Paper 1

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CURRENT LIGHTING SOLUTIONS, LLC d/b/a GE CURRENT,
Petitioner,

v.

JIAXING SUPER LIGHTING ELECTRIC APPLIANCE CO., LTD.,
Patent Owner.

Case IPR2023-00271
Patent 10,295,125

PETITION FOR *INTER PARTES* REVIEW UNDER 35 U.S.C. § 312

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PETITIONER'S EXHIBIT LIST

Exhibit	Shorthand	Description
1001	'125 Patent	U.S. Patent No. 10,295,125
1002	Baker	Declaration of R. Jacob Baker, Ph.D.
1003	Appendix B	CV of R. Jacob Baker, Ph.D.
1004	'125 Prosecution History	Prosecution History of U.S. Patent No. 10,295,125
1005	Takahashi	U.S. Patent No. 9,271,354
1006	Shimasaki	U.S. Patent No. 8,833,965
1007	Guang	U.S. Patent No. 9,338,853
1008	Takigami	U.S. Patent No. 6,365,841
1009	Robertson	U.S. Patent No. 7,114,830
1010	Van Der Wel	U.S. Patent No. 9,146,017
1011	Wilcox	U.S. Patent No. 9,726,330
1012	Luk	U.S. Patent No. 6,846,094
1013	Demuynck	U.S. Patent No. 9,328,874
1014	Kamada	U.S. Patent No. 7,948,001
1015	Jing	Chinese Patent No. CN203036295U to Jing Certified Translation
1016		Draft Litigation Stipulation
1017	*CH Lighting* Action Claim Constructions	Claim Construction Order, *Jiaxing Super Lighting Electric Appliance Co., Ltd. v. CH Lighting Technology Co., Ltd.*, No. 6:20-cv-00018, Dkt. 57 (W.D. Tex. Oct. 24, 2020)
1018	Bisberg	U.S. Patent No. 8,558,255
1019	Nakamura	U.S. Patent No. 6,331,891
1020	Kawabata	U.S. Patent No. 8,591,057
1021	Kawashima	U.S. Patent App. Pub. No. 2014/0218908
1022	'711 Prosecution History	Prosecution History of U.S. Patent No 9,609,711
1023	Lerman	U.S. Patent No. 8,461,602
1024	Litigation Scheduling Order	Scheduling Order, *Jiaxing Super Lighting Electric Appliance Co., Ltd. v. Current Lighting Solutions, LLC,* No. 6:22-cv-00534, Dkt. 31 (W.D. Tex. Dec. 12, 2020)

Claim Listing

Claim	Limitation No.	Limitation
1	1[p]	An LED tube lamp, comprising:
	1[a]	a lamp tube;
	1[b]	two end caps, each of the two end caps coupled to a respective end of the lamp tube;
	1[c]	a power supply disposed in one or two end caps;
	1[d]	an LED light strip disposed on an inner circumferential surface of the lamp tube, the LED light strip comprising a mounting region and a connecting region, the mounting region for mounting a plurality of LED light sources, the connecting region having at least two soldering pads, and the mounting region and the connecting region being electrically connected to the plurality of LED light sources and the power supply; and
	1[e]	a protective layer disposed on a surface of the LED light strip, the protective layer having a plurality of first openings to accommodate the plurality of LED light sources and at least two second openings to accommodate the at least two soldering pads.
2	2	The LED tube lamp as claimed in claim 1, wherein the protective layer further comprises a third opening adjacent to the two second openings.
6	6	The LED tube lamp as claimed in claim 1, wherein the LED light strip further comprises a first wiring layer, wherein the plurality of LED light sources are disposed on a first side of the first wiring layer and are electrically connected to the first wiring layer.
9	9	The LED tube lamp as claimed in claim 1, wherein at least one of the two end caps comprises at least one conductive pin electrically connected to the power supply.

Claim	Limitation No.	Limitation
10	10	The LED tube lamp as claimed in claim 1, further comprising a diffusion film coated on a surface of the lamp tube.
11	11	The LED tube lamp as claimed in claim 10, wherein the diffusion film is coated on an inner surface of the lamp tube.
13	13	The LED tube lamp as claimed in claim 1, wherein the LED light strip attached to an inner surface of the lamp tube.
14	14	The LED tube lamp as claimed in claim 1, wherein the power supply comprises a circuit board disposed inside one of the end caps, the circuit board electrically connecting the connecting region.
15	15	The LED tube lamp as claimed in claim 14, wherein the circuit board is parallel to a longitudinal direction of the lamp tube.
29	29[p]	An LED tube lamp, comprising:
	29[a]	a lamp tube;
	29[b]	two end caps attached at two ends of the lamp tube, respectively;
	29[c]	a power supply disposed in one or both of the end caps;
	29[d]	a light strip disposed inside the lamp tube, the light strip comprising a mounting region and a connecting region;
	29[e]	a plurality of LED light sources mounted on the mounting region, the mounting region and the connecting region being electrically connected to the plurality of LED light sources and the power supply;
	29[f]	at least two soldering pads arranged on the connecting region for electrically connecting the power supply;
	29[g]	a recognizing mark arranged on the connecting region; and
	29[h]	a protective layer disposed on the light strip.

Claim	Limitation No.	Limitation
30	30	The LED tube lamp as claimed in claim 29, wherein the protective layer comprises a plurality of first openings arranged on the mounting region for accommodating the LED light sources and at least two second openings arranged on the connecting region for accommodating the at least two soldering pads.
31	31	The LED tube lamp as claimed in claim 30, wherein the protective layer further comprises a third opening, wherein the third opening comprises the recognizing mark.
32	32	The LED tube lamp as claimed in claim 31, wherein the LED light strip attached to an inner surface of the lamp tube.
33	33	The LED tube lamp as claimed in claim 31, wherein the power supply comprises a circuit board disposed inside one of the end caps, and the connecting region electrically coupled to the circuit board.
34	34	The LED tube lamp as claimed in claim 33, wherein the circuit board is parallel to a longitudinal direction of the lamp tube.
36	36	The LED tube lamp as claimed in claim 31, wherein the light strip further comprises a first wiring layer, wherein the protective layer covers a first side of the first wiring layer, and wherein the plurality of LED light sources are disposed on the first side of the first wiring layer and are electrically connected to the first wiring layer.
39	39	The LED tube lamp as claimed in claim 29, wherein at least one of the two end caps comprises at least one conductive pin electrically connected to with the power supply.
40	40	The LED tube lamp as claimed in claim 39, wherein the LED tube lamp further comprises a diffusion film coated on a surface of the lamp tube.

Claim	Limitation No.	Limitation
41	41	The LED tube lamp as claimed in claim 40, wherein the diffusion film is coated on an inner surface of the lamp tube.

I. INTRODUCTION

The ’125 Patent describes an LED tube lamp having a lamp tube, two end caps attached at the ends of the lamp tube, a power supply disposed in one or both of the end caps, and an LED light strip disposed inside the lamp tube. EX1001, Abstract. The ’125 Patent admits that these elements were known in LED tube lamps, but asserts that the wires of such lamps may be easily damaged during movement. *Id.,* 2:39-49. The ’125 Patent purports to solve this problem by disposing on the LED light strip a protective layer having openings to accommodate the LED light sources and soldering pads. *Id.,* 3:25-40.

But protective layers having openings for LED light sources and soldering pads were disclosed by Shimasaki before the ’125 Patent was filed. *See* EX1006, 4:40-52. Additionally, using protective layers on LED light strips was known in LED lighting technology before the ’125 Patent, as reflected in Takahashi. *See* EX1005, 9:20-22; EX1014, 7:24-42; EX1002, ¶42. The claimed LED tube lamp structural elements (a lamp tube, end caps, a power supply, and an LED light strip disposed inside the lamp tube) were also disclosed in multiple prior art references, including Takahashi, Shimasaki, and Guang. *See* EX1005, 6:40-62; EX1006, 3:51-61, 4:12-39; EX1007, 6:26-38. Accordingly, the prior art renders obvious the challenged claims.

II. MANDATORY NOTICES

A. Real Party in Interest (37 C.F.R. § 42.8(b)(1))

The real party-in-interest is the Petitioner Current Lighting Solutions, LLC d/b/a GE Current ("Current Lighting").

B. Related Matters (37 C.F.R. § 42.8(b)(2))

1. Litigation

The '125 Patent is currently being asserted by Patent Owner Jiaxing Super Lighting Electric Appliance Co., Ltd. and its exclusive licensee Obert, Inc. in *Jiaxing Super Lighting Electric Appliance Co., Ltd. et al. v. Current Lighting Solutions, LLC d/b/a GE Current*, Case No. 6:22-cv-00534 (W.D. Tex.) ("*Current* Action"). The '125 Patent was previously asserted in a separate, concluded litigation in *Jiaxing Super Lighting Electric Appliance Co., Ltd. et al. v. CH Lighting Technology Co., Ltd. et al*, Case No. 6:20-cv-00018 (W.D. Tex.) ("*CH Lighting* Action").

2. Administrative Proceedings

The '125 Patent has not been challenged in any prior petitions.

C. Lead and Back-Up Counsel (37 C.F.R. § 42.8(b)(3))

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D. Service Information (37 C.F.R. § 42.8(b)(4))

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Petitioner consents to electronic service.

III. GROUNDS FOR STANDING

Petitioner certifies: the '125 Patent is available for IPR; Petitioner is not barred or estopped from requesting an IPR on the grounds identified herein. The '125 Patent has not been subject to a previous FWD in an estoppel-based AIA proceeding.

IV. STATEMENT OF PRECISE RELIEF REQUESTED

A. Claims for Which Review Is Requested (37 C.F.R. § 42.104(b)(1))

Petitioner requests review and cancellation of Claims 1, 2, 6, 9-11, 13-15, 29-34, 36, and 39-41.

B. Statutory Grounds of Challenge (37 C.F.R. § 42.104(b)(2))[1]

Claims 1, 2, 6, 9-11, 13-15, 29-34, 36, and 39-41 are invalid under §103 over these combinations of art:

Ground	Basis	Claims	Prior Art Combination
1	§103	1, 2, 6, 9-11, 13-15	Takahashi (EX1005), Shimasaki (EX1006)
2	§103	1, 2, 6, 9, 13-15	Guang (EX1007), Shimasaki
3	§103	10, 11	Guang, Shimasaki, Takahashi
4	§103	1, 2, 6, 9-11, 13-15	Takahashi, Shimasaki, Jing (EX1015)
5	§103	1, 2, 6, 9, 13-15	Guang, Shimasaki, Jing
6	§103	10, 11	Guang, Shimasaki, Takahashi, Jing
7	§103	2, 29-34, 36, 39-41	Takahashi, Shimasaki, Takigami (EX1008)
8	§103	2, 29-34, 36, 39	Guang, Shimasaki, Takigami
9	§103	40, 41	Guang, Shimasaki, Takahashi, Takigami

[1] All Grounds are supported by a POSITA's general knowledge. *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337-38 (Fed. Cir. 2020).

Ground	Basis	Claims	Prior Art Combination
10	§103	2, 29-34, 36, 39-41	Takahashi, Shimasaki, Jing, Takagami
11	§103	2, 29-34, 36, 39	Guang, Shimasaki, Jing, Takagami
12	§ 103	40, 41	Guang, Shimasaki, Takahashi, Jing, Takigami

Filed August 13, 2014, Takahashi is prior art under §102(a)(2).

Published August 1, 2013, Shimasaki is prior art under §102(a)(1).

Filed July 17, 1998, and issued April 2, 2002, Takigami is prior art under §102(a)(1).

Filed September 17, 2014, Guang is prior art under §102(a)(2).

Filed December 12, 2012 and published July 3, 2013, Jing is prior art under §102(a)(1).

V. THE GROUNDS IN THIS PETITION ARE NOT CUMULATIVE

The factors considered under 35 U.S.C. §§ 314(a) and 325(d) do not weigh in favor of exercising discretion to deny institution. The '125 patent has not been challenged in any prior IPR petition. As such, none of the discretionary factors set forth in *General Plastic* apply to this Petition. *See General Plastic Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, at 15-16 (PTAB Sept. 6, 2017) (Paper 19) (precedential).

The grounds in this petition are not cumulative over the prior art references and combinations considered during prosecution of the '125 Patent. Takahashi, Shimasaki, and Takigami were not before the Examiner during prosecution.[2] *See generally* EX1001, cover pages 1-4; EX1004. In a Notice of Allowance mailed January 11, 2019, the Examiner cited U.S. Application Publication No. 2016/0081147 that ultimately issued as Guang. Specifically, the Examiner noted that Guang and other prior art references disclose

> a LED tube lamp, comprising:
> a lamp tube, two end caps, each of the two end caps coupled to a respective end of the lamp tube, a power supply disposed in one or two end caps, an LED light strip disposed on an inner circumferential surface of the lamp tube, the LED light strip comprising a mounting region and a connecting region, the mounting region for mounting a plurality of LED light sources, the connecting region having at least two connection terminals, and the mounting region and the connecting region being electrically connected to the plurality of LED light sources and the power supply; but does not teach the allowable subject matters described above.

[2] U.S. Patent App. Pub. 2015/0077001, later issued as Takahashi, was cited by the Examiner, but not substantively discussed during the prosecution of U.S. Patent No 9,609,711, a parent to the '125 Patent. *See* EX1022, p.370/582.

EX1004 at 310/418. The Examiner indicated that the allowable subject matter was a protective layer having openings disposed on an LED light strip (claim 1), and soldering pads and a recognizing mark arranged on the connecting region (claim 29). EX1004 at 309/418. But there is nothing in the '125 Patent prosecution history indicating whether the Examiner considered whether the '125 Patent claims would have been obvious if Guang's teachings were combined with a protective layer or a recognizing mark, as taught by Shimasaki and Takigami. Accordingly, discretionary denial under either of §§ 314(a) or 325(d) is not warranted.

VI. LEVEL OF ORDINARY SKILL IN THE ART

A POSITA as of September 28, 2014[3]—the '125 Patent's earliest claimed priority date—would have had a Bachelor's degree in electrical engineering, or an equivalent field, as well as at least 1-2 years of academic or industry experience in lighting design, including knowledge of LEDs and related technology for driving LEDs. EX1002, ¶26. A person of ordinary skill in the art with a higher level of education may have fewer years of academic or industry experience, or vice versa. *Id.* A POSITA would have been familiar with the field of technology described in

[3] All statements in this Petition about the knowledge and skills of, and what would have been obvious to, a POSITA are offered from the perspective of this date. EX1002, ¶28.

§VII. *Id.* The prior art and the '125 Patent also evidence this level of ordinary skill. *See Chore-Time Equip., Inc. v. Cumberland Corp.*, 713 F.2d 774, 779 (Fed. Cir. 1983); *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). Here, the background described in §VII and the prior art described herein demonstrate that a POSITA would have been familiar with various aspects of LED lighting device design. EX1002, ¶26.

VII. FIELD OF TECHNOLOGY

Consumer interest in LED lamps increased in the mid-2010s due to improved energy efficiency and longer life span. EX1002, ¶29. For example, Takahashi notes that "[i]n recent years, . . . semiconductor light-emitting elements such as LEDs [have] gained in popularity as a substitute for an incandescent light bulb." EX1005, 1:20-24. Shimasaki describes a recent "increase in output and improvement of efficiency" in LED lighting. EX1006, 1:26-29. A POSITA would have understood the need for increased reliability and efficiency in LED tube lamps. EX1002, ¶29.

A. LED Tube Lamps

LED tube lamps are LED lighting devices that are used in place of fluorescent tube lamps. EX1002, ¶30. LEDs can be disposed inside tubes made to fit into existing fluorescent light sockets or fixtures. *Id.; see*, *e.g.*, EX1007, 4:16-19 LED tube lamps include end caps with electrode pins for connecting to a lighting fixture. *See* EX1007, 7:39-46.

LED lamp tubes can include diffusion elements applied to the tube, and a POSITA would understand that there are several methods of diffusing light from LED tube lamps, including diffusion films. *See*, *e.g.*, EX1006, 7:18-45, EX1002, ¶31. A POSITA would have understood that all such methods diffuse light from LED tube lamps and help create a uniform light output, and that diffusion films can have certain advantages over other diffusion treatments. *See*, *e.g.* EX1010, 2:7-19, 5:55-67, 6:60-7:22,; EX1002, ¶¶31-32.

LED lights present numerous advantages over fluorescent and incandescent lights, including lower energy consumption, longer life, improved robustness, lower cost, and less toxic materials. EX1002, ¶¶29, 33.

B. LED Light Strips

LEDs for use in tube lamps were typically mounted in arrays on LED light strips made of various materials, including traditional printed circuit boards (PCBs) and flexible circuit boards or strips. *See*, *e.g.*, EX1006, 4:40-44; EX1002, ¶¶34-35. Flexible circuit boards were well-known and commonly used for LED light strips and provided a versatile substrate for mounting LEDs. *See*, *e.g.*, EX1012, 1:63-66, 6:44-54; EX1013, 7:58-61;EX1002, ¶35.

LED strips for LED tube lamps were arranged in numerous ways within the tube, such as adhered directly on an inner surface of the tube or mounted on an intermediate structure. *See*, *e.g.*, EX1011, 10:46-49, EX1013, 8:9-14, 10:44-50,

FIG.6; EX1012, 1:63-66; EX1010, 6:5-39; EX1002, ¶36. Ultimately, there were many known ways of disposing an LED strip within and on the inner surface of a lamp tube, each with the benefit of supporting and securing the LED strip in place. EX1002, ¶36. A POSITA would be familiar with manufacturing methods for LED strips and for mounting LED chips. EX1018, 7:10-55, 7:56-8:5; EX1019; EX1002, ¶37.

Using reflective solder resist layers in LED lighting applications was a well-known technique for increasing the light output efficiency of LED lighting devices. *See*, *e.g.*, EX1014, 7:9-35; EX1002, ¶42. A white resist layer incorporated on the surface of an LED strip, for example, was known to improve light output efficiency by reflecting light and preventing light absorption through the substrate on which the LEDs are disposed. EX1014, 7:9-35; EX1002, ¶42. Such a resist layer is a protective layer for the LED strip in that it covers patterned conductors or wiring layers and offers a degree of protection against damage and corrosion to the conductors (e.g., wiring layers). EX1002, ¶42. A POSITA would have understood that such resist layers were typically applied before mounting LED elements onto the wiring layers of the board, with openings masked during application or etched thereafter to expose mounting regions for the LED elements to be mounted onto. *See*, *e.g.*, EX1014, 7:36-42; EX1008; EX1002, ¶43. Such openings were known to enable mounting of LED chips and facilitate other electrical connections, such as

from solder pads to a power supply. EX1002, ¶43-44. Connecting LED light strips to a power supply using solder pads was also well-known. *See*, *e.g.*, EX1020, FIGS.7-9, 11:6-61; EX1002, ¶44-45.

C. LED Power Supplies

LED tube lamps, and indeed most LED lighting, typically have a power supply circuit that includes various components and provides power to the LEDs. *See*, *e.g.*, EX1007, 5:4-15, 6:26-7:6; EX1020, 1:29-36, 4:42-44, 11:51-61; EX1005, 6:55-65; EX1002, ¶38. Power supplies for LED lighting were known to have AC/DC converters, constant-current circuits, and filtering elements like capacitors or inductors. EX1020, 4:42-44, 11:51-61; EX1007, 6:26-7:6; EX1002, ¶39-40. Such power supply circuits could have been positioned for LED tube lamps in any of several ways according to the needs of a given LED tube lamp. *See*, *e.g.*, EX1006. 3:39-61; EX1021, ¶[0049], EX1020, 11:51-61, FIGS.7-9, EX1007, 7:7-9; EX1005, 8:12-19; EX1002, ¶41.

VIII. THE '125 PATENT

Entitled "LED Tube Lamp," the '125 Patent is directed to an LED tube lamp that includes a lamp tube, end caps, a power supply, an LED light strip, and a protective layer disposed on the LED light strip. EX1001, Abstract. The LED tube lamp includes "a lamp tube, two end caps attached at two ends of the lamp tube respectively, a power supply disposed in one of the two end caps or separately in

both of the end caps, an LED light strip disposed inside the lamp tube and a protective layer disposed on the LED light strip." *Id.* The LED light strip 2, shown below in FIG. 22, comprises an [orange] mounting region and a [purple] connecting region, where the mounting region "is for mounting a plurality of LED light sources" to the LED light strip, and the connecting region is a region of the LED light strip "hav[ing] at least two soldering pads [b]." *Id.*; *see also id.*, 3:32-34; 32:8-33.[4] The mounting region and the connecting region are electrically connected to the plurality of LED light sources and power supply 5. *Id.*, Abstract.

