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(71) **Applicant**: **COOPER TECHNOLOGIES COMPANY** [US/US]; 600 Travis Street, Suite 5600, Houston, TX 77002 (US).

(72) **Inventor**: **CLEMENTS, Russ**; 969 Gilbert St Se, Atlanta, GA 30316 (US).

(74) **Agent**: **NEUFELD, Robert, T.**; King & Spalding, 1100 Louisiana, Suite 4000, Houston, TX 77002-5213 (US).

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(54) **Title**: EDGELIT MULTI-PANEL LIGHTING SYSTEM

(57) **Abstract**: A lighting system can include a lightguide having an edge and two major surfaces. The lightguide can be mounted in a frame so that one of the major surfaces faces towards an area to be illuminated, while the other major surface faces away from the area. LEDs can couple light into the lightguide edge, with the coupled light emitting from both major surfaces. Light emitted from the major surface that faces away from the area to be illuminated can be reflected back into the lightguide by a reflective surface. The reflective surface can be separated from the lightguide by an air gap. The air gap can promote internal reflection at the major surface facing away from the area to be illuminated, thereby enhancing homogeneity and output of light towards the area to be illuminated. The frame can include integral wireways, reflector retention clips, and grounding circuitry.

EDGELIT MULTI-PANEL LIGHTING SYSTEM

TECHNICAL FIELD

Embodiments described herein generally relate to lighting fixtures and, more particularly, to systems involving multiple edgelit lightguides.

BACKGROUND

With greater adoption of Light Emitting Diode (LED) light sources, new lighting systems have begun incorporating alternative means for casting, distributing, and reflecting light. While edgelit lighting systems are desirable for many applications, improved technologies are needed in order for edgelit systems to meet their full potential. Need is apparent for improvement in the fixtures that mount and provide power and other facilities for edgelit lighting systems. For example, need exists for improved wire management technology. As another example, need exists for improved mounting technologies for lightguides and associated reflectors. In this representative context, embodiments described herein relate to lighting systems, including edgelit systems involving edgelit lightguides.

SUMMARY

A lighting system can comprise at least two lightguides that each receives, guides, and distributes light. In certain embodiments, each lightguide can comprise a slab, plate, sheet, panel, or other piece of optical material that in outline may be rectangular, square, circular, triangular, or some other appropriate shape or geometric form. The piece of optical material can be flat, slightly curved, or have another appropriate profile or geometry. The lightguides can be mounted in a frame. A light source can couple light into one or more edges of the lightguides. The coupled light can propagate in the lightguides and emit from major surfaces of the lightguides, thereby distributing and spreading the light. In a typical application, one of the major surfaces of each lightguide faces away from an area to be illuminated, while the other major surface faces towards the area to be illuminated. Light emitted from the major surface that faces away from the area to be illuminated can be redirected towards the area to be illuminated by a reflective

surface positioned next to that major surface. The reflective surface, which can be diffusely reflective, specularly reflective, or a combination of specularly and diffusely reflective, can be spaced slightly away from the lightguide. The space between the lightguide and the reflective surface can provide an air gap. The air gap can promote internal reflection at the major surface facing away from the area to be illuminated and further can enhance light uniformity or homogeneity in the area to be illuminated. Promoting internal reflection on the major surface facing away from the area to be illuminated can reduce the amount of light that emits from the lightguide in the "wrong" direction and needs to be redirected towards the area to be illuminated. The frame can comprise one or more channels for distributing or carrying electrical lines for supplying electrical power. The channels, which can function as wireways, can be integral with the frame, for example formed during molding or other appropriate frame fabrication process.

The foregoing discussion of lighting systems is for illustrative purposes only. Various aspects of the present technology may be more clearly understood and appreciated from a review of the following detailed description of the disclosed embodiments and by reference to the drawings and the claims that follow. Moreover, other aspects, systems, methods, features, advantages, and objects will become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such aspects, systems, methods, features, advantages, and objects are to be included within this description, are to be within the scope of the present technology, and are to be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE FIGURES

Reference will be made below to the accompanying drawings, wherein:

Figure 1A and 1B (collectively Figure 1) illustrate a lighting system according to some example embodiments. Figure 1A illustrates a perspective view of the lighting system as assembled, while Figure 1B illustrates an internal side of an endplate of the lighting system.

Figures 2A, 2B, and 2C (collectively Figure 2) illustrate additional internal features of the lighting system illustrated in Figure 1 according to some example

embodiments. Figure 2A illustrates internal portions of the lighting system, provided by removing an endplate of the lighting system to expose internal features. Figure 2B illustrates an expanded view of the left-hand side of Figure 2A. Figure 2C illustrates a perspective view of the lighting system from an overhead vantage point that shows internal features of the lighting system.

Figure 3 illustrates another internal view of the lighting system illustrated in Figure 1 according to some example embodiments. For the view of Figure 3, the lighting system is cut between the two endplates (with only one endplate shown, in cross section), and the result is shown in perspective.

Figure 4 illustrates another internal view of the lighting system illustrated in Figure 1 according to some example embodiments. Figure 4 is similar to Figure 2B, but depicting separation between a lightguide and a reflector of the lighting system to enhance illumination output in a desired direction.

Figures 5A, 5B, 5C, 5D, 5E, and 5F (collectively Figure 5) illustrate a reflector of the lighting system illustrated in Figure 1 according to some example embodiments. Figure 5A illustrates a perspective view. Figures 5B, 5C, and 5D illustrate orthogonal views. Figure 5E illustrates a detail view. Figures 5F and 5G illustrate cross sectional views taken in the detail view of Figure 5E.

Figures 6A, 6B, 6C, 6D, 6E, 6F, and 6G (collectively Figure 6) illustrate an endplate of the lighting system illustrated in Figure 1 according to some example embodiments. Figure 6A illustrates a perspective view. Figures 6B, 6C, 6D, and 6E illustrate orthogonal views. Figure 6F illustrates a detail view. Figure 6G illustrates a cross sectional view taken in the detail view of Figure 6F.

Figure 7 illustrates packaging for the lighting system illustrated in Figure 1 according to some example embodiments.

Many aspects of the technology can be better understood with reference to these drawings. The elements and features shown in the drawings are not necessarily drawn to scale, emphasis instead being placed upon clearly illustrating the principles of exemplary embodiments of the present technology. Moreover, certain dimensions may be exaggerated to help visually convey such principles. In the drawings, reference numerals

designate like or corresponding, but not necessarily identical, elements throughout the several views.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

A lighting system can comprise a light source and an element that receives, transmits, and emits light produced by the light source. In certain embodiments, the light source comprises one or more light emitting diodes. In certain embodiments, the element that receives, transmits, and emits light comprises a lightguide. The lightguide may have a generally planar format as may be provided with a slab, plate, sheet, or panel of optical material, for example. A frame may position such light emitting diodes beside an edge of the lightguide, and the lightguide may emit light in a beneficial direction as well as in an opposing direction. A reflective element positioned at a standoff distance from the lightguide may redirect the light that is emitted in the opposing direction, causing it to head in the beneficial direction. An air gap associated with the standoff distance may reduce the amount of light that the lightguide emits in the opposing direction, so that less light needs redirection. The air gap can further enhance homogeneity of the lightguide as viewed by someone in an illuminated area, for example avoiding a spotted or wetted appearance. In certain embodiments, the frame may have one or more built-in channels that serve as wireways for routing wires that supply electrical power to the lighting system.

The present technology can be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the technology to those having ordinary skill in the art. Furthermore, all "examples" or "exemplary embodiments" given herein are intended to be non-limiting and among others supported by representations of the present technology.

Turning now to the figures, a lighting system 10 according to some example embodiments is illustrated in Figure 1. Figure 1A provides a perspective view. Figure 1B shows an internal side of an endplate 12 of the lighting system 10 along with representative adjoining elements.

As illustrated, the example lighting system 10 comprises two lightguides 200, each with an associated reflector 300, that are held in position by a frame 100. The frame 100 comprises two endplates 12, with a wireway bracket 17 and a reflector clamp bracket 19 extending between the two endplates 12. In additional to its structural role, the wireway bracket 17 provides a wireway for electrical supply lines. In addition to its structural role, the reflector clamp bracket 19 pulls heat associated with the lighting system 10 generating light and dissipates the heat.

A respective line of light emitting diodes 222 extends along an edge 250 of each of the two lightguides 200. In some embodiments, reflective tape is applied to edges of each lightguide that do not have adjacent light emitting diodes 222. Light emitting diodes 222 provide an example of a light source; however, in some embodiments, other appropriate light sources may be substituted. The light emitting diodes 222 emit light into the lightguides 200, and the light propagates in the two lightguides 200 guided by total internal reflection between two major surfaces 281, 282 of the lightguides 200. While light that is emitted into the lightguides 200 at relatively shallow angles undergoes total internal reflection, light at steeper angles spills through the major surfaces 281, 282.

The major surfaces 281 of the two lightguides 200 are oriented by the frame 100 for illuminating an area to be illuminated, while the major surfaces 282 are oriented away from the area to be illuminated. Thus, when the lighting system 10 is installed, light emitting through the major surfaces 281 provides beneficial illumination, while light emitting through the major surfaces 282 is in the opposite direction for providing beneficial illumination. The reflectors 300 redirect the light that is headed in the wrong direction so that the redirected light can provide beneficial illumination.

