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(54) Title: LIGHT PIPE ASSEMBLY

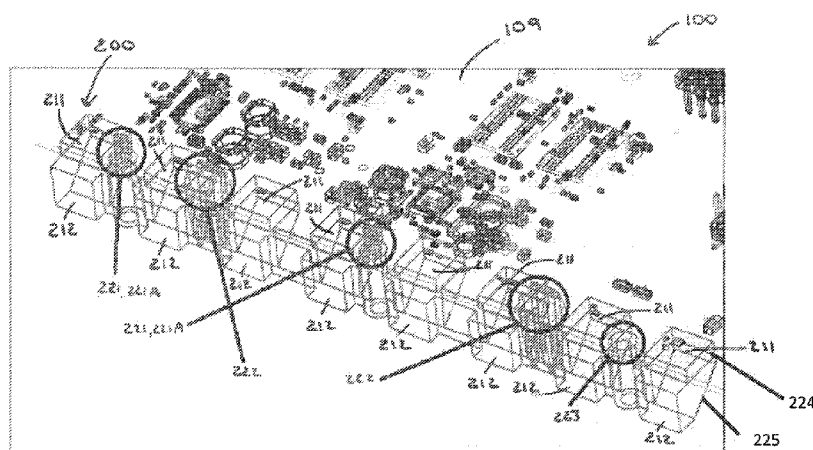


FIG. 2

(57) Abstract: A light pipe assembly (200) for installing onto a printed circuit board is provided. The board is within an electronic device. The assembly includes light pipes (210). Each light pipe has an entrance end (211) facing towards a respective light emitting element on a top surface of the board, and an exit end (212) facing towards a respective light receiving element on a front wall of the electronic device. The assembly further includes locating pins (221) for positioning the light pipe assembly in an intended location on the board when the pins are inserted through corresponding positioning holes in the board. The assembly also includes one or more snap-in fasteners (222) for holding the light pipe assembly 200 to the board. The assembly additionally includes one or more posts (221A, 223) for lifting the light pipe assembly a predetermined distance away from the top surface of the board.

LIGHT PIPE ASSEMBLY

CROSS REFERENCES

This application claims priority to a U.S. Provisional Application, Serial No.
5 61/970000, filed on March 25, 2014, which is herein incorporated by reference in its entirety.

TECHNICAL FIELD

The present principles relate generally to electronic devices and, more
10 particularly, to a light pipe assembly for electronic devices.

BACKGROUND

Consumer demand for electronic devices which are more powerful and sophisticated and are yet quiet, compact, and robust has not been satisfied.
15 However, the reality is that modern electronic products packaging continues to evolve towards lower cost parts, lower cost assembly techniques, and simpler assemblies. Meeting the consumer demand remains a difficult challenge in light of the electronic industry evolution.

Products, such as set top boxes, digital versatile disk (DVD) players, game
20 consoles, and computing devices have evolved to a point where often these products utilize a structure that packages all electronic components on a single printed circuit board (PCB). Included in this packaging may be one or more indicator lights, usually utilizing light emitting diodes (LEDs).

While light sources are easily placed on the circuit board, they are small and
25 do not have any light focusing capabilities in and of themselves. Therefore, to better project the light to the outside through a front panel, structures known as light pipes are employed. However, these light pipes are often individually connected to each light source assembly or may be grouped in sets that connect to each light source assembly. In both cases, separate mechanical components are created and used
30 for these light pipes which increases the number of parts and increases the cost for the product. This trend can be in contrast to an integrated solution. For example, a separate mechanical frame structure is often needed for the location and retention of the printed circuit board assembly itself in the mechanical package. Additionally, the light pipes are each separate mechanical structures.

In the prior art, light pipes are typically mounted to the wall of a cover of an electronic device, directly in front of the light pipe. The light pipe is typically heat staked directly to the wall of the cover.

Thus, the factory would have to heat stake the light pipe to the cover when
5 heat staking is otherwise usually performed by the plastics vendor that manufactures the light pipe. This adds to the amount of labor the factory would have to perform as well as introducing more risk that the light pipe could be improperly attached as the factory is not as familiar with the procedure as the plastics vendor.

Moreover, due to the order of assembly of this unit, the PCB would have to be
10 snapped in place beneath the light pipe as the light pipe is being heat staked to the cover. This would introduce more risk to the PCB.

Further, the heat stakes that are attached to the wall of the cover involve additional tooling during the creation of the features, thereby increasing cost.

Also, by heat staking the light pipe to the wall of the cover, more tolerances
15 must be taken into consideration during tolerance analysis.

Since light sources and associated parts in many types of electronic devices increase costs and the number of parts, a need exists for a light pipe assembly that avoids the need for staking light pipes to the wall of a cover of an electronic device.

20 SUMMARY

These and other drawbacks and disadvantages of the prior art are addressed by the present principles, which are directed to a light pipe assembly for electronic devices.

According to an aspect of the present principles, there is provided a light pipe
25 assembly for installing onto a printed circuit board. The printed circuit board is within an electronic device. The assembly includes a plurality of light pipes. Each of the light pipes has an entrance end that faces towards a respective light emitting element on a top surface of the printed circuit board, and an exit end that faces towards a respective light receiving element on a front wall of the electronic device.
30 The assembly further includes one or more locating pins for positioning the light pipe assembly in an intended location on the printed circuit board when the pins are inserted through corresponding positioning holes in the printed circuit board. The assembly also includes one or more snap-in fasteners for holding the light pipe assembly to the printed circuit board. The assembly additionally includes one or

more posts for lifting, supporting, maintaining or positioning the light pipe assembly and/or the entrance end a predetermined distance away from the top surface of the printed circuit board.