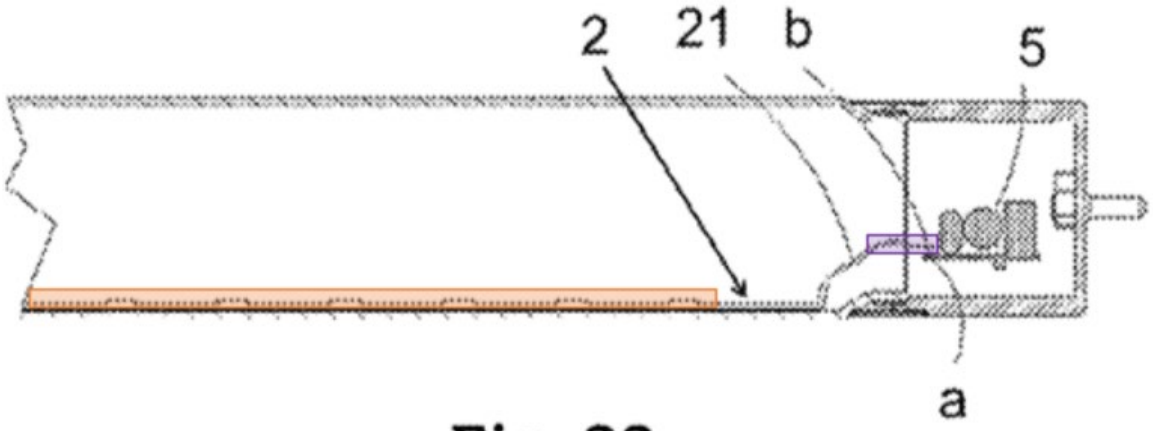


Fig. 22

Id., FIG.22.

[4] Note that 21 in FIG. 22 is a "freely extending portion" of light strip 2 that extends into the end cap. EX1001, 32:34-39.

A. Background

The ’125 patent is directed to “an LED tube lamp compris[ing] a plurality of LED light sources, an end cap, a power supply disposed in the end cap, a lamp tube, and an LED light strip.” EX1001, 2:65-67. In other words, the ’125 patent discloses and claims aspects of an LED tube lamp for replacing a fluorescent tube lamp. EX1002, ¶46.

1. LED tube lamp replacements

The ’125 Patent teaches that replacing incandescent and fluorescent lighting with LED tube lamps has become increasingly common due to the benefits of LED tube lamps relative to incandescent and fluorescent lighting. EX1001 at 2:25-26. For example, “LED tube lamps are mercury-free in comparison with fluorescent tube lamps that need to be filled with inert gas and mercury.” *Id*., 2:26-27. LED tube lamps also have improved durability and longevity compared to traditional incandescent and fluorescent lightings. *Id.*, 2:34-35 And LED tube lamps typically consume less energy to output the same brightness. *Id.*, 2:34-36 These factors mean that LED tube lamps are typically considered a cost effective lighting option. *Id*., 2:36-38.

The ’125 Patent admits that typical LED tube lamps “have a lamp tube, light sources in the lamp tube, two caps connected to two ends of the lamp tube, and one power supply or two at the ends of the lamp tube.” *Id.*, 2:39-42. “The caps receive

external electricity and transmit it to the power supply and the light sources through a wire or wires (wire bonding)." *Id.*, 2:42-44.

2. Issues with LED tube lamps

According to the '125 Patent, a drawback to LED tube lamps is that "wires may be easily damaged and even broken due to any movement during manufacturing, transportation, and usage of the LED tube lamp and therefore may disable the LED tube lamp." '125 Patent, 2:45-49.

3. Summary of alleged invention of the '125 Patent

The '125 Patent purports to solve the wire-damage problem described above by "provid[ing] an LED lamp tube" that includes "a lamp tube, two end caps each of which coupled to a respective end of the lamp tube, a power supply disposed in one or two of the end caps, an LED light strip disposed on an inner circumferential surface of the lamp tube, and ***a protective layer disposed on the LED light strip***."[5] *Id.*, 3:25-31. According to the '125 Patent the protective layer is "made of an ink with the function of resisting soldering and increasing reflectivity." *Id*., 29:45-48. "The protective layer have [sic] a plurality of first openings to accommodate the plurality of LED light sources and at least two second openings to accommodate the at least two soldering pads." *Id*., 3:36-40. FIG. 25 below shows the connecting

[5] All emphasis added unless otherwise noted.

region of the protective layer having openings over the "b" solder pads, and additional openings "c" and "d" adjacent to openings "b". *Id.*, 33:5-23. The '125 Patent also discloses similar openings in the mounting region accommodating LEDs *Id.*, 3:36-40.

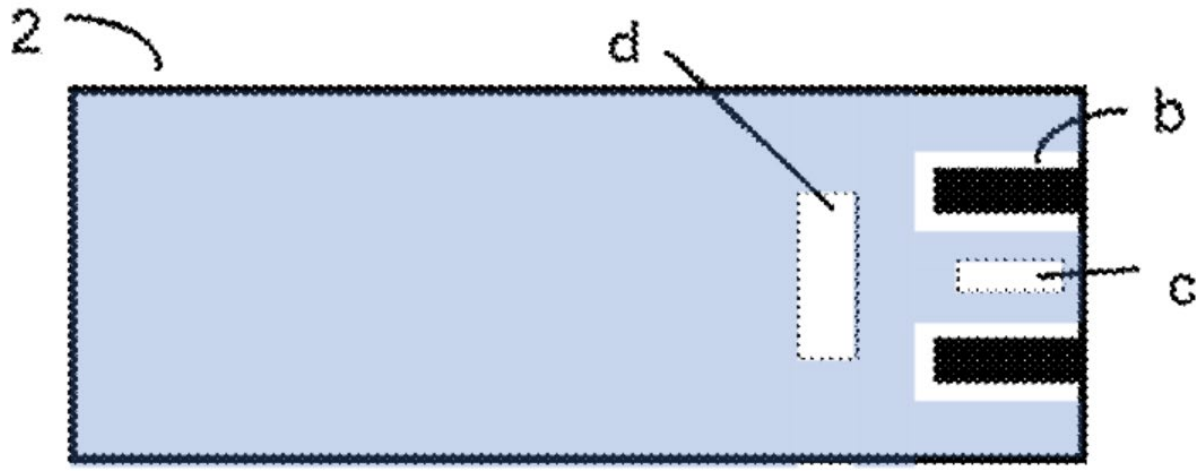


Fig. 25

Id., FIG.25.

B. Claim Construction (37 C.F.R. § 42.104(b)(3))

Claim terms are given a meaning in accordance with the standard used in §282(b) civil actions, including their "ordinary and customary meaning … as understood by [a POSITA] and the prosecution history." 37 C.F.R. §42.100(b).

1. "electrically connected/coupled"

Petitioner does not believe this term needs explicit construction, but notes that the specification expressly indicates that the term is broad enough to cover both direct connections and indirect connections (via intervening components). EX1001, 13:5-20.

2. "disposed on an inner circumferential surface of the lamp tube"

Petitioner does not believe this term needs explicit construction, but notes that the specification expressly indicates that the term "on" is broad enough to cover both direct contact or through "intervening elements." EX1001, 12:5-17.

Moreover, even if PO argues that there is a distinction between an intervening adhesive and some other intervening element, the proposed grounds below address both options. Grounds 1-3 include an intervening support structure, and Grounds 4-6 include only an intervening adhesive.

3. Prior Constructions

The following terms of the '125 Patent were previously construed in the *CH Lighting* Action:

Term/Claim	**Construction**
"a power supply disposed in one or more end caps" (claims 1, 29)	Plain and ordinary meaning
"the power supply comprises a circuit board disposed inside one of the end caps" (claim 14)	Plain and ordinary meaning

"recognizing mark" (claim 29)	Plain and ordinary meaning wherein the plain and ordinary meaning is a "reference point"

EX1017, 2-3/7. The Grounds herein establish the invalidity of the challenged claims under these constructions.

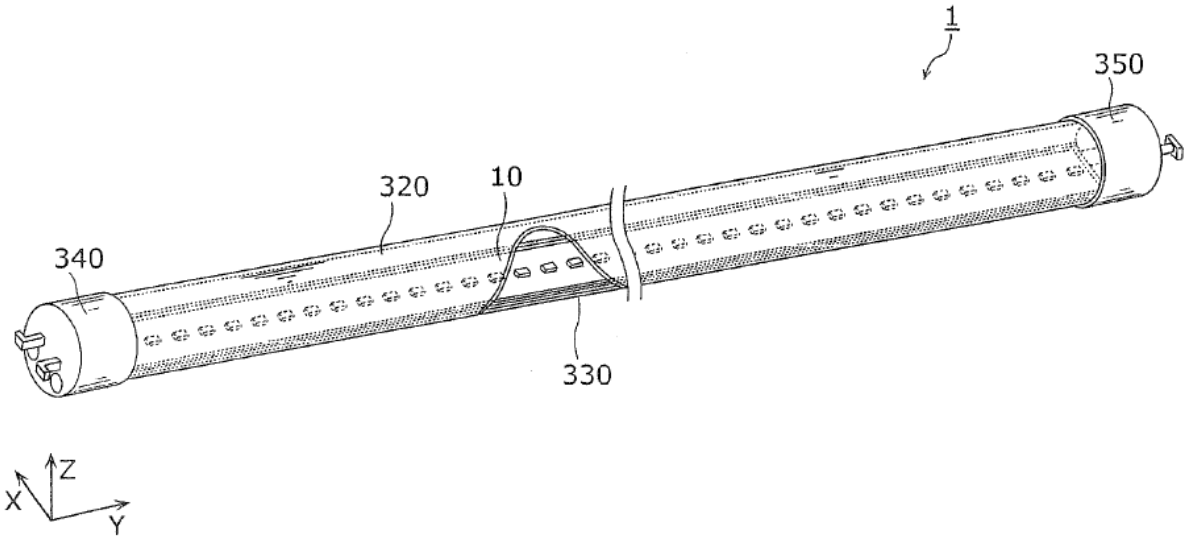
IX. REASONS FOR THE RELIEF REQUESTED UNDER 37 C.F.R. §§ 42.22(A)(2) AND 42.104(B)(4)

A. Ground 1 – Takahashi and Shimasaki Render Obvious Claims 1, 2, 6, 9-11, and 13-15

1. Takahashi

Takahashi is titled "Lighting Source and Lighting Apparatus." Takahashi notes that "[i]n recent years, . . . semiconductor light-emitting elements such as LEDs [have] gained in popularity as a substitute for an incandescent light bulb." EX1005, 1:20-24. Takahashi describes a "straight tube LED lamp" that "substitutes for a conventional straight tube fluorescent lamp." EX1005, 6:28-31.

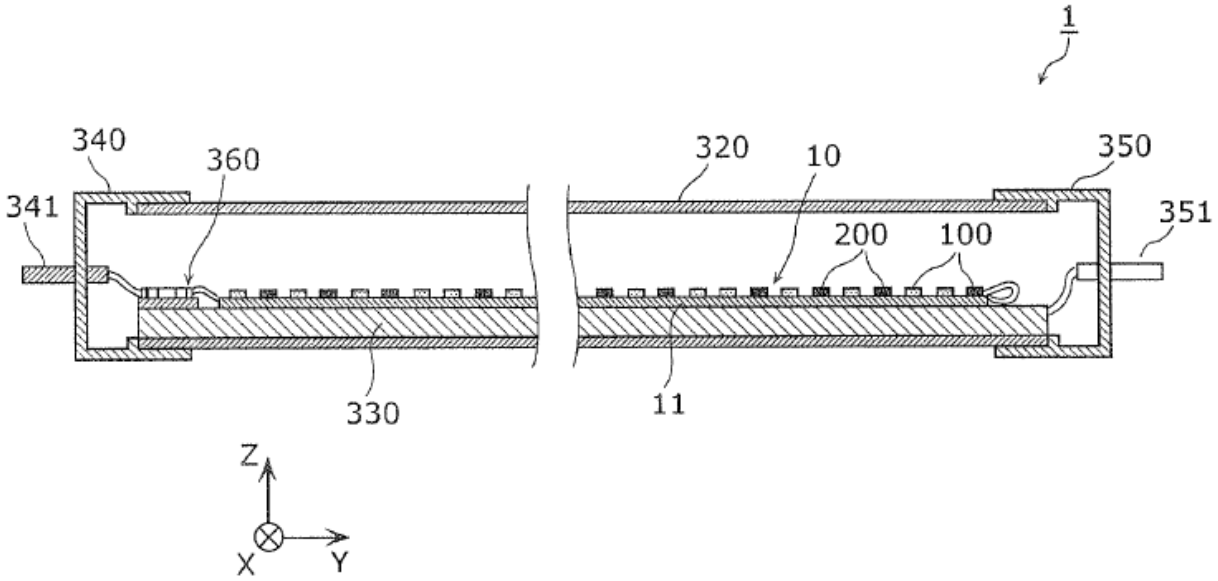
FIG. 1



EX1005, FIG.1.

Takahashi's FIG.1 discloses "the straight tube LED lamp 1 is a lighting source including: an LED module 10; an elongated case 320 that houses the LED module 10; a base platform 330; a feeding base (feeding-side base) 340 provided to one of end portions in a longitudinal direction (tube axis direction) of the case 320; a non-feeding base 350 provided to the other of the end portions in the longitudinal direction of the case 320; and a lighting circuit (not shown)." EX1005, 6:40-48. Takahashi discloses that "[t]he straight tube LED lamp 1 is supported by a lighting appliance by the feeding base 340 and the non-feeding base 350 being attached to a

socket of the lighting appliance with a feeding pin 341 and a non-feeding pin 351." EX1005, 6:50-54. The pins 341 and 351 are illustrated in FIG.2 below.



EX1005, FIG.2.

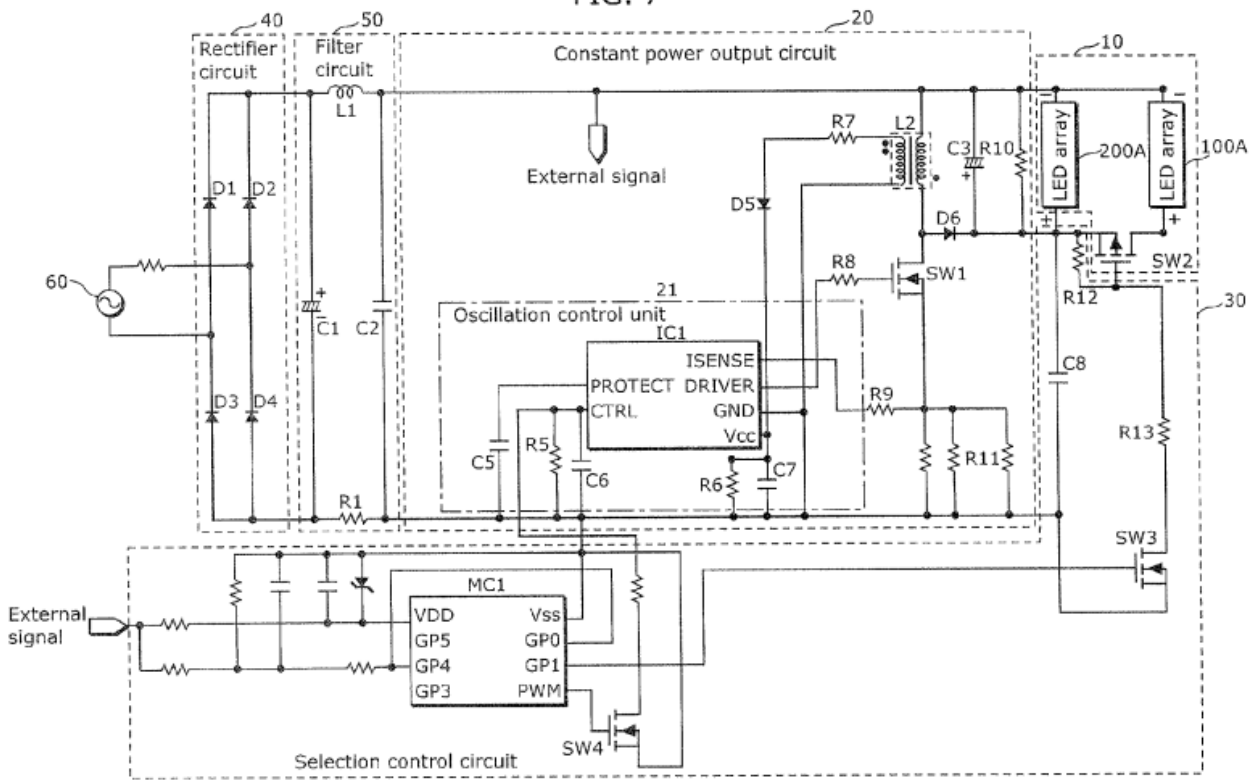
Takahashi discloses the "case 320 is an elongated translucent cover covering the LED module 10 and having translucency." EX1005, 7:7-8. "The case 320 can be made of a transparent resin material or glass." EX1005, 7:11-12. Takahashi notes that "the case 320 may include a light diffusion unit having a light diffusion function to diffuse light from the LED module 10." EX1005, 7:23-25. "Examples of the light diffusion unit include a light diffusion sheet or a light diffusion film provided to at least one of the inner surface and the outer surface of the case 320." EX1005, 7:27-29.

Takahashi discloses that "the base platform 330 holds (supports) the LED module 10 and the drive circuit 360" and "is firmly fixed to the inner surface of the

case 320." EX1005, 7:47-51; EX1002 ¶57. Takahashi discloses that "the LED module 10 is elongated in a tube axis direction of the case 320, and LED elements 100 and LED elements 200 that are surface mount devices (SMDs) are mounted on a board 11." EX1005, 8:5-8; EX1002 ¶57. In FIG.2, Takahashi also discloses a "drive circuit 360 [which] may be disposed inside the feeding base 340 via a lead wire connected to a connection terminal on the board 11" EX1005, 8:17-19; EX1002 ¶57. "The board 11 is an LED mounting board which has at least a surface including an insulating material and on which LED elements are mounted. EX1005, 9:9-11.

Additionally, Takahashi discloses in FIG.7, below, a "circuit configuration diagram including an LED lamp." EX1005, 4:33-34; EX1002 ¶58. "FIG. 7 illustrates the LED module 10, the constant power output circuit 20, the selection control circuit 30, a rectifier circuit 40, a filter circuit 50, and an alternating-current (AC) source 60." EX1005, 13:49-52. Drive circuit 360 includes at least constant power output circuit 20 and selection control circuit 30. EX1005, 6:55-65; EX1002 ¶58. A POSITA would have understood that all of these components make up a power supply for Takahashi's LED tube lamp. EX1002 ¶58.

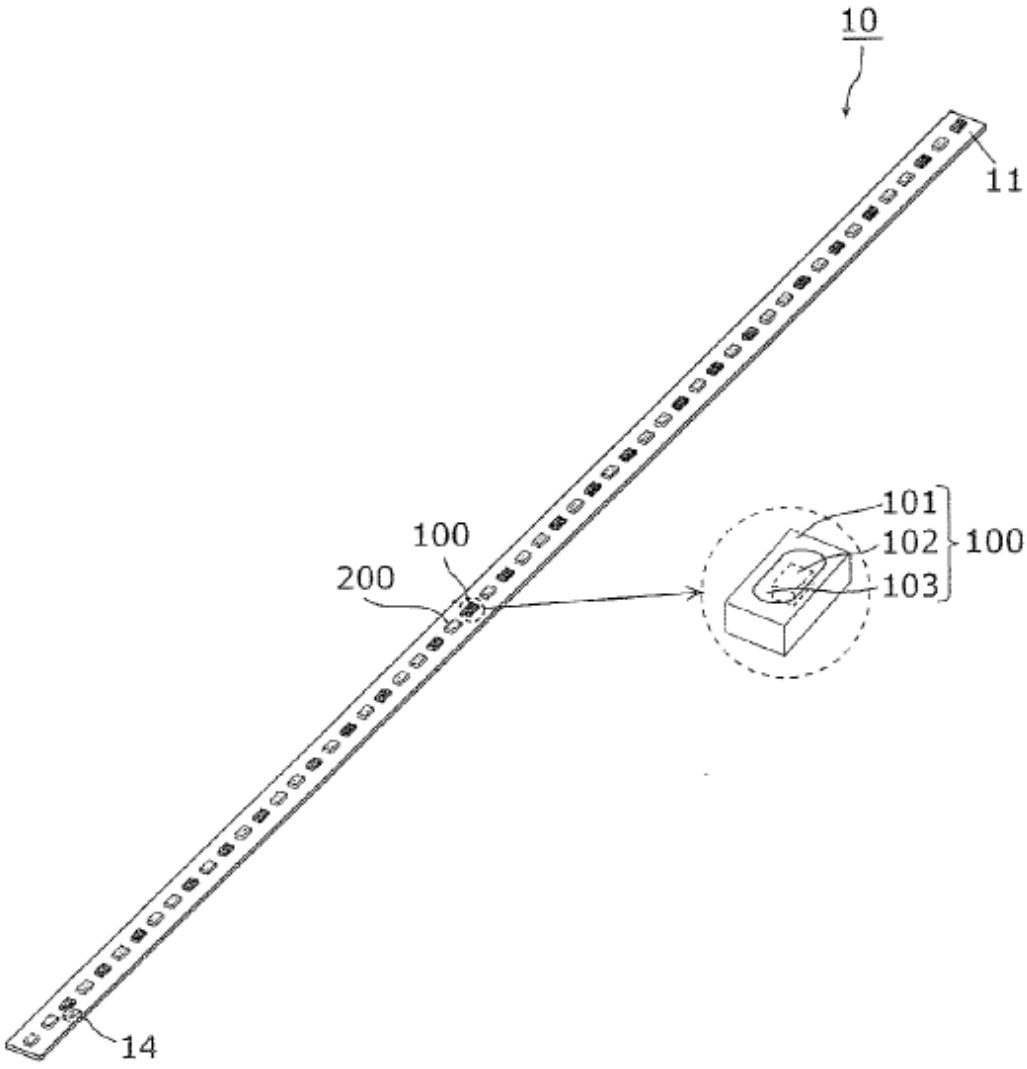
FIG. 7



EX1005, FIG.7.

