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(54) **LIGHT STRIP**

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(56) References cited:

EP-A2- 1 357 331

DE-U1- 29 706 201

DE-U1-202005 002 425

DE-U1-202005 006 643

US-A- 4 908 743

US-A1- 2008 239 716

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a light strip, in particular an elongated flexible light strip comprising a plurality of light sources.

BACKGROUND

[0002] Illuminating objects and/or spaces by means of elongated lighting arrangements is known.

[0003] EP 1 756 471 discloses an elongated flexible lighting system which comprises an array of light sources that are illuminated by electric power. It further comprises an elongated translucent extrusion of flexible material. The array of light sources is integral to the extrusion with said extrusion transmitting and dispersing the light from the array such that the lighting system gives the appearance that the array of light sources is a continuous light source.

[0004] The light sources are received in a cavity within the extrusion. The lighting system further comprises an upper cavity to provide for secondary optics to light strip and to help to diffuse the light from the light sources. The light strip has limited flexibility and robustness.

[0005] US 7,401,949 also discloses lighting apparatus for providing illumination to an object or surface, wherein the light sources are received in a cavity.

[0006] EP 0 939 876 discloses a method for production of conducting element, which conducting element consists at least of an elongated electricity conductive conductor part, in which several electric components, bringing out the lighting operation or the like according to the use of the conducting element, are attached to one after another in the longitudinal direction(s), whereafter the said entirety is surrounded by a casing part protecting the same. The conducting element is manufactured from an essentially flat conductor part, such as a band a strip or the like, into which there has been attached electric components, such as probes, LEDs, resistors and/or the like by arranging the same, preferably throughout built-in when viewed in a cross section with a casing material forming the said casing part, by exploiting a continuous manufacturing process, such as extrusion or the like. The document also relates to a conducting element to be manufactured by the method.

[0007] The conducting element is a thin ribbon which is stored on rolls and which is particularly designed for building into a vinyl floor.

[0008] EP 0 760 448 discloses an integral single piece extruded LED light strip and an associated process for producing such an LED light strip. The light strip includes first and second bus elements spaced apart from one another by a predetermined distance. The light strip also includes at least one light emitting diode (LED) connected between the bus elements that is illuminated when the first bus element conducts electricity provided from a

power source. An extruded plastic material completely encapsulates the first and second bus elements and the LED, thereby providing a barrier to protect the elements from damage and to make the light strip impervious to moisture. A process for manufacturing an integrally formed single piece light strip is also disclosed.

[0009] The thermoplastic extrusion material completely encapsulates the first and second bus elements and the LED and urges the first and second bus elements and the LED into operative contact. To provide a robust light strip the thermoplastic extrusion material must harden, losing its flexibility.

[0010] It is further noted that DE 20 2005 002 425, DE 297 06 201, US 2008/0239716, EP 1 357 331, and DE 20 2005 006 643 disclose LED-based light strips, and US 4,908,743 discloses a light strip having a plurality of spaced low-voltage light bulbs.

SUMMARY

[0011] There is a desire for an improved light strip providing increased versatility in providing illumination patterns.

[0012] In view of this desire, in a first aspect the flexible light strip of claim 1 is provided.

[0013] The flexible printed circuit board forms a carrier for the light sources and the first conductors, possibly also for further objects, e.g. control elements, resistors and the like. The board preferably forms a generally flat strip-shaped object with a flexibility such that the board may be bent to small radii at least substantially normal to the general plane of the board. The board may advantageously also be bendable substantially in the plane of the board, which will, however, in most cases have a larger minimum bending radius than the former direction to prevent damage to the board and/or conductors arranged on the board. The housing forms a barrier between the light sources, the circuit board and the first conductors on the one hand and the outside world on the other hand. The light strip, including housing, being a flexible object facilitates handling and storage, e.g. coiled and/or bundled, and facilitates arranging a plurality of light sources along an object and adaptation of the light strip to a substrate to which it is to be mounted.

[0014] The light sources emitting substantially normal to the circuit board facilitates manufacturing and/or mounting the light strip, in that the emission direction of the light sources is readily discernible and in that light may be emitted radially from around bends with small radii.

[0015] Arranging the first and second portions such that the emitted light is reflected off the second portion, allows providing illumination to desired directions other than normal to the circuit board, while retaining, e.g., the above-described beneficial mounting and/or handling properties. This significantly increases the number of possible locations and uses for the light strip. Advantageously, the first and second portions are arranged so

that the individual light sources are not directly visible, such that the emitted light or light cones are visible, but the light sources themselves and related objects are obscured from direct vision.

[0016] The first and second portions of the housing may generally have different optical properties, e.g. different refractive index, reflective index and/or transmittance for one or more wavelengths of the light emitted by the light sources, so as to provide desired illumination effects.

[0017] Advantageously the housing is provided via moulding and/or extrusion techniques. This allows manufacturing light strips substantially uninterrupted for tens to hundreds of meters on end at substantially continuous properties and at a substantially constant quality. The first and second portions may be co-moulded and/or co-extruded during such manufacturing process. Suitable materials for the flexible circuit board comprise (strips of) insulating plastics materials such as nylon, kapton, mylar, etc. Suitable materials for the housing comprise resilient plastics such as polyurethane, polyvinylchloride, PET, silicone rubber, etc, as well as mixtures thereof.

[0018] Claims 2 and 3 define light strips with particularly useful light emission intensity distributions.

[0019] Further, in another aspect, the flexible light strip of claim 4 is provided.

[0020] As set out above, the flexible printed circuit board, the plurality of light sources and the housing allow to provide an illumination arrangement with a plurality of light sources along an object which is shielded from outside influences, e.g. protected against bad weather.

[0021] The light strip comprising second electrical conductors allows providing operational security to the device. Further, the second electrical conductors may be manufactured in different manners than via printed circuit techniques which reduces costs. In particular when the second electrical conductors are manufactured as electric cables, e.g. copper wires and/or strands, their electrical resistance is significantly reduced compared to conductors manufactured with printed circuit techniques. The flexible light strip of claim 4 allows powering an elongated flexible light strip with a power source connected on one side of the light strip and delivering electrical power to light sources remote from the position of the connection of the power source since electrical losses in the printed circuit board are counteracted by the parallel second conductors which suffer less to substantially no losses. Interconnecting the first and second conductors on plural positions allows powering light sources from opposite sides which may result in a substantially constant optical output power of the light sources of the section concerned. This allows providing longer light strips with sufficient optical intensity without requiring additional power connections and/or interruptions than in the case of single-sided powering.

[0022] The flexible light strip of claim 5 reduces manufacturing costs, since manufacturing costs of elongated flexible printed circuit boards generally increases non-

linearly with the length of the circuit boards, whereas manufacturing a housing, in particular via extrusion techniques may be substantially continuous at substantially constant or even decreasing cost per produced length.

