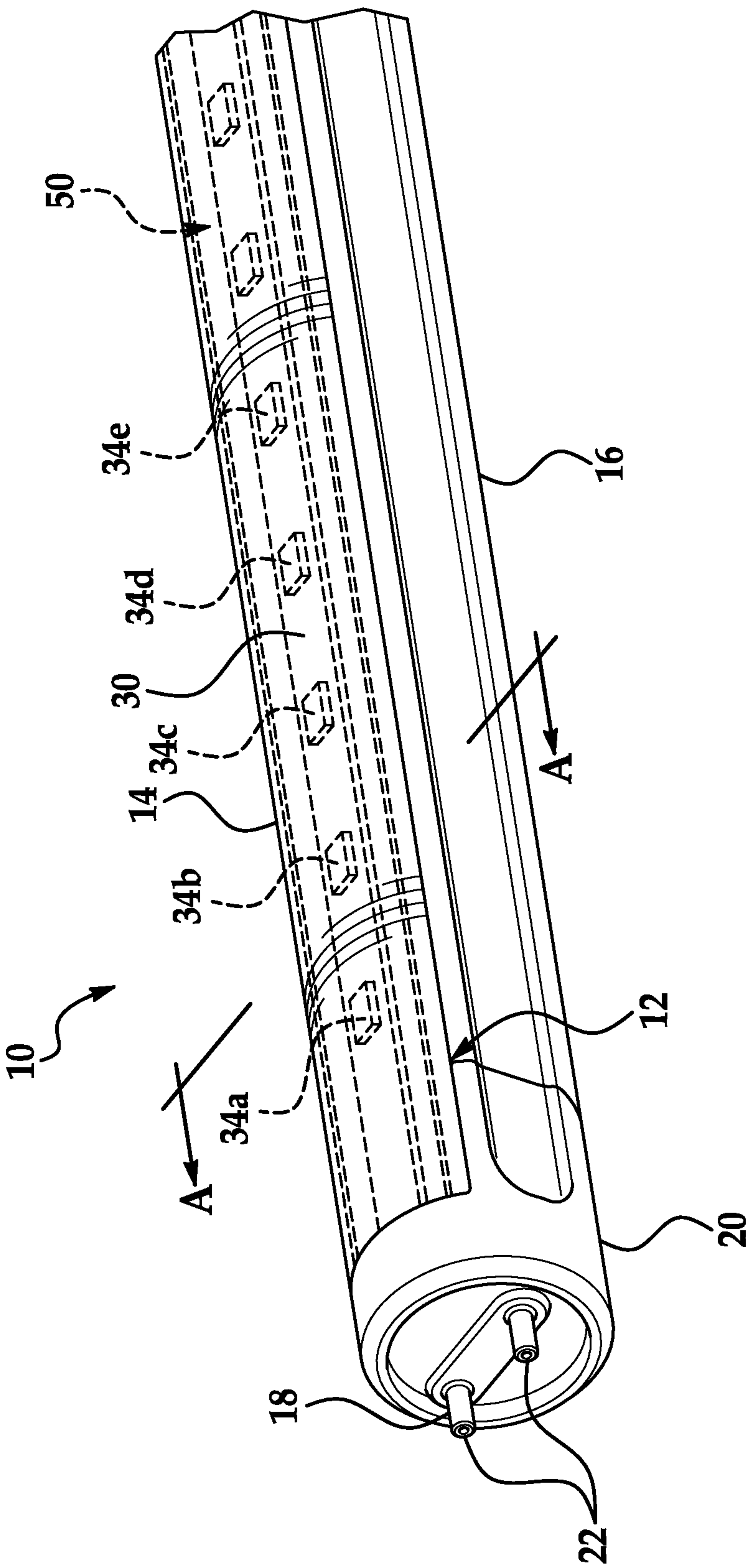

FIG. 1

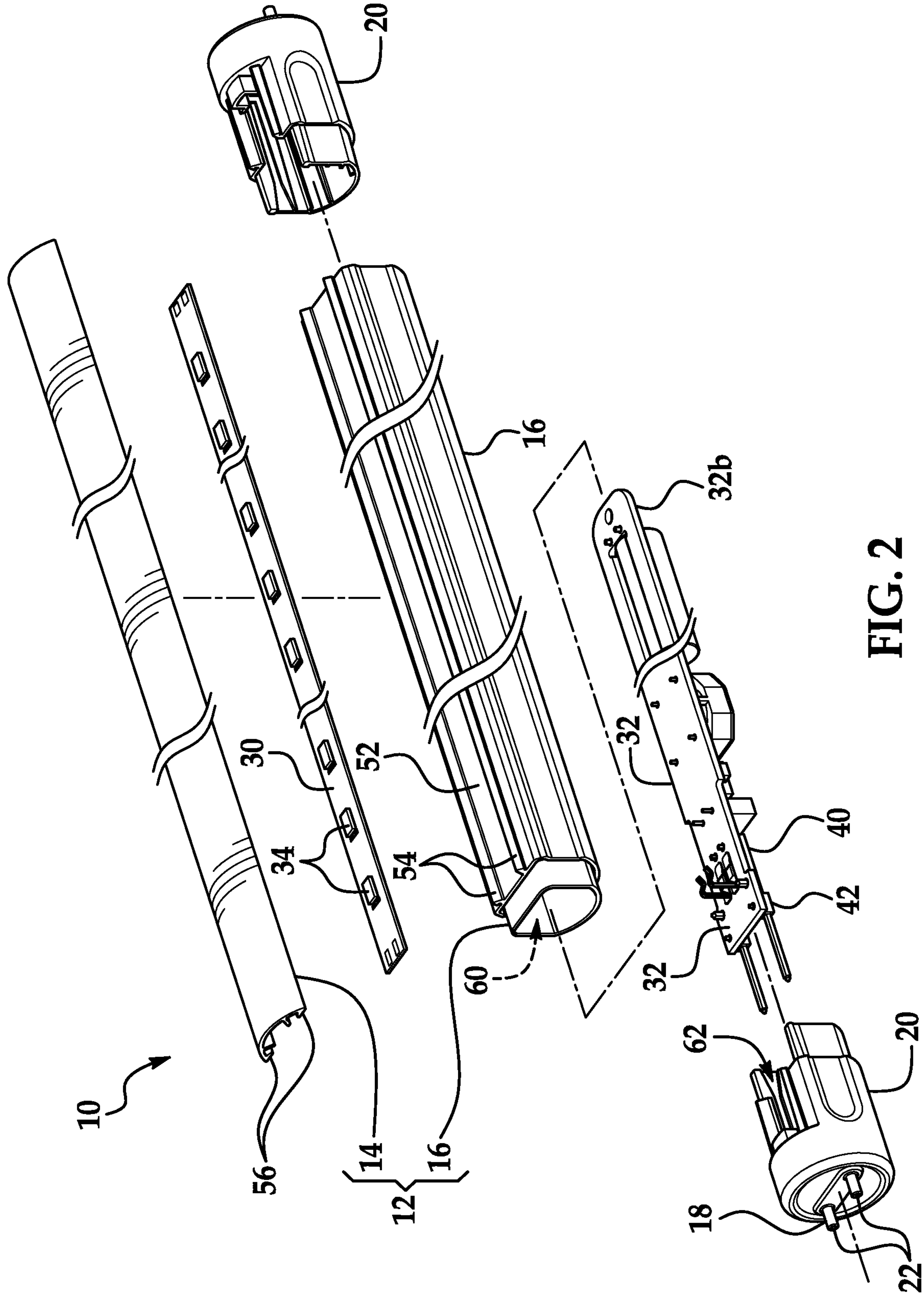

FIG. 2

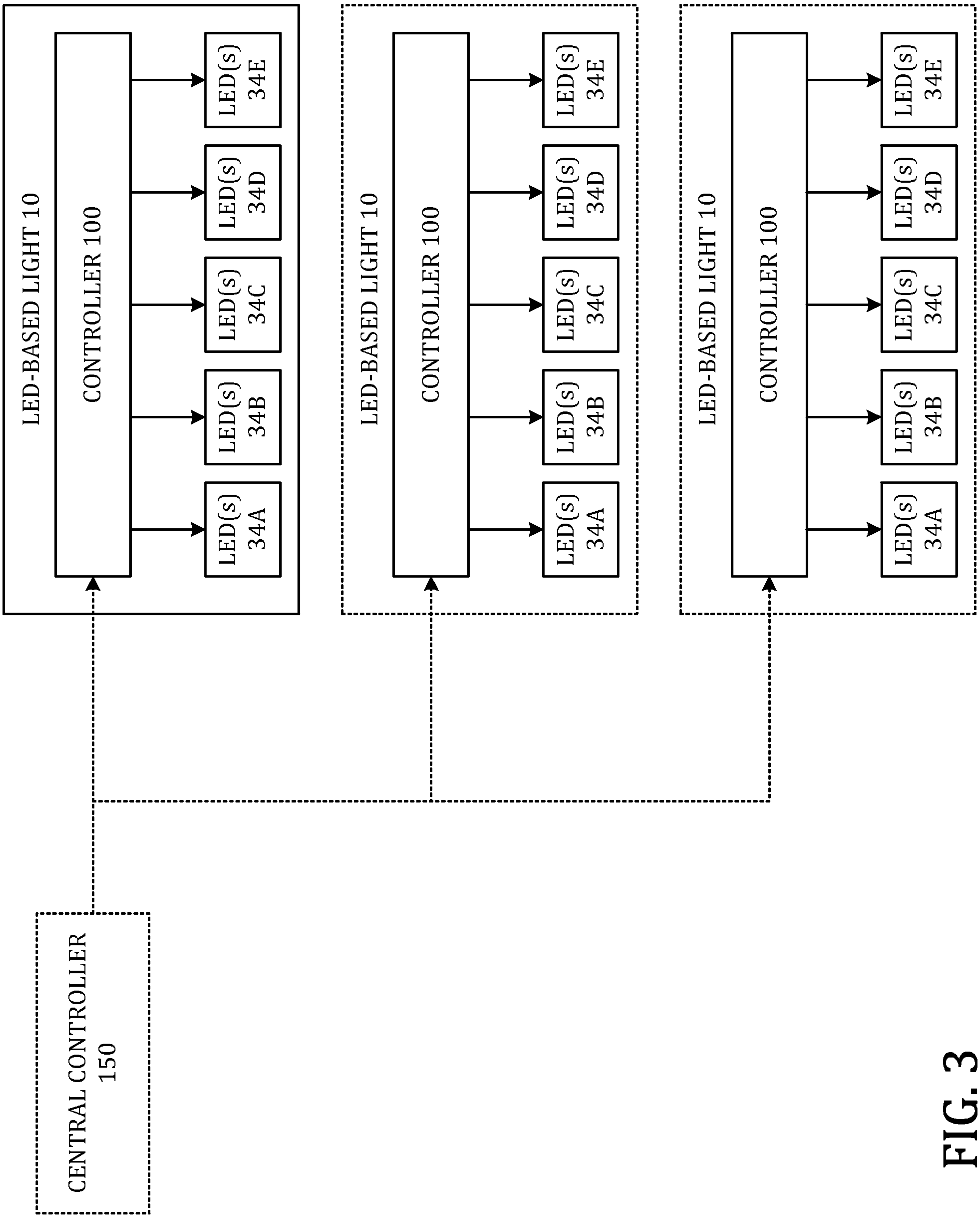
LED-BASED LIGHT 10
CONTROLLER 100
LED(s) 34A
LED(s) 34B
LED(s) 34C
LED(s) 34D
LED(s) 34E
LED-BASED LIGHT 10
CONTROLLER 100
LED(s) 34A
LED(s) 34B
LED(s) 34C
LED(s) 34D
LED(s) 34E
LED-BASED LIGHT 10
CONTROLLER 100
LED(s) 34A
LED(s) 34B
LED(s) 34C
LED(s) 34D
LED(s) 34E
CENTRAL CONTROLLER 150