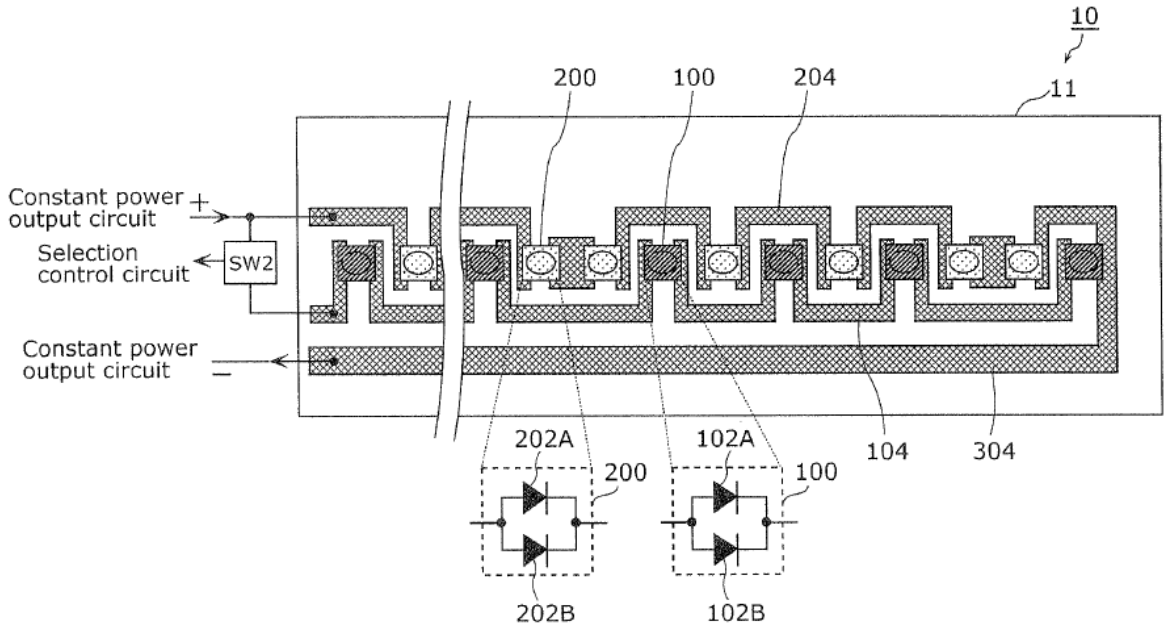
Takahashi teaches that "to enhance reflectivity and protect wiring, a white resist may be applied to the front surface of the board 11." EX1005, 9:20-22; EX1002, ¶59. The board 11 and its wiring layers are illustrated in FIGs.3 and 4.

FIG. 3



EX1005, FIG.3.

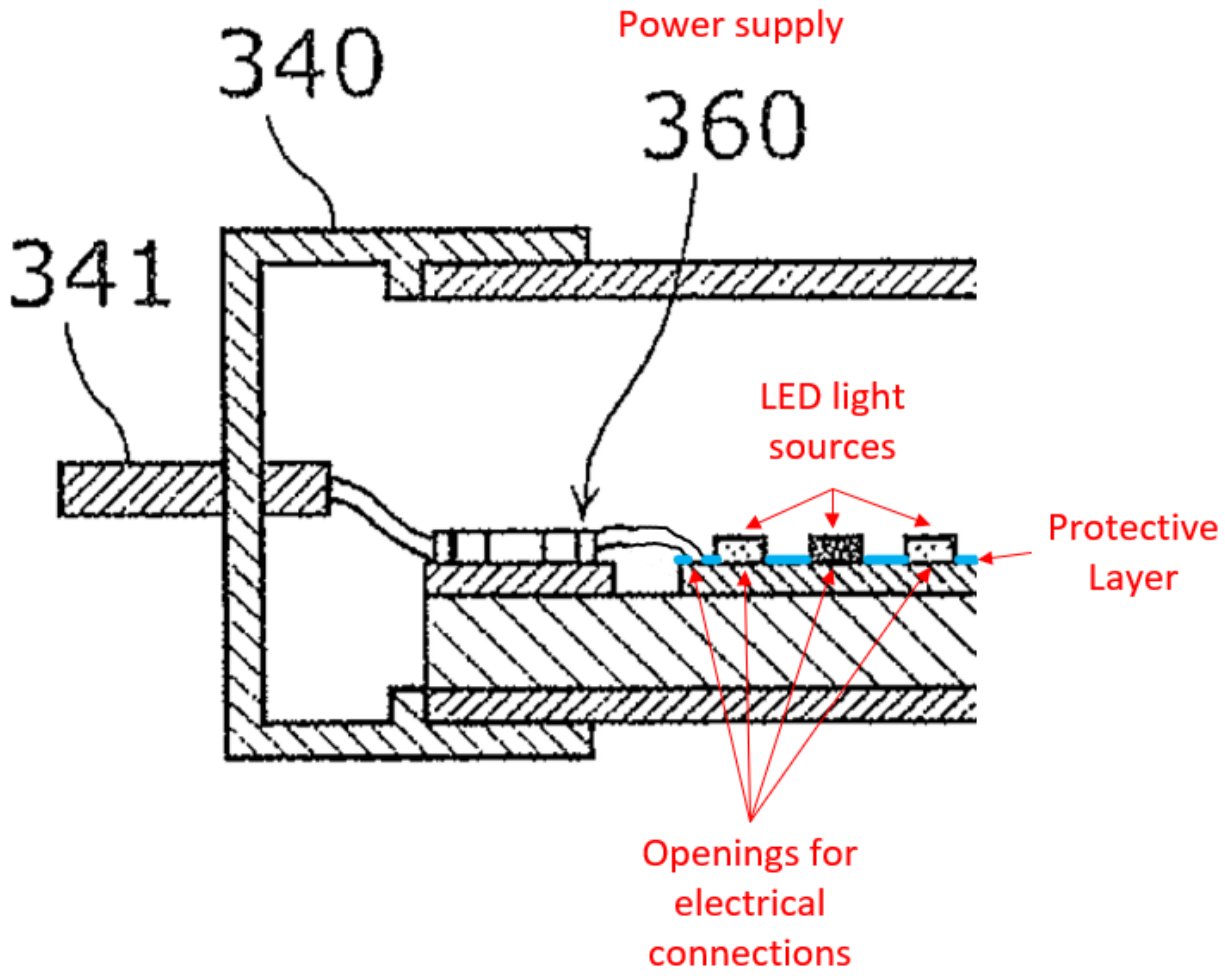
FIG. 4



EX1005, FIG.4.

While Takahashi discloses a "white resist" layer, Takahashi does not specifically disclose the details of the white resist layer, e.g., openings to accommodate the LEDs or solder pads for connection to the power circuits discussed in FIG.7. EX1002, ¶65. But a POSITA would understand that openings in the protective layer for solder pads and LEDs would be necessary for proper connection between the components. *Id.*. For example, Takahashi teaches connecting the LEDs to wiring lines on the board and connecting the lines to a connection terminal (soldering pads) and to the drive circuit (power supply). *See* EX1005, 9:27-42, FIG.4. A POSITA would understand that such electrical connections would be more

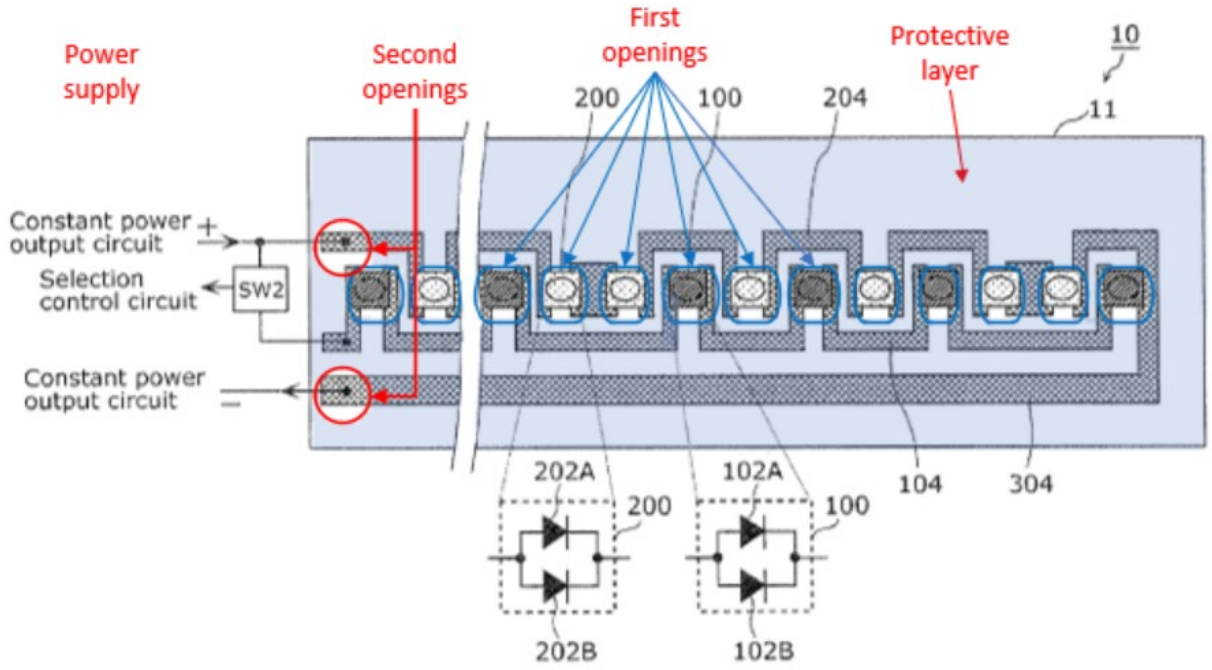
difficult if not impossible to make if the protective layer did not have openings to accommodate those elements. EX1002, ¶66. Therefore, a POSITA would have been motivated to include openings in Takahashi's protective layer as shown in modified FIGS.2 and 4 below.[6] *Id.*



EX1005, FIG. 2.

[6] All colorized figures herein are annotated.

FIG. 4



EX1005, FIG. 4.

2. Shimasaki

Shimasaki is titled "Light-Emitting Circuit, Luminaire, and Manufacturing Method for the Light-Emitting Circuit." Shimasaki notes a recent "increase in output and improvement of efficiency" of LED lighting. EX1006, 1:26-29. Shimasaki discloses a "direct tube type LED lamp 2 [that] has dimensions and an external shape substantially the same as those of an existing direct tube type fluorescent lamp." EX1006, 4:1-4. "[F]or example, the direct tube type LED lamp 2 has dimensions and an external shape substantially the same as those of 20 W and 40 W direct tube type fluorescent lamps." EX1006, 4:5-9.

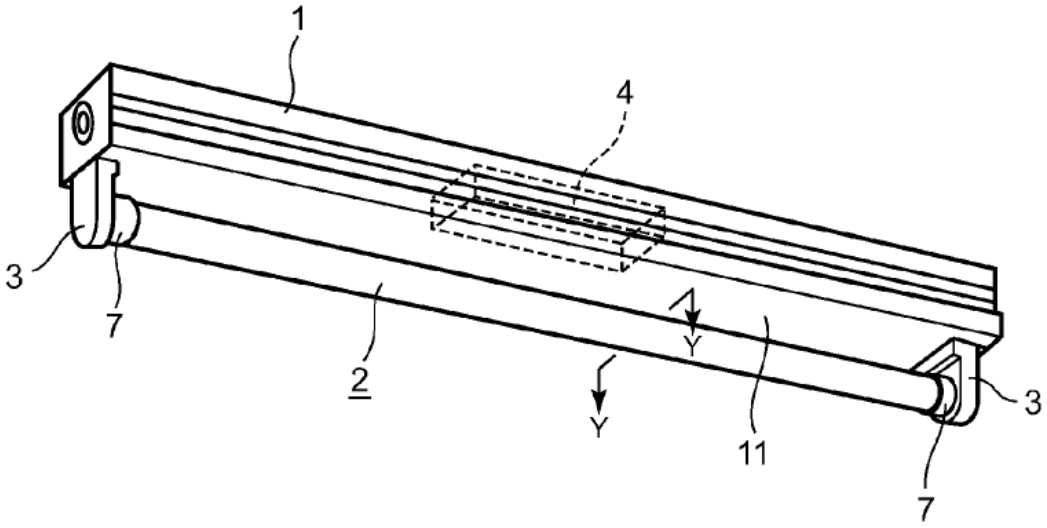


FIG. 1

EX1006, FIG.1.

Shimasaki's LED lamp "includes an elongated main body 5 having a substantially cylindrical shape in external appearance, a light source section 6, and cap sections 7." EX1006, 4:12-14. "As shown in FIG. 2 [below], the main body 5 has an internal space." EX1006, 4:15. "The main body 5 is formed in a substantially cylindrical shape and manufactured by extrusion molding from a synthetic resin material such as translucent polycarbonate resin having diffusibility." EX1006, 4:16-19. "On the inner wall of the main body 5, a pair of 20 supporting rails 51 opposed to each other and projecting to the inner side is formed." EX1006, 4:19-21 "An elongated attachment member 52 is supported by the supporting rails 51 and disposed along the longitudinal direction of the main body 5." EX1006, 4:21-23.

"Power supply terminals 71 and an earth terminal 72 projecting from both ends of the direct tube type LED lamp 2 shown in FIG. 16 [below] [which] are connected to the socket sections 3." EX1006, 3:48-50.

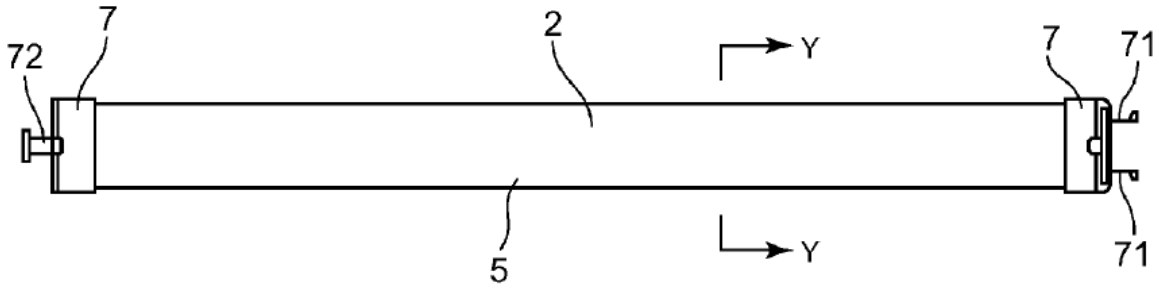
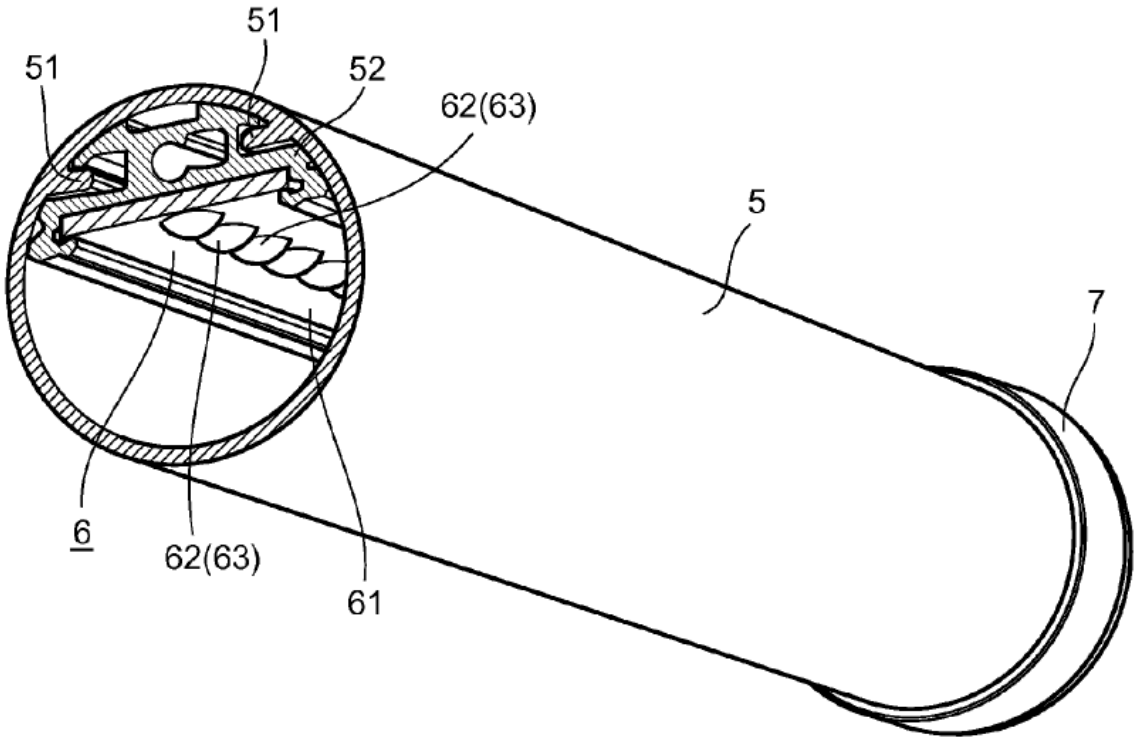


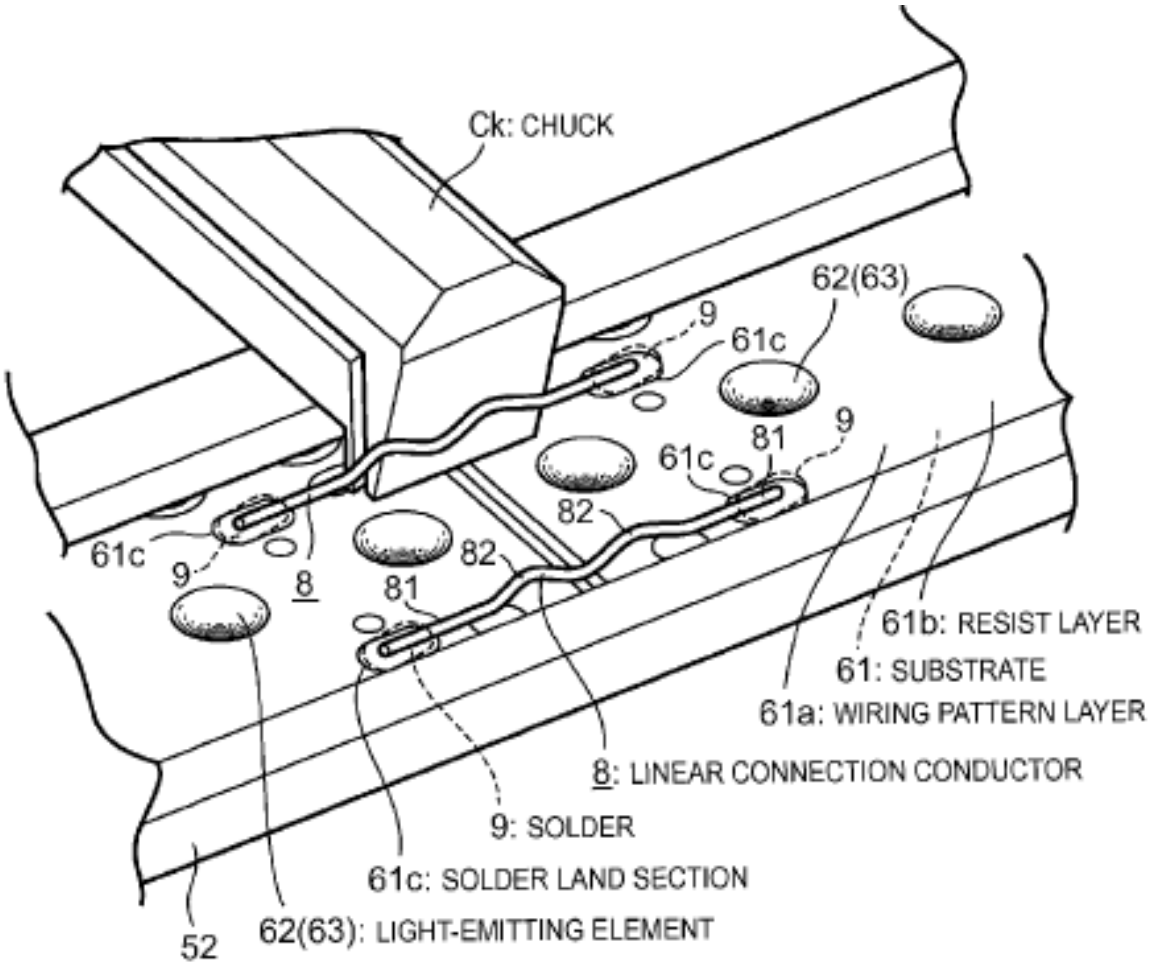
FIG. 16

Shimasaki's "light source section 6 includes a substrate 61, a plurality of light-emitting elements 62 linearly arranged and mounted on the substrate 61, and a phosphor layer 63 that covers the light-emitting elements 62." EX1006, 4:33-39. "A plurality of the substrates 61 are arranged and disposed in the longitudinal direction of the light source section 6." *Id*.