Further, connecting portions are effectively shielded by the housing against localised stress and strain, (localised) deformation and/or outside influences. Thus, robustness of the flexible light strip is increased. Also electrical cables for use as the second conductors may be provided with or without shielding and as single-wire or plural-wire cable (e.g. flatbed cable) on reels of tens to hundreds of meters at substantially constant or even decreasing cost per length. Thus, such substantially continuous cables may also fortify one or more connection portions.

[0023] The second electrical conductors may be most easily connected to the flexible printed circuit board one or more connection portions between printed circuit board sections. This obviates further connection portions.

[0024] In the flexible light strip of claim 6, the second conductors, in particular when in the form of metallic wires or cables, provide increased mechanical robustness to the light strip, in particular by decreasing variations of mechanical properties of the light strip. This assists preventing localisation of stress and related damage and it also facilitates handling and storage.

[0025] The housing material of a flexible light strip advantageously closely follows the contours of the circuit board, the light sources, and any further objects associated therewith so as to provide the light strip as an integral whole. The outside shape of the light strip may be substantially constant, providing a pleasing appearance and facilitating mounting and handling. Advantageously the light strip is a substantially massive object, having substantially no cavities, so as to have increased robustness against vandalism and/or deformation under pressure of mounting arrangements and/or loads. Resistance to deformation further provides increased reliability of the illumination pattern to be provided by the flexible light strip.

[0026] The light strips of claims 8 and/or 9 allow colourful and/or dynamic illumination, e.g. colour-varying, intensity varying, flashing and/or running lights.

[0027] In a further aspect an assembly according to claim 10 is provided. This facilitates interconnecting first and second conductors, thus reducing power losses along circuit board sections. The assembly according to claim 11 facilitates interconnecting plural light strips, with improved power delivery per light strip.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The above-described aspects will hereafter be more explained with further details and benefits with reference to the drawings showing various embodiments by way of example and in which:

Fig. 1A is a perspective view of a flexible light strip,

which is not part of the invention;

Fig. 1B is a schematic cross section view of the flexible light strip of Fig. 1A as indicated in Fig. 1A;

Fig. 2A is a perspective view of a embodiment a flexible light strip;

Fig. 2B is a schematic cross section view of the flexible light strip of Fig. 2A as indicated in Fig. 2A;;

Figs. 3-6 are cross-sectional views of further embodiments of a flexible light strip;

Fig. 7 is a cross-sectional view of a light strip which is not part of the invention

Fig. 8A illustrates an assembly of a further embodiment of a flexible light strip and a connector;

Fig. 8B illustrates energy distribution along the flexible light strip of Fig. 8A;

Fig. 9A illustrates an assembly of plural flexible light strips and plural connectors;

Fig. 9B illustrates energy distribution along the flexible light strip of Fig. 9A.

DETAILED DESCRIPTION OF EMBODIMENTS

[0029] It is noted that the drawings are schematic, not necessarily to scale and that details that are not required for understanding the present invention may have been omitted. The terms "upward", "downward", "below", "above", and the like relate to the embodiments as oriented in the drawings, unless otherwise specified. Further, like elements are denoted by the same numeral, where useful such like elements may be individualised with an alphabetic suffix.

[0030] Fig. 1A shows an elongated light strip 1 extending in a direction of length L for a first length D and comprising a flexible printed circuit board 2 which is a generally flat strip extending in the direction of width W and the direction of length L, which is perpendicular to the width W. A plurality of light sources 3 are arranged on the flexible printed circuit board 2 along the length L for emitting light and a housing 4 which is formed around the flexible printed circuit board 2 and the light sources 3 so as to form an integrated flexible elongated object.

[0031] In Fig. 1A the reference coordinate system used in this disclosure (width W, length L, height H) is shown for clarity. The three directions W, L and H are generally mutually perpendicular. The reference coordinate system used is however to be understood in relation to the local position and shape of the circuit board 2 defining an origin plane WL with a H normal to the plane WL, and with H having an origin on the circuit board 2. With bending or flexing of (the circuit board 2 of) the light strip 1 (the plane WL and the normal H of) the coordinate system deform(s) accordingly.

[0032] Fig. 1B shows the embodiment of Fig. 1A in cross-section view in a WH plane as indicated in Fig. 1A.

[0033] The flexible circuit board 2 comprises first conductors (not shown) for carrying current which are arranged on the flexible printed circuit board 2 connected to and arranged for energizing the light sources 3. The

first conductors can be contacted via contact pads 5 on the circuit board 2.

[0034] The light sources 3 shown are surface mounted LEDs which are arranged to emit light upward in a cone with an opening angle centered substantially in the direction of a local normal (i.e. in a direction of positive H as specified above) to the flexible printed circuit board 2. Surface mounted LEDs are generally energy efficient, small-size and flat light sources compared to encapsulated LEDs and/or incandescent lamps etc. However, other types of LEDs, e.g. OLEDs and/or other types of light sources are useable and considered contained within the scope of this disclosure.

[0035] The light strip 1 further comprises second conductors 6 extending underneath and in parallel to the flexible printed circuit board 2 along the length D of the light strip 1.

[0036] The housing 4 comprises a first portion 7 and a second portion 8 extending along the flexible printed circuit board 2. The housing 4 provides a bottom face 10 opposite a top face 11, and opposite left and right faces 12 and 13, respectively. On one or more of the faces structures 14 may be provided for mounting the light strip to a mounting object, e.g. one or more clamps or rails etc.

[0037] In the housing 4, the first portion 7 is substantially translucent for light emitted by the light sources 3, advantageously it is substantially transparent with little to no optical losses. The second portion 8 has another refractive index than the first portion 7 and is opaque for the light emitted by the light sources 3. Various options are possible, e.g. the second portion may be reflective, translucent or transparent for the light of the light sources and/or have different properties for different portions of the visible spectrum, i.e. transparent for one colour of light and reflective for another colour. The first and second portions 7, 8 are formed around the circuit board 2 with any object arranged on it such that an object is formed which is closely encapsulated by the material(s) forming the housing 4 and such that an integrated and substantially massive object is formed, which is still flexible at least in the LH direction, preferably also in the WL direction and allowing helical (or cork-screw like) bending. The light strip 1 is mountable onto a substrate with a bottom side (surface at negative H side) and due to its flexibility it can follow curves and bends of the substrate with the emission direction of the light sources 3 facing locally outward from the substrate (in the direction of the local normal, along H).

[0038] In the embodiment of the light strip 1 of Figs. 1A, 1B, the first and second portions of the housing 7, 8 are arranged such that the light emitted by the light sources 3 is reflected off the second portion 8 to produce an illumination pattern with increased intensity in a direction substantially normal to the flexible printed circuit board 2.