According to another aspect of the present principles, there is provided an electronic device. The electronic device includes a front wall having light receiving elements thereon. The electronic device further includes a horizontal printed circuit board, orthogonal to the front wall. The horizontal printed circuit board has an edge portion in contact with, or proximate to, the front wall. The horizontal printed circuit board further has a top surface with light emitting elements. The electronic device also includes a light pipe assembly affixed to the printed circuit board and having a plurality of light pipes. Each of the plurality of light pipes has an entrance end that faces towards a respective light emitting element on a top surface of the printed circuit board, and an exit end that faces towards a respective one of the light receiving elements on the front wall.

According to yet another aspect of the present principles, there is provided a method for installing a light pipe assembly onto a printed circuit board in an electronic device. The method includes creating or obtaining a light pipe assembly having light pipes. Each of the light pipes has an entrance end that faces towards a respective light emitting element on a top surface of the printed circuit board and an exit end that faces towards a respective light receiving element on a front wall of the electronic device. The light pipe assembly further has positioning pins and snap-in fasteners. The method further includes positioning the light pipe assembly parallel to the printed circuit board with the positioning pins of the light pipe assembly located over corresponding positioning holes in the printed circuit board. The method also includes pushing the light pipe assembly towards the printed circuit board and continuing pushing until the snap-in fasteners of the light pipe assembly go through the corresponding fastener holes in the printed circuit board and are engaged by the printed circuit board.

These and other aspects, features and advantages of the present principles will become apparent from the following detailed description of exemplary embodiments, which is to be read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The present principles may be better understood in accordance with the following exemplary figures, in which:

FIG. 1 shows a top side view of a portion of a printed circuit board (PCB) 100 having a light pipe assembly 200 attached thereto, in accordance with an embodiment of the present principles;

FIG. 2 shows a bottom side view of the portion of the PCB 100 and light pipe assembly 200 of FIG. 1, in accordance with an embodiment of the present principles;

FIG. 3 shows a front inside view of an electronic device 300 within which the PCB 100 and light pipe assembly 200 of FIG. 1 are located, in accordance with an embodiment of the present principles;

FIG. 4 shows a top view of the light pipe assembly 200, in accordance with an embodiment of the present principles;

FIG. 5 shows a side view of the light pipe assembly 200, in accordance with an embodiment of the present principles;

FIG. 6 shows a bottom view of the light pipe assembly 200, in accordance with an embodiment of the present principles; and

FIG. 7 shows a method 700 for installing a light pipe assembly onto a printed circuit board, in accordance with an embodiment of the present principles.

DETAILED DESCRIPTION

The present principles are directed to a light pipe assembly for electronic devices.

In the prior art as noted above, light pipes are typically mounted to the wall of a cover of an electronic device, directly in front of a printed circuit board (PCB) within the electronic device. The attachment of the light pipe to the wall instead of the PCB disadvantageously results in more tolerances coming into play when lining up the light pipe with a light source, requires additional tooling to create the features that hold the light pipe, and requires an additional step of heat staking (if this is the chosen method) that must be taken to attach the light pipe to the wall.

Advantageously, the present principles allow a light pipe to attach directly to a printed circuit board (PCB). This avoids order of assembly issues, additional tooling costs, additional work at the factory, and risks to the PCB, while also minimizing tolerance stack-up issues. Moreover, by snapping the light pipe directly to the PCB, one can ensure that the light pipe will be correctly placed over the top of the light

source (for example, but not limited to, one or more light emitting diodes (LEDs), and so forth).

These and many other attendant advantages of the present principles over the prior art are readily determined by one of ordinary skill in the art given the
5 teachings of the present principles provided herein.

A light pipe is a translucent piece of plastic that guides light from a light source (e.g., an LED, and so forth) to a preferred area. Light pipes are used in a large variety of consumer electronics. In contrast to the conventional approach of mounting a light pipe to a wall that is proximate to a PCB, embodiments of the
10 present principles advantageously snap and/or otherwise mount a light pipe directly to the PCB that includes the light source. By attaching the light pipe to the PCB, the assembly of the product is made much easier. There are several other advantages of this type of design. A minimal amount of experience and equipment is needed to snap the light pipe into place, whereas an approach involving heat staking can be
15 very much the opposite. Since the light source and the light pipe are mounted to the same object, the dimensions are easier to control.

FIG. 1 shows a top side view of a portion of a printed circuit board (PCB) 100 having a light pipe assembly 200 attached thereto, in accordance with an embodiment of the present principles. FIG. 2 shows a bottom side view of the
20 portion of the PCB 100 and light pipe assembly 200 of FIG. 1, in accordance with an embodiment of the present principles. FIG. 3 shows a front inside view of an electronic device 300 within which the PCB 100 and light pipe assembly 200 of FIG. 1 are located, in accordance with an embodiment of the present principles. FIG. 4 shows a top view of the light pipe assembly 200, in accordance with an embodiment
25 of the present principles. FIG. 5 shows a side view of the light pipe assembly 200, in accordance with an embodiment of the present principles. FIG. 6 shows a bottom view of the light pipe assembly 200, in accordance with an embodiment of the present principles.