FIG. 3

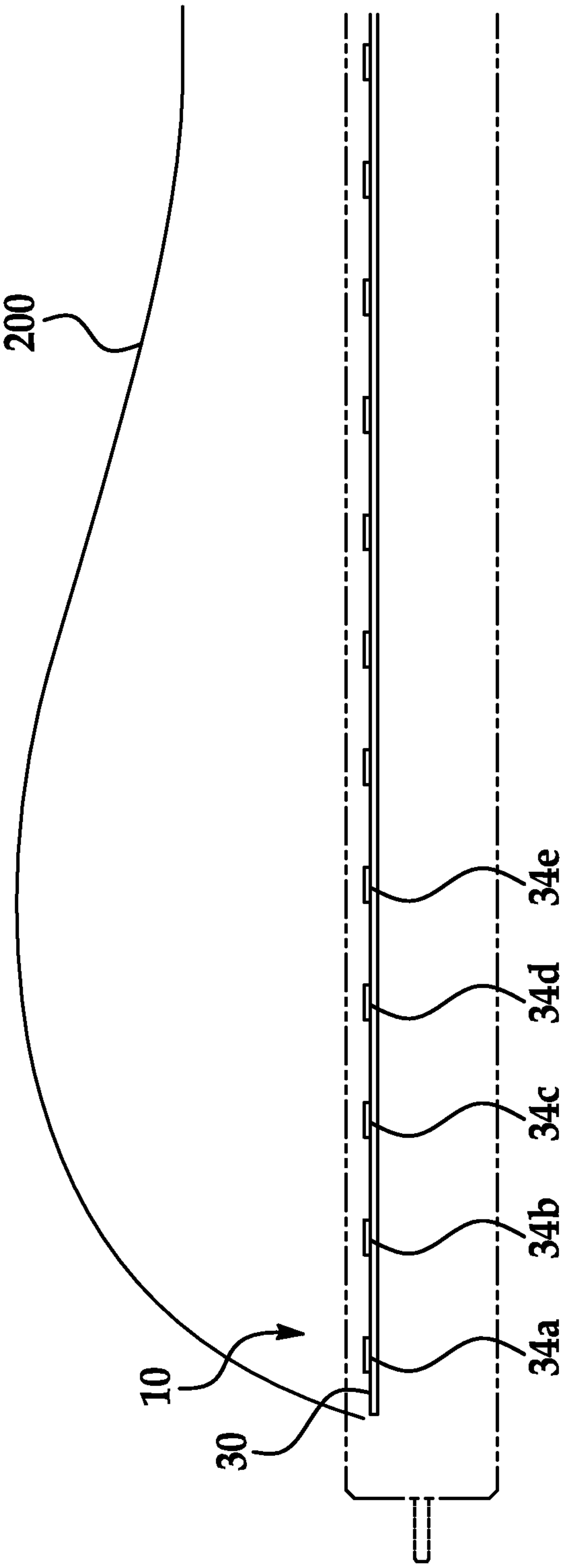

FIG. 4

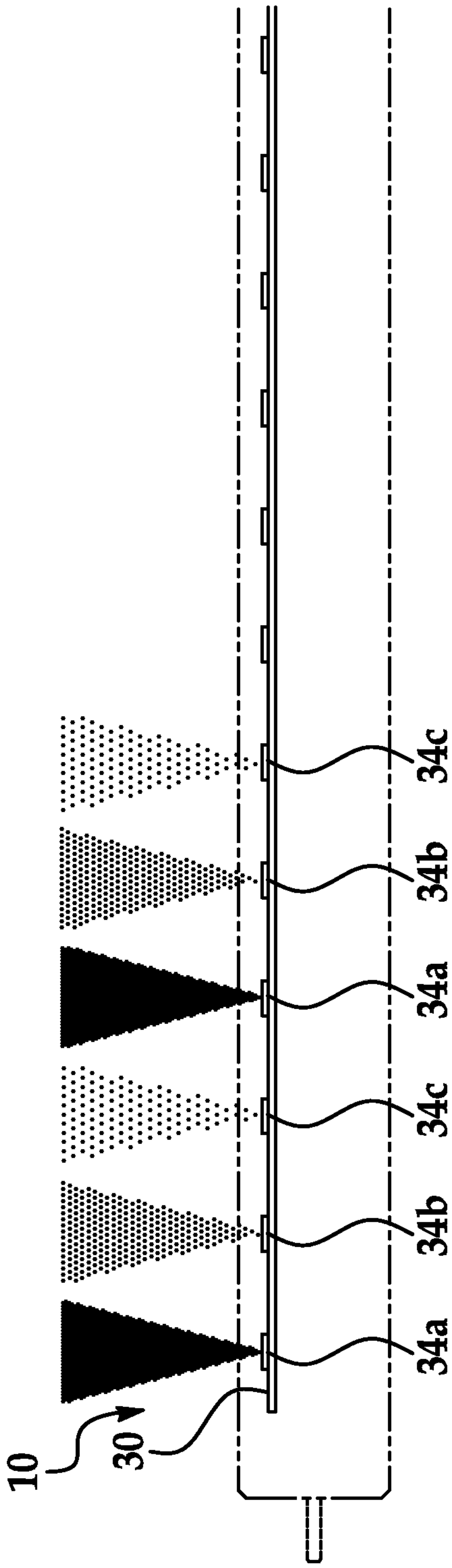