[0039] Figs. 2A and 2B show another embodiment of a light strip 1, in which the first and second portions 7, 8 of the housing 4 are arranged such that the light emitted by the light sources 3 is reflected off the second portion

8 and the main distribution direction of the emitted light is redirected from the normal (H) to produce an illumination intensity pattern with a maximum intensity in a direction E at an angle α to the normal of the flexible printed circuit board 2. Here the angle α is about 45 degrees and the light is emitted from both the top face 11 and a side face 13. The embodiment is particularly well suited for illuminating a first face of an object with the bottom face 10 of the light strip mounted to a second face of the object or to another object, e.g. for illuminating a building wall. The circuit board 2 and objects thereon are substantively obscured from view when the second portion 8 is opaque for any viewer observing the light strip from the direction H or from an angle opposite α . The second conductors 6 are hidden from view by the circuit board 2 and/or by the second portion 8 being opaque. Inclusion of the conductors 6 in the housing 4 allows to fix their position relative to the circuit board 2, facilitating handling of the light strip and preventing conductors from obscuring light from the light sources 3. Depending on the relative shapes of the first and second housing portions 7, 8 (and/or any further housing portions) the second conductors 6 may be arranged on various positions within the housing allowing to optimise the shape of the light strip to a particular use and/or fixation method.

[0040] LEDs produce little heat and may thus be suitably used in heat-sensitive surroundings and/or locations where humans and/or animals are likely to touch the light strip. Locations which may be suitably provided with the light strip of Figs 1A-2B, in particular with LEDs as light sources, are further the underside of table tops and/or along counters of shops and/or bars, etc.

[0041] The interface between the first and second housing portions 7, 8 may be formed to be highly reflective or for diffusively reflecting the light in one or more directions W, H, L. The angle α may be smaller or larger than 45 degrees, typically it is in the range of between 30-60 degrees with a total opening angle P spanning from about zero degrees (i.e. along the normal in H direction) to about 90 degrees (i.e. parallel the circuit board 2). If the angle α is larger than about 30 degrees and the total opening angle β starts at about 5 degrees obscuring the light sources 3 and/or the circuit board 2 is facilitated also at a relatively flat light strip in H direction.

[0042] Depending on the light cone emitted by one or more light sources 3 and/or desired uses, other arrangements of the first and second housing portions 7, 8, are possible, and further housing portions 9 may be provided. Figs. 3-7 show some of such variants.

[0043] The light strip of Fig. 3 resembles Figs. 2A, 2B but allows for a wider light cone of the light source with a similar illumination pattern of the light strip. In the light strips of Figs. 4 and 5 the first and second portions are arranged such that at least about half the intensity emitted from the light strip is emitted from the side faces 12, 13, providing illumination in two different directions. The embodiment of Fig. 5 allows mounting the light strip 1 with the bottom face 10 to a substrate while allowing access

to the circuit board 2 and the second conductors 6, e.g. for mounting, control and/or maintenance.

[0044] One or more interfaces between different housing portions 7-9 and/or (portions of) outside faces 10-14 may be curved, corrugated or otherwise non-planar to achieve particular light intensity distributions and/or mounting structures. Examples are illustrated in Figs. 6 and 7. In Fig. 6 the top and side faces 11-13 are integrated to form a dome shaped or lens shaped face 15. In Fig. 7 the first and second portions provide a substantially parabolic reflector. Various other shapes are possible, e.g. different aspect ratios of the housing 4 (size ratios in W and H directions).

[0045] The first and second (and any optional further) housing portions may be co-extruded in one extrusion step or in subsequent extrusion steps. In the latter case, the second conductors 6 and/or the circuit board 2 may be fixed to and/or (possibly partially) enclosed by one portion and the housing may be finished in a subsequent process step by one or more further portions. This may facilitate manufacturing the light strip.

[0046] Figs. 8A and 9B illustrate (effects of) providing the light sources 3 with electrical power using the second conductors 6; this may also be put to advantage for a light strip with a substantially uniform housing 4 comprising no optically different portions 7, 8.

[0047] Fig. 8A is a view in cross-section along L of a light strip 1 having length D (not shown, but compare to Fig. 1A) and a strip connector 15. In the light strip 1 the flexible printed circuit board 2 comprises a plurality of circuit board sections 2A, 2B, 2C, etc., which are mechanically and electrically interconnected with connection portions 17 in direction L such that the flexible printed circuit board 2 extends substantially uninterruptedly for the length D of the light strip 1. The connection portions 17 may comprise connectors, wires and/or solder bridges which contact the optional contact pads 5 of adjacent circuit board sections 2A, 2B, 2C. The housing 4 of the light strip 1 and the second conductors 6 are substantially continuous along the sections 2A, 2B, 2C and along the connection portions 17 in between the sections 2A, 2B, 2C.

[0048] In Fig. 8A is indicated that the second electrical conductors 6 are electrically connected with a conductive bridge 18, (e.g. a connector, one or more wires or solder portions, etc., to the connection portion 17 and therewith to the first conductors arranged on the circuit board sections 2A, 2B, 2C. The second electrical conductors 6 may be connected to (the first conductors of) the flexible printed circuit board 2 in plural positions.

[0049] Electrical power may be provided to the light strip 1 by means of the strip connector 16 having a connection to a power outlet, here a power cord 19. The strip connector 16 further interconnects at least one first conductor with at least one second conductor 6 of at least one flexible light strip 1.

[0050] Fig. 8B is a graph showing the effect of the interconnection of the first conductors and the second con-

ductors 6. The graph has length L on the ordinate axis and electrical power P available to the light sources 3 on the abscissa (in no particular units or scale). Assuming the electrical-to-optical efficiency η of all light sources 3 to be substantially equal, the electrical power translates into optical power scaled by the factor η . Curves a and b indicate the power P available by powering the respective circuit board section 2A, 2B only from the left hand side, and curves c and d indicate the power P available by powering only from the right hand side. Due to the electrical resistance a drop in power P along the length L is discernible. By applying power to a section from both left and right sides the power drop may be counteracted and a substantially constant electrical and optical power may be achieved along the circuit board sections 2A, 2B; see curves e and f.

[0051] A further effect of interconnecting first and second conductors on opposite ends of a circuit board (section) is that when one or more first conductors become damaged and/or broken, power is still provided to the light sources 3 on either side of the damaged location, reducing or preventing failure of a portion of the light sources 3.

[0052] Fig. 9A, 9B, show, similar to Figs. 8A and 8B, an assembly of plural flexible light strips 1A, 1B connected with connectors 16, 20, 21. The connector 16 is substantially identical to the connector 16 of Fig. 8A. The connector 20 interconnects the light strips 1A, 1B mechanically and interconnects electrically at least one first conductor of both flexible light strips 1A, 1B and least one second conductor 6 of at least one of the flexible light strips 1A, 1B, advantageously both, such that the second conductors 6 are interconnected as well and power losses in the second conductors 6 are counteracted. The connector 21 ends the assembly, interconnects the first and second conductors and prevents electrical connections being open to the outside world. Thus, also with a plurality of light strips 1A, 1B, (optical) power losses are reduced and a substantially homogeneous illumination may be achieved over the entire length of the plurality of light strips 1A, 1B, etc.