The lighting system 10 may be installed above or otherwise adjacent an area to be illuminated. The installation may involve replacement of one or more drop-in panels of a suspended ceiling, recess in ceiling or a wall, or mounting to a surface of a wall or ceiling or other appropriate structure, for example. Thus in operation, the lighting system 10 can illuminate an area by emitting light outward from the major surfaces 281 of the lightguides 200, including light that reflects off the reflectors 300. Light from light emitting diodes 222 adjacent a vertex of the lighting system 10 transmits into an edge 250 of the lightguides 200 and scatters, distributes, and/or reflects off the reflector 300, and

emits from the major surfaces 281 of the lightguides 200. More specifically, the coupled light from the light emitting diodes 222 propagates along the lightguides 200guided by total internal reflections off the major surfaces 281, 282 of the lightguides 200. Portions of the light incident to the major surfaces 281, 282 transmit through those surfaces 281, 282. Light transmitting through the major surface 281 is distributed to an area to be lit, for example a room. Light transmitting through the major surface 282 is directed back through the lightguide 200 by the reflector 300, for ultimate emission through the major surface 281 as beneficial illumination.

In certain example embodiments, each reflector 300 comprises a mirror or specularly reflective surface. In certain embodiments, each reflector 300 comprises a diffusely reflective surface such as a surface coated with flat white paint. In certain example embodiments, each reflector 300 is treated with a power coating or a gloss or matte powder paint. In certain example embodiments, each reflector 300 is faceted or comprises a surface relief pattern or other features that promote directionality of light reflection. In certain example embodiments, the reflectors 300 are curved or domed and are highly reflective. As will be discussed in further detail below and depicted in other figures, an air gap between each reflector 300 and its associated lightguide 200 reduces light transmission through the lightguide's major surface 282 and thus increases light output from the lightguide's major surface 281.

In various embodiments, the lighting system 10 may vary in shape and size. For example, although the lighting fixture 10 illustrated in Figure 1 has a footprint or outline that is approximately square, lighting fixtures of triangular, square, rectangular, polygonal, circular, or other appropriate shapes are within the scope and spirit of the embodiments described herein. The lighting system 10 may be formed from various types of suitable materials. In some exemplary embodiments, the frame 100 is formed from a combination of plastic and metal, and the lightguides 200 are formed from a plastic, polymer, acrylic, glass, or other suitable material and may include reinforcements such as glass. In the example embodiment of Figure 1, the endplates 12 can be made of plastic via molding, and the wireway bracket 17 and reflector clamp bracket 19 can comprise aluminum or other suitable metal or rigid material. In some embodiments, one or both of the wireway bracket 17 and the reflector clamp bracket 19 comprise aluminum

extrusions. Thus, the frame 100 and its components can support/enclose the lightguides 200.

In the illustrated example embodiment, elements of the lighting system 10 are arranged in a polyhedron. The lightguides 200 form two faces of the polyhedron, meeting in vertex at the apex of the lighting system 10. In the illustrated example embodiment, the two lightguides 200 converge in an obtuse angle. The endplates 12 form two additional faces of the polyhedron. A fifth face of the polyhedron is provided by the aperture 181 of the lighting system 10, which is the portion of the lighting system 10 that emits light into the area to be illuminated. Thus, the outline or footprint of the lighting system can provide a fifth polyhedron face opposite the vertex formed between the two lightguides 200.

Referring now to Figure 2, this figure illustrates additional internal features of the lighting system 10 illustrated in Figure 1 according to some example embodiments. Figure 2A provides an internal view of the lighting system 10, provided by removing one of the two endplates 12 of the lighting system 10 to expose representative internal features. Figure 2B illustrates an expanded view of the left-hand side of Figure 2A with additional elements removed to benefit the view. Figure 2C illustrates a overhead perspective view of the lighting system 10 that shows internal features of the lighting system 10.

Figure 2A depicts the reflector 300 raised above the lightguide 200 to provide an air gap for enhancing reflection off the outwardly facing major surface 281 of the lightguide 200 as discussed above and as described in further detail below. As best shown in Figures 2B and 2C, the endplates 12 comprise reflector and waveguide restraints 232 for restraining the reflectors 300 and the waveguides 200 in the frame 100. For each reflector 300, the restraints 232 are positioned along the reflector edges to urge the reflector edge against the adjoining waveguide edge. As shown in Figure 3, the reflector edge, in turn, is urged against an adjoining shoulder 338 of the frame 100. In the illustrated example embodiment, each restraint 232 comprises a flap of material on the frame 100 that is angled inward, over the adjoining edges of the reflector and waveguide 200. In the illustrate embodiment, the flap is an integral and seamless part of the frame 100. In other embodiments, the flap may be fastened to the frame 100 using

adhesive, screws, rivets, or another appropriate means. Accordingly, the waveguide edge is sandwiched between the shoulder 338 of the frame 100 and the reflector edge. As depicted in Figures 3 and 4 and discussed below, portions of the reflector 300 that are away from the reflector edges are raised so that an air gap 333 is provided between a majority of the reflector's surface area and the lightguide 200.

As shown in Figure 2B, the lighting system 10 further comprises a spring system 231 for urging each lightguide 200 towards its associated light emitting diodes 222. The spring system 231 promotes coupling of light into the waveguides 200 and relaxes tolerances to realize economical and fabrication benefits. Various example embodiments of the spring system 231 as well as various embodiments of light sources and technology for aligning light emitting diodes to waveguide edges are disclosed in U.S. Patent Application No. 13/788,827 entitled "Edgelit Lighting Fixture and Assembly" that was filed on March 7, 2013 in the name of James Blessitt, Russ Clements, and Ellis Patrick, the entire contents of which are hereby incorporated herein by reference. Embodiments of the lighting system 10 can comprise one or more of the various technologies, systems, and elements disclosed in U.S. Patent Application No. 13/788,827.

Figure 2 further illustrates a wire management system 275 that is integrated with the frame 100. The wire management system 275 routes electrical lines 276 that supply electrical power for the light emitting diodes 222. In the illustrated example embodiment, the electrical lines 276 comprise individually insulated electrical conductors or wires. The wire management system 275 maintains the electrical lines 276 in a linear array, as illustrated.

The illustrated wire management system 275 provides a channel that extends along an upper edge of the endplate 12. Segments of the channel are located on the inward facing side of the endplate 12, which is visible in Figures 2A, 2B, 2C, 6A, and 6D. Other segments of the channel are located on the outward facing side of the endplate 12, which is shown in Figure 6C. More specifically, the inward facing side comprises recessed regions 234 in which the electrical lines 276 extend lengthwise next to one another. Tabs 233 are located between the recessed regions, and the electrical lines 276 extend on the outward facing side of the endplate 12 at those tabs 233. Thus, the electrical lines 276 continue "behind" the tabs from perspective of Figures 2A, 2B, and

2C. Accordingly, the channel and the electrical lines 276 oscillate or weave between sides of the endplate 12 and thus sides of the frame 100. Openings or slots are provided at the transitions between sides of the endplate 12 to facilitate lacing the electrical lines 276 into the channel.

Referring now to Figure 3, this figure illustrates another internal view of the lighting system 10 illustrated in Figure 1 according to some example embodiments. In Figure 3, the lighting system 10 is shown in perspective as cut between the two endplates 12. Figure 3 depicts the shoulder 338 and the retainers 232 capturing the edges of the lightguide 200 and the reflector 300. Figure 3 further illustrates an example embodiment of the reflector 300 having a concave reflective surface that provides an air gap 333 for promoting internal reflection at the major surface 281 of the lightguide 200.

Referring now to Figure 4, this figure illustrates another internal view of the lighting system 10 illustrated in Figure 1 according to some example embodiments. The view of Figure 4 is similar to that of Figure 2B, but emphasizing example separation between the lightguide 200 and the reflector 300 of the lighting system 10. The separation enhances illumination output in a desired direction as discussed above. The separation further helps avoid a spotty or wetted appearance that may result from intermittent, uncontrolled contact between the reflector 300 and the lightguide 200. As illustrated in Figure 4, the major surface 282 of the lightguide 200 contacts the reflector 300 at a perimeter of the lightguide 200. In the illustrated example embodiment, contact is limited to the edges of the lightguide 200 to avoid or limit frustration of total internal reflection at the major surface 282. The shoulder 338 of the frame 100 (illustrated in Figure 3) essentially limits contact to portions of the lightguide 200 that are hidden from the view of a person located in an area illuminated by the lighting system 10.

Referring now to Figure 5, this figure illustrates a reflector 300 of the lighting system 10 illustrated in Figure 1 according to some example embodiments. Figure 5A illustrates a perspective view. Figures 5B, 5C, and 5D illustrate orthogonal views. The view of Figure 5C is taken at section B-B as indicated on Figure 5B, while the view of Figure 5D is taken at section A-A as indicated on Figure 5B. Figure 5E illustrates a detail view taken in the area of Figure 5B denoted "C." Figures 5F and 5G illustrate

cross sectional views taken in the detail view of Figure 5D. Figure 5F is taken at indicated section D-D, while Figure 5G is taken at indicated section E-E.