Thus, the PCB 100 is included within the electronic device 300. The
30 electronic device 300 can be, but is not limited to, a set top box, a television, a digital versatile disk (DVD) player, a game console, a computing device, and so forth. While only one PCB 100 is shown within the electronic device 300, in other embodiments, more than one PCB can be included within the electronic device 300. It is to be appreciated that the present principles are applicable to any of the PCBs

within an electronic device. In the embodiment of FIG. 3, the electronic device 300 includes a front wall 310 that forms part of an overall cover of the electronic device 300. Other elements of the electronic device, including other walls and so forth, are omitted for the sake of brevity and clarity. However, one of ordinary skill in the art will be readily familiar with the construction of such electronic devices. Of course, the present principles are not limited to an electronic device having the exact configuration as shown and described herein and, thus, other configurations of an electronic device to which the present principles can be applied are readily determined by one of ordinary skill in the art given the teachings of the present principles provided herein, while maintaining the spirit of the present principles.

The PCB 100 is arranged in a horizontal position within the electronic device 300 such that the PCB 100 is substantially orthogonal to the front wall 310 of the electronic device 300. The PCB 100 is attached to a base 366 of the electronic device 300. In an embodiment, an edge 188 portion of the PCB 100 is in contact with, or proximate to, the front wall 310 of the electronic device 300. The front wall 310 includes an element(s) thereon designed to be illuminated (hereinafter "light receiving elements"). It is to be appreciated that while the embodiment of at least FIG. 3 involves the front wall 310 of the electronic device 300, in other embodiments, other walls or surfaces (e.g., side wall 377) of the electronic device 300 may be involved. These and other variations of the application of the present principles are readily determined by one of ordinary skill in the art given the teachings of the present principles provided herein, while maintaining the spirit of the present principles.

The light pipe assembly 200 is affixed to the PCB 100. In an embodiment, the light pipe assembly 200 is constructed as an integral unit. In other embodiments, the light pipe assembly 200 can be formed as separate pieces, as readily appreciated by one of ordinary skill in the art given the teachings of the present principles provided herein.

The light pipe assembly 200 includes light pipes 210. Each of the light pipes 210 has an entrance end 211 that faces towards light emitting elements 102 on the top surface 101 of the PCB 100. Each of the light pipes 210 also has an exit end 212 that faces towards light receiving elements 311 on the front wall 310 of the electronic device 300. The light emitting elements 102 can be light emitting diodes or any other suitable light source depending upon the implementation. The pipes

210 can further include between the entrance end 211 and the exit end 212 a body for propagating light to the exit end 212 that includes a rear wall 224 that is parallel to the exit end 212 and extends upward from the rear side of the entrance end 221 and angle wall 225 that extends at an acute angle from the top edge of the rear wall 224.

The light pipe assembly 200 further includes pins 221, opposing snap-in fasteners 222, and a post 223.

The pins 221, also referred to herein as “positioning pins”, position the light pipe assembly 200 in the intended location when the pins 221 are inserted within corresponding positioning holes 189 in the PCB 100. The pins 221 include a post portion or shoulder 221A to lift the light pipe assembly 200 a certain predetermined distance away from a surface (e.g., the top surface 101) of the PCB 100.

The opposing snap-in fasteners 222, also referred to herein as “snaps”, hold the light pipe assembly 200 to the PCB 100. The snaps 222 mate with corresponding fastener holes 188 in the PCB 100 when the light pipe assembly 200 is pushed towards the PCB 100. The mating is facilitated by at least angled portions of the snaps 222 that push together while the assembly 200 is pushed towards the PCB 100. Once the snaps 222 are pushed through the corresponding fastener holes 188 in the PCB 100, the snaps 222 spread apart to securely hold the light pipe assembly 200 to the PCB 100.

In particular, in an embodiment, each of the snaps 222 include angled portions 266 and ledge portions 267. In the embodiment shown, each snap 222 includes two angled portions 266 and two ledge portions 267. Each angled portion 266 is adjacent to a corresponding ledge portion 267. In an embodiment, at least part of the ledge portion 267 can be orthogonal to the bottom surface 109 of the PCB 100. In other embodiments, the ledge portion 267 can simply be an edge. When the snaps are pushed through the corresponding fastener holes 188, the angled portions 266 are pushed together to allow the angled portions 266 (as well as the ledge portions 267) to pass through the corresponding fastener holes 188 and spread away from each other once through such that the ledge portions 267 contact the bottom surface 109 of the PCB 100 to secure the light pipe assembly 200 to the PCB 100.

The post 223 acts like a shoulder (e.g., shoulder 221A) to lift the light pipe assembly 200 away from a surface (e.g., the top surface 101) of the PCB 100 by the predetermined distance.

While certain numbers of pins 221, snaps 222, and posts 223 are shown herein, it is to be appreciated that any number of these elements can be used in accordance with the present principles, depending upon the implementation. Moreover, while snap-in fasteners 222 are shown herein, it is also to be appreciated that other types of fasteners can also be used in accordance with the teachings of the present principles.

FIG. 7 shows a method 700 for installing a light pipe assembly onto a printed circuit board, in accordance with an embodiment of the present principles.

At step 710, a light pipe assembly 200 having light pipes 210 is created or obtained. Each light pipe 210 has an entrance end 211 that faces towards a respective light emitting element 102 on the top surface 101 of the PCB 100. Each light pipe 210 also has an exit end 212 that faces towards a respective light receiving element 311 on the front wall 310 of the electronic device 300. The light pipe assembly 200 further includes pins 221, opposing snap-in fasteners 222, and a post 223. The opposing snap-in fasteners 222, hold the light pipe assembly 200 to the PCB 100. The pins 221 position the light pipe assembly 200 in the intended location when the pins 221 are inserted within corresponding positioning holes 189 in the PCB 100. The pins 221 include a shoulder 221A. The shoulder 221A and the post 223 lift the light pipe assembly 200 a certain predetermined distance away from a surface (e.g., the top surface 101) of the PCB 100.