[0053] A connector 16 may be provided to connect (and provide power to) one single or more than one light strip 1, e.g. plural light strips 1 in a star-shape. A connector 20, 21 may comprise a further connector for connecting to a power source.

[0054] Connectors 16, 20, 21 may be formed to contact the first and/or second conductors of a light strip 1 which has been cut to a desired length, e.g. with teeth penetrating the housing 4 upon being clamped to the cut end of the light strip 1, facilitating mounting and use of the light strip 1. To optimise shielding of the light strip 1 against outside influences, one or more connectors 16, 20, 21 may be provided with a seal, e.g. one or more O-rings, to seal against the housing.

[0055] The first and second conductors may be configured for powering a portion or all light sources 3 in series or in parallel. Parallel connection is preferred since

it reduces the possible effect of one or more defect individual light sources 3. For parallel connection of monochrome LEDs a set of two conductors (+ and -) powered by DC power may suffice. To independently control different light sources, different conductors, control electronics and/or control cables may be provided. E.g. when using red, green and blue light LEDs a set of four connections may be used: one connection for each colour and a common ground connection. This may be provided with four first conductors and four second conductors (e.g. see Figs 1A-2B, 5 and 6). Further conductors for further options and/or controls are also possible.

[0056] It has been found that a light strip with monochrome LEDs as surface mounted light sources on flexible printed circuit strips can provide adequate intensity for illumination of a building or an ornamental rail along several tens to about a hundred meters when powered from one side. Interconnecting first and second conductors on opposite ends of a light strip can about double such length without unacceptable decrease in emitted intensity; and it allows to concatenate further light strips with similar effects. Thus, less (connections to) power outlets are required which significantly facilitates use of the light strips and reduces costs.

[0057] The invention is not restricted to the above described embodiments which can be varied in a number of ways within the scope of the claims. For instance, several light sources may be arranged as groups with different mutual separation.

[0058] Different shapes of the housing and/or optically different portions thereof are possible. Such portions may have (mutually) different colours and/or transparencies. One or more portions may comprise scattering material, e.g. reflective particles embedded in the material to diffuse light. One or more optically different portions may provide a graded refractive index profile to provide lens-operation in a substantially rectangular object.

[0059] The circuit board 2 may be coloured and/or made reflective. The housing may comprise one or more strips, films, and/or coating layers, etc, possibly integrated with a strip, film, coating, etc, on the circuit board 2, which may correspond to the colour of the substrate and/or be diffusely reflective, to reduce visibility of the light strip when the light level of the light sources is below environmental light or the light sources are off (i.e. not lit). Elements and aspects discussed for or in relation with a particular embodiment may be suitably combined with elements and aspects of other embodiments, unless explicitly stated otherwise.

Claims

1. Flexible light strip (1, 1A, 1B) comprising a flexible printed circuit board (2, 2A, 2B), a plurality of light sources (3) arranged on the flexible printed circuit board (2, 2A, 2B) for emitting light first conductors for carrying current arranged on the

flexible printed circuit board (2, 2A, 2B) connected to and arranged for energizing the light sources (3), and

a housing (4) which is formed around the flexible printed circuit board (2, 2A, 2B) and the light sources (3) so as to form an integrated flexible elongated object;

wherein the light sources (3) are arranged to emit light substantially normal to the flexible printed circuit board (2, 2A, 2B);

wherein the housing (4) comprises at least a first portion (7) and a second portion (8) extending along the flexible printed circuit board (2, 2A, 2B),

wherein the first portion (7) is substantially translucent for light emitted by the light sources (3)

characterised in that the first and second portions (7; 8) are arranged such that the emitted light is reflected off the second portion (8) and the main distribution direction of the emitted light is redirected to produce an intensity pattern with a maximum intensity in a direction (E) at a nonzero angle (α) to the normal (H) of the flexible printed circuit board (2, 2A, 2B).

2. Flexible light strip (1, 1A, 1B) according to claim 1, wherein the angle (α) to the normal (H) of the flexible printed circuit board (2, 2A, 2B) is in a range of 30-60 degrees, e.g. about 45 degrees, to the normal (H) of the flexible printed circuit board (2, 2A, 2B).

3. Flexible light strip (1, 1A, 1B) according to claim 1 or 2, wherein at least about half the emitted intensity of the light emitted by the light sources (3) is reflected off the second portion (8) and is redirected thereby and to be emitted from the light strip (1, 1A, 1B) in the direction (E) at the angle (α) to the normal (H) to the flexible printed circuit board (2).

4. Flexible light strip (1, 1A, 1B) according to any preceding claim, wherein the flexible light strip (1, 1A, 1B) has a substantially rectangular shape in cross section with first and second opposite faces (10; 11) and third and fourth opposite faces (12; 13), the flexible printed circuit board (2) extends substantially parallel the first face and the first and second portions (7; 8) are arranged such that at least about half the intensity emitted from the light strip (1, 1A, 1B) is emitted from the third and/or fourth faces (12; 13).

5. Flexible light strip (1, 1A, 1B) according to any preceding claim, wherein the light strip (1, 1A, 1B) comprises one or more second electrical conductors (6) extending substantially uninterrupted in parallel to the flexible printed circuit board (2, 2A, 2B) and being electrically connected to the flexible printed circuit board (2, 2A, 2B) in plural positions; and wherein the housing (4) is formed around the flexible

printed circuit board (2, 2A, 2B), the light sources (3) and the second electrical conductors (6) so as to form an integrated flexible elongated object.

6. Flexible light strip (1, 1A, 1B) according to any preceding claim, wherein the flexible printed circuit board (2) comprises a plurality of sections (2A, 2B, 2C) which are mechanically and electrically interconnected with connection portions (17) and wherein the housing (4) is substantially continuous along the plurality of sections (2A, 2B, 2C).

7. Flexible light strip (1, 1A, 1B) according to claim 6, wherein the one or more second electrical conductors (6) are substantially continuous along the plurality of sections (2A, 2B, 2C).

8. Flexible light strip (1, 1A, 1B) according to any preceding claim, wherein the flexible light strip (1, 1A, 1B) is a substantially massive object.

9. Flexible light strip (1, 1A, 1B) according to any preceding claim, wherein at least some of the plurality of light sources (3) are arranged for emitting coloured light.

10. Flexible light strip (1, 1A, 1B) according to any preceding claim, wherein at least some of the plurality of light sources (3) are arranged for being individually controllable.