Id., FIG. 2.

As shown in FIG. 5, inset below, "[a] wiring pattern layer 61a formed of a copper foil is formed on the front surface side of the substrate 61." *Id.*, 4:44-52. "A resist layer 6lb is laminated on the wiring pattern layer 61a as appropriate." *Id.* "The resist layer 61b is a white resist layer having high reflectance." *Id.* "The resist layer 61b is laminated over substantially the entire surface of the front layer of the substrate 61 excluding a mounting region of the light-emitting elements 62 and solder land sections 61c …." *Id.* "The solder land sections 61c are a part of the wiring pattern layer 6la and are portions where the wiring pattern layer 61a, on which the resist layer 61b is not laminated, is exposed to the surface and formed in a corner-rounded rectangular shape." *Id.*, 6:24-30.



EX1006, FIG. 5.

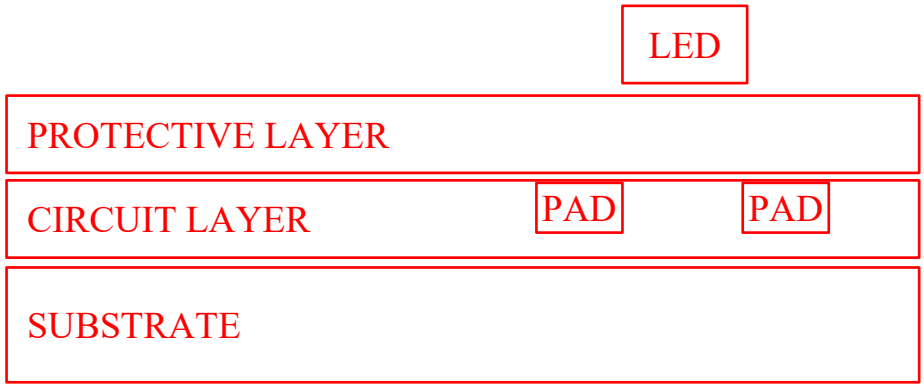
3. Motivation to Combine

As explained above in Section IX.A.1, Takahashi teaches a protective layer disposed on a surface of the LED light strip in the form of a white resist layer "to enhance reflectivity and protect wiring." EX1005, 9:20-22.

Takahashi does not describe explicitly that the protective layer has openings to accommodate the LEDs or its connection terminal to which "lead wire is soldered" "to be fixed to the board 11" (EX1005, 9:40-42). EX1002, ¶65. But a POSITA

would have also understood that Takahashi implicitly teaches openings in the protective layer for its soldering pads and LEDs. EX1002, ¶65. And, because a POSITA would have viewed such connections—between the LEDs and the board, and between the drive circuit 360 and the connection terminal 14 of the board—to be necessary for the operation of Takahashi's LED lamp, a POSITA would have been motivated to include such openings through Takahashi's "white resist" layer on "the front surface of the board 11." EX1005, 9:20-22; EX1002, ¶65.

More particularly, Takahashi teaches connecting the LEDs to wiring lines on the board and connecting the lines to a connection terminal (soldering pads) and to the drive circuit (power supply). *See* EX1005, 9:27-42, FIG.4. A POSITA would have understood that—"to … protect wiring"—the protective layer must necessarily be above the wiring. EX1002, ¶65. And—"to enhance reflectivity"—the protective layer must necessarily be below the LEDs (and not over the LEDs). *Id.* As illustrated conceptually below, a POSITA would have also understood that such circuit boards are typically manufactured layer-by-layer, such that the circuits would be added as a layer over a substrate, and the protective layer would be added as an additional layer over the circuits. *Id.*

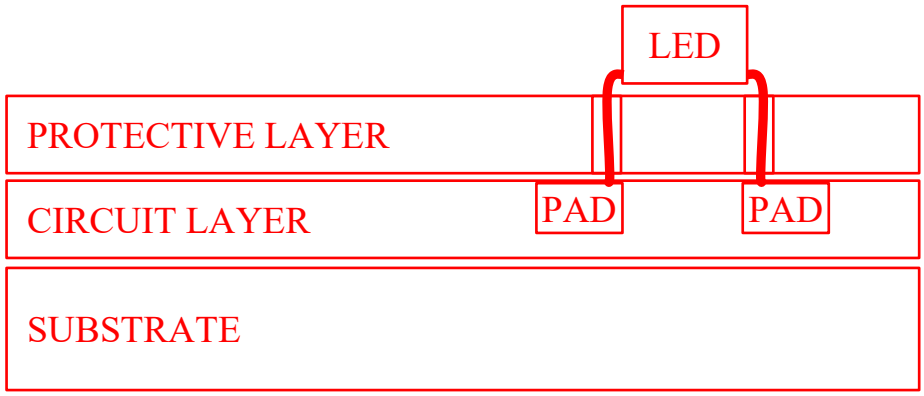


In this illustrated example, the circuit layer includes two solder pads for connecting the LED to receive power. *Id.*, ¶66. And POSITA would have understood that similar solder pads could desirably be formed adjacent to an end of the LED strip to allow connection of the strip to a power supply. *Id.*

A POSITA would have understood that such electrical connections would be more difficult, and likely impossible, without creating openings in the protective layer through which to make the connections. EX1002, ¶66. Additionally, POSITA would have understood that such a protective layer serves a solder resist function that ensures solder bridges or electrical shorts do not form where undesired when soldering electrical components to a substrate, for which purpose the protective "resist" layer must be in place before LED connections are soldered. *Id.*; *see also id.*, ¶42. As such, in this type of layered manufacturing, a POSITA would have expected the protective layer to be applied over the entire area and then etched to remove portions of the coating where a connection is needed between layers. *Id.*, ¶66

Alternatively, a POSITA would have understood that a mask could be applied to the circuit layer before applying the protective layer, such that when the mask is removed, similar openings would remain for connections to the LEDs or the power supply. *Id.* A POSITA would have understood that such masking would occur before placement of the LEDs, at least because the effectiveness of masking depends on the mask being placed directly on the underlying layer. *Id.* Otherwise, during deposition of the protective layer, material could seep under the mask, resulting in ill-defined boundaries that frustrate the purpose of masking, such that placing the mask over LEDs would be ineffective. *Id.*

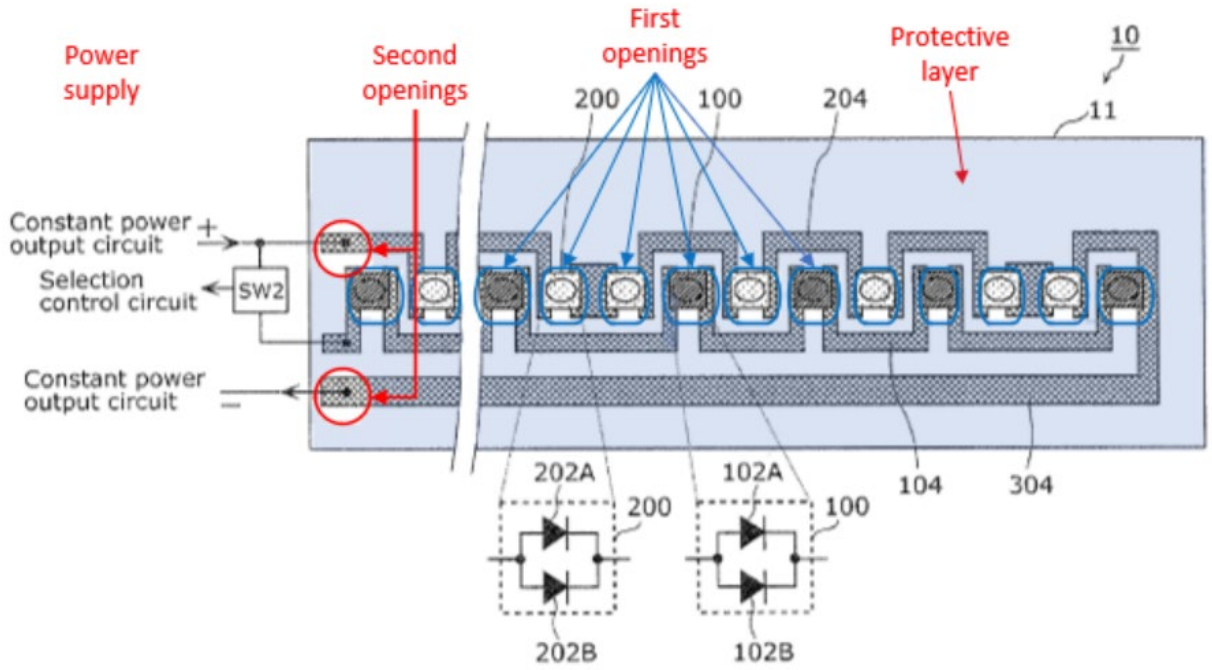
In either option, the protective layer would be between the circuit layer and the LED, such that openings would necessarily be included for electrical connections, as indicated below. *Id.*



Therefore, a POSITA would have been motivated to include openings in Takahashi's protective layer for its LEDs and its power supply connections, shown conceptually

below. *Id.* In the absence of explicit disclosure within Takahaski, a POSITA would have also been motivated to look elsewhere for details of such openings. *Id.*

FIG. 4



Shimasaki explicitly discloses such openings through a protective resist layer to allow for LED connections and board-level connections. EX1002, ¶67. Specifically, "resist layer 61b is laminated over substantially the entire surface of the front layer of the substrate 61 excluding a mounting region of the light-emitting elements 62 and solder land sections 61c." EX1006, 4:40-52. As discussed in Section IX.A.2 above, a POSITA would have understood this resist layer to be a

protective layer including openings exposing LED light sources and soldering pads to enable electrical connections. EX1002, ¶63.

Moreover, a POSITA would have been motivated to include such openings in Takahashi's "white resist" layer (EX1005, 9:20-22) to enable the soldered connections contemplated by Takahashi (*id.*, 9:40-42) because soldered connections through such openings represented a desirable one of a limited number of options. First, Takahashi's soldered connections could theoretically have been enabled by omitting the resist layer, but doing so would sacrifice the benefits—enhanced reflectivity and protection for wiring—taught by Takahashi (*id.*, 9:20-22). EX1002, ¶68. Alternatively, Takahashi's connection terminal could have theoretically been replaced by a mechanical plug connector, but a POSITA would have viewed a soldered connection as a more-reliable connection. *Id.* For example, soldering typically secures and strengthens the direct contact between a wire and the solder pads, and eliminates an intermediate connection that would otherwise be present between the wire and the connector. *Id.* Additionally, a POSITA would have expected soldered connections to be less susceptible to oxidation that could impede the connection between plug connectors, at least because the solder fills and surrounds the interface between the wire and the solder pad, whereas a connector—even when tight—permits air (and entrained moisture) to intrude into the interface between the pin and socket. *Id.* Thus, a POSITA would have preferred openings in

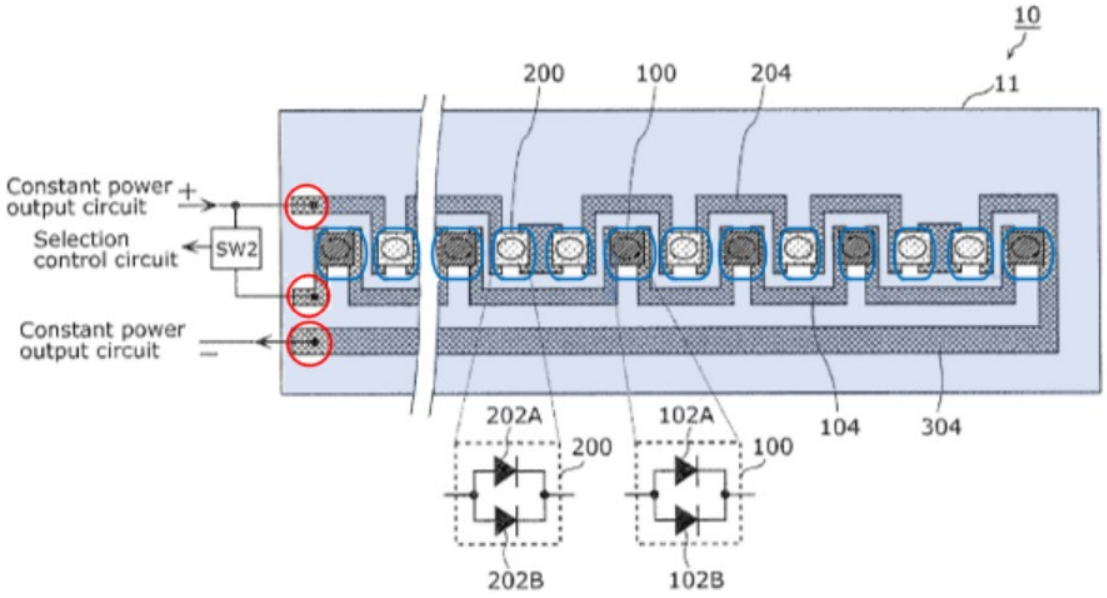
Takahashi's resist layer for solder pads as preferred among a small set of known options. *Id.*

Finally, a POSITA would have reasonably expected to successfully incorporate such openings into Takahashi's resist layer to allow connections through that layer, at least because such openings and connections were known in the art, and because Shimasaki successfully uses them in the same field—i.e., connection between a power circuit and an LED light strip. EX1006, 3:42-46, 3:51-61; EX1002, ¶69.

4. Takahashi-Shimasaki

For the reasons explained above in §IX.A.3, Takahashi-Shimasaki rendered obvious LED lamps similar to Takahashi's but including openings in the protective layer for soldered connections as disclosed by Shimasaki. The modified Takahashi FIG. 4 below includes openings in the protective layer for each of (blue) LEDs and (red) solder pads.

FIG. 4

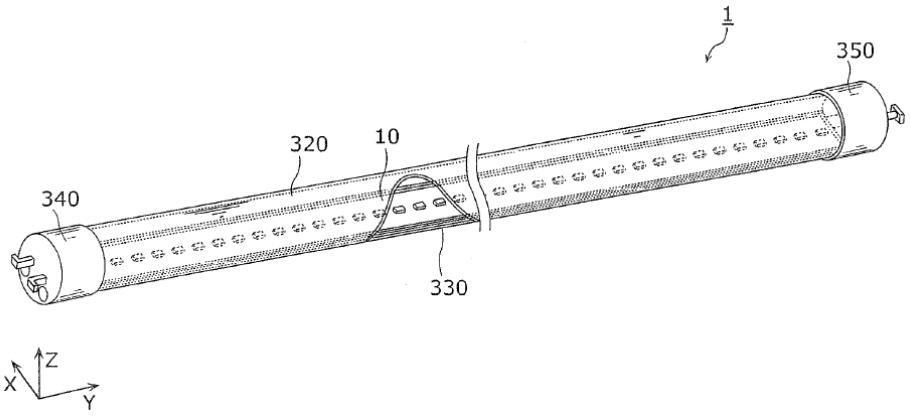


5. Element-by-Element Analysis

(a) *Limitation 1[p]*

To the extent the preamble is limiting, Takahashi teaches an LED tube lamp. Takahashi teaches a "straight tube LED lamp 1." EX1005, 6:28-54; FIGS.1, 2; EX1002, ¶54.

FIG. 1



EX1005, FIG.1.

(b) *Limitation 1[a]*

Takahashi-Shimasaki renders obvious a lamp tube. Takahashi teaches "the straight tube LED lamp 1 . . . include[es] . . . an elongated case 320 that houses the LED module 10." EX1005, 6:41-43; EX1002, ¶55.

(c) *Limitation 1[b]*

Takahashi-Shimasaki renders obvious two end caps coupled to the ends of the lamp tube. Takahashi discloses feeding base 340 and non-feeding base 350 (end caps) coupled to respective ends of elongated case 320 (lamp tube). EX1005, 6:36-54; FIGS.1, 2. The end caps include feeding pin 341 and non-feeding pin 351 for coupling and electrically connecting the LED tube lamp to a lighting appliance. EX1005, 6:36-54; EX1002, ¶55.

FIG. 1

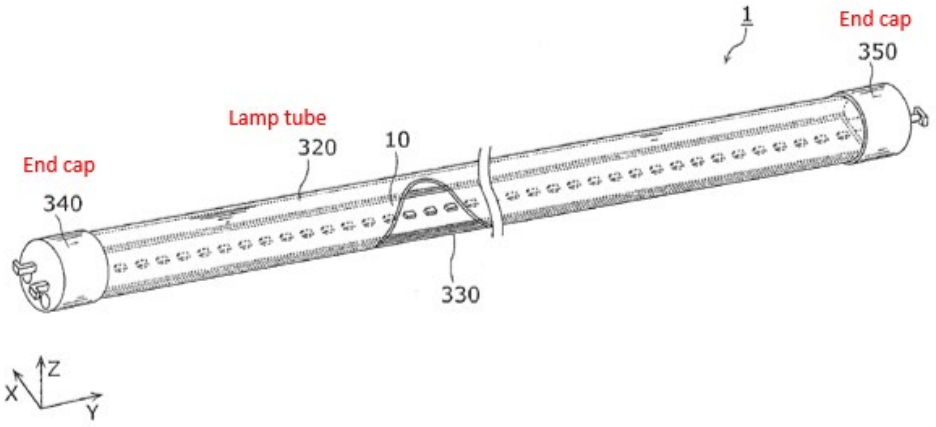
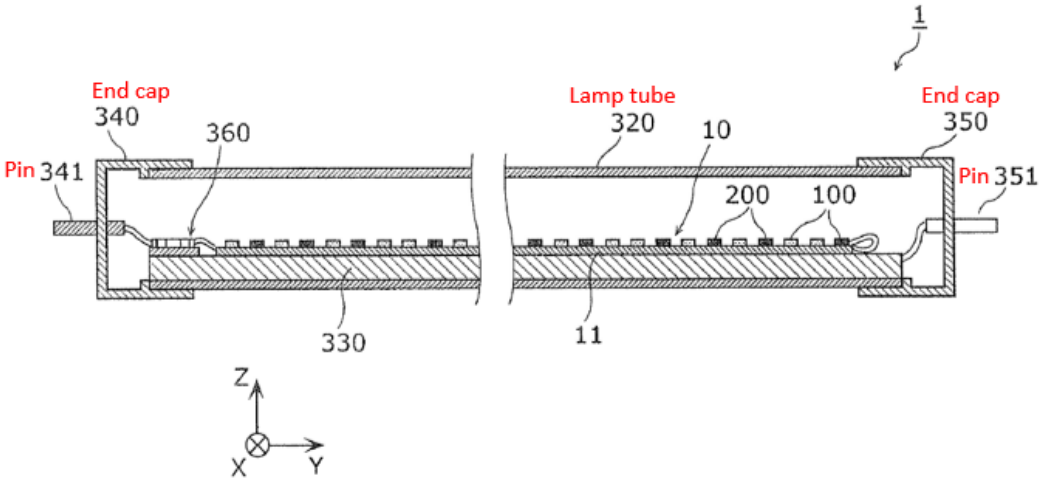