In the illustrated embodiment, the reflector 300 comprises holes 550 for hanging the reflector 300 during fabrication, specifically while the reflector is powder coated. In some example embodiments, the reflector 300 comprises a matte white material for diffuse reflectance. In some example embodiments, the reflector 300 provides specular reflectance, such as via a mirrored metallic coating. In some example embodiments, the reflector 300 is embossed. In some embodiments, the reflector 300 is formed of embossed metal. In some embodiments, the reflector 300 is dish-shaped and formed from a thin sheet of metal. In some embodiments, the reflector has a matte powder that provides a rough surface that avoids a wetted appearance. In some embodiments, the reflector 300 reflects light using a combination of specular and diffuse reflection. As discussed above, the illustrated example reflector 300 is concave to limit contact between the reflector 300 and the lightguide 200.

Referring now to Figure 6, this figure illustrates an endplate of the lighting system 10 illustrated in Figure 1 according to some example embodiments. Figure 6A illustrates a perspective view. Figures 6B, 6C, 6D, and 6E illustrate orthogonal views.

Figure 6C illustrates a grounding circuit 666 that is integrated with the endplate 12 to provide grounding to metal components of the frame 100 via physical contact that provides electrical connectivity. The grounding circuit 666 may be embedded in the endplate 12 by positioning one or more electrically conductive wires or electrical traces in a cavity of a mold for the endplate 12 and then injecting molten plastic in the cavity. When the solidified plastic is removed from the mold, the grounding circuit 666 is formed within the endplate 12.

Figure 6F illustrates a detail view of the endplate 12 that is taken at the area of Figure 6B denoted “A” and that describes an example embodiment of the wire management system 275. The detail view of Figure 6F illustrates the tab 233 and the openings 651 for lacing the electrical lines 276 into the channel of the wire management system 275.

Figure 6G illustrates a cross sectional view taken in the detail view of Figure 6F at indicated section B-B. Figure 6G further illustrates the wire management system 275, depicting the channel 661 of the wire management system 275 in cross section.

Figure 7 illustrates packaging for the lighting system 10 illustrated in Figure 1 according to some example embodiments. In the illustrated embodiment, the packaging system 700 comprises three packaging pieces 705, 715 that are fitted within the lighting system 10 via the aperture 181. Two of the packaging pieces 715 are wedge-shaped and are located below the two waveguides 200. A third packaging piece 705 is block-shaped and is located under the reflector clamp bracket 19.

The packaging pieces 705, 715 may be formed of foam, cardboard, or other appropriate material and collectively or individually coated with plastic film. In some embodiments, the three packaging pieces 705, 715 are combined into one piece. Such a combination may be formed by a unitary molding of foam. Alternatively, the three packaging pieces 705, 715 may be formed individually via molding or other appropriate process and then joined together using adhesive, for example.

In some example embodiments, the packaging system 700 comprises one or more thermoformed plastic inserts with a molded handle. The thermoformed insert(s) can be clear so that the lighting system may be operated and provide illumination during construction, and the insert removed after construction activities are completed.

In addition to protecting the lighting system 10 during shipment, the packaging system 700 facilitates installation of the lighting system 10 without installation personnel needing to touch the lightguides 200. An installer can mount the lighting system 10 overhead while the packaging pieces 705, 715 remain in the aperture 181, thus avoiding risk of marring the lightguides 200.

Once the lighting system 10 is mounted, the installer can readily remove the packaging pieces 705, 715. In situations where constructions activities are ongoing at a site, the packaging pieces 705, 715 can remain in the aperture 181 after mounting. After construction tasks are complete, the packaging pieces 705, 715 may be removed from the aperture 181. In this manner, the lighting system 10 remains clean and avoids accumulation of dust and debris associated with sawing and other typical construction site activities.

Technology for lighting systems has been described. From the description, it will be appreciated that an embodiment of the present technology overcomes the limitations of the prior art. Those skilled in the art will appreciate that the present technology is not limited to any specifically discussed application or implementation and that the embodiments described herein are illustrative and not restrictive. From the description of the exemplary embodiments, equivalents of the elements shown therein will suggest themselves to those skilled in the art, and ways of constructing other embodiments of the present technology will appear to practitioners of the art. Therefore, the scope of the present technology is to be limited only by the claims that follow.

CLAIMS

What is claimed is:

1. A lighting system comprising:

a lightguide comprising:

a first major surface;

a second major surface extending alongside the first major surface; and

an edge formed between the two major surfaces;

one or more LEDs disposed along the edge to couple light into the lightguide through the edge;

a reflector comprising a reflective surface region that is positioned adjacent the first major surface of the lightguide to reflect the coupled light that has exited the lightguide through the first major surface such that the reflected light reenters the lightguide through the first major surface; and

a frame supporting the lightguide, the reflector, and the one or more LEDs so that the second major surface is oriented for providing illumination,

wherein an air gap separates the reflective surface region from the first major surface of the lightguide and the reflector adjoins the first major surface along the edge.

2. The lighting system of Claim 1, wherein the first major surface has a middle,

wherein the reflective surface region extends from the middle towards the edge, and

wherein the air gap is wider at the middle of the first major surface than along the edge.

3. The lighting system of Claim 1, wherein the air gap varies across the reflective surface region.

4. The lighting system of Claim 1, wherein the reflective surface region is concave, and

wherein the lightguide comprises a slab of optical material.

5. The lighting system of Claim 1, wherein the frame comprises an integral wiring channel and an integral grounding trace.

6. The lighting system of Claim 1, wherein the reflector further comprises a second reflective surface region that encloses the reflective surface region, and

wherein the second reflective surface region adjoins the first major surface.

7. A lighting system comprising:

a first lightguide and a second lightguide;

a frame positioning the first lightguide and the second lightguide to form an obtuse angle between the first lightguide and the second lightguide;

a plurality of LEDs supported by the frame and oriented to feed light into respective edges of the first lightguide and the second lightguide; and

a plurality of electrical lines that are electrically connected to the plurality of LEDs and that are supported by a channel formed in the frame.

8. The lighting system of Claim 7, wherein the frame comprises a sheet, and

wherein a first segment of the channel is open on a first side of the sheet and second segment of the channel is open on a second side of the sheet.

9. The lighting system of Claim 7, wherein the frame comprises a member comprising a first side and a second side, and

wherein the plurality of electrical lines extend alongside the member in the channel, oscillating between the first side and the second side of the member.

10. The lighting system of Claim 7, wherein the plurality of electrical lines comprises a plurality of individually insulated wires that are maintained in a linear array by one or more slots in the frame.

11. The lighting system of Claim 7, wherein the first waveguide and the second waveguide each comprises a respective plate of optical material.

12. The lighting system of Claim 7, wherein the frame positions the first lightguide and the second guide according to a polyhedron, with the first lightguide forming a first face of the polyhedron, the second lightguide forming a second face of the polyhedron, and a third face of the polyhedron providing an aperture, and

wherein the first lightguide and the second lightguide are oriented to provide illumination through the aperture.

13. The lighting system of Claim 7, wherein the frame comprises a member comprising:

a first side;

a second side;

a first slot extending into the sheet from an edge of the member; and

a second slot extending into the sheet from the edge of the member,

wherein a first segment of the channel extends on the first side,

wherein a second segment of the channel adjoins the first segment and extends from the first side to the second side at the first slot,

wherein a third segment of the channel adjoins the second segment and extends on the second side,

wherein a fourth segment of the channel adjoins the third segment and extends to the first side at the second slot, and

wherein a fifth segment of the channel adjoins the fourth segment and extends along the first side.

14. The lighting system of Claim 7, wherein the frame comprises a sheet comprising:

a first side;

a second side;

a second edge;

a first slot extending into the sheet from the second edge; and

a second slot extending into the sheet from the second edge,

wherein the plurality of electrical lines comprise a linear array of wires, and

wherein the linear array of wires:

extends along the first side of the sheet to the first slot;

transitions from the first side of the sheet to the second side of the sheet at the first slot;

extends from the first slot to the second slot along the second side of the sheet;

transitions from the second side of the sheet to the first side of the sheet at the second slot; and

extends along the first side of the sheet from the second slot.

15. A lighting system comprising:

a plurality of lightguides, each comprising a respective slab of optical material that comprises a respective edge;

a plurality of light emitting diodes oriented to emit light into the plurality of lightguides through the respective edges;

a plurality of electrical conductors electrically coupled to the plurality of light emitting diodes; and

a frame positioning the plurality of lightguides to form polyhedron faces, comprising:

a first face at which a first lightguide of the plurality of lightguides is disposed along with a first reflector, the first lightguide comprising a first outward facing surface and a first inward facing surface;

a second face at which a second lightguide of the plurality of lightguides is disposed along with a second reflector, the second lightguide comprising a second outward facing surface and a second inward facing surface; and

a third face comprising an aperture,

wherein the first reflector is concave and comprises a first reflective surface region that faces the first outward facing surface and is separated from the first outward facing surface by a first air gap, and

wherein the second reflector is concave and comprises a second reflective surface region that faces the second outward facing surface and is separated from the second outward facing surface by a second air gap.

16. The lighting system of Claim 15, wherein the frame comprises an integral channel through which the plurality of electrical conductors extend,

wherein the first and second reflective surface regions are diffusely reflective, and

wherein the frame comprises two endplates that provide additional polyhedron faces.