11. Assembly comprising at least one flexible light strip (1, 1A, 1B) according to claim 5 or according to claim 5 and any claim dependent of claim 5, and further comprising one or more connectors (16, 20, 21) for interconnecting at least one first conductor with at least one second conductor (6) of the at least one flexible light strip (1, 1A, 1B).

12. Assembly of claim 11, comprising at least a first flexible light strip (1A) and a second flexible light strip (1B), the first and second flexible light strips (1A; 1B) both being a flexible light strip (1, 1A, 1B) according to claim 4 or according to claim 4 and any claim dependent of claim 4, wherein the assembly further comprises at least one connector (16, 20, 21) for interconnecting at least one first conductor of both the first and second flexible light strips (1A; 1B) and least one second conductor (6) of at least one of the first and second flexible light strips (1A; 1B).

Patentansprüche

1. Flexibles Leuchtband (1, 1A, 1B), aufweisend eine flexible Leiterplatte (2, 2A, 2B), eine Mehrzahl von Lichtquellen (3) zum Emittieren

- von Licht, angeordnet auf der flexiblen Leiterplatte (2, 2A, 2B),
 erste Leiter zum Leiten von Strom, angeordnet auf der flexiblen Leiterplatte (2, 2A, 2B), angeschlossen und angeordnet zum Speisen der Lichtquellen (3), und
 ein Gehäuse (4), das um die flexible Leiterplatte (2, 2A, 2B) und die Lichtquellen (3) geformt ist, sodass ein integriertes flexibles längliches Objekt ausgeformt ist;
 wobei die Lichtquellen (3) so angeordnet sind, dass Licht im Wesentlichen normal zur flexiblen Leiterplatte (2, 2A, 2B) emittiert wird;
 wobei das Gehäuse (4) aufweist, mindestens einen ersten Abschnitt (7) und einen zweiten Abschnitt (8), die sich entlang der flexiblen Leiterplatte (2, 2A, 2B) erstrecken,
 wobei der erste Abschnitt (7) im Wesentlichen lichtdurchlässig für das von den Lichtquellen (3) emittierte Licht ist,
dadurch gekennzeichnet, dass die ersten und zweiten Abschnitte (7; 8) so angeordnet sind, dass das emittierte Licht an dem zweiten Abschnitt (8) reflektiert und die Hauptverteilungsrichtung des emittierten Lichtes so umgeleitet wird, dass ein Intensitätsmuster entsteht mit einer maximalen Intensität in einer Richtung (E) bei einem Winkel ungleich null (α) zur Normale (H) der flexiblen Leiterplatte (2, 2A, 2B).
2. Flexibles Leuchtband (1, 1A, 1B) gemäß Anspruch 1, wobei der Winkel (α) zu der Normale (H) der flexiblen Leiterplatte (2, 2A, 2B) zwischen 30 und 60 Grad, z.B. ungefähr 45 Grad, zur Normale (H) der flexiblen Leiterplatte (2, 2A, 2B) beträgt.
 3. Flexibles Leuchtband (1, 1A, 1B) gemäß Anspruch 1 oder 2, wobei mindestens ungefähr die Hälfte der emittierten Intensität des von den Lichtquellen (3) emittierten Lichtes von dem zweiten Abschnitt (8) reflektiert, dadurch umgeleitet, und von dem Leuchtband in einer Richtung (E) bei einem Winkel (α) zur Normale (H) der flexiblen Leiterplatte (2) emittiert wird.
 4. Flexibles Leuchtband (1, 1A, 1B) gemäß irgendeinem der vorangegangenen Ansprüche, wobei das flexible Leuchtband (1, 1A, 1B) im Querschnitt eine im Wesentlichen rechteckige Form mit ersten und zweiten sich gegenüberliegenden Flächen (10; 11) und dritten und vierten sich gegenüberliegenden Flächen (12; 13) aufweist, wobei sich die flexible Leiterplatte (2) im Wesentlichen parallel zur ersten Fläche erstreckt, und der erste und zweite Abschnitt (7; 8) so angeordnet sind, dass mindestens ungefähr die Hälfte der von dem Leuchtband (1, 1A, 1B) emittierten Intensität von der dritten und/oder vierten Fläche (12; 13) emittiert wird.
 5. Flexibles Leuchtband (1, 1A, 1B) gemäß irgendeinem der vorangegangenen Ansprüche, wobei das Leuchtband (1, 1A, 1B) einen oder mehrere zweite elektrische Leiter (6) aufweist, die sich im Wesentlichen durchgehend parallel zu der flexiblen Leiterplatte (2, 2A, 2B) erstrecken und an mehreren Positionen elektrisch mit der flexiblen Leiterplatte (2, 2A, 2B) verbunden sind; und wobei das Gehäuse (4) um die flexible Leiterplatte (2, 2A, 2B), die Lichtquellen (3) und die zweiten elektrischen Leiter (6) geformt ist, sodass ein integriertes flexibles längliches Objekt ausgebildet ist.
 6. Flexibles Leuchtband (1, 1A, 1B) gemäß irgendeinem der vorangegangenen Ansprüche, wobei die flexible Leiterplatte (2) eine Mehrzahl von Bereichen (2A, 2B, 2C) aufweist, die durch Verbindungselemente (17) mechanisch und elektrisch miteinander verbunden sind; und wobei das Gehäuse (4) entlang der Mehrzahl von Bereichen (2A, 2B, 2C) im Wesentlichen kontinuierlich ist.
 7. Flexibles Leuchtband (1, 1A, 1B) gemäß Anspruch 6, wobei der eine oder mehrere zweite Leiter (6) entlang der Mehrzahl von Bereichen (2A, 2B, 2C) im Wesentlichen kontinuierlich ist.
 8. Flexibles Leuchtband (1, 1A, 1B) gemäß irgendeinem der vorangegangenen Ansprüche, wobei das flexible Leuchtband (1, 1A, 1B) ein im Wesentlichen massives Objekt ist.
 9. Flexibles Leuchtband (1, 1A, 1B) gemäß irgendeinem der vorangegangenen Ansprüche, wobei zumindest einige der Mehrzahl von Lichtquellen (3) zum Emittieren von farbigem Licht angeordnet sind.
 10. Flexibles Leuchtband (1, 1A, 1B) gemäß irgendeinem der vorangegangenen Ansprüche, wobei zumindest einige der Mehrzahl von Lichtquellen (3) so angeordnet sind, dass diese individuell steuerbar sind.
 11. Anordnung, aufweisend mindestens ein flexibles Leuchtband (1, 1A, 1B) gemäß Anspruch 5 oder gemäß Anspruch 5 und jedem von Anspruch 5 abhängigem Anspruch, und weiterhin aufweisend einen oder mehrere Konnektoren (16, 20, 21) zum Verbinden mindestens eines ersten Leiters mit mindestens einem zweiten Leiter (6) des mindestens einen flexiblen Leuchtbandes (1, 1A, 1B).
 12. Anordnung gemäß Anspruch 11, aufweisend mindestens ein erstes flexibles Leuchtband (1A) und ein zweites flexibles Leuchtband (1B), das erste und zweite flexible Leuchtband (1A; 1B) sind dabei flexible Leuchtbänder (1, 1A, 1B) gemäß Anspruch 4

oder gemäß Anspruch 4 und jedem von Anspruch 4 abhängigem Anspruch,
wobei die Anordnung weiter aufweist, mindestens einen Konnektor (16, 20, 21) zum Verbinden mindestens eines ersten Leiters sowohl des ersten als auch des zweiten flexiblen Leuchtbandes (1A; 1B) mit mindestens einem zweiten Leiter (6) des mindestens einen ersten und zweiten flexiblen Leuchtbandes (1A, 1B).