1
End cap
350
Lamp tube
320
10
End cap
340
330
Z
X
Y

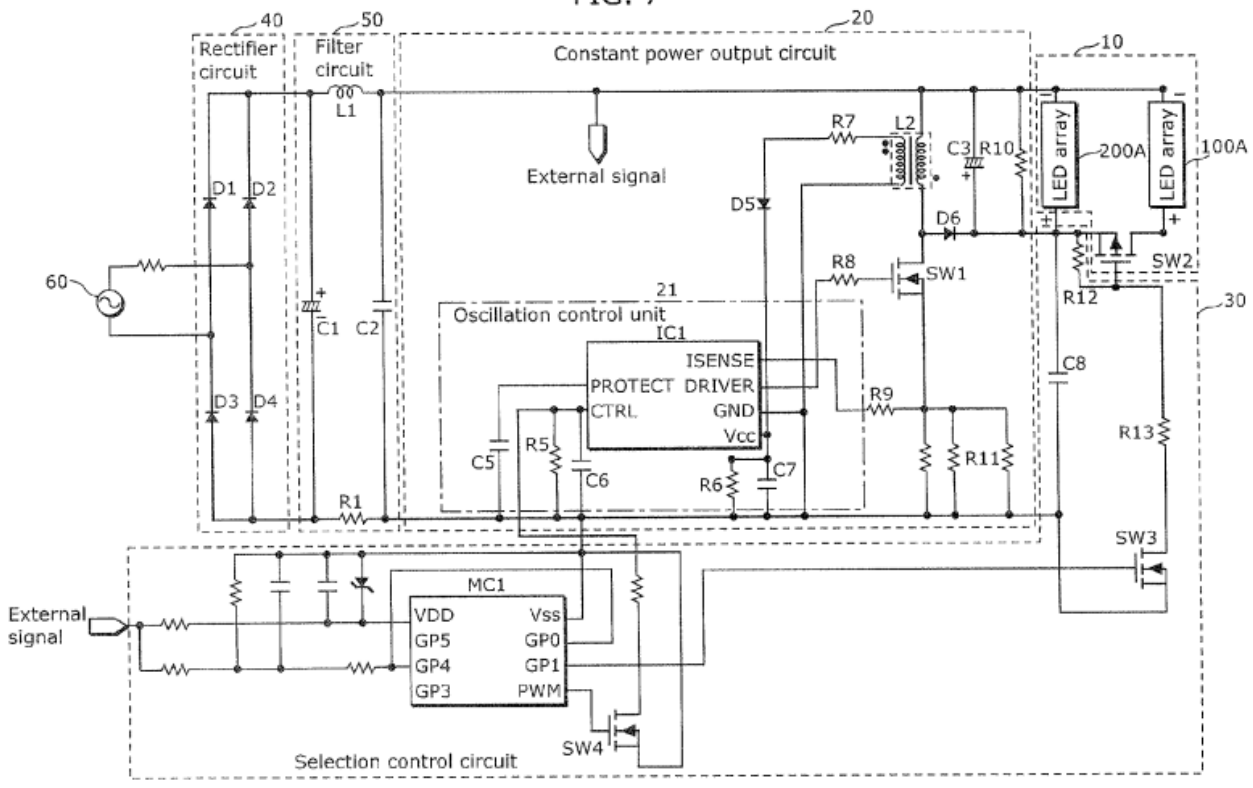
FIG. 2


1
End cap
340
360
Pin 341
Lamp tube
320
10
End cap
350
200
100
Pin 351
330
11
Z
X
Y

(d) *Limitation 1[c]*

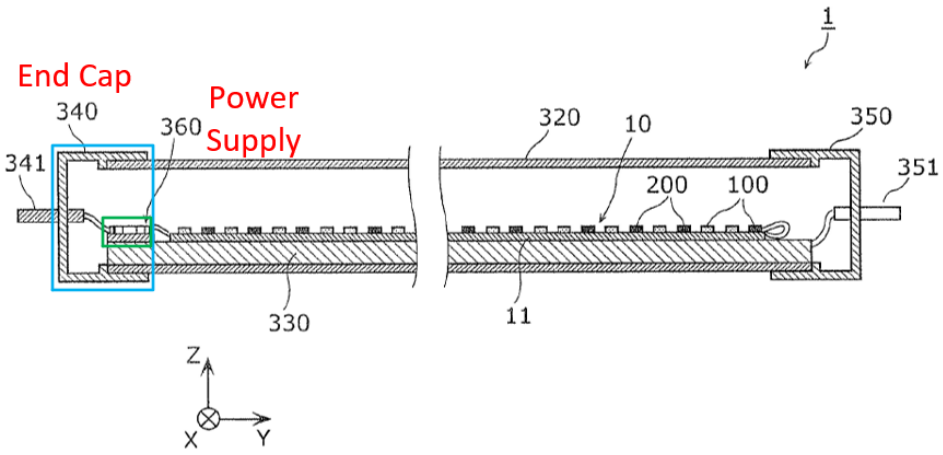
Takahashi-Shimaskai renders obvious a power supply disposed in the end caps. Takahashi teaches drive circuit 360 includes constant power output circuit 20 and rectifier circuit 40 illustrated in FIG.7 below. EX1005, FIG.7, 18:20-23, 13:48-60, 6:55-60 ("a drive circuit 360 . . . which includes . . . a constant power output circuit . . . that ***supplies constant power*** to the LED module 10"). A POSITA would have understood that drive circuit 360 is a power supply. EX1002, ¶58.

FIG. 7



Takahashi teaches that "the drive circuit 360 [power supply] may be ***disposed inside the feeding base 340*** [end cap]," in FIG.2 below. EX1005, 8:16-19; *see also* EX1005, 9:38-40, FIG.2; EX1002, ¶57.

FIG. 2

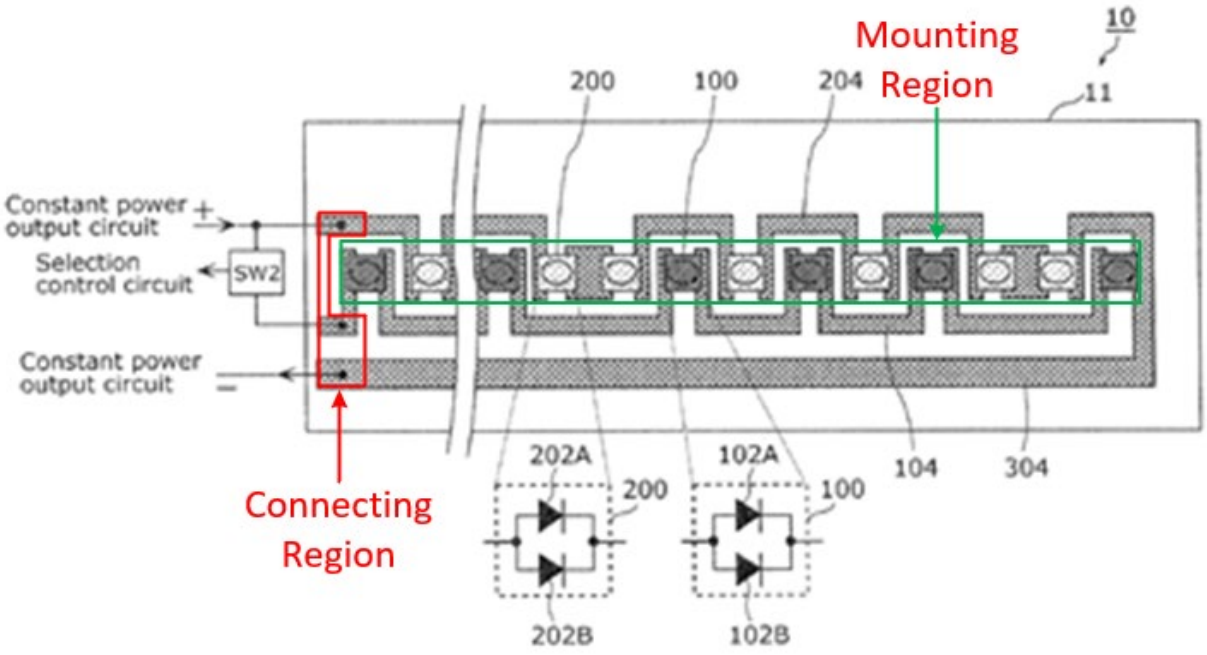


(e) *Limitation 1[d]*

Takahashi-Shimasaki renders obvious this limitation. Takahashi teaches an LED light strip disposed on the inner surface of the lamp tube. EX1002, ¶64. Takahashi discloses in FIGS.1 and 2 that LED module 10 (LED light strip) is attached to base platform 330 and is disposed on an inner circumferential surface of elongated case 320 (lamp tube). EX1005, 7:47-58 (stating the LED module 10 held by base platform 330 "is firmly fixed to the inner surface of the case 320").

In FIG.4 below, Takahashi's LED light strip includes a [green] mounting region for mounting LED light sources (LED elements 100/200) and a [red] connecting region having at least two soldering pads. EX1005, FIGS.3, 4.

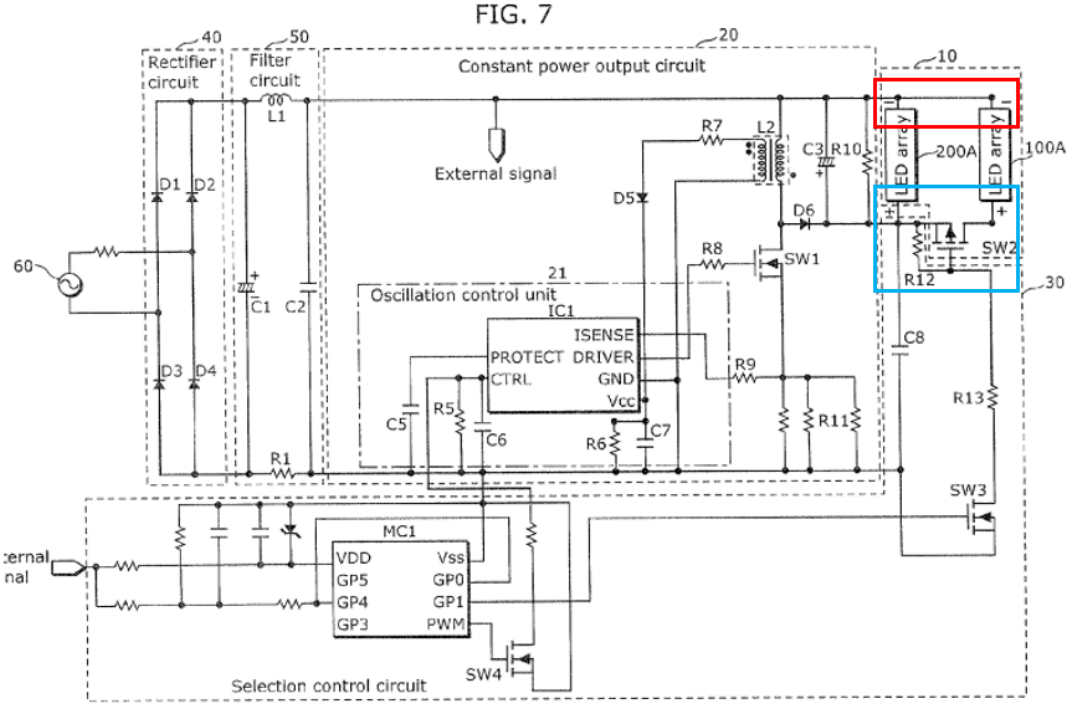
FIG. 4



Takahashi teaches "lines 104, 204, and 304 are formed on the board 11" and "connection terminal 14 … is provided on the board 11." EX1005, 9:33-38. "The lines 104, 204, and 304 are connected to the connection terminal 14 and to the drive circuit 360 provided inside the feeding base 340." EX1005, 9:38-40. The drive circuit 360 is connected to the board 11 via "a lead wire [] soldered at the connection terminal 14 to be fixed to the board 11." EX1005, 9:40-42; *see also id.*, 8:16-19.

Takahashi further teaches that drive circuit 360 includes constant power output circuit 20. EX1005, 18:20-23. Illustrated in FIG.4 above and FIG.7[7] below, "[t]he constant power output circuit 20 has the negative output terminal connected to the [red] cathode terminals of the LED arrays 200A and 100A, and the [blue] positive output terminal connected to the anode terminal of the LED array 200A and the FET switch SW2." EX1005, 15:11-15, FIG.7.

FIG. 7



[7] FIG.4 is "an exemplary layout view of LED elements in the LED module according to Embodiment 1" and FIG.7 is "a circuit configuration diagram including the LED lamp according to Embodiment 1." EX1005, 4:23-24, 33-34.

As such, a POSITA would have understood that Takahashi's drive circuit 360 is connected to the board 11 via three different connections using a soldered lead wire in the connecting region in FIG.4 above. EX1002, ¶58. Thus, Takahashi's connecting region has at least two soldering pads. *Id.* Takahashi's mounting region and connecting region are electrically connected to the LED light sources and the power supply. EX1005, 9:33-42, 18:20-23, 15:11-15, FIGS.4, 7; EX1002, ¶58.

Shimasaki is consistent in teaching an LED light strip having a mounting region for mounting LEDs electrically connected to a connecting region having soldering pads and to a power supply, and attached to an inner circumferential surface of the lamp tube via an attachment member. EX1006, FIGS.2, 5, 6; 3:11-16, 4:12-26, 4:33-52. 6:24-40; EX1002, ¶61.

(f) *Limitation 1[e]*

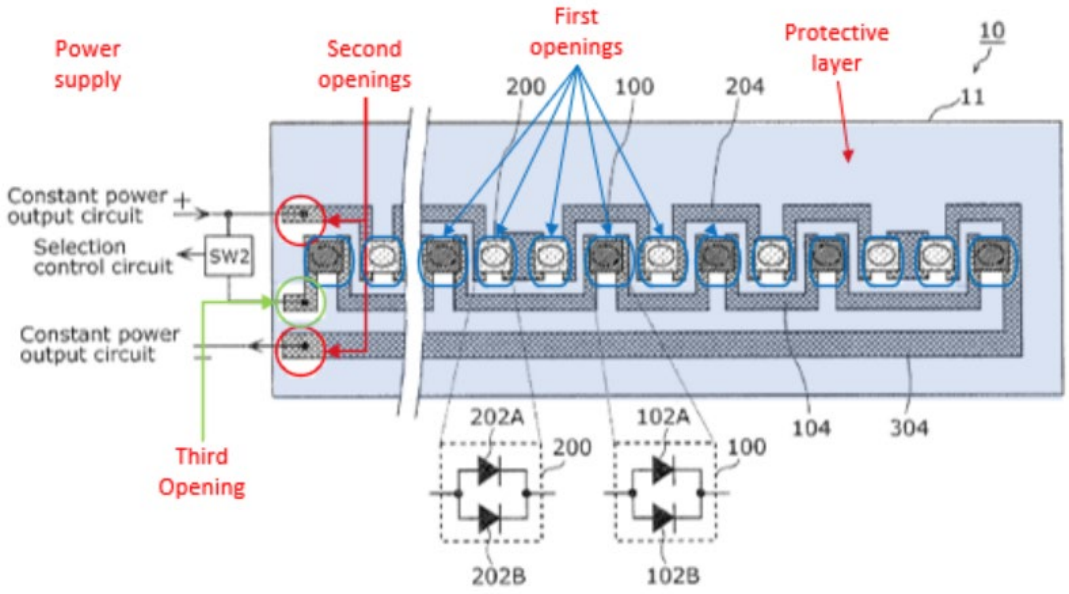
As discussed above in §§IX.A.3-IX.A.4, Takahashi-Shimaskai rendered obvious a protective layer disposed on the LED light strip having openings for the LED light sources and at least two solder pads. Takahashi teaches that "to enhance reflectivity and ***protect wiring***, a white resist [layer] may be applied to the front surface of board 11." EX1005, 9:20-22. And Shimasaki discloses "[a] resist layer 61b . . . having high reflectance . . . laminated over substantially the entire surface of the front layer of the substrate 61 ***excluding a mounting region of the light-emitting elements 62 and solder land sections 61c***" (EX1006, 4:40-52; *see also id.*,

6:26-34; FIGS.5, 6)—i.e., openings in the resist layer for the LEDs and solder pads. EX1002, ¶63.

(g) *Claim 2*

See Limitation 1[e]. Takahashi-Shimasaki renders obvious a protective layer comprising a third opening adjacent to two second openings, i.e., solder pads. FIG.4 of Takahashi below shows three adjacent solder land sections, one for each of lines 104, 204, 304, and Shimasaki teaches that a protective layer should not be applied to solder land sections. EX1005, FIGs.4, 7; EX1006, 4:40-52, 6:26-34; EX1002, ¶98.

FIG. 4

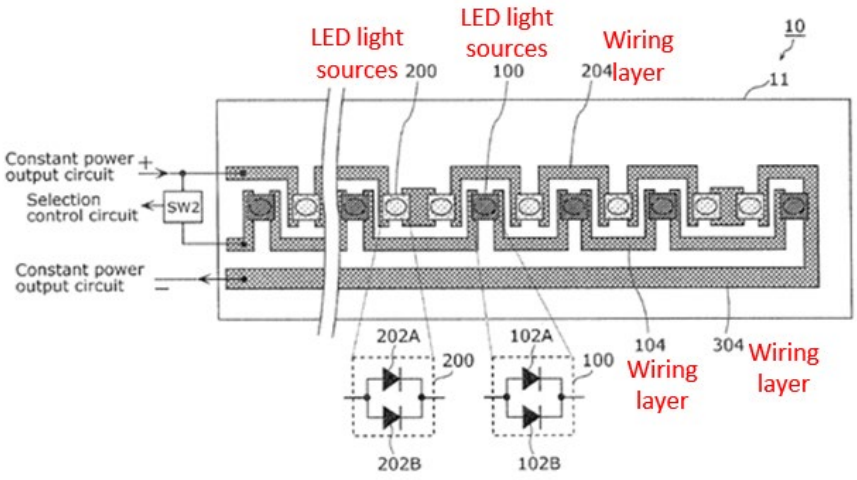


(h) *Claim 6*

Takahashi-Shimasaki renders obvious a wiring layer on which LED light sources are disposed and electrically connected. Takahashi's LED light strip

includes a wiring layer, shown in FIG.4 as lines 104, 204, and 304, and LED elements 100 and 200 disposed on and electrically connected to a first side of the wiring layer. *See* EX1005, 8:25-33, 9:9-42; FIG.4.

FIG. 4



Shimasaki also teaches "LEDs [62] are . . . electrically connected onto wiring pattern layer 61a." EX1006, 5:7-13, FIG.5; see *also* EX1006, 4:40-52; Abstract; claims 1, 7.

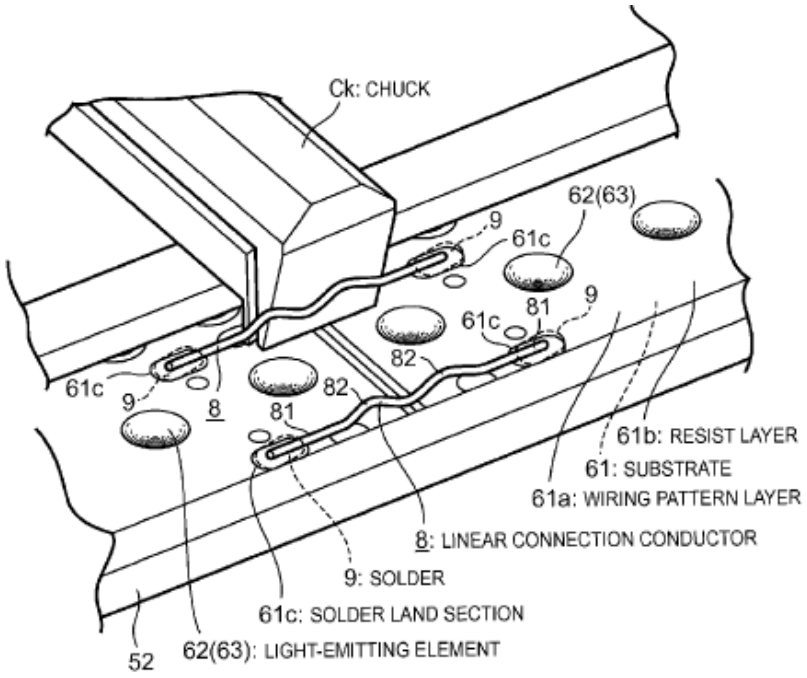
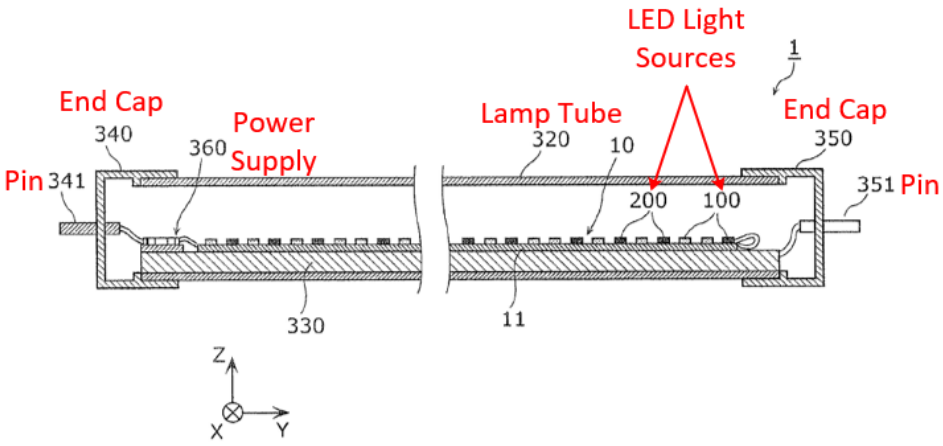


FIG. 5

(i) ***Claim 9***

Takahashi-Shimasaki renders obvious an end cap including a conductive pin electrically connected to the power supply. As discussed above regarding Limitations 1[b] and 1[c], Takahashi discloses feeding base 340 (end cap) having feeding pin 341 (conductive pin) electrically connected to drive circuit 360 (power supply). *See* EX1005, FIGS.1, 2; 6:36-65 ("drive circuit 360 receives power from an external power source via the feeding pin 341.").

FIG. 2



Shimasaki similarly describes cap sections 7 (end caps) having power supply terminals 71 (conductive pins) electrically connected to the power supply in FIG.16 below. EX1006, FIG.16, 3:47-50, 11:4-12.