FIG. 5

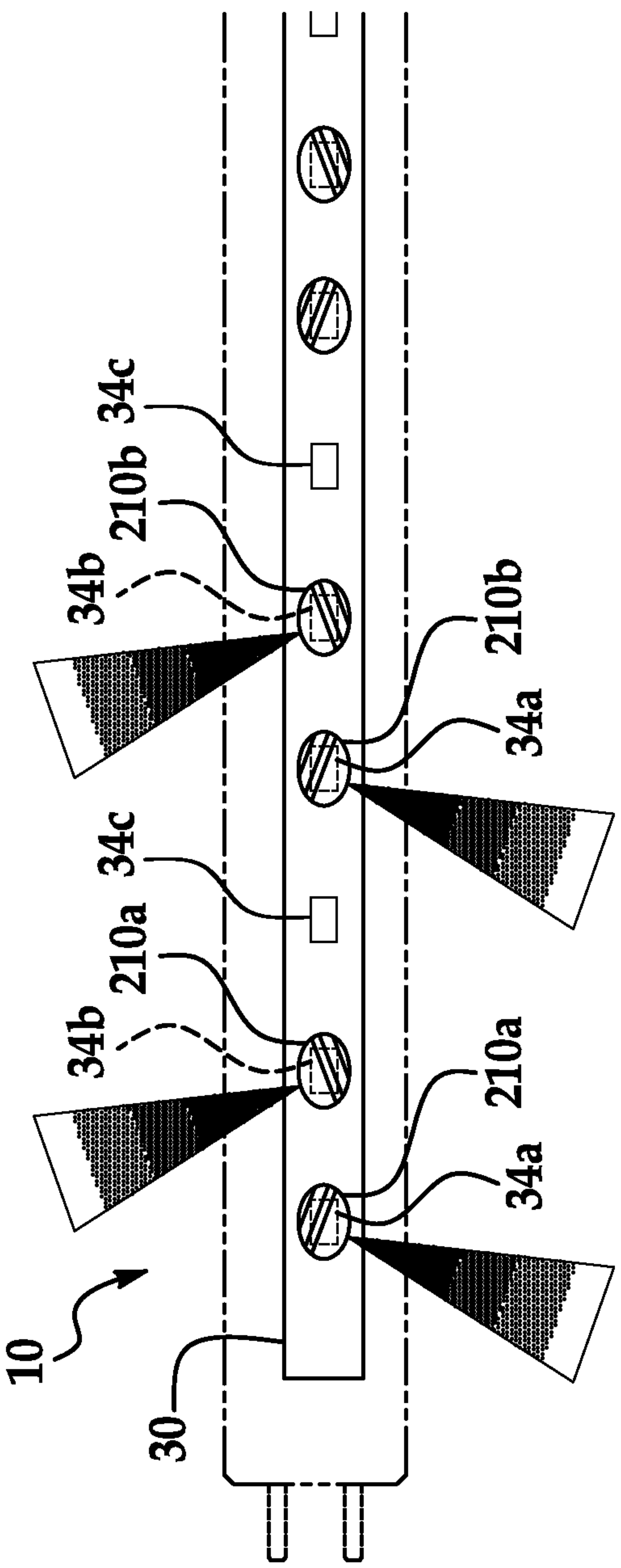

FIG. 6