Revendications

1. Bande d'éclairage flexible (1, 1A, 1B) comprenant une carte de circuit imprimé flexible (2, 2A, 2B), une pluralité de sources lumineuses (3) agencées sur la carte de circuit imprimé flexible (2, 2A, 2B) pour émettre de la lumière, des premiers conducteurs pour transporter un courant, agencés sur la carte de circuit imprimé flexible (2, 2A, 2B), connectés et agencés pour mettre sous tension les sources lumineuses (3), et un boîtier (4) qui est formé autour de la carte de circuit imprimé flexible (2, 2A, 2B) et des sources lumineuses (3) afin de former un objet allongé flexible intégré ; dans laquelle les sources lumineuses (3) sont agencées pour émettre de la lumière de façon sensiblement normale par rapport à la carte de circuit imprimé flexible (2, 2A, 2B) ; dans laquelle le boîtier (4) comprend au moins une première partie (7) et une seconde partie (8) s'étendant le long de la carte de circuit imprimé flexible (2, 2A, 2B), dans laquelle la première partie (7) est sensiblement translucide pour de la lumière émise par les sources lumineuses (3), **caractérisée en ce que** les première et seconde parties (7 ; 8) sont agencées de sorte que la lumière émise soit réfléchie à partir de la seconde partie (8) et la direction de distribution principale de la lumière émise soit redirigée pour produire un motif d'intensité avec une intensité maximum dans une direction (E) à un angle non nul (α) par rapport à la normale (H) de la carte de circuit imprimé flexible (2, 2A, 2B).
2. Bande d'éclairage flexible (1, 1A, 1B) selon la revendication 1, dans laquelle l'angle (α) par rapport à la normale (H) de la carte de circuit imprimé flexible (2, 2A, 2B) est dans une plage de 30 à 60 degrés, par exemple environ 45 degrés, par rapport à la normale (H) de la carte de circuit imprimé flexible (2, 2A, 2B).
3. Bande d'éclairage flexible (1, 1A, 1B) selon la revendication 1 ou 2, dans laquelle au moins environ la moitié de l'intensité émise de la lumière émise par les sources lumineuses (3) est réfléchie à partir de la seconde partie (8) et est redirigée par celle-ci et

pour être émise à partir de la bande d'éclairage (1, 1A, 1B) dans la direction (E) à l'angle (α) par rapport à la normale (H) à la carte de circuit imprimé flexible (2).

4. Bande d'éclairage flexible (1, 1A, 1B) selon une quelconque revendication précédente, dans laquelle la bande d'éclairage flexible (1, 1A, 1B) présente une forme sensiblement rectangulaire en section transversale avec des première et deuxième faces opposées (10 ; 11) et des troisième et quatrième faces opposées (12 ; 13), la carte de circuit imprimé flexible (2) s'étend sensiblement parallèlement à la première face et les première et seconde parties (7 ; 8) sont agencées de sorte qu'au moins environ la moitié de l'intensité émise à partir de la bande d'éclairage (1, 1A, 1B) soit émise à partir des troisième et/ou quatrième faces (12 ; 13).
5. Bande d'éclairage flexible (1, 1A, 1B) selon une quelconque revendication précédente, dans laquelle la bande d'éclairage (1, 1A, 1B) comprend un ou plusieurs seconds conducteurs électriques (6) s'étendant de façon sensiblement ininterrompue en parallèle à la carte de circuit imprimé flexible (2, 2A, 2B) et électriquement connectés la carte de circuit imprimé flexible (2, 2A, 2B) dans plusieurs positions ; et dans laquelle le boîtier (4) est formé autour de la carte de circuit imprimé flexible (2, 2A, 2B), des sources lumineuses (3) et des seconds conducteurs électriques (6) afin de former un objet allongé flexible intégré.
6. Bande d'éclairage flexible (1, 1A, 1B) selon une quelconque revendication précédente, dans laquelle la carte de circuit imprimé flexible (2) comprend une pluralité de sections (2A, 2B, 2C) qui sont mécaniquement et électriquement interconnectées avec des parties de connexion (17) et dans laquelle le boîtier (4) est sensiblement continu le long de la pluralité de sections (2A, 2B, 2C).
7. Bande d'éclairage flexible (1, 1A, 1B) selon la revendication 6, dans laquelle le ou les seconds conducteurs électriques (6) sont sensiblement continus le long de la pluralité de sections (2A, 2B, 2C).
8. Bande d'éclairage flexible (1, 1A, 1B) selon une quelconque revendication précédente, dans laquelle la bande d'éclairage flexible (1, 1A, 1B) est un objet sensiblement massif.
9. Bande d'éclairage flexible (1, 1A, 1B) selon une quelconque revendication précédente, dans laquelle au moins certaines parmi la pluralité de sources lumineuses (3) sont agencées pour émettre de la lumière colorée.

10. Bande d'éclairage flexible (1, 1A, 1B) selon une quelconque revendication précédente, dans laquelle au moins certaines parmi la pluralité de sources lumineuses (3) sont agencées pour pouvoir être individuellement commandées. 5
11. Ensemble comprenant au moins one bande d'éclairage flexible (1, 1A, 1B) selon la revendication 5 ou selon la revendication 5 et une quelconque revendication dépendant de la revendication 5, et 10
comprenant en outre un ou plusieurs connecteurs (16, 20, 21) pour interconnecter au moins un premier conducteur avec au moins un second conducteur (6) de l'au moins une bande d'éclairage flexible (1, 1A, 1B). 15
12. Ensemble selon la revendication 11, comprenant au moins une première bande d'éclairage flexible (1A) et une seconde bande d'éclairage flexible (1B), les 20
première et seconde bandes d'éclairage flexibles (1A ; 1B) étant toutes les deux une bande d'éclairage flexible (1, 1A, 1B) selon la revendication 4 ou selon la revendication 4 et une quelconque revendication dépendant de la revendication 4, 25
dans lequel l'ensemble comprend en outre au moins un connecteur (16, 20, 21) pour interconnecter au moins un premier conducteur à la fois des première et seconde bandes d'éclairage flexibles (1A; 1B) et 30
au moins un second conducteur (6) d'au moins une des première et seconde bandes d'éclairage flexibles (1A ; 1B).