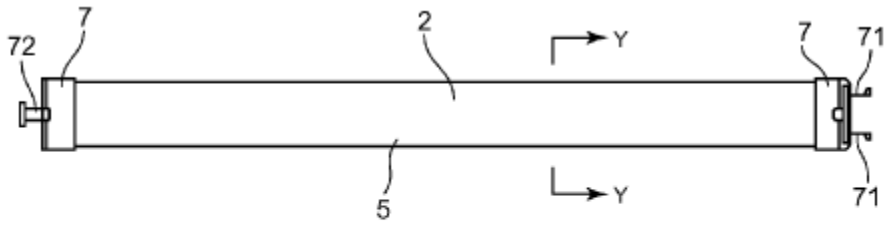


FIG. 16

(j) ***Claim 10***

Takahashi-Shimasaki renders obvious a diffusion film coated on the lamp tube. Takahashi discloses "a light diffusion unit," examples of which "include a

light diffusion sheet or ***a light diffusion film*** provided to at least one of the inner surface and the outer surface of the case 320." EX1005, 7:23-45.

(k) *Claim 11*

Takahashi-Shimasaki renders obvious the diffusion film on an inner surface of the lamp tube. *See* Claim 10, §IX.A.5(j) above. EX1005, 7:23-45 ("a light diffusion film provided to . . . the inner surface . . . of the case 320 [lamp tube]").

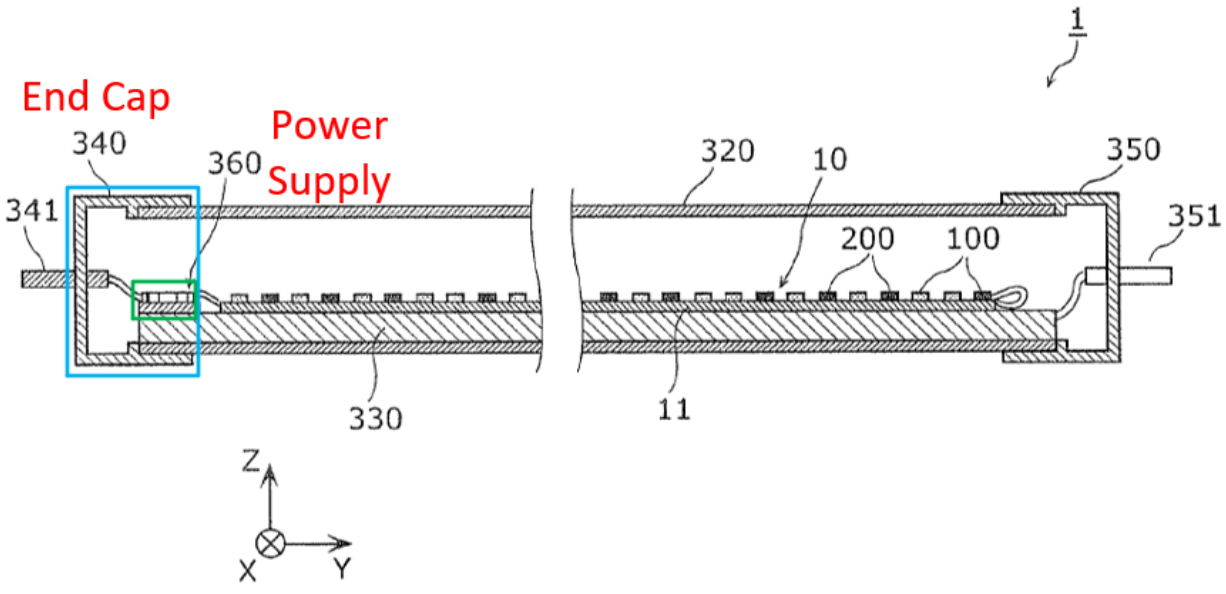
(l) *Claim 13*

Takahashi-Shimasaki renders obvious a light strip attached to the lamp tube's inner surface. *See* Limitation 1[d], §IX.A.5(e); *see also* EX1005, 7:47-58 (stating the LED light strip held by base platform 330, "is firmly fixed to the inner surface of the case 320"); EX1006, 4:12-26 (teaching an "attachment member" for attaching the LED light strip to an inner surface of the lamp tube). A POSITA would have understood there are many ways to attach LED strips within lamp tubes, including attaching the strip directly to the lamp tube's inner circumferential surface. EX1002, ¶36. Selection of one method over another is merely a simple substitution of one known technique for attaching an LED light strip to a lamp tube with another known technique for attaching an LED light strip to a lamp tube. *Id.* A POSITA would further recognize that such a substitution would predictably yield an LED tube lamp having LED light sources mounted on the lamp tube's interior. *Id.*

(m) ***Claim 14***

Takahashi-Shimasaki renders obvious that the power supply is a circuit board disposed in an end cap and electrically connected to the connecting region. *See* Limitation 1[c], §IX.A.5(d). Takahashi teaches that "drive circuit 360 may be disposed inside the feeding base 340 via a lead wire connected to a connection terminal on the board 11." EX1005, 8:16-19; FIGS.3, 4, 7. FIG.2 below shows [green] drive circuit 360 (i.e., a power supply) disposed inside [blue] cap section 7 (end cap) electrically connected via lead wires to the connecting region of board 11.

FIG. 2



A POSITA would recognize that a circuit, such as Takahashi's drive circuit 360, would include a circuit board because circuit boards have been used as electronic substrates for decades. EX1002, ¶58; *see, e.g.,* EX1005, FIG.7 (illustrating that drive circuit 360 includes multiple electrical components); 8:9-13 ("drive circuit 360 included the FET switch SW2").

(n) *Claim 15*

Takahashi-Shimasaki renders obvious that the circuit board is parallel to the longitudinal direction of the lamp tube. Takahashi teaches the circuit board of drive circuit 360 (power supply) is parallel to a longitudinal direction of elongated case 320 (lamp tube), in FIG.2 of Takahashi above at Claim 14, §IX.A.5(m). *See* EX1005, 8:16-19 and FIG.2.

B. Ground 2 – Guang and Shimasaki Render Obvious Claims 1, 2, 6, 9, and 13-15

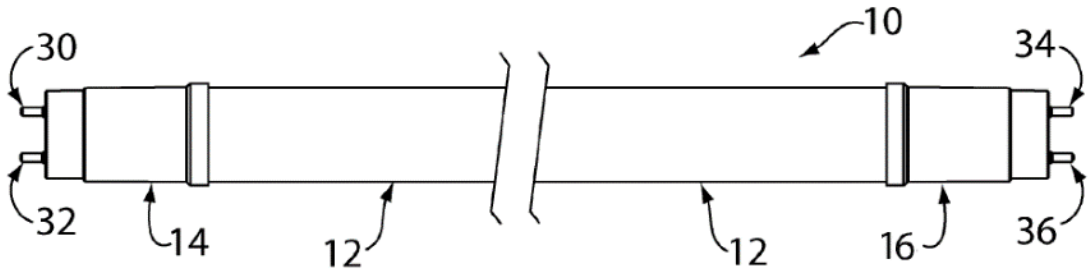
1. Guang

Guang is titled "LED Tube Driver Circuitry for Ballast and Non-Ballast Fluorescent Tube Replacement." Guang discloses "[a]n LED lamp tube and driver circuit that is [a] direct replacement for fluorescent tubes with or without ballasts, that works with standard AC high voltage current input, with high frequency pulse current input, or with lower voltage input." EX1007, Abstract. Guang notes that "there has been over the past decade an enormous commercial move toward replacing both incandescent and fluorescent light fixtures with light-emitting diode

(LED) lighting." EX1007, 4:13-16 "Arrays of LEDs can be fitted in tubes that are physically compatible replacement for fluorescent tubes, using the same sockets for their electrodes to fit into." EX1007, 4:16-19.

Guang describes FIG.4, reproduced below, as showing "a side view of an assembled fluorescent compatible LED tube lamp 10 (containing an LED array and the LED driver circuitry of the present invention) comprising of a cylindrical translucent or transparent tube 12, enclosed at the left end by a left PCB housing 14 with a first pair of electrode pin 30 and 32 and on the right end by a right PCB housing 16 with a second pair of electrode pins 34 and 36." EX1007, 15:52-58. "The PCB housings function as end caps for the tube 12." EX1007, 15:58-59.

Fig. 4



Guang, FIG.4.

Inside the tube, Guang discloses a "rectifier and filter printed circuit board (PCB) and [a] step-down constant current PCB 19 [which] are each to be enclosed by a PCB housing (14 or 16)." EX1007, 15:6-9. Guang discloses that the PCBs rectify and filter external AC current from the pins to DC power, such that the PCB

output leads are electrically connected to an LED array 20. EX1007, 15:21-36. "The filtered DC power is modified by the step-down constant current circuit of the driver circuitry to supply DC power at a voltage and current level that will drive the LED array 20 to illuminate in accordance with its capabilities." EX1007, 15:36-40. These features are shown in FIGS.1, 3 of Guang, reproduced below.

Fig. 1

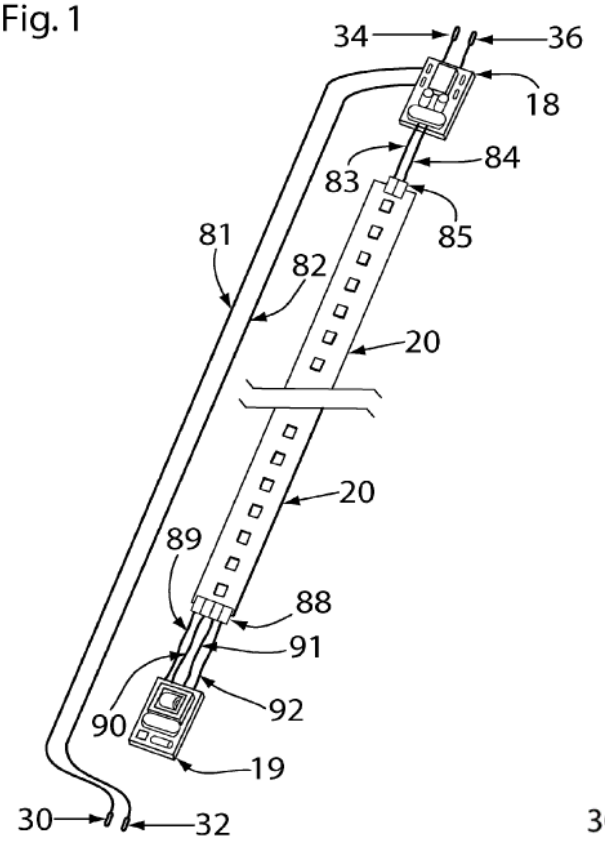
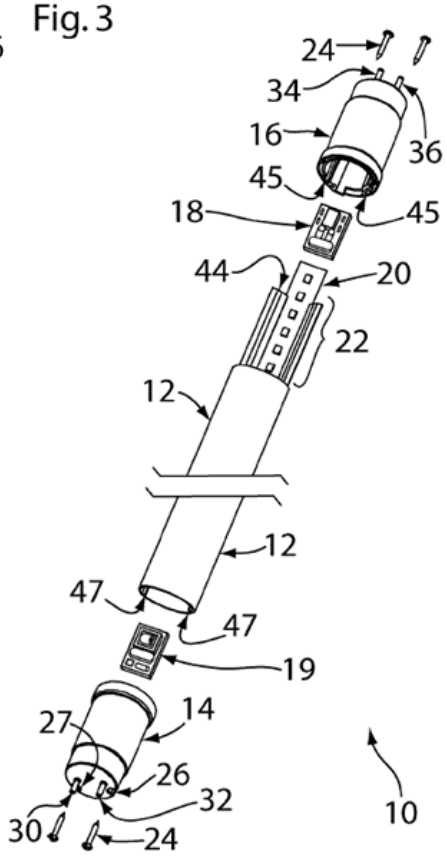


Fig. 3



Guang teaches a power supply configured as one or both of "rectifier and filter printed circuit board (PCB) 18" and "step-down constant current PCB 19 [which] are each to be enclosed by a PCB housing (14 or 16)." EX1007, 15:6-9. Guang teaches that connections between these power supply PCBs and the LED light strip

could be made with pin connectors. EX1007, FIG.1, 8:45-49 ("The filtered DC output from PCB 18 is conducted via wires 83 and 84 through their 2-pin connector 85 on the LED array PCB on long conductors (not shown) layered within that PCB that terminate at two of the four pins at 4-pin connector 88.").

2. Motivation to Combine

First, Guang contemplates using alternative construction techniques, noting that "[o]ther forming techniques and other materials may be employed" to create LED lamp tubes for the same ends (i.e., LED lamp tubes as fluorescent light replacements) as those explicitly described by Guang. EX1007, 16:41-48; EX1002, ¶¶74, 77.

Protective Layer. A POSITA would have been motivated to incorporate Shimasaki's resist layer on the surface of Guang's LED array, as illustrated conceptually below. EX1002, ¶77-80. A POSITA would have been motivated by Shimasaki to incorporate a protective layer into Guang's LED tube lamp, for example to reflect light and thereby maximize the core light-emitting function of the lamp for a given power level (e.g., maximizing efficiency). *Id*. Shimasaki provides explicit motivations to add a protective layer. First, Shimasaki teaches that a protective layer (resist layer) can enhance reflectivity. EX1006, 4:40-52; EX1002, ¶77. Shimasaki's "resist layer 61b" has high reflectance and "is laminated over substantially the entire surface of the front layer of the substrate 61." EX1006, 4:40-

52; EX1002, ¶63. Indeed, use of high-reflectance resist layers in LED lighting applications and devices was a well-known technique used by a POSITA to form LED lighting devices even prior to Shimasaki. EX1002, ¶¶42, 77. Incorporating a protective layer was known by a POSITA to benefit LED lighting devices by improving light output efficiency and preventing light absorption through the substrate on which LEDs are disposed. EX1002, ¶77. A POSITA would have thus been motivated to take advantage of these benefits by incorporating a reflective resist layer on Guang's LED array surface. *Id.*

Moreover, a POSITA would understand that Shimasaki's resist layer 61b would benefit Guang's LED array 20 because it would protect the wiring on LED array 20 from corrosion and damage. EX1002, ¶78. The openings in Shimasaki's protective layer would allow for this protection while facilitating electrical connections between the LED tube lamp's electrical components, such as connecting LED light sources to wiring of the LED tube lamp and connecting soldering pads to a power supply. EX1006, 4:40-525:7-13; 6:35-40; EX1002, ¶78. A POSITA would have understood that the openings in Shimasaki's resist layer would provide locations for reliably connecting electrical components to the LED light strip. EX1002, ¶¶78-79. Thus, a POSITA would have been motivated to incorporate a resist layer onto Guang's LED array 20 to protect the wiring and improve connection reliability. *Id.*

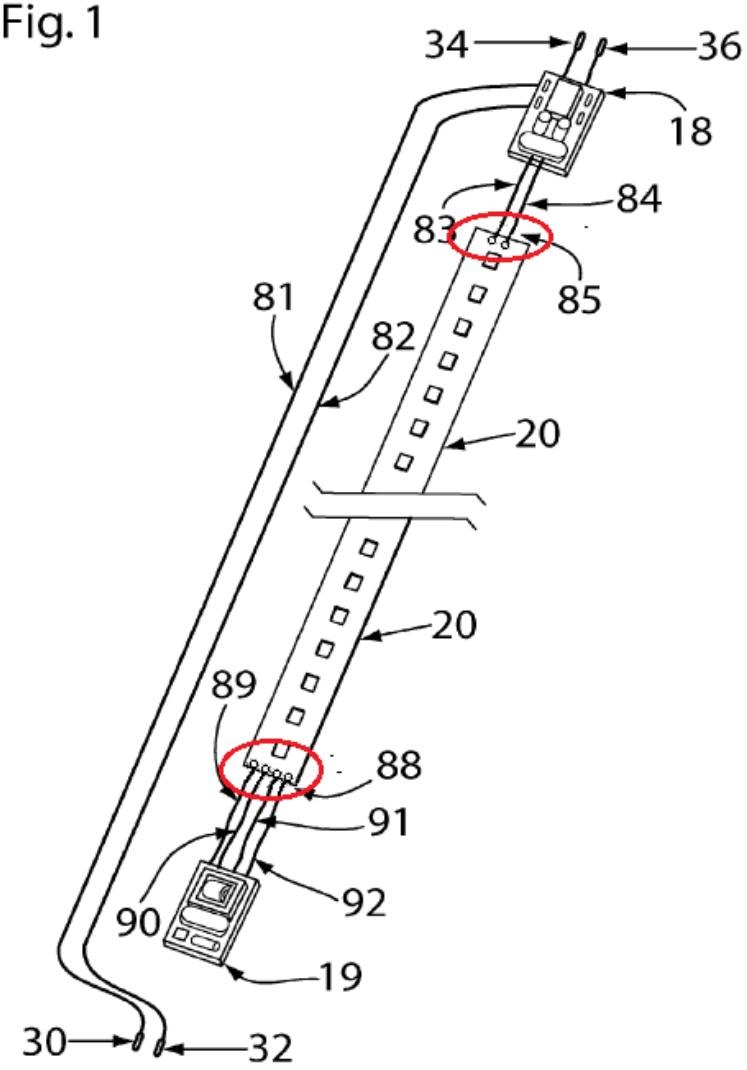
A POSITA would have understood that the modifications of Guang to include a reflective solder resist layer on the surface of a substrate upon which LEDs are disposed merely involved using a well-known LED lighting device manufacturing technique, for a known purpose, such as to improve the light output efficiency of the LED lighting device. EX1002, ¶80. Additionally, a POSITA would have expected this modification to yield predictable results—improving the light output efficiency and the electrical connections of the LED lamp tube of Guang—which were well-known benefits obtained by applying a reflective solder resist layer to a surface of a substrate on which LED light sources are disposed. EX1002, ¶80.

Solder Pads. A POSITA would have also been motivated to use Shimasaki's solder pads on Guang's LED array 20 instead of pin connectors for connecting the LED array 20 to (power supply) PCBs 18 and 19 for each of several independent reasons. EX1002, ¶¶74.

First, a POSITA would have understood that the LED array of Guang's tube lamp could be connected to power supply components using solder pads, shown in red in modified FIG.1 of Guang below, rather than pin connectors, as both pin connectors and soldering techniques were well known techniques for making electrical connections. EX1002, ¶77; *see* EX1006, 4:47-52, 6:20-40, 7:31-41, and 10:4-7. Shimasaki confirms that using solder lands (pads) was known for making

such connections in LED tube lamps. EX1006, FIG. 5, 3:11-18, 4:47-52; EX1002, ¶¶63, 77.

Fig. 1



A POSITA would have understood that such a modification merely substitutes one known technique for making electrical connections for LED lighting devices for another known technique and the results of both techniques are predictable (*e.g.*, working electrical connections suitable for receiving and distributing power from a power supply to LED light sources). EX1002, ¶75.

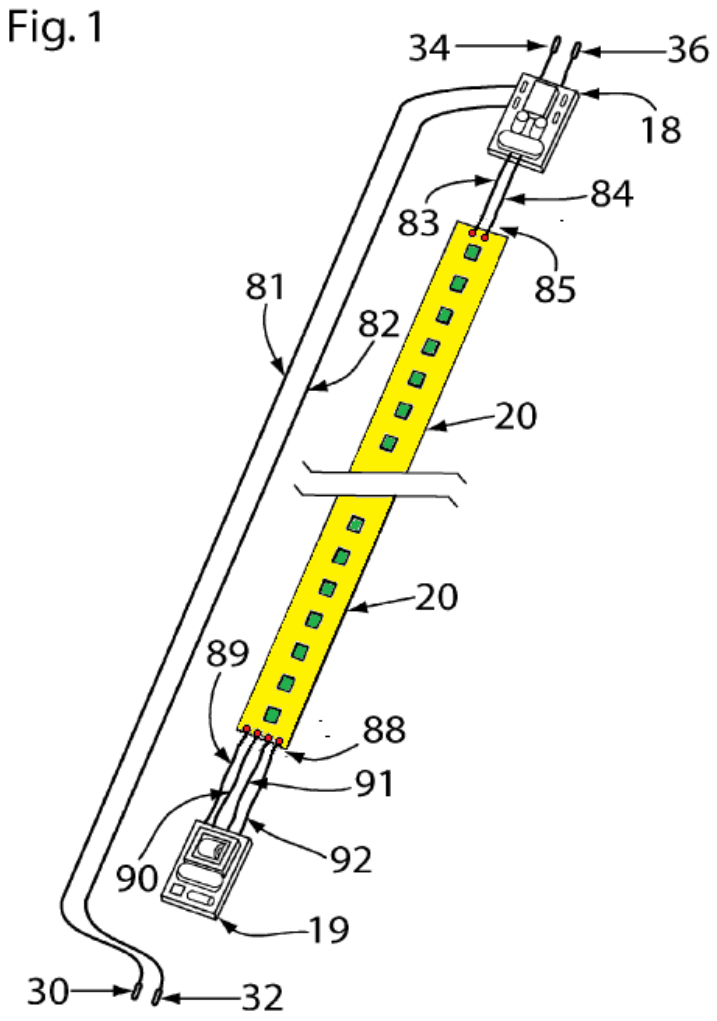
Second, a POSITA would have been motivated to utilize solder pads instead of pin connectors to enable automation of manufacturing processes, as taught by Shimasaki, which describes using automatic supply machines and techniques to manufacture LED light devices. EX1006. 5:40-7:64; 9:29-31 (describing use of automatic joining processes to produce LED lighting arrays with electrical connections formed using solder pads); EX1002, ¶75. To that end, Shimasaki explains that the use of connectors (instead of solder pads) makes it "difficult to efficiently perform work for connecting the substrates" and "is not advantageous in terms of costs." EX1006, 1:35-38. Thus, a POSITA would have recognized that the use of solder pads would improve manufacturability and reduce costs for such an LED. EX1002, ¶75.