At step 720, the light pipe assembly 200 is positioned parallel to the PCB 100 with the pins 221 of the light pipe assembly 200 located over corresponding positioning holes 289 in the PCB 100.

At step 730, the light pipe assembly 200 is pushed towards the PCB 100 and continue pushing until the snaps 222 of the light pipe assembly 200 go through the corresponding fastener holes 188 in the PCB 100 and are engaged by the bottom surface 109 of the PCB 100.

The present description illustrates the present principles. It will thus be appreciated that those skilled in the art will be able to devise various arrangements that, although not explicitly described or shown herein, embody the present principles and are included within its spirit and scope.

All examples and conditional language recited herein are intended for pedagogical purposes to aid the reader in understanding the present principles and the concepts contributed by the inventors to furthering the art, and are to be construed as being without limitation to such specifically recited examples and
5 conditions.

Moreover, all statements herein reciting principles, aspects, and embodiments of the present principles, as well as specific examples thereof, are intended to encompass both structural and functional equivalents thereof. Additionally, it is intended that such equivalents include both currently known
10 equivalents as well as equivalents developed in the future, i.e., any elements developed that perform the same function, regardless of structure.

Reference in the specification to “an embodiment” of the present principles, as well as other variations thereof, means that a particular feature, structure, characteristic, and so forth described in connection with the embodiment is included
15 in at least one embodiment of the present principles. Thus, the appearances of the phrase “in an embodiment”, as well any other variations, appearing in various places throughout the specification are not necessarily all referring to the same embodiment.

Although the illustrative embodiments have been described herein with
20 reference to the accompanying drawings, it is to be understood that the present principles is not limited to those precise embodiments, and that various changes and modifications may be effected therein by one of ordinary skill in the pertinent art without departing from the scope or spirit of the present principles. All such changes and modifications are intended to be included within the scope of the present
25 principles as set forth in the appended claims.

CLAIMS:

1. A light pipe assembly (200) for installing onto a printed circuit board, the printed circuit board being within an electronic device, the assembly comprising:
- 5 a plurality of light pipes (210), each having an entrance end (211) that faces towards a respective light emitting element on a top surface of the printed circuit board, and an exit end (212) that faces towards a respective light receiving element on a front wall of the electronic device;
- one or more locating pins (221) for positioning the light pipe assembly in an
- 10 intended location on the printed circuit board when the pins are inserted through corresponding positioning holes in the printed circuit board;
- one or more snap-in fasteners (222) for holding the light pipe assembly to the printed circuit board; and
- one or more posts (221A, 223) for supporting the light pipe assembly a
- 15 predetermined distance away from the top surface of the printed circuit board.
2. The light pipe assembly of claim 1, wherein each of the locating pins (221) comprise a shoulder (221A) to support the light pipe assembly 200 the predetermined distance away from the top surface of the printed circuit board.
- 20
3. The light pipe assembly of claim 1, wherein each of the posts (221A) is formed as part of a one respective of the locating pins (221).
4. The light pipe assembly of claim 1, wherein the light pipe assembly is
- 25 formed as a single piece of translucent plastic.
5. An electronic device (300), comprising:
- a front wall (310) having light receiving elements (311) thereon;
- a horizontal printed circuit board (100), orthogonal to the front wall, and
- 30 having an edge portion (188) in contact with, or proximate to, the front wall, and further having a top surface (101) with light emitting elements (102); and
- a light pipe assembly (200) affixed to the printed circuit board and having a plurality of light pipes (210), each of the plurality of light pipes having an entrance end (211) that faces towards a respective light emitting element (102) on a top

surface (101) of the printed circuit board, and an exit end (212) that faces towards a respective one of the light receiving elements on the front wall.

5 6. The electronic device of claim 5, wherein the electronic device (300) is a set top box.

10 7. The electronic device of claim 5, wherein the light pipe assembly (200) further comprises one or more snap-in fasteners (222) for holding the light pipe assembly to the printed circuit board (100).

15 8. The electronic device of claim 5, wherein the light pipe assembly (200) further comprises one or more locating pins (221) for positioning the light pipe assembly in an intended location on the printed circuit board (100) when the pins are inserted through corresponding positioning (189) holes in the printed circuit board.

20 9. The electronic device of claim 8, wherein each of the locating pins (221) comprise a shoulder (221A) to lift the light pipe assembly (200) a predetermined distance away from the top surface (101) of the printed circuit board (100).

25 10. The electronic device of claim 8, wherein the light pipe assembly (200) further comprises one or more posts (221A, 223) for maintaining the light pipe assembly a predetermined distance away from the top surface (101) of the printed circuit board.

30 11. The electronic device of claim 10, wherein each of the posts (221A) is formed as part of a one respective of the locating pins (221).

 12. The electronic device of claim 5, wherein the light pipe assembly (200) is formed as a single piece of translucent plastic.

13. A method (700) for installing a light pipe assembly onto a printed circuit board in an electronic device, the method comprising:

creating or obtaining (710) a light pipe assembly having light pipes, each of the light pipes having an entrance end that faces towards a respective light emitting
5 element on a top surface of the printed circuit board and an exit end that faces towards a respective light receiving element on a front wall of the electronic device, the light pipe assembly further having positioning pins and snap-in fasteners,

positioning (720) the light pipe assembly parallel to the printed circuit board with the positioning pins of the light pipe assembly located over corresponding

10 positioning holes in the printed circuit board; and

pushing (730) the light pipe assembly towards the printed circuit board and continuing pushing until the snap-in fasteners of the light pipe assembly go through the corresponding fastener holes in the printed circuit board and are engaged by the printed circuit board.