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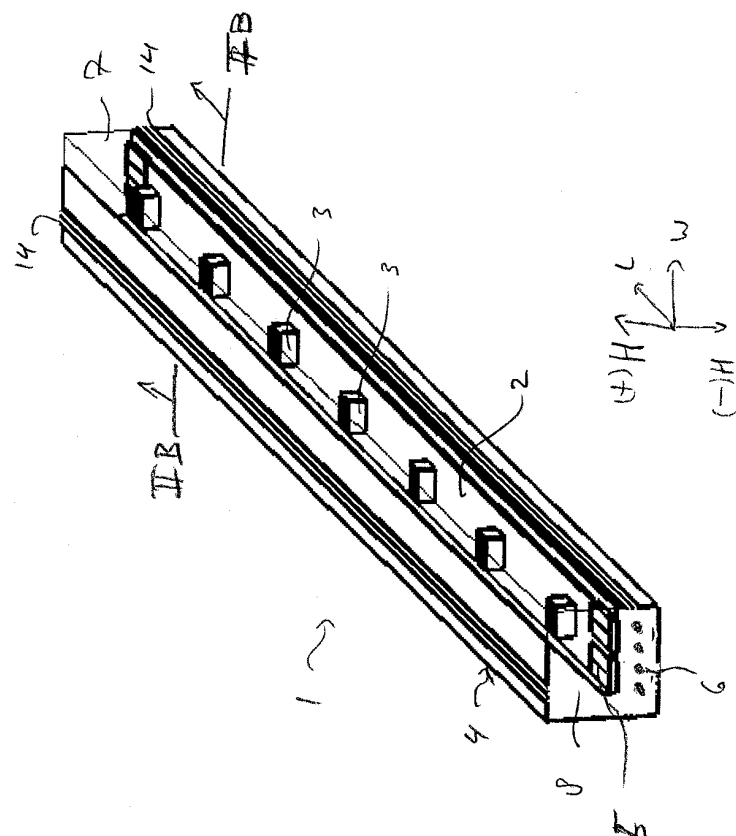