17. The lighting system of Claim 15, wherein the frame comprises a first aperture and a second aperture,

wherein the frame comprises an inward facing surface and an outward facing surface,

where the plurality of electrical conductors:

run on the inward facing surface to the first aperture;

run from the inward facing surface to the outward facing surface at the first aperture;

run from the first aperture to the second aperture on the outward facing surface;

run from the outward facing surface to the inward facing surface at the second aperture; and

run from the second aperture on the inward facing surface.

18. The lighting system of Claim 15, wherein the frame comprises an endplate formed from plastic encapsulating a grounding circuit.

19. The lighting system of Claim 15, wherein the plurality of electrical conductors comprises a plurality of individually insulated wires,

wherein the frame comprises a channel that maintains the plurality of individually insulated wires in a linear array,

wherein the first reflective surface region of the first reflector is operative to reflect light emitted by the first outward facing surface of the first lightguide for transmission through the first lightguide and emission from the lighting system via the aperture, and

wherein the second reflective surface region of the second reflector is operative to reflect light emitted by the second outward facing surface of the second lightguide for transmission through the second lightguide and emission from the lighting system via the aperture.

20. The lighting system of Claim 15, wherein the frame comprises a channel in which the plurality of electrical conductors are disposed, and

wherein the channel alternates between being open on an inward facing side of the frame and being open on an outward facing side of the frame.

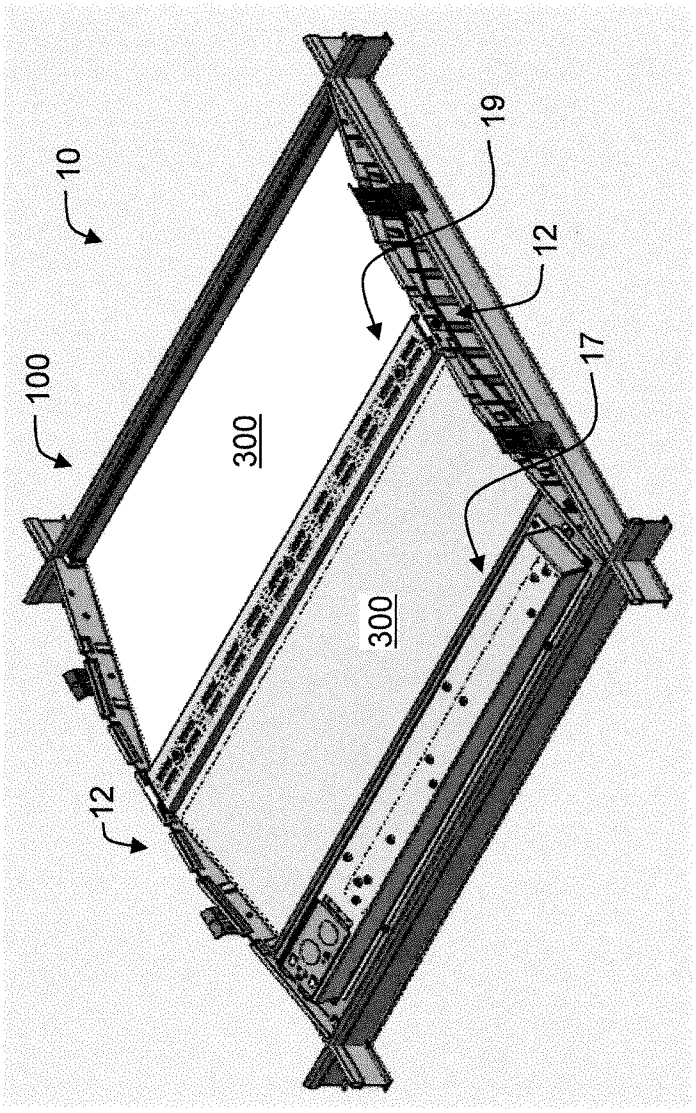
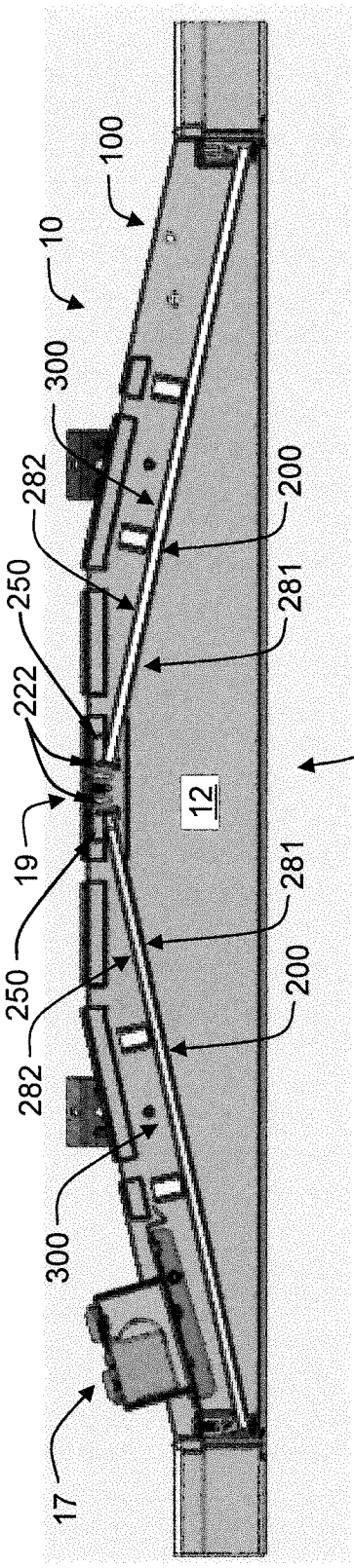

10
100
300
300
19
12
17
12

FIG. 1A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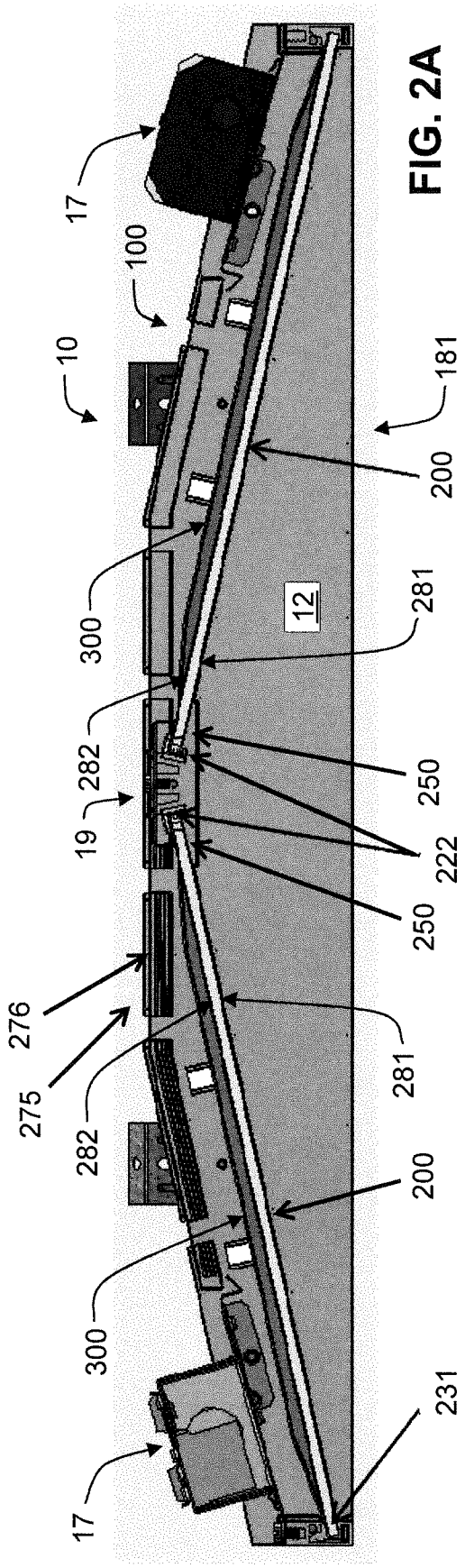
250
222
19
250
282
300
17
200
281
181
12
281
200