Third, a POSITA would have expected the use of solder pads instead of connectors to result in a more-reliable connection between the power supply and the LED light strip. EX1002, ¶76. For example, soldering typically secures and strengthens the direct contact between a wire and the solder pads, and eliminates an intermediate connection that would otherwise be present between the wire and the connector. *Id.* Additionally, a POSITA would have expected soldered connections to be less susceptible to oxidation that could impede the connection between the pins and sockets in Guang's pin connectors, at least because the solder fills and surrounds the interface between the wire and the solder pad, whereas a connector—even when

tight—permits air (and entrained moisture) to intrude into the interface between the pin and socket. *Id.*

3. Guang-Shimasaki

As explained above in Section IX.B.2, Guang-Shimasaki rendered obvious LED lamps similar to those of Guang but including a resist layer with openings for soldered connections as disclosed by Shimasaki. The modified version of Guang's FIG. 1 below includes a [yellow] resist layer on the front of the printed circuit board, with openings for each of [green] LEDs and [red] solder pads. EX1002, ¶74, 77.



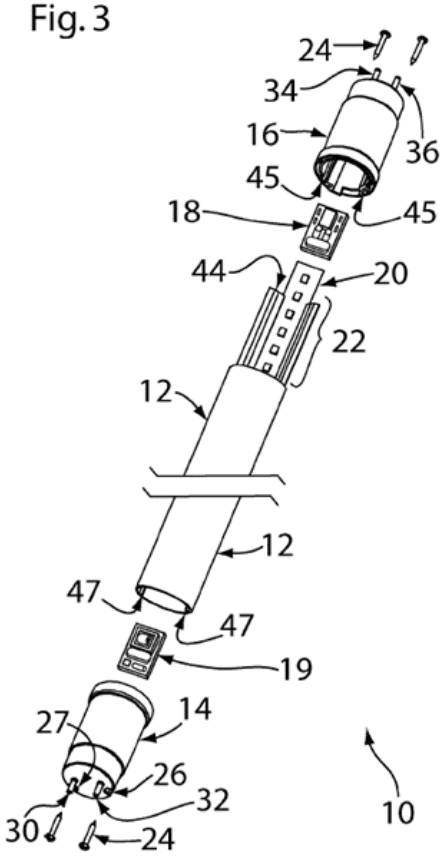
The Guang-Shimasaki LED light strip would use solder pads to form connections between the LED light strip and the power supply PCBs in lieu of each of the pins of Guang's pin connectors.

4. Element-by-Element Analysis

(a) *Limitation 1[p]*

To the extent it is limiting, Guang renders obvious an LED tube lamp. In FIG.3 of Guang, reproduced below, Guang discloses "[a]n LED lamp tube and driver circuit that is direct replacement for fluorescent tubes." EX1007, Abstract; 5:55-61.

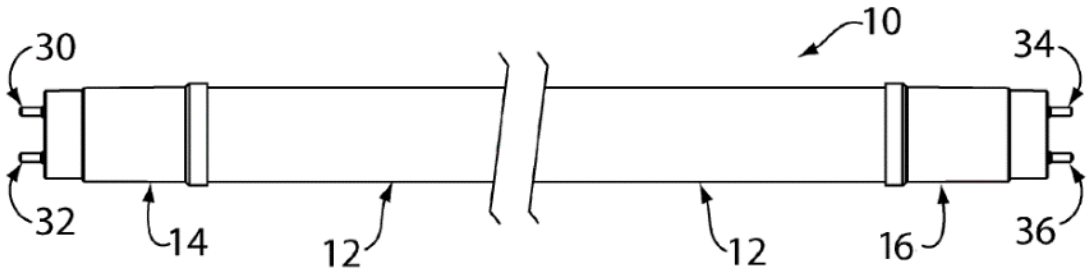
Fig. 3



(b) ***Limitation 1[a]***

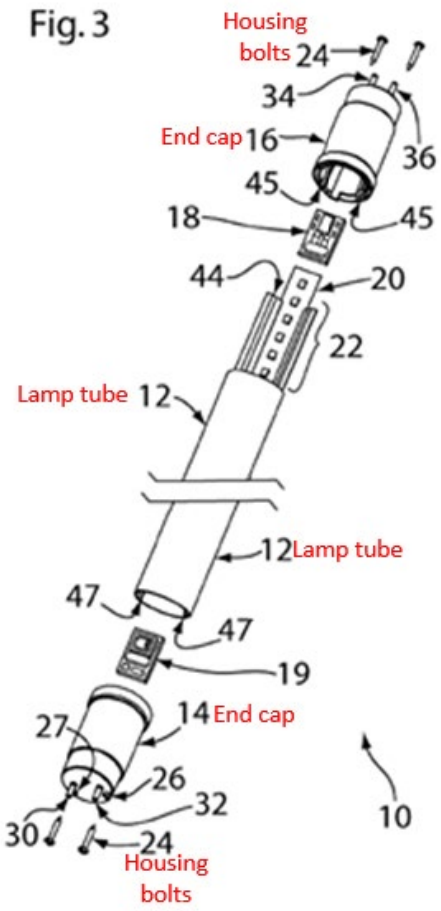
Guang teaches a lamp tube. Guang discloses "a tube for enclosing an LED light source." EX1007, claim 1; 6:26-30.

Fig. 4



(c) ***Limitation 1[b]***

Guang teaches two end caps coupled to the ends of the lamp tube. Guang discloses "the tube having a first end cap and a second end cap, each of the first and second end caps having respectively a first pair of electrode pins and a second pair of electrode pins" EX1007, claim 1; 6:26-30; FIG.4 (showing PCB housings 14, 16 (end caps) at each end of tube 12). Guang also teaches that the end caps (PCB housings) 14 and 16 are coupled to respective ends of the tube with housing bolts 24. EX1007, 15:1-7; FIG.3.



(d) *Limitation 1[c]*

Guang teaches a power supply disposed in the end caps. Guang teaches "a rectifier and filter circuit printed circuit board (PCB) 18" and a "step-down constant current circuit PCB 19." EX1007, 8:16-27. A POSITA would recognize that rectifying, filtering, and constant-current circuits, such as the ones taught by Guang, constitute a power supply in LED lighting applications. EX1007, 6:12-20; 8:16-56; EX1002, ¶73. Guang also explicitly teaches the rectifier and filter power supply components "physically located in one end cap" connected by tube-length wires "to

the rest of the driver circuit, including the step-down constant current circuit . . . physically located in the opposite end cap." EX1007, 13:25-50; *see also* EX1007, 7:7-15; 15:6-15, FIGS.1, 3, claims 12, 30.

Fig. 1

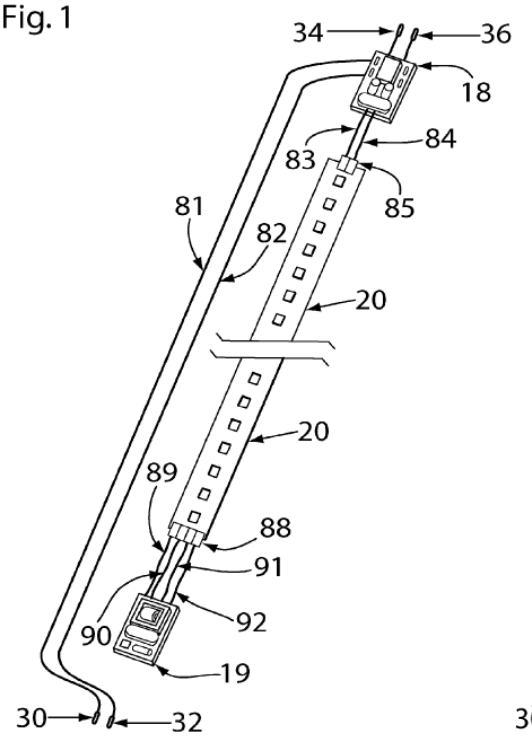
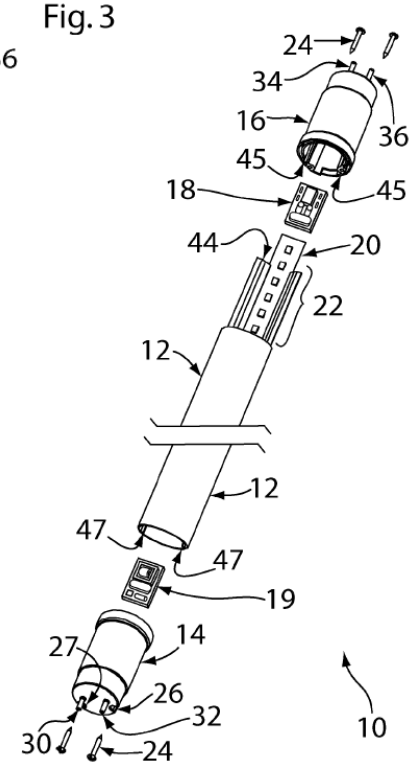


Fig. 3

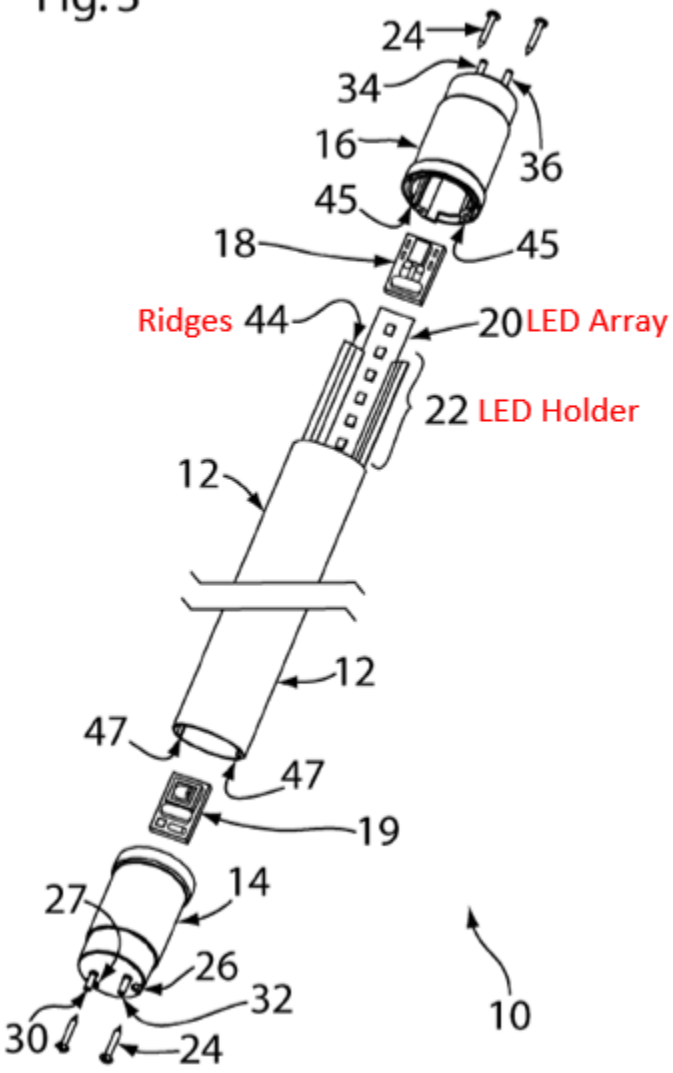


(e) *Limitation 1[d]*

Guang teaches an LED light strip disposed on the inner surface of the lamp tube. Guang teaches that LED array PCB 20 (LED light strip) can be disposed inside the lamp tube, supported on an LED holder. EX1007, 4:15-19; 15:43-45. More specifically and illustrated in FIG. 3, Guang explains "the LED array 20 is supported inside the tube 12 by means of the LED holder 22 with ridges 44 for longitudinal strength." EX1007, 15:44-46. "The channels 45 inside tube end 16 (and like channels in the other tube end) receive and hold flanged LED array holder 22 with

its ridges 44." EX1007, 15:49-51. A POSITA would have understood, based on the arrangement of channels 45 on one lower portion of PCB housings 14 and 16, that LED array 20 supported by LED holder 22 is disposed on a circumferential surface of tube 12. EX1002, ¶72.

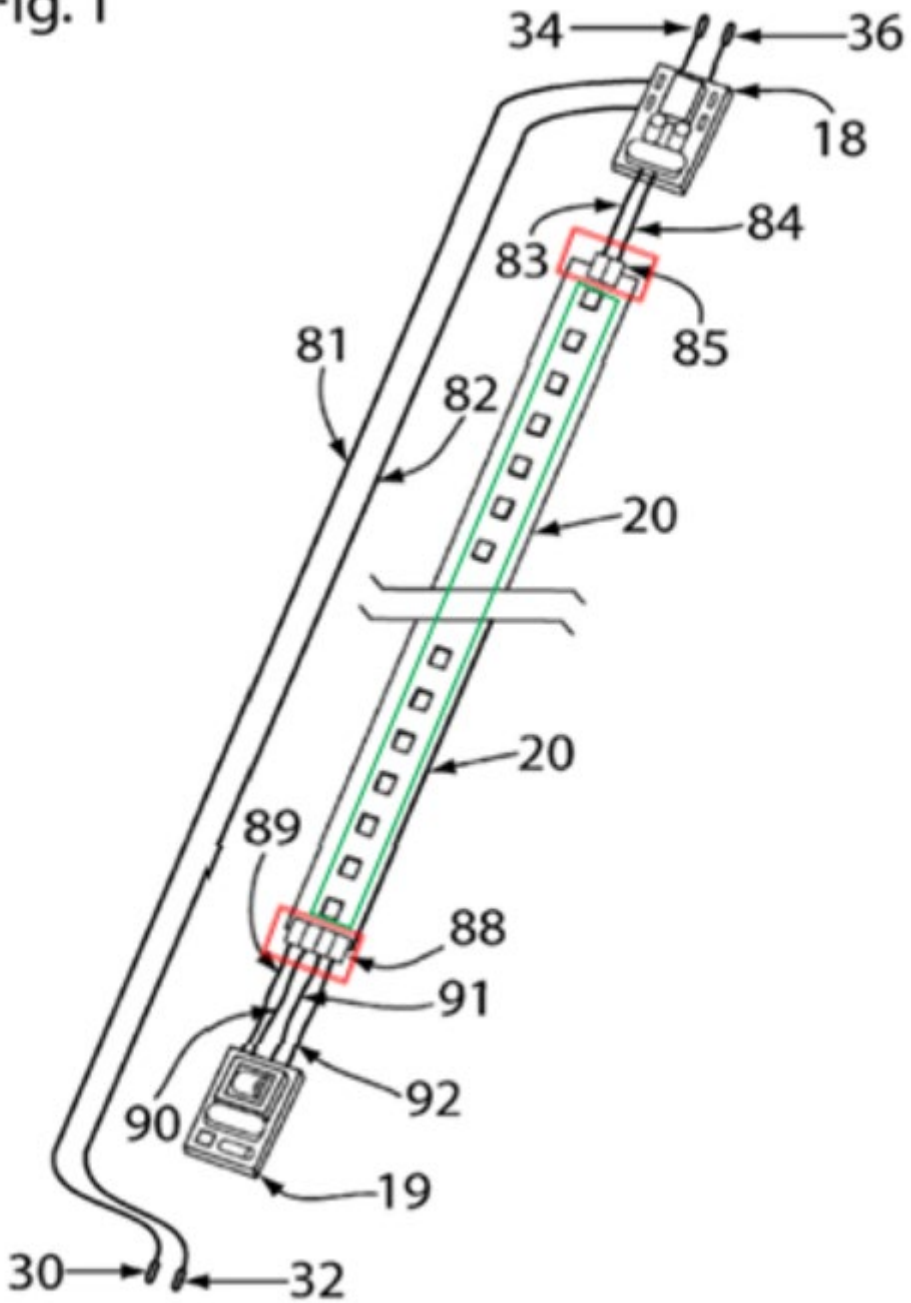
Fig. 3



Illustrated in FIG.1 below, LED array PCB 20 (LED light strip) of Guang includes a [green] mounting region for mounting LED light sources and a [red]

connecting region electrically connected to the LED array PCB 20 and PCBs 18 and 19 (power supply). EX1007, 7:7-8:56, 16:41-48, FIG.3.

Fig. 1



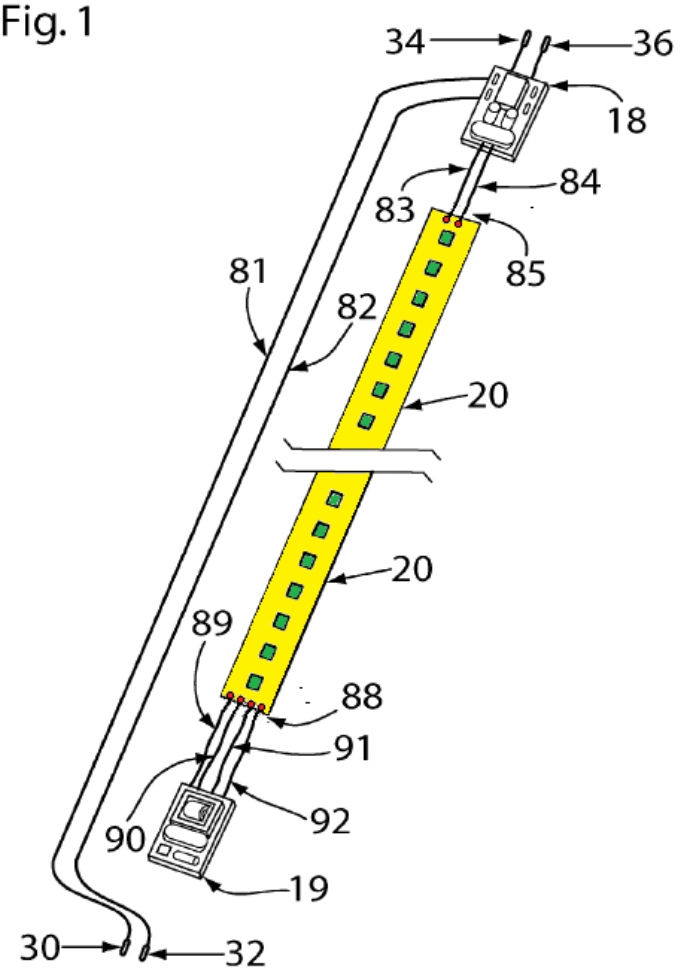
(f) *Limitation 1[e]*

As explained in Sections IX.B.2-IX.B.3 above, Guang-Shimasaki renders obvious a protective layer disposed on the LED light strip with openings for the LED light sources and at least two solder pads. EX1002, ¶77-80. Guang as modified includes "[a] resist layer 61b . . . having high reflectance . . . laminated over substantially the entire surface of the front layer of the substrate 61 ***excluding*** a mounting region of the light-emitting elements 62 and solder land sections 61c" (EX1006, 4:40-52, 6:26-34)—i.e., openings in the resist layer for the LEDs and solder pads. EX1002, ¶77.

(g) *Claim 2*

As explained in Sections IX.B.2-IX.B.3 and for Limitation 1[e] above, Guang-Shimasaki renders obvious openings in a protective layer for solder pads. Guang explicitly discloses a 4-pin connector. EX1007, 8:45-56. Substituting each pin with a solder pad in the Guang-Shimasaki lamp would result in four solder pads, each of which would need an opening in the protective layer. EX1002, ¶79. Having separate openings for each of the solder pads is beneficial because the protective layer acts as a solder resist (EX1002, ¶¶43, 79), as indicated by Shimasaki's protective layer's designation as a "resist layer 61b." EX1006, 4:40-52; EX1002, ¶79. Thus, the openings would help prevent undesired solder bridges from short-circuiting the solder pads. EX1002, ¶79.