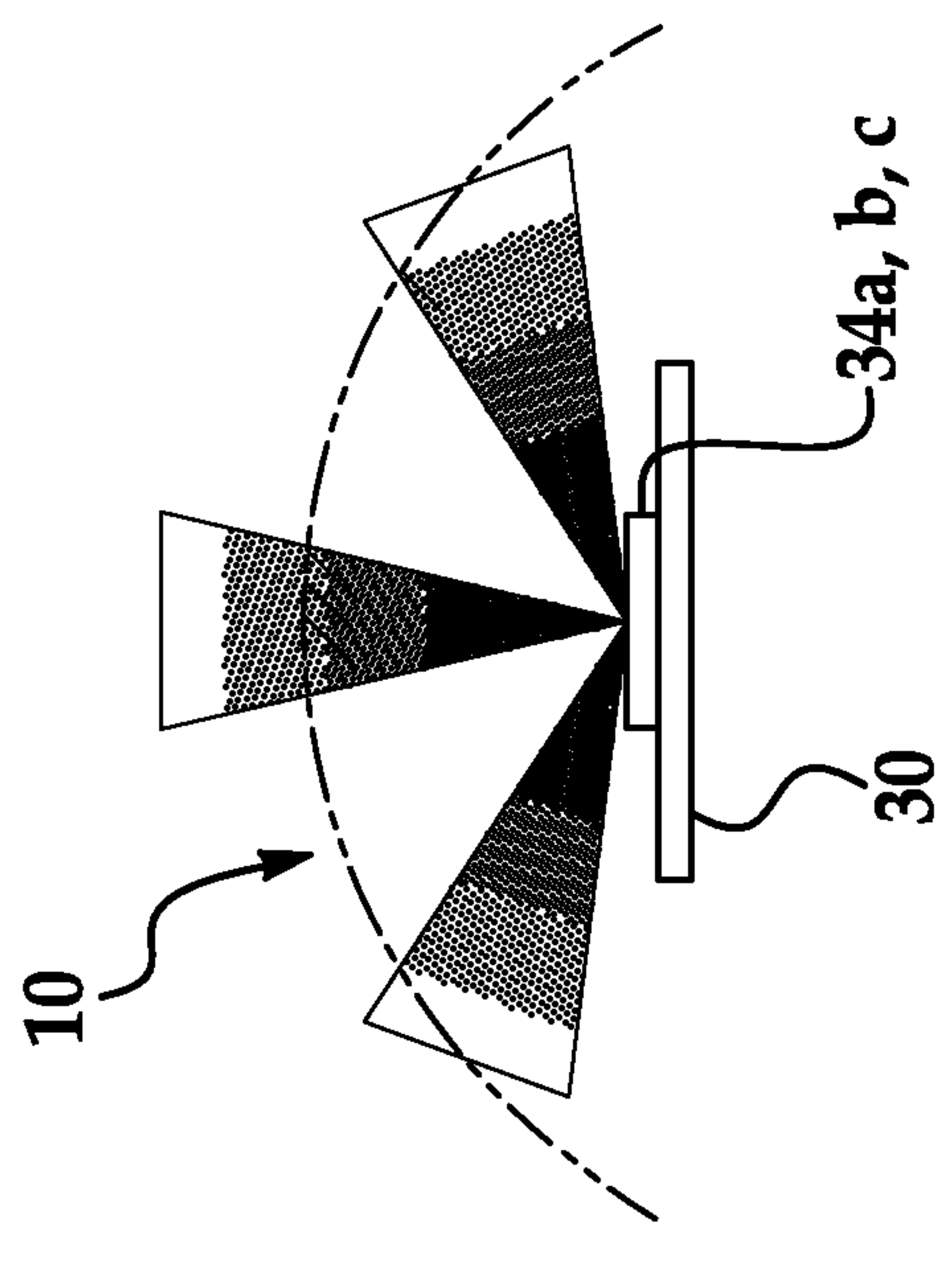

FIG. 7

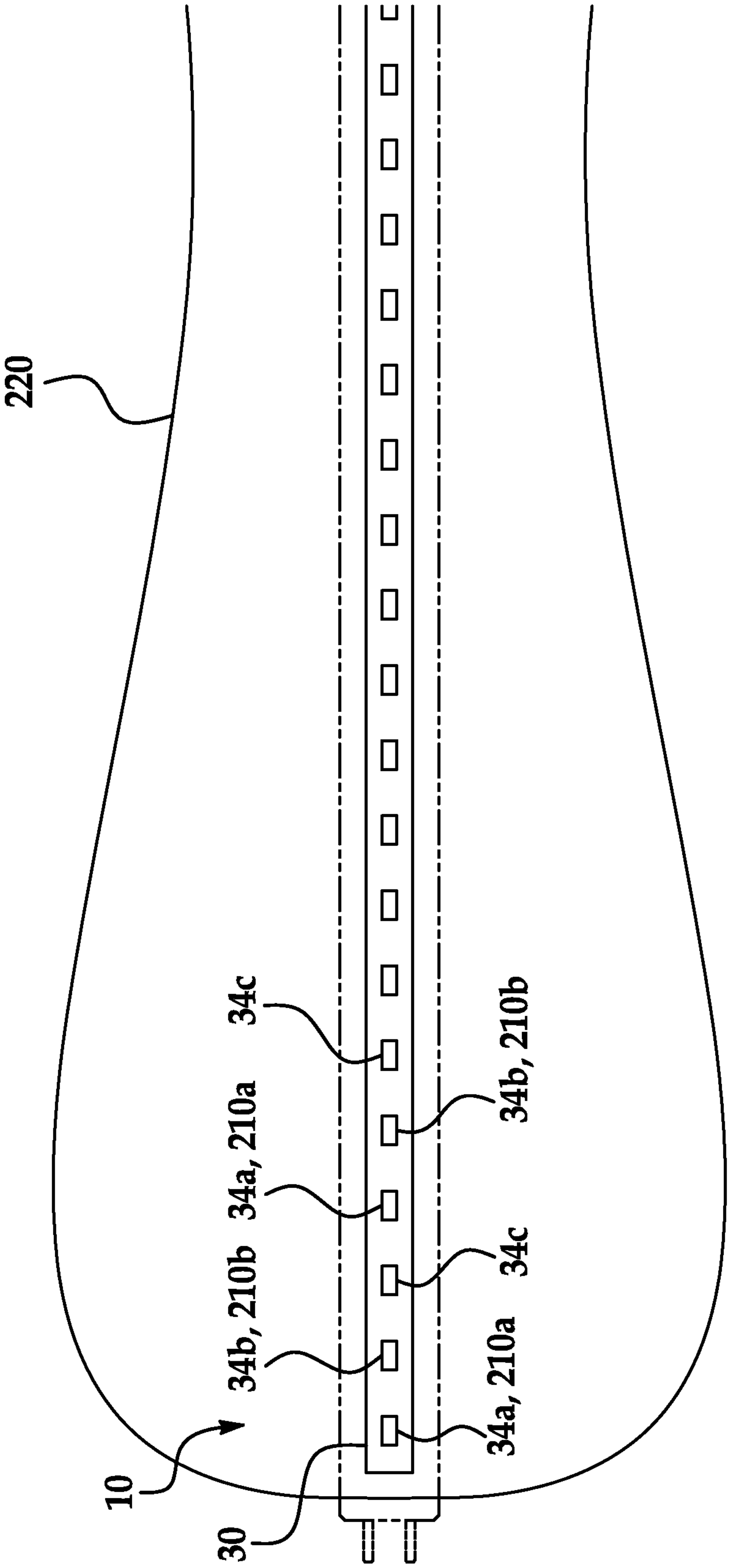
220
34c
34b, 210b
34a, 210a
34b, 210b
34c
34a, 210a
34b, 210b
34a, 210a
10
30

FIG. 8

FIG. 1