FIG. 1B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19
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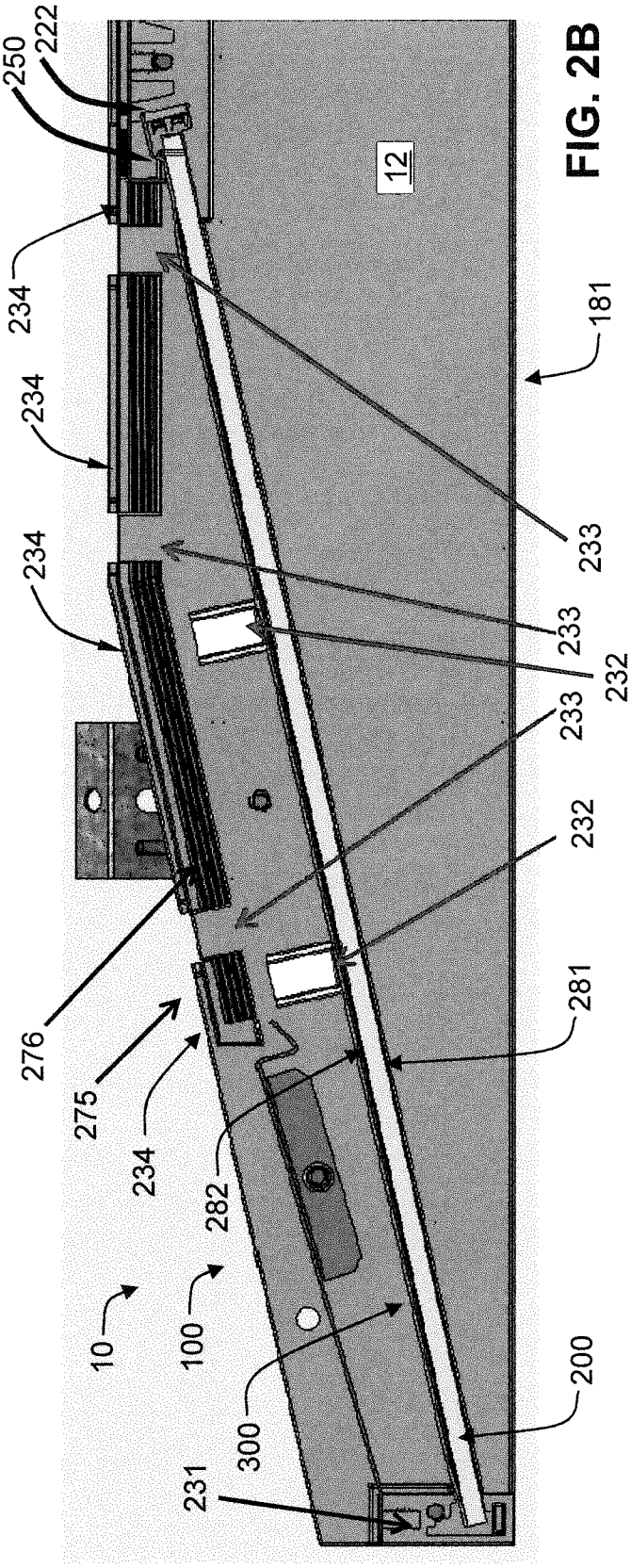
200
300
231
17

FIG. 2A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222
12
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281
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234
282
10
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300
200
231