Fig. 2A

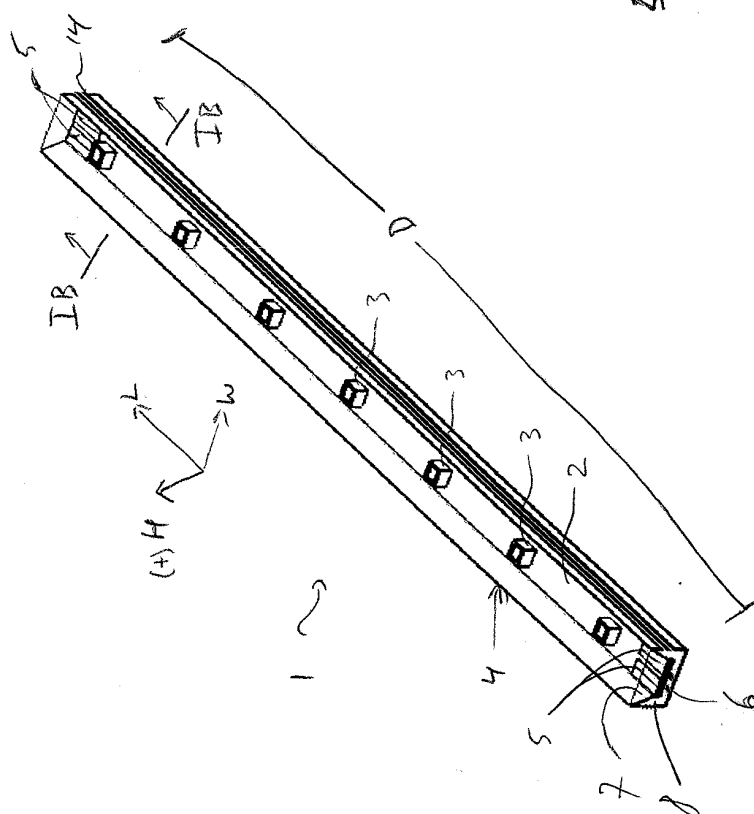
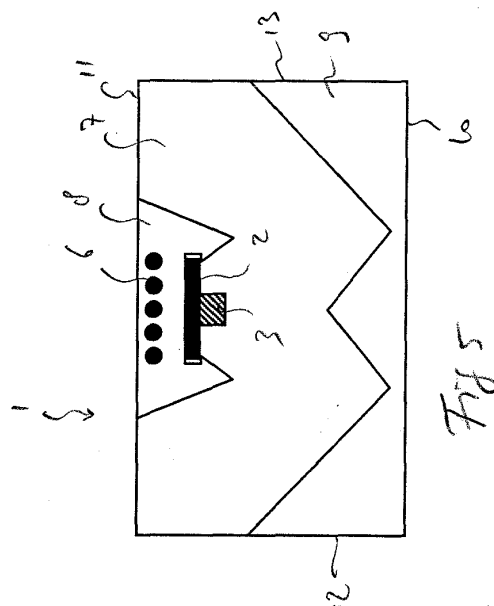
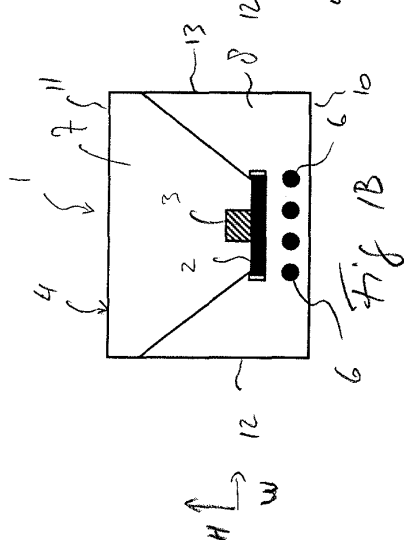
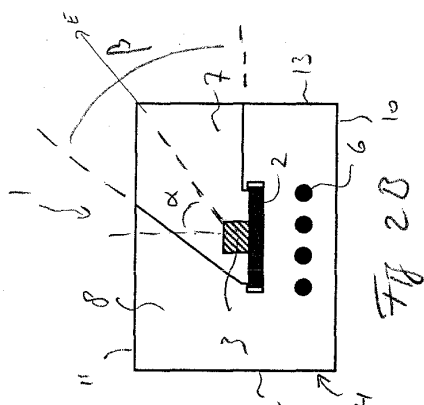
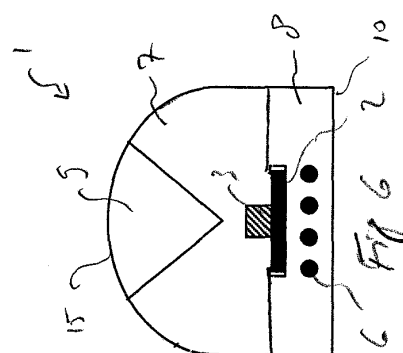
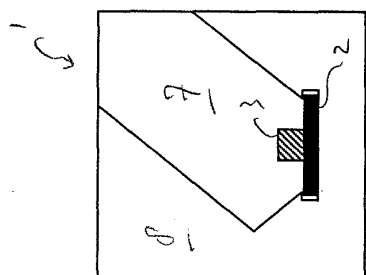
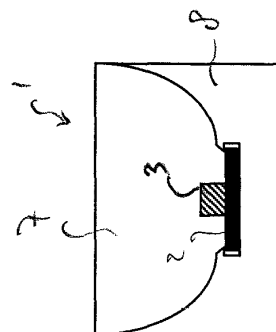
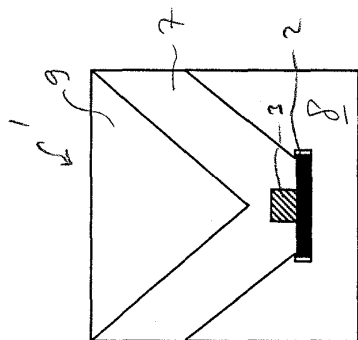
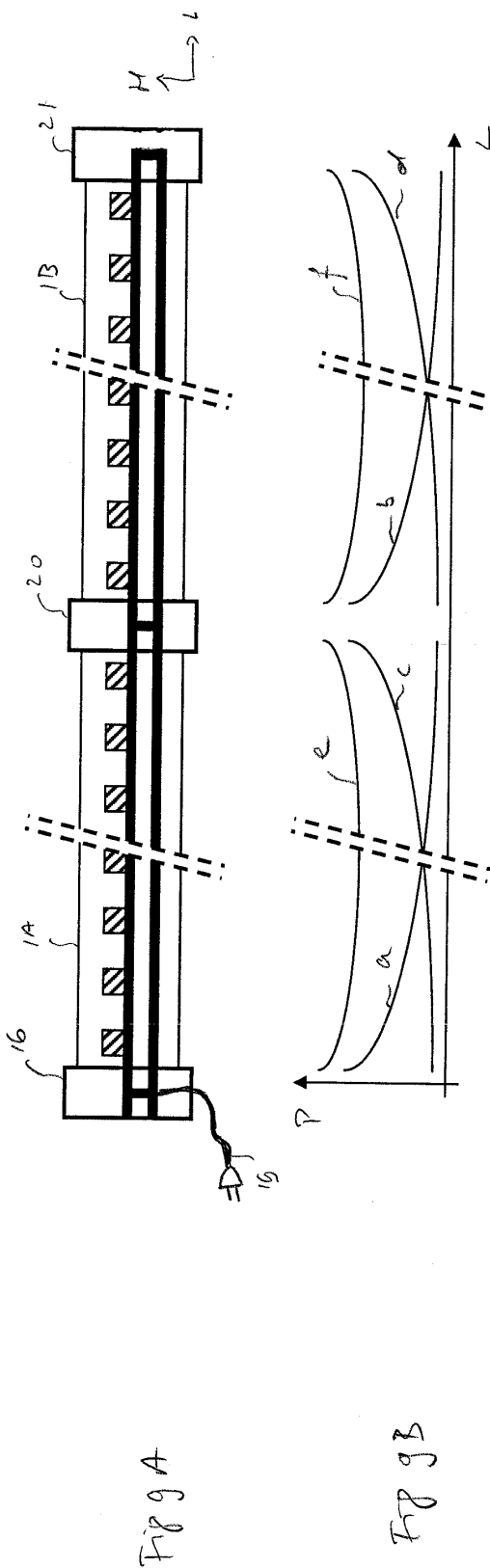
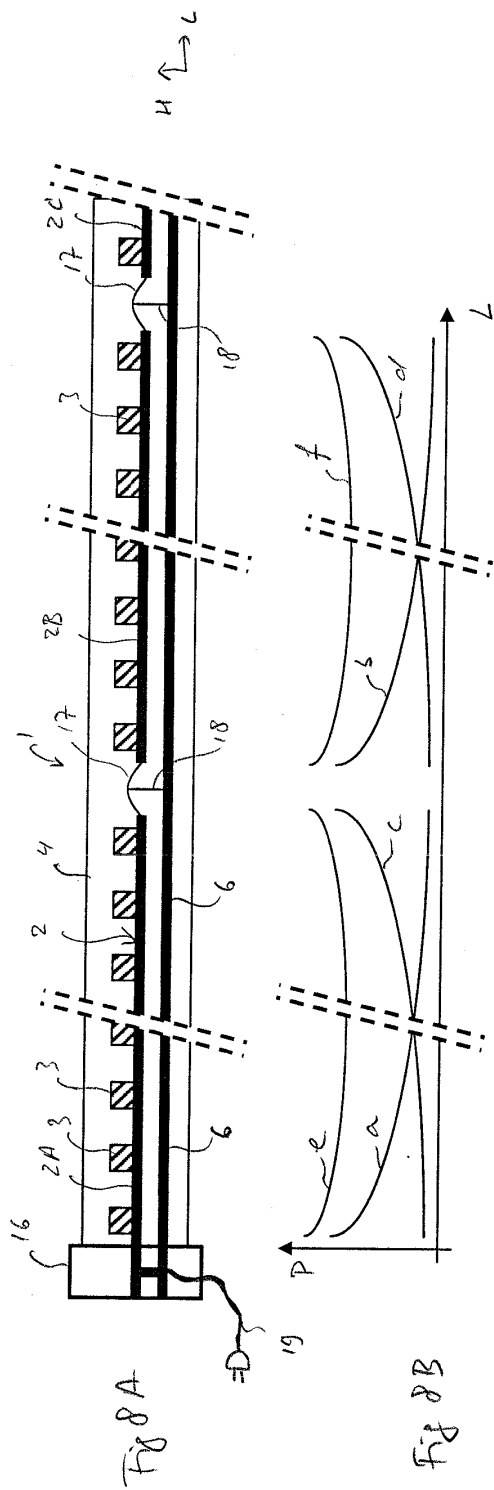


Fig. 1A





REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1756471 A [0003]
- US 7401949 B [0005]
- EP 0939876 A [0006]
- EP 0760448 A [0008]
- DE 202005002425 [0010]
- DE 29706201 [0010]
- US 20080239716 A [0010]
- EP 1357331 A [0010]
- DE 202005006643 [0010]
- US 4908743 A [0010]