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14. The method of claim 13, wherein the light pipe assembly further has one or more posts for lifting the light pipe assembly a predetermined distance away from the top surface of the printed circuit board.

20 15. The method of claim 13, wherein each of the positioning pins have a shoulder for lifting the light pipe assembly a predetermined distance away from the top surface of the printed circuit board.

25 16. The method of claim 13, wherein the light pipe assembly is formed as a single piece of translucent plastic.

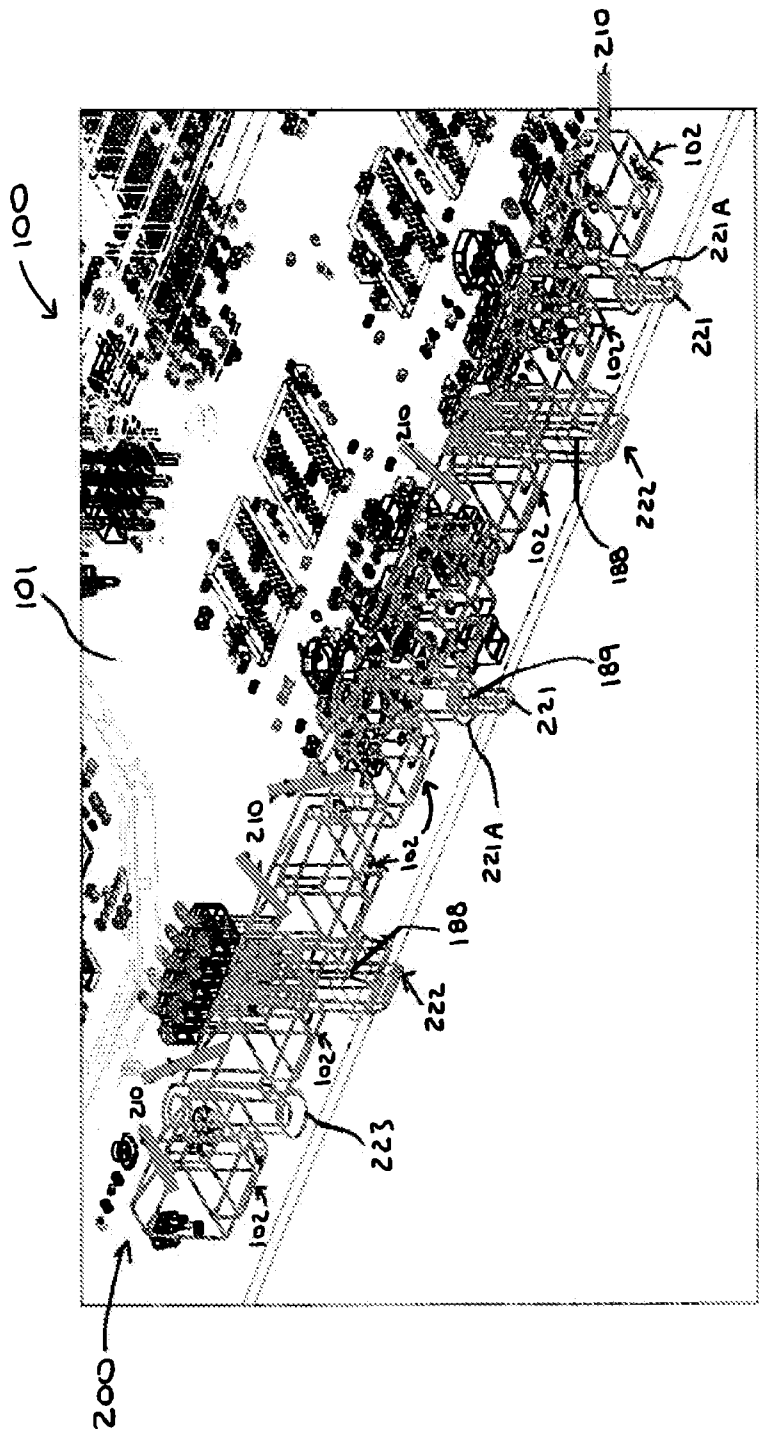


FIG. 1

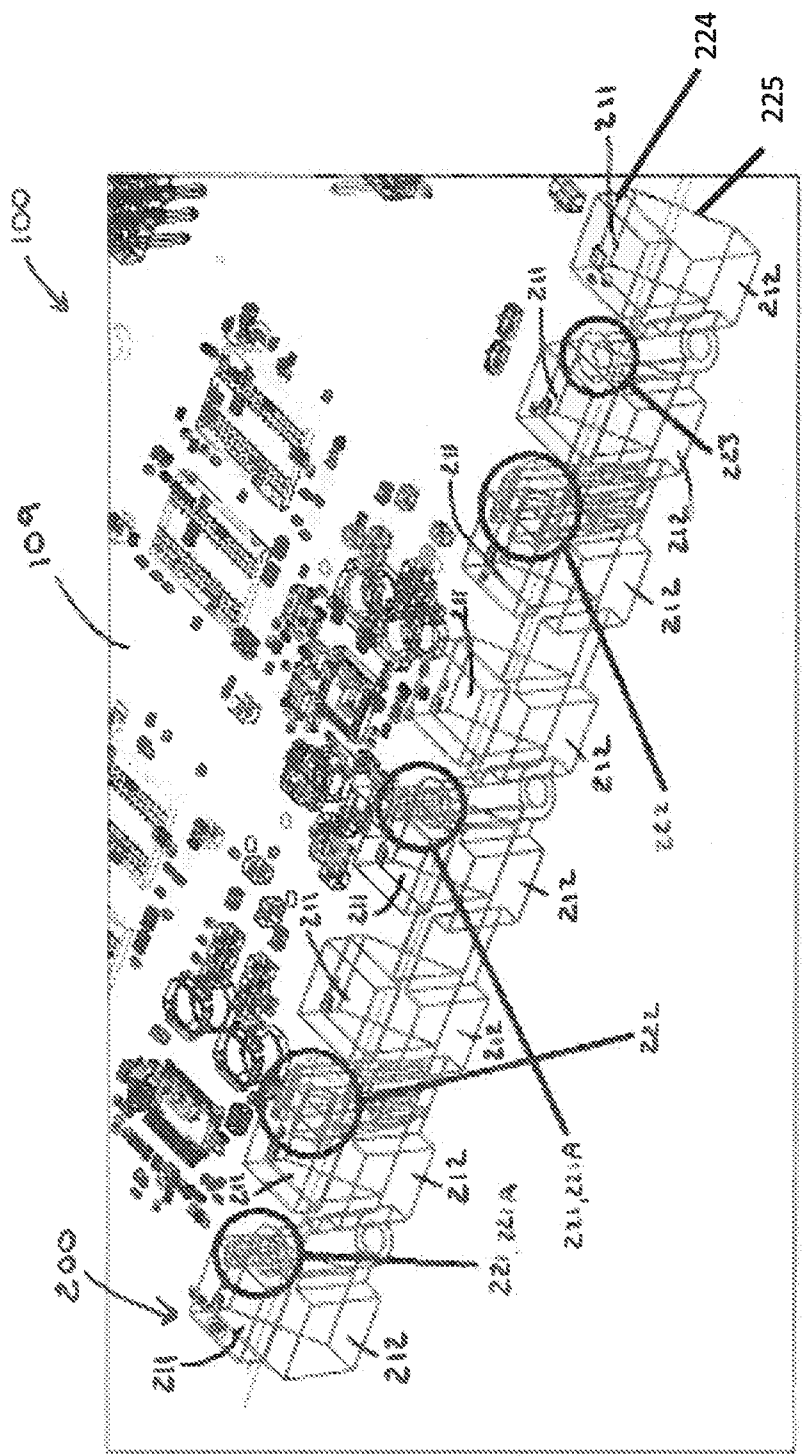


FIG. 2

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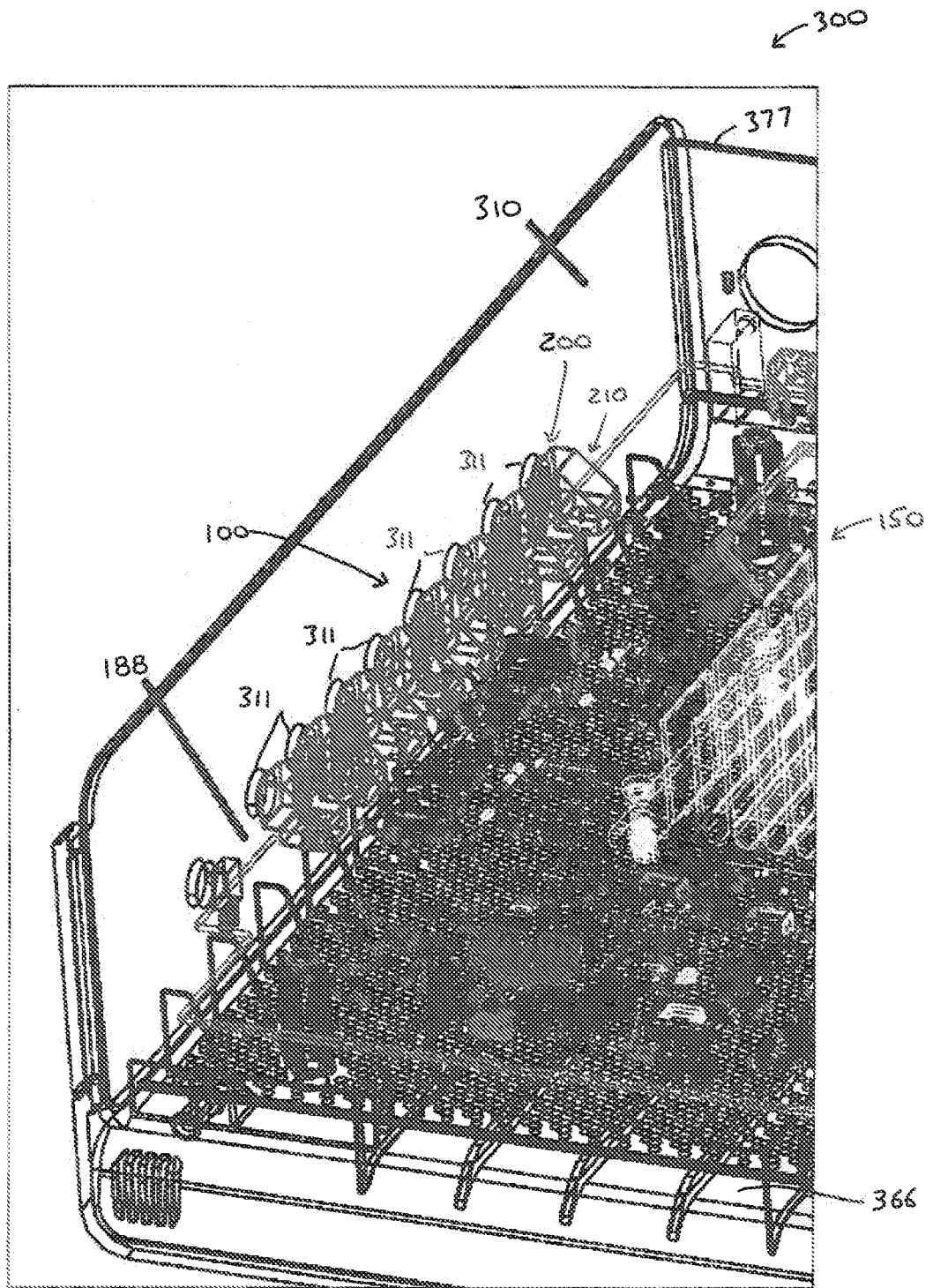