FIG. 2B

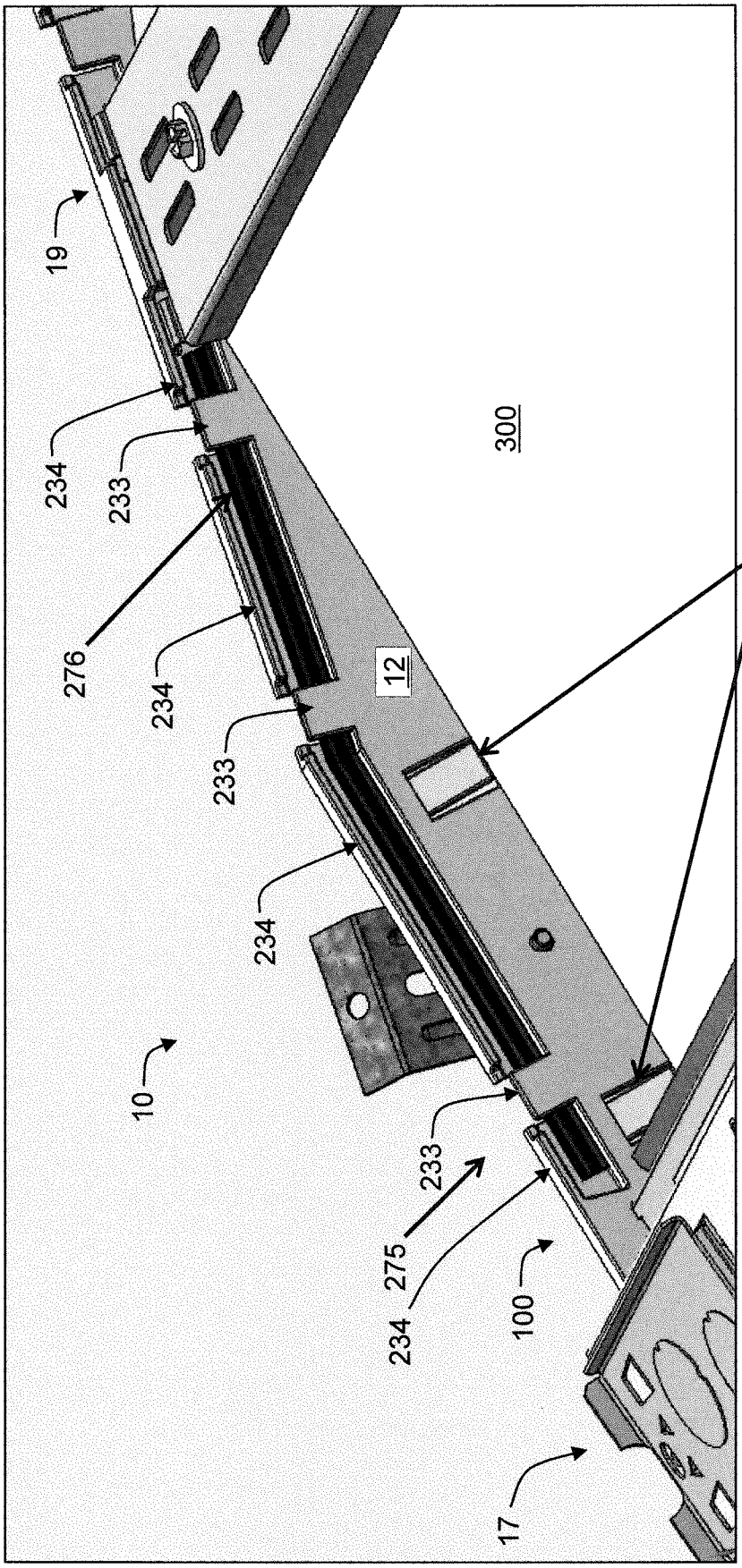


FIG. 2C

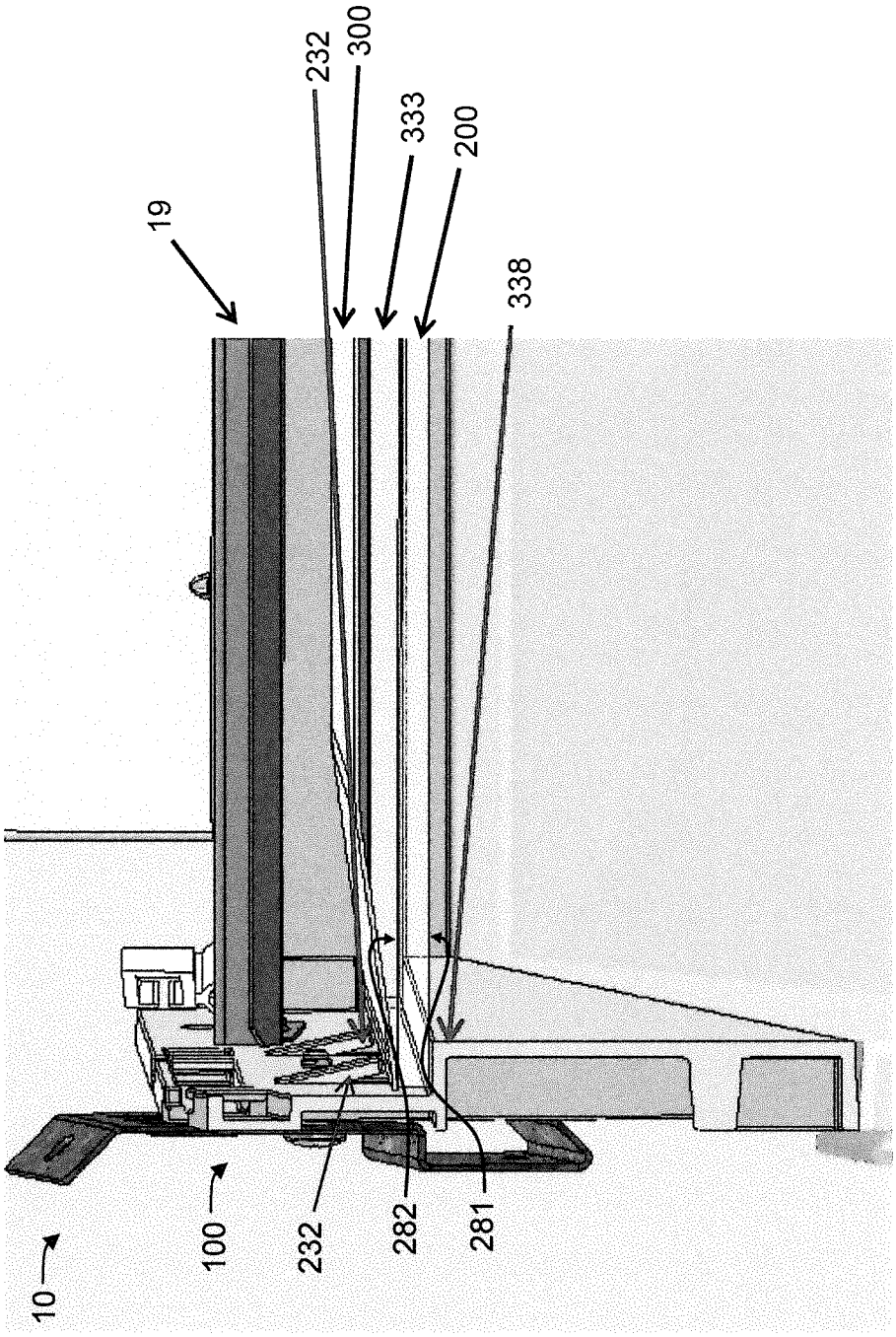


FIG. 3

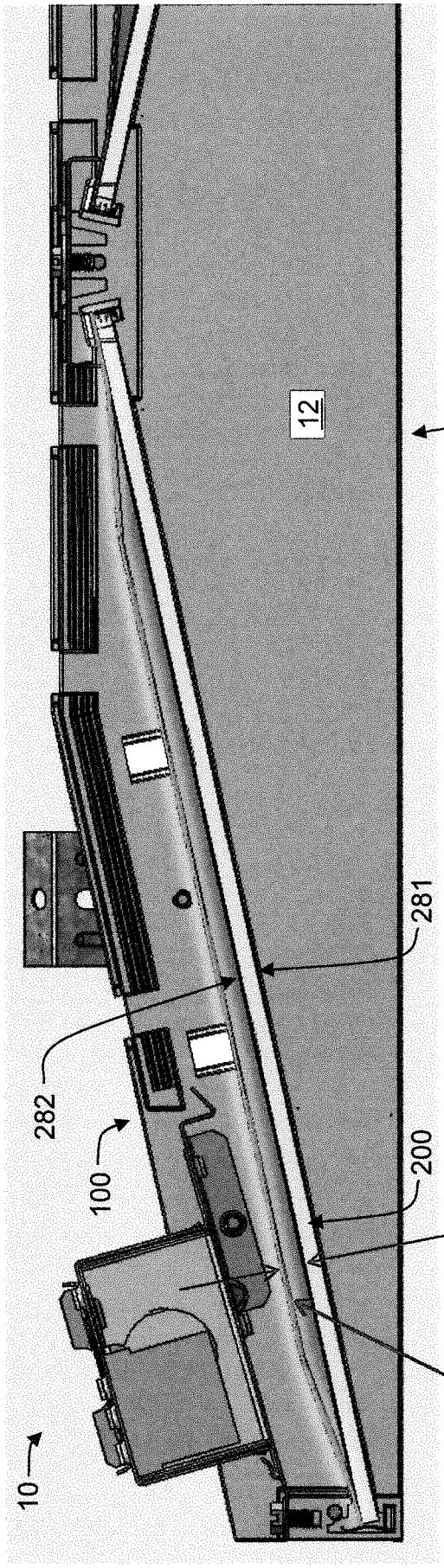


FIG. 4

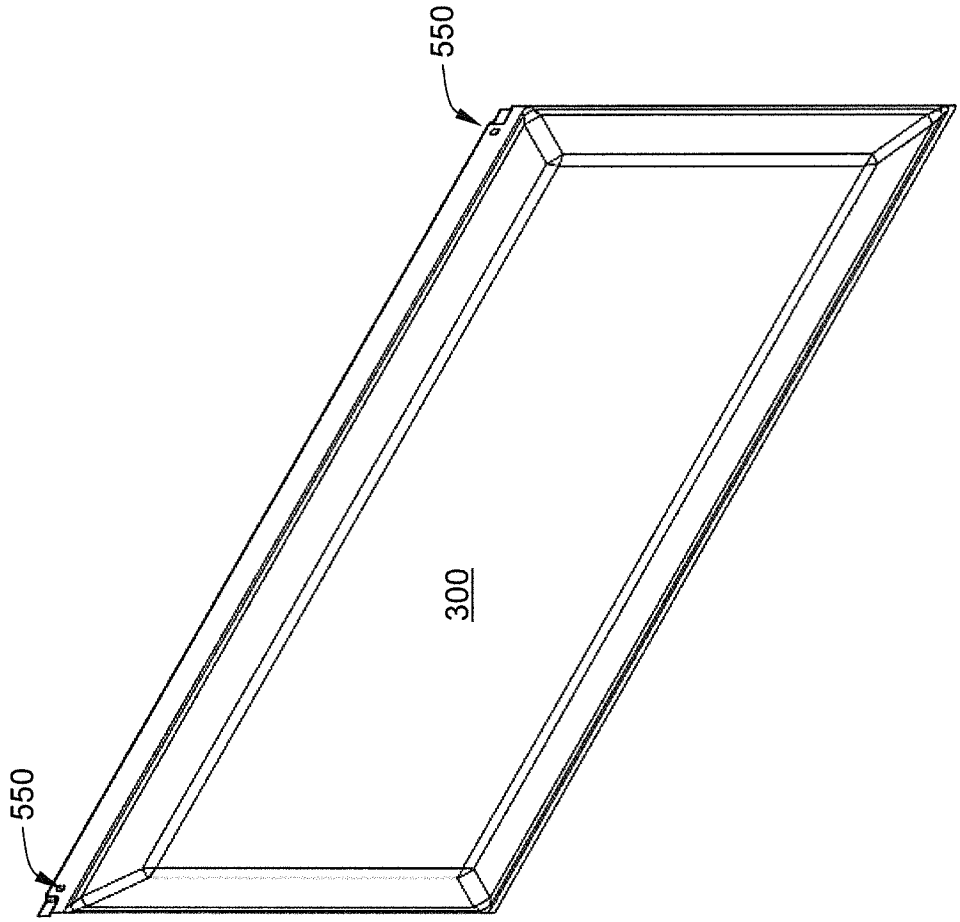


FIG. 5A

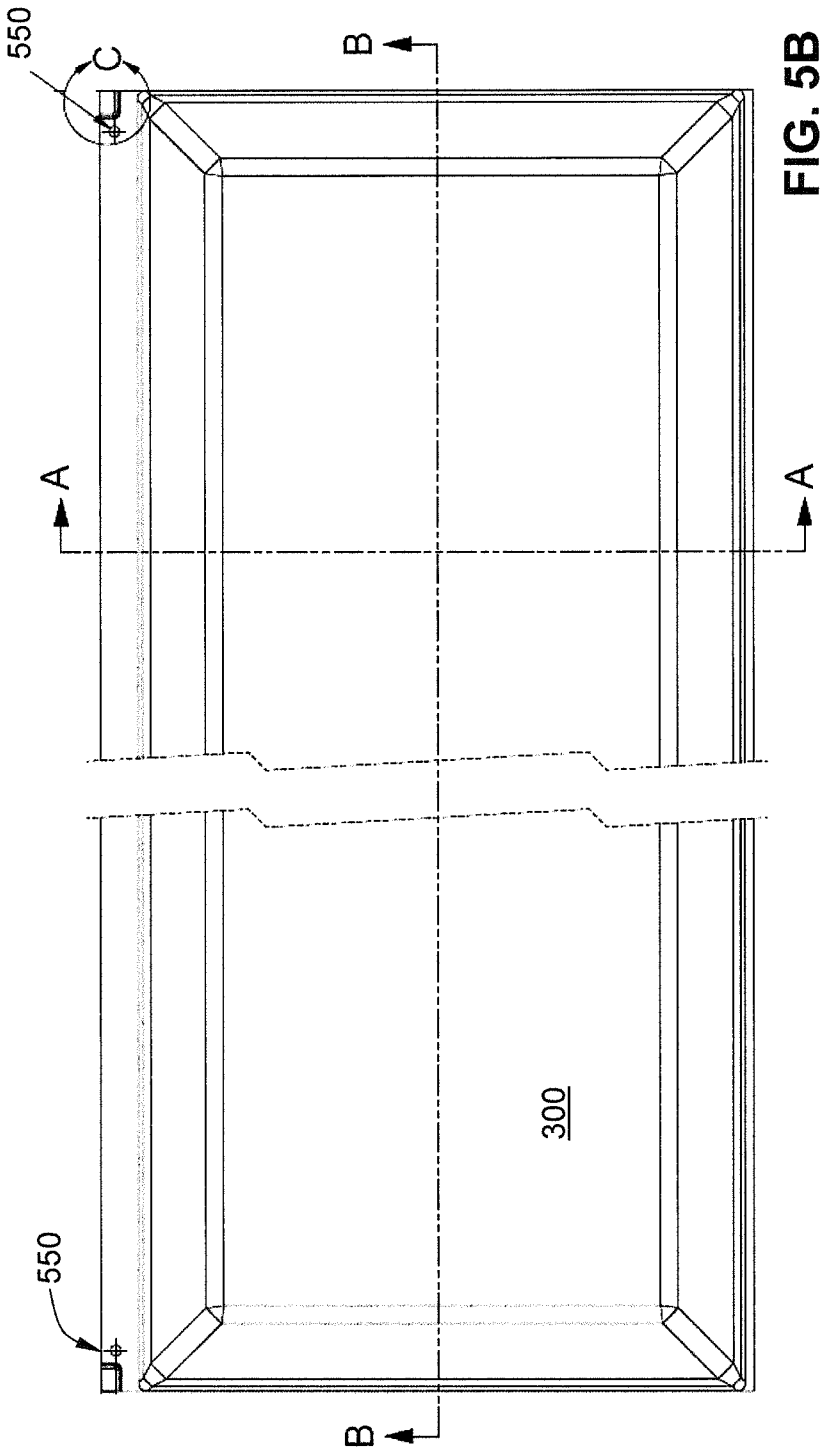


FIG. 5B

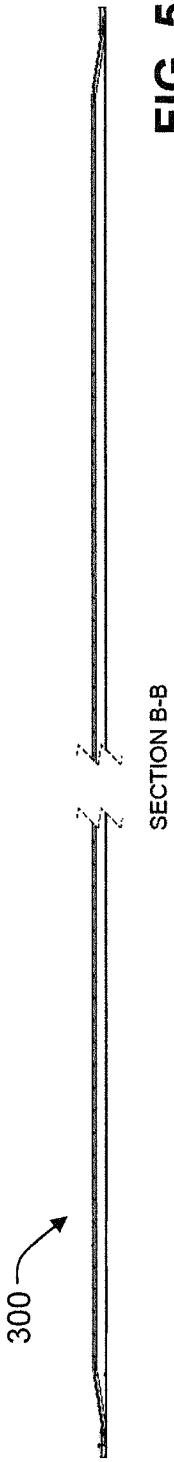
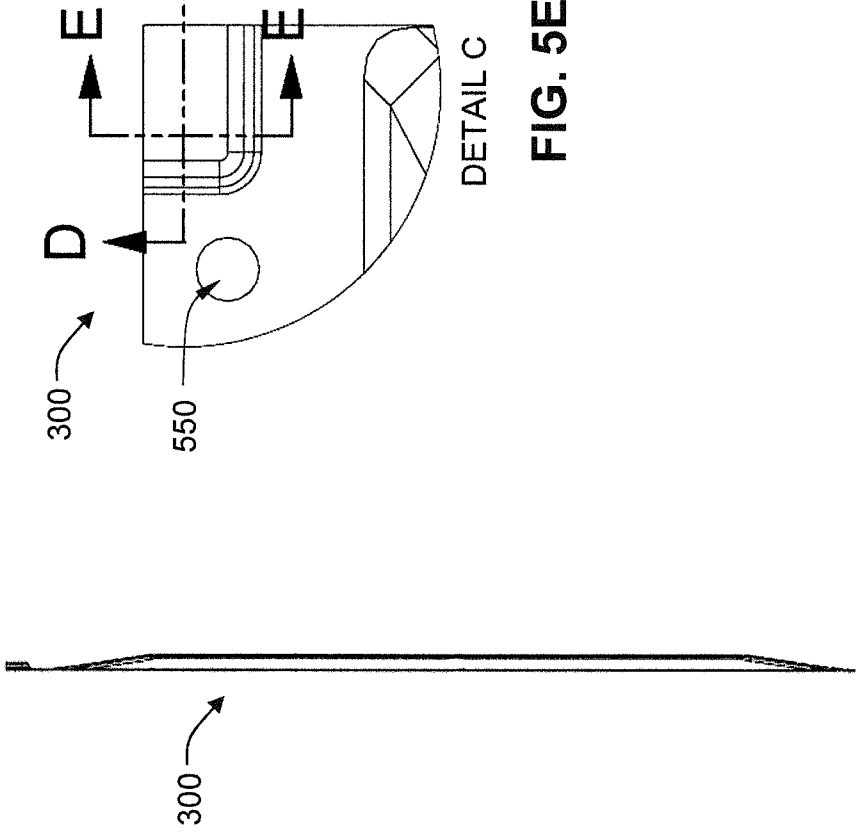