FIG. 3

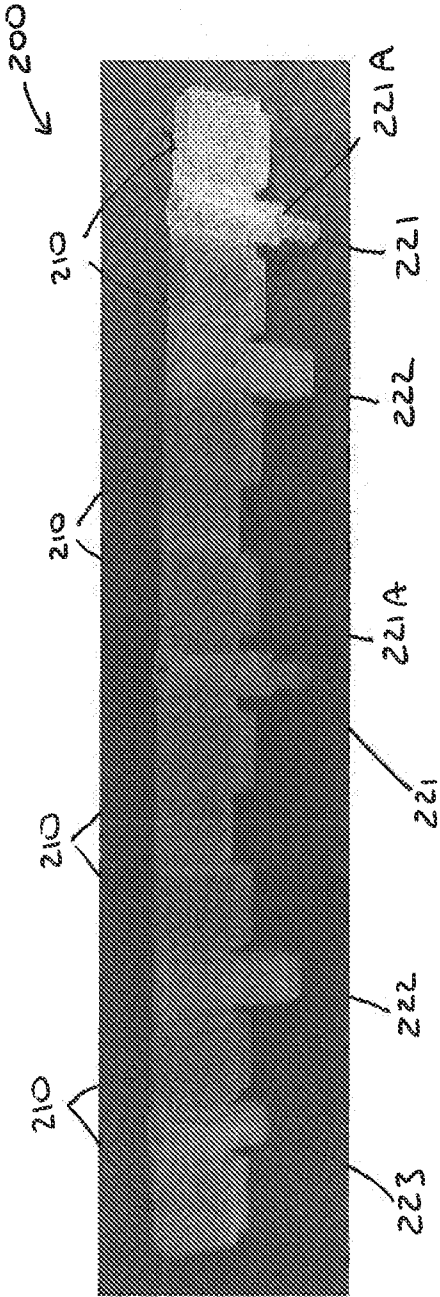


FIG. 4

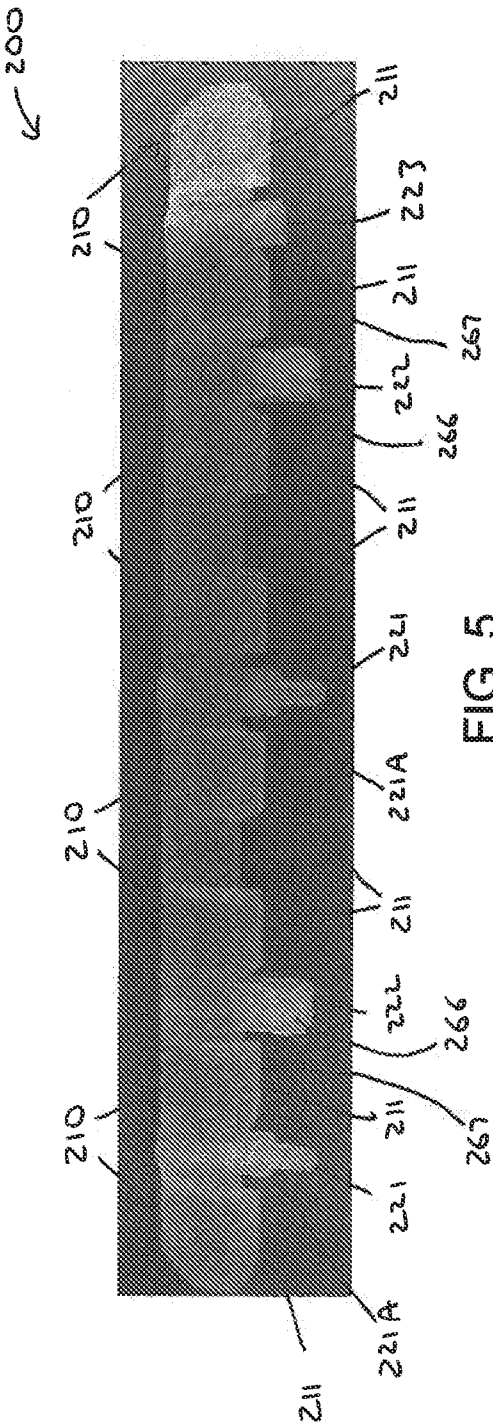


FIG. 5

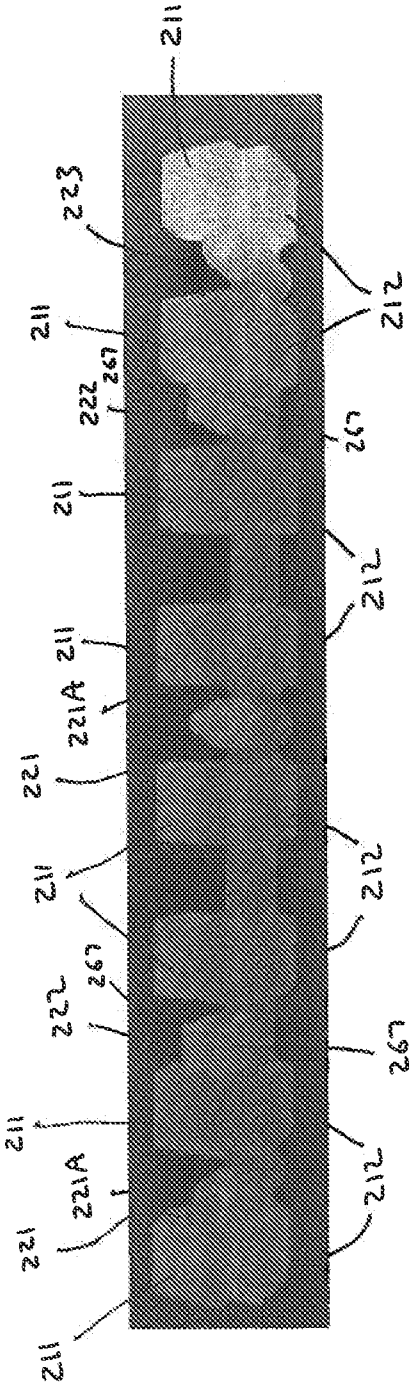


FIG. 6

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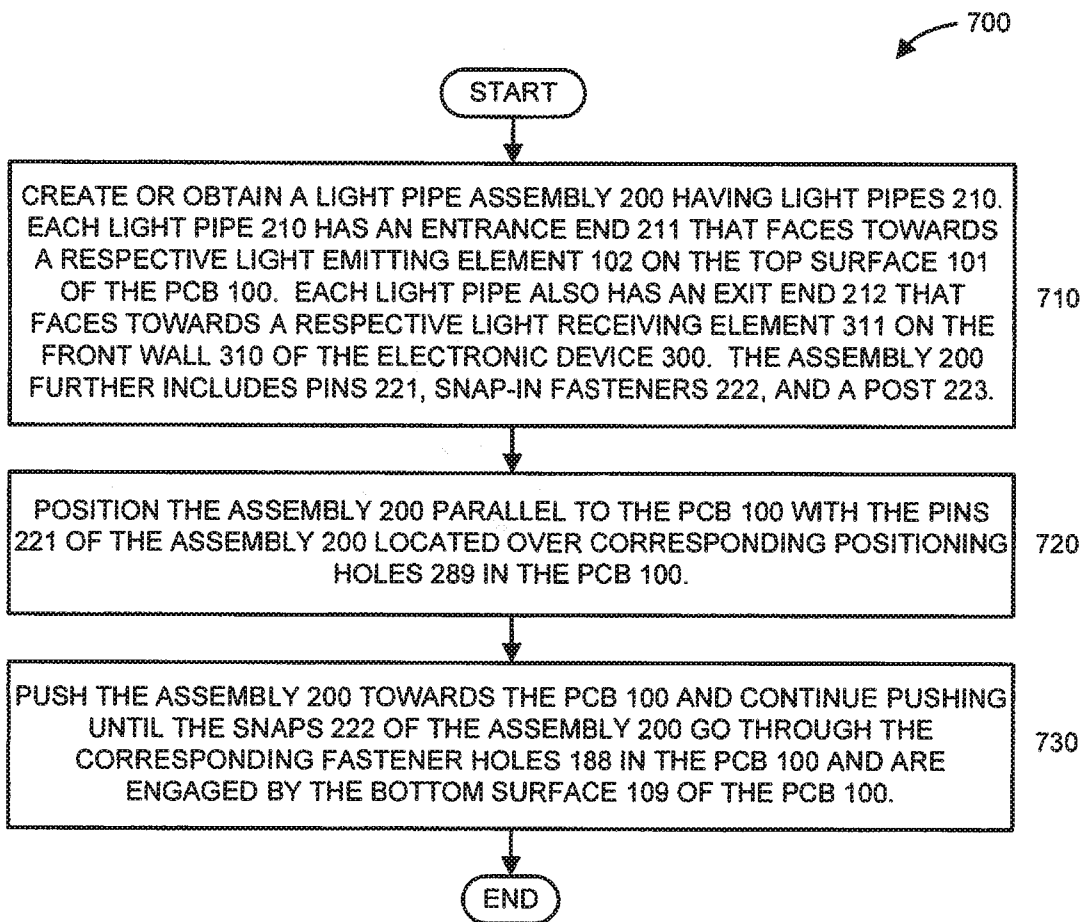


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/021424

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/42 F21V8/00 H01H13/02 H01R13/66 H01R13/717
ADD.

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)
G02B H01H H01R

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2012/174266 A1 (THOMSON LICENSING [FR]; PROCTOR CHRISTOPHER MICHAEL WILLIAM [US]; SUTT) 20 December 2012 (2012-12-20) figures 1,2,5,6 -----	1-5,7-16
X	US 5 938 324 A (SALMON D MILES E [US] ET AL) 17 August 1999 (1999-08-17) column 2, line 58 - line 61; figures 1,4 -----	1,5,13
X	US 6 924 437 B1 (CREEKMORE NORMAN L [US] ET AL) 2 August 2005 (2005-08-02) figure 4 -----	1,5,13
X	US 2009/283321 A1 (HUANG BIN [CN] ET AL) 19 November 2009 (2009-11-19) paragraphs [0020], [0025]; figure 6 ----- -/--	1,5,6,13



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2015/021424

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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