FIG. 5C

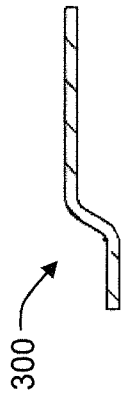


SECTION A-A

FIG. 5D

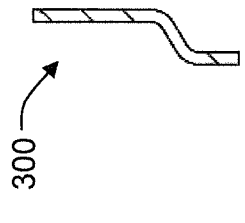
DETAIL C

FIG. 5E



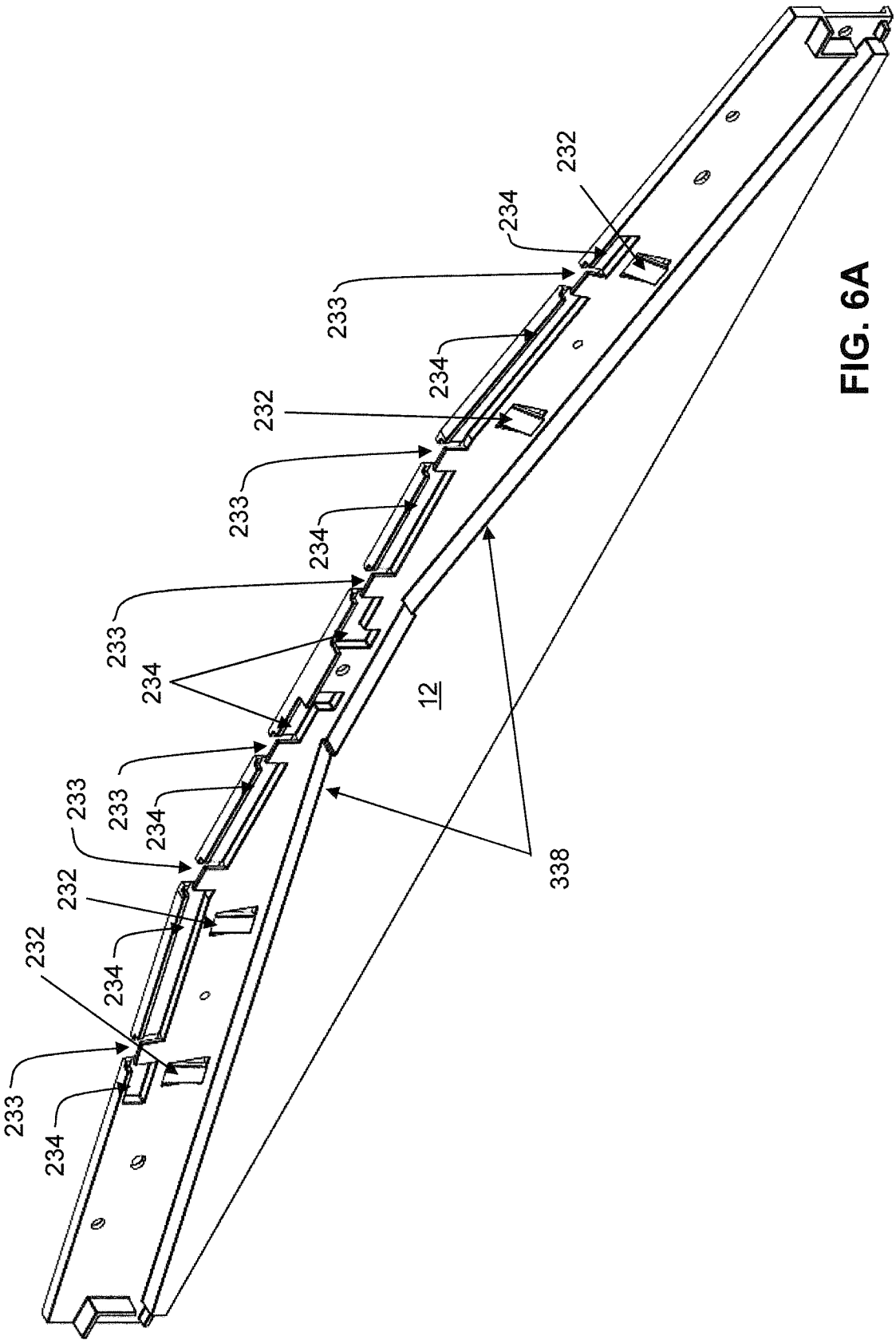
SECTION D-D

FIG. 5G



SECTION E-E

FIG. 5F


232
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338

FIG. 6A

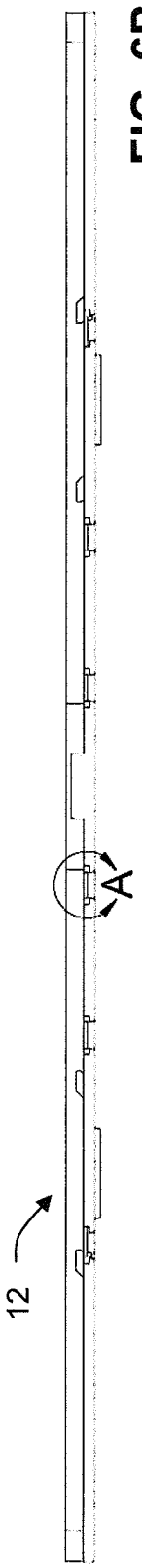

FIG. 6B

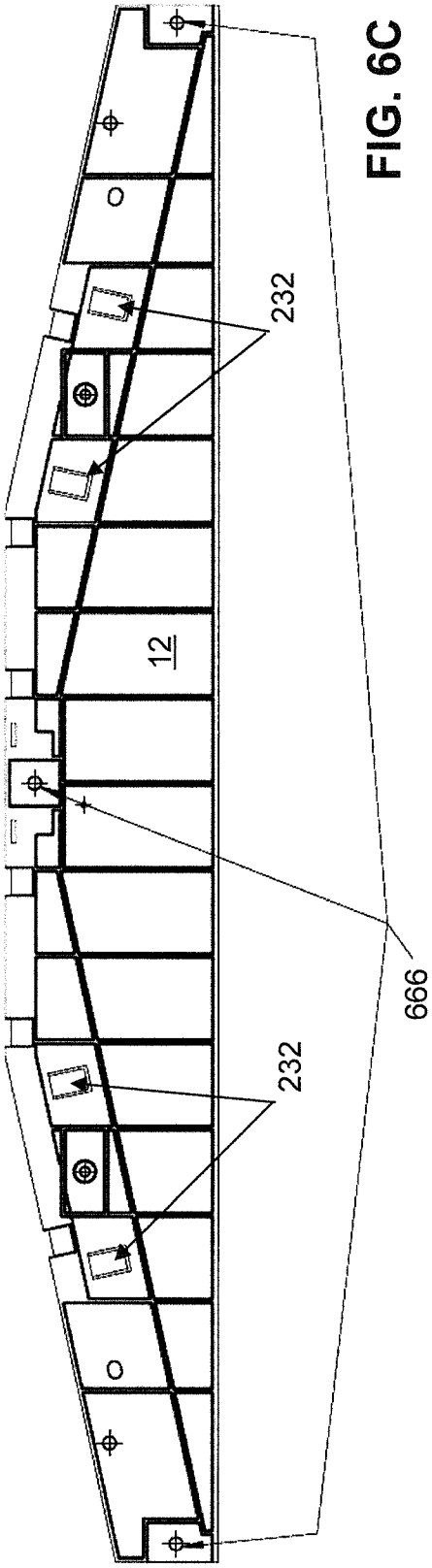

FIG. 6C

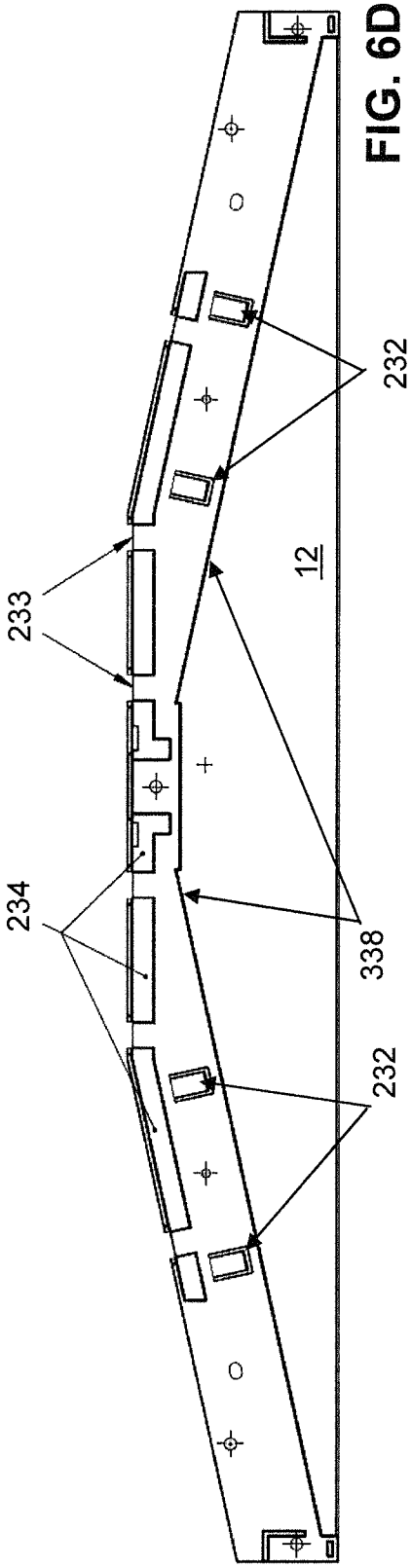

FIG. 6D

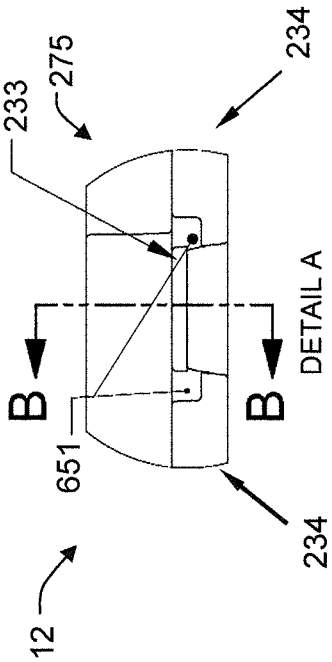

FIG. 6F

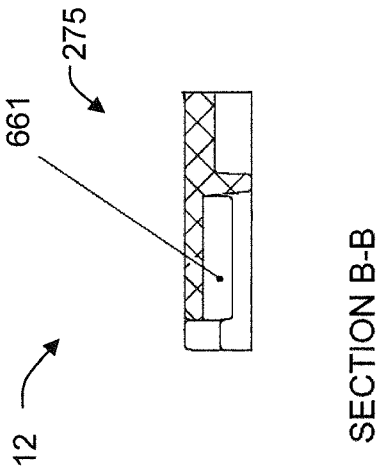

FIG. 6G

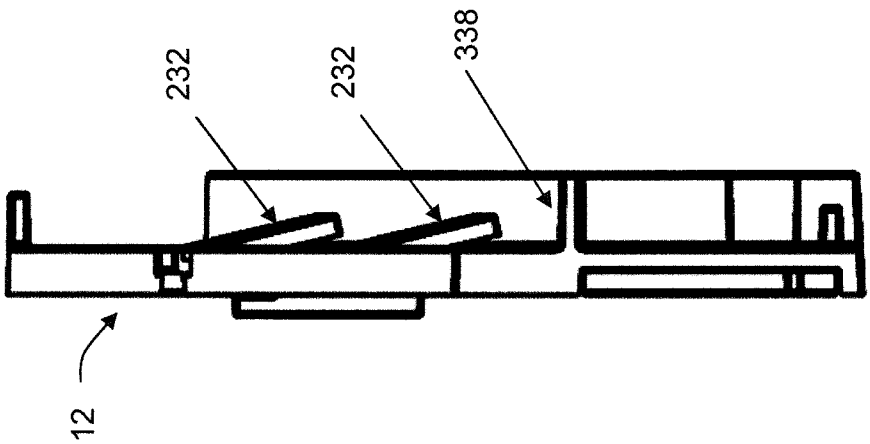

FIG. 6E

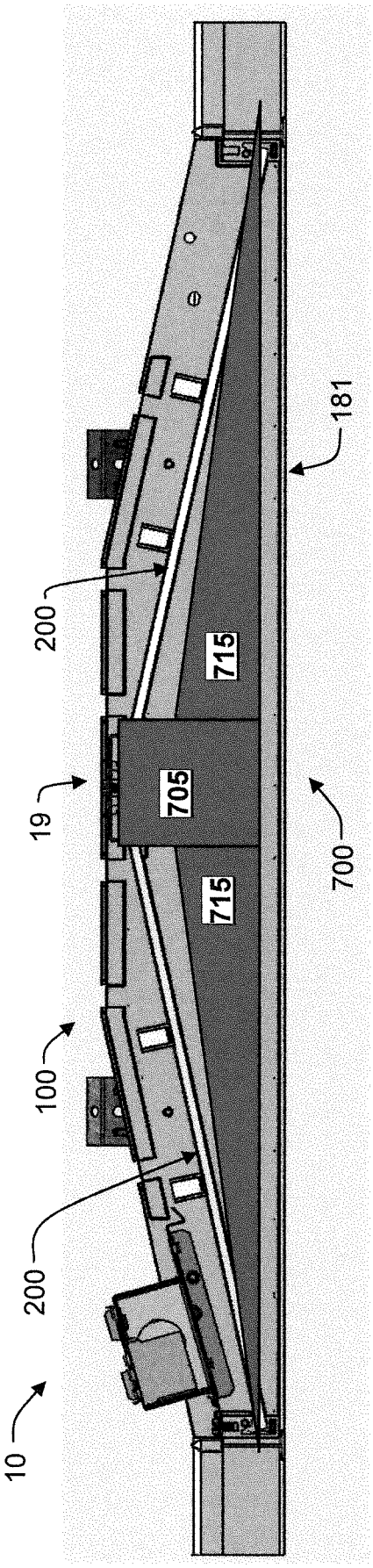

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2014/026328

A. CLASSIFICATION OF SUBJECT MATTER

F21V 7/10 *(2006.01)*
F21V 8/00 *(2006.01)*
F21Y 101/02 (2006.01)

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F21V 7/10, 8/00, F21S 13/00, F21Y 101/02

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

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

PatSearch (RUPTO internal), Espacenet, PAJ, USPTO, Information Retrieval System of FIPS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2012/030387 A2 (CREE, INC.) 08.03.2012	1-20
A	US 7963689 B2 (KUN DIAN PHOTOELECTRIC ENTERPRISE CO.) 21.06.2011	1-20
A	US 5931556 A (NSI ENTERPRISES, INC.) 03.08.1999	1-20

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 June 2014 (25.06.2014)	28 August 2014 (28.08.2014)

Name and mailing address of the ISA/RU:
FIPS,
Russia, 123995, Moscow, G-59, GSP-5,
Berezhkovskaya nab., 30-1
Facsimile No. +7 (499) 243-33-37

Authorized officer

M. Trofimova

Telephone No. 8(495)531-64-81