Fig. 1



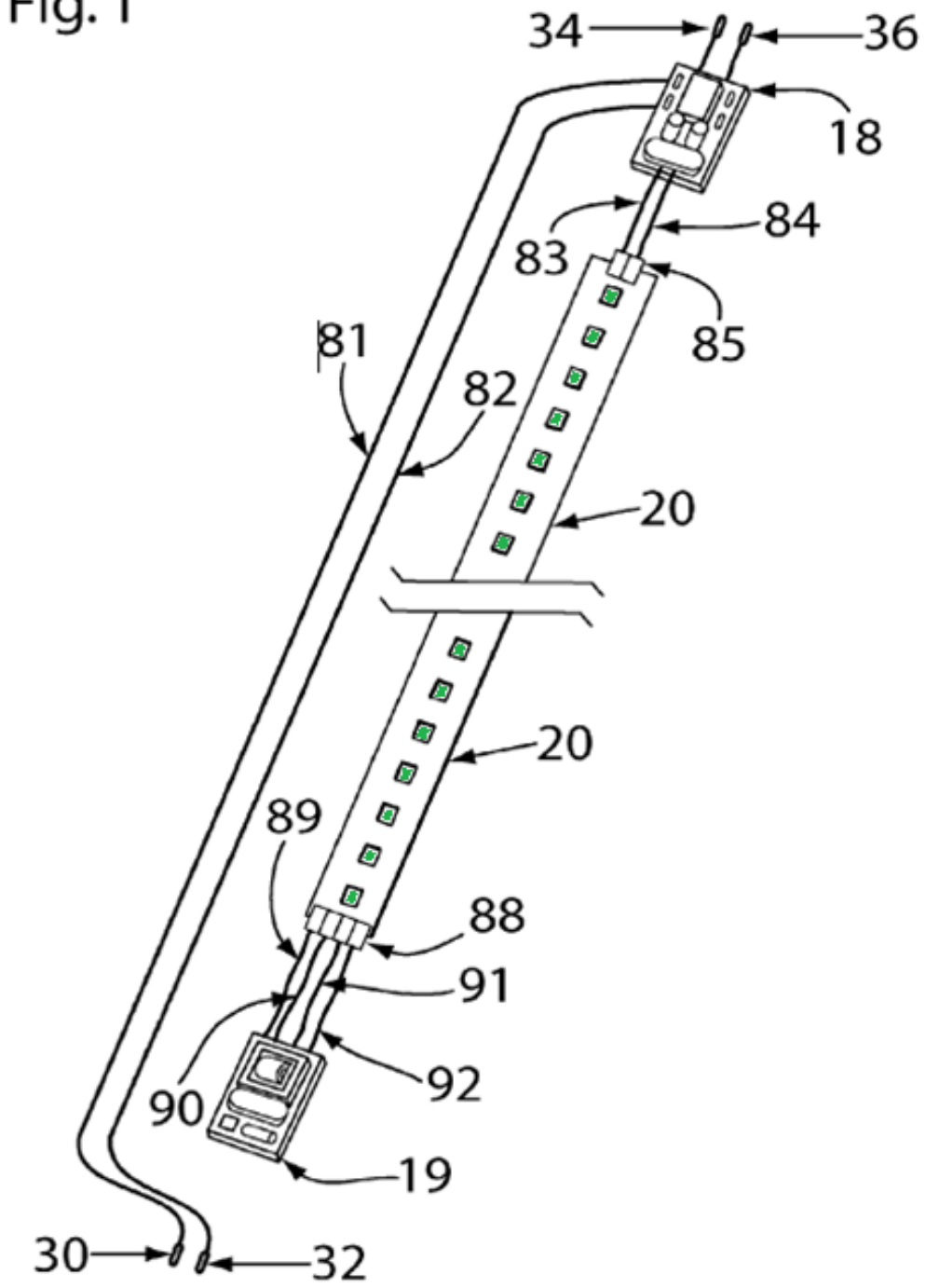
Thus, Guang-Shimasaki renders obvious four adjacent openings for soldering pads, as indicated by the red circles shown in the modified Guang FIG.1 above. EX1002, ¶79. This necessarily includes a third opening adjacent to the first two openings.

(h) ***Claim 6***

Guang-Shimasaki renders obvious the LED light strip includes a wiring layer where the LED light sources are disposed and electrically connected. Guang discloses LED array 20 (LED light strip) having a plurality of [green] LED light

sources disposed on a first side of LED array 20. *See* EX1007, FIGS.1 and 2, 8:17-67.

Fig. 1



Guang further discloses that LED array PCB 20 is electrically connected to PCBs 18/19 via wires such that "current is output . . . to the LED array PCB." 8:45-55, 8:64-67. Guang does not explicitly describe the wiring layer for the LEDs. EX1002, ¶81. But POSITA would have understood that the LED light sources of Guang are disposed on a first side of and electrically connected to a wiring layer as claimed based on Guang's use of a known structure. EX1002, ¶81; EX1007, FIGS.1, 3 (showing a plurality of LED light sources on a same surface of the LED array), 8:45-49 (disclosing connections between power supply elements through "long conductors" "***layered*** within [the LED array] PCB"). Should PO argue otherwise, a POSITA would have also been motivated to look elsewhere for details of an LED light strip. EX1002, ¶82.

Shimasaki confirms the use of "wiring pattern layer 61a . . . formed on the front surface side of the substrate 61." EX1006, 4:40-52. Shimasaki also discloses that "light-emitting elements . . . are bonded on the substrate 61 . . . and electrically connected onto the wiring pattern layer." EX1006, 5:7-13; *see also* EX1006, claims 1, 7. A POSITA would have been motivated to combine Shimasaki's wiring pattern layer 61a into Guang's LED array 20 to implement the electrical connections disclosed by Guang in a way that was known to promote efficient manufacturing and light functionality in the same LED lamp application. *See* EX1006, 1:35-38, 5:7-13; EX1002, ¶82.

(i) ***Claim 9***

Guang-Shimasaki renders obvious an end cap including a conductive pin electrically connected to the power supply. Guang discloses "end cap electrode pins 30 and 32" and "end cap electrode pins 34 and 36". . . electrically connected (i.e., "wired directly") to the power supply, in FIGS.3 and 4 below. EX1007, 8:28-45; EX1002, ¶71; *see also* EX1007, claim 1; FIGS.1, 2, 3, 4; 8:57-9:50; 15:9-15; 15:62-16:2.

Fig. 4

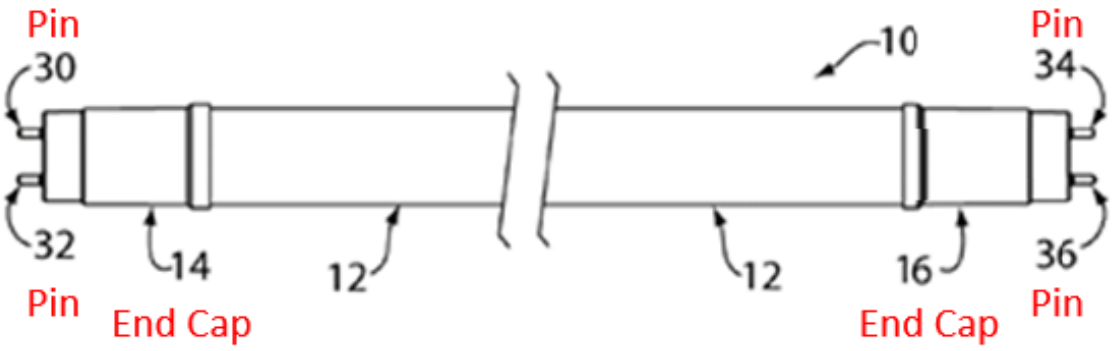
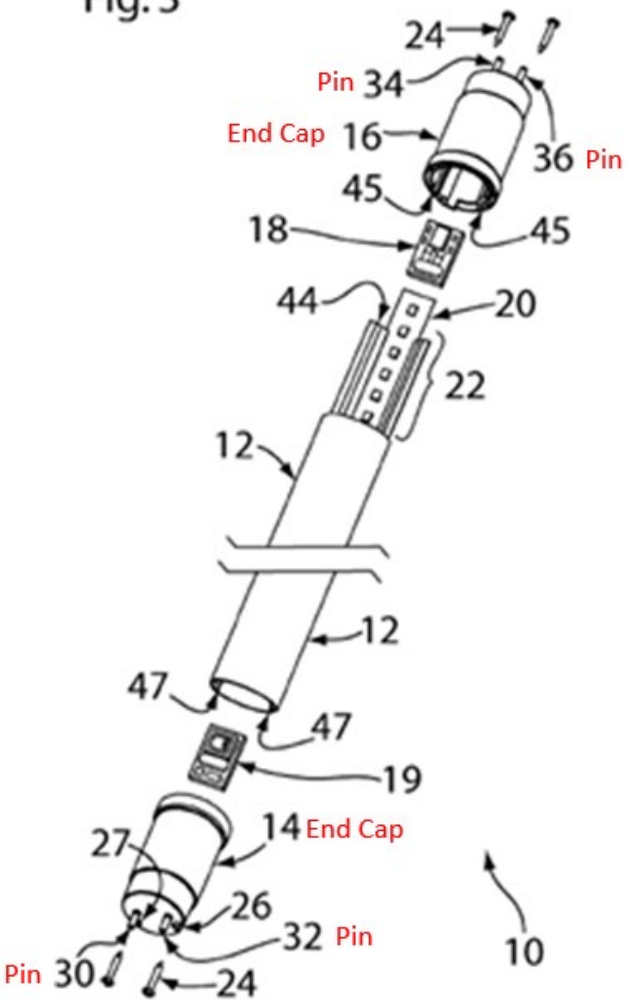


Fig. 3



Shimasaki similarly describes cap sections 7 (end caps) having power supply terminals 71 (conductive pins electrically connected to the power supply) in FIG.16 below. EX1006, FIG.16, 3:47-50, 11:4-12; EX1002, ¶61.

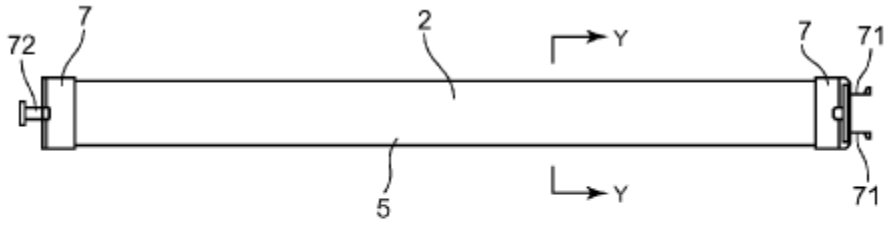


FIG. 16

(j) *Claim 13*

See Limitation 1[d], §IX.B.4(e).

(k) *Claim 14*

Guang-Shimasaki renders obvious a power supply circuit board disposed in one of the end caps and electrically connected to the connecting region. Guang teaches "a rectifier and filter circuit printed circuit board (PCB) 18" and a "step-down constant current circuit PCB 19" (power supply) that are printed circuit boards and, shown in FIGS.1 and 3 below, are disposed in an end cap and connected to the connecting region. EX1007, 8:16-27, 13:25-50, 7:7-15, 15:6-15, FIGS.1, 3, claims 12, 30; *see* Limitations 1[d] and 1[e], §§IX.B.4(e), IX.B.4(f).

Fig. 1

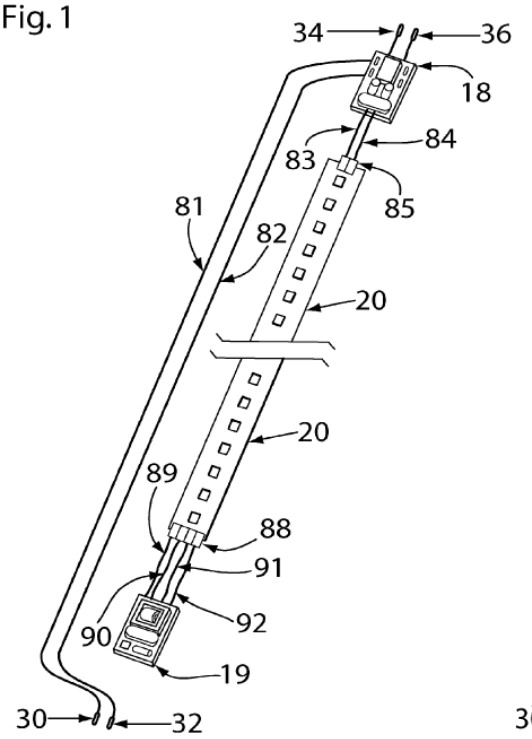
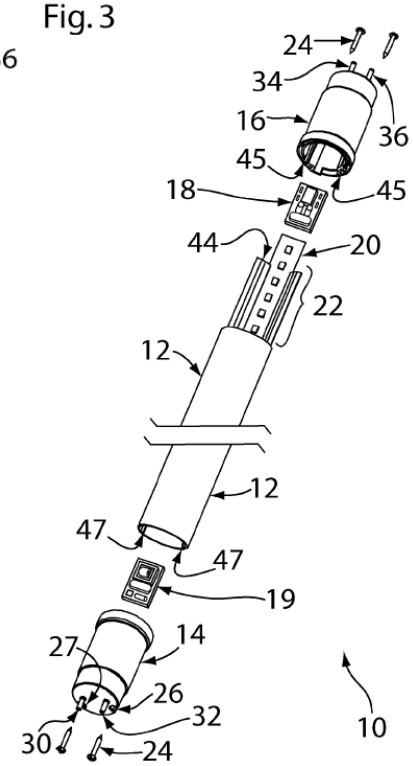


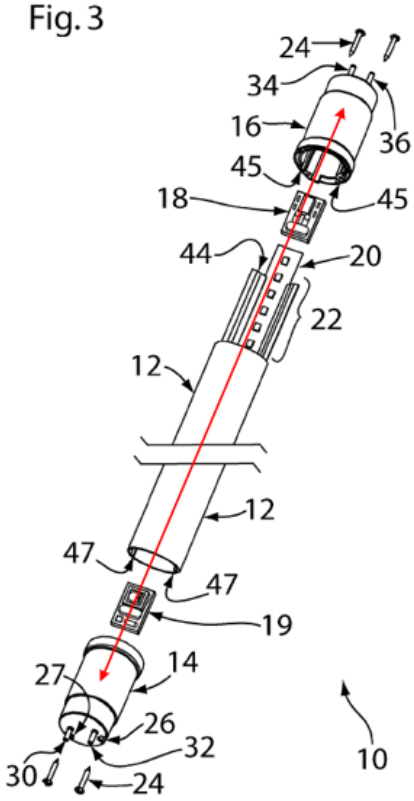
Fig. 3



(l) ***Claim 15***

Guang-Shimasaki renders obvious arranging the circuit board parallel to the longitudinal direction of the lamp tube. As shown in FIG.3 below (PCBs 18 and 19 are oriented so their longer side is parallel to the [red] longitudinal direction of the lamp tube).

Fig. 3



C. Ground 3 – Guang, Shimasaki, and Takahashi Render Obvious Claims 10 and 11

1. Motivation to combine

As explained in Sections IX.B.2 IX.B.4, Guang-Shimasaki renders obvious claim 1.

A POSITA would also have been motivated to combine Guang-Shimasaki with the diffusion film taught by Takahashi with a reasonable expectation of success. EX1002, ¶83-84.

A POSITA would have recognized that diffusion films, as taught by Takahashi, could be applied to a surface of a lamp tube of an LED tube lamp, such as the LED tube lamps of Guang and Shimasaki. EX1002, ¶31-32, 83. Takahashi's

diffusion techniques discussed include "a light diffusion sheet or a light diffusion film provided to at least one of the inner surface and the outer surface of the case 320. EX1005, 7:27-29. Guang and Shimasaki also explicitly teach LED tube lamps having diffusion elements. EX1002, ¶83. Guang teaches that LED tube lights are available with "***frosted*** [diffusing] lens styles" and specifically contemplates a "***translucent*** or transparent tube 12". EX1007, 4:29-31, 15:55; EX1002, ¶83. Shimasaki teaches that "main body 5 is formed . . . from a synthetic resin material such as translucent polycarbonate resin having diffusibility." EX1002, ¶83; EX1006, 4:16-19; *see also* EX1006, 8:41-44 (contemplating light transmitting through the translucent tube).

A POSITA would have understood that incorporating the diffusion layer of Takahashi would enable diffusion of light from the Guang-Shimasaki LED tube lamp. EX1002, ¶31, 84; *see* EX1005, 7:18-45. A POSITA would have been motivated to incorporate the diffusion film of Takahashi in order to create a uniform or smooth light output from the LED tube lamp of Guang-Shimasaki. EX1002, ¶84. Takahashi teaches several effective methods for diffusing light from an LED lamp tube, demonstrating that such elements would have been known to a POSITA before the '125 Patent, and that using any of the various diffusing elements would be merely substituting one known element for another. EX1002, ¶84. This substitution would yield the predictable result of an LED tube lamp diffusing light. *Id*.

A POSITA would have been motivated to utilize Takahashi's light diffusion film because diffusion films were known to have advantages over other diffusion treatments, including precision control over diffusion film thickness and the corresponding level of diffusion, ease of manufacturing, and safety. EX1002, ¶¶32 (citing EX1010, 2:14-19, 2:50-55, 5:55-67, 6:60-7:11), 84.

2. Guang-Shimasaki-Takahashi

For the reasons explained above in §IX.C.1, Guang-Shimasaki-Takahashi rendered obvious LED lamps similar to those discussed above at §IX.B.3 but including a diffusion film applied to an the inner surface of the tube lamp, as disclosed by Takahashi.

3. Element-by-Element Analysis

(a) ***Claim 10***

For the reasons explained in §§IX.C.1-IX.C.2, Guang-Shimasaki-Takahashi renders obvious a diffusion film coated on a surface of the lamp tube. EX1005, 7:23-45 ("a light diffusion film provided to at least one of the inner surface and the outer surface of the case 320".).

(b) ***Claim 11***

For the reasons explained in §§IX.C.1-IX.C.2, Guang-Shimasaki-Takahashi renders obvious a diffusion film coated on the inner surface of the lamp tube. EX1005, 7:23-45 ("a light diffusion film provided to … the inner surface … of the case 320".)

D. Ground 4-6 – Obvious Further in View of Jing

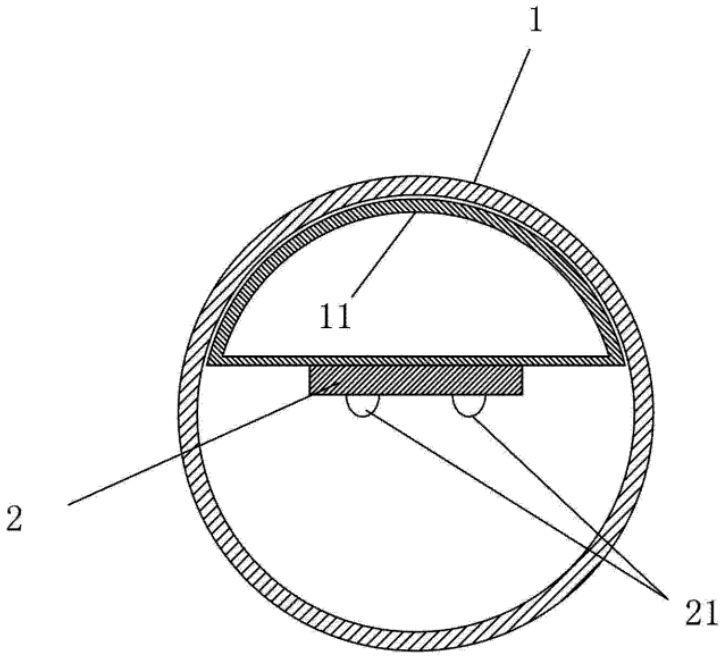
Ground 4: Claims 1, 2, 6, 9-11, and 13-15 are obvious over Ground 1 in view of Jing.

Ground 5: Claims 1, 2, 6, 9, and 13-15 are obvious over Ground 2 in view of Jing.

Ground 6: Claims 10 and 11 are obvious over Ground 3 in view of Jing.

1. Jing

Jing is titled "LED Fluorescent Lamp." In "Background Technology," Jing describes an "LED fluorescent lamp in the prior art is composed of a glass lamp tube 1 [and] a light emitting component arranged in the lamp tube 1 . . . The light emitting component includes a bracket 11 made of aluminum profiles extending from one end of the lamp tube to the other end, and a circuit board 2 fixed on the bracket, which extends along the axis of the lamp tube and is equipped with LED lamp beads 21." EX1015, ¶[0002].



EX1015, FIG.1.

"This structure has the following shortcomings: . . . Due to the barrier of the bracket, when the LED light source in the enclosed space inside the lamp tube works, the heat generated is transferred to the bracket through the circuit board, and then transferred from the bracket to the external space through the glass wall of the lamp tube. In this way, the heat resistance will be larger through two heat conduction exchange layers." EX1015, ¶¶[0004]-[0005].

In "Invention Content," Jing states that "[t]he technical problem to be solved is to reduce the manufacturing cost." EX1015, ¶[0006]. "This Utility Model sets reflective film layers on the inner and outer walls of the lamp tube, so that the light emitted from the LED light source to the back of the lamp tube can be fully utilized due to reflection, thereby correspondingly enhancing the luminance of the LED

fluorescent lamp." EX1015, ¶[0018]. "The further improvement of the Utility Model is that the inner wall of the lamp tube 1 corresponding to the back of the circuit board 2 is coated with a film that can reflect light by electroplating, spraying or vacuum coating." EX1015, ¶[0032].

Jing teaches that the LED fluorescent lamp "is composed of a lamp tube 1 with a circular section and glass material, a circuit board 2 arranged in the lamp tube 1 extending along the axis, and a plug with a driver arranged on both ends of the lamp tube 1 and electrically connecting the circuit board 2 with the external power supply." EX1015, ¶[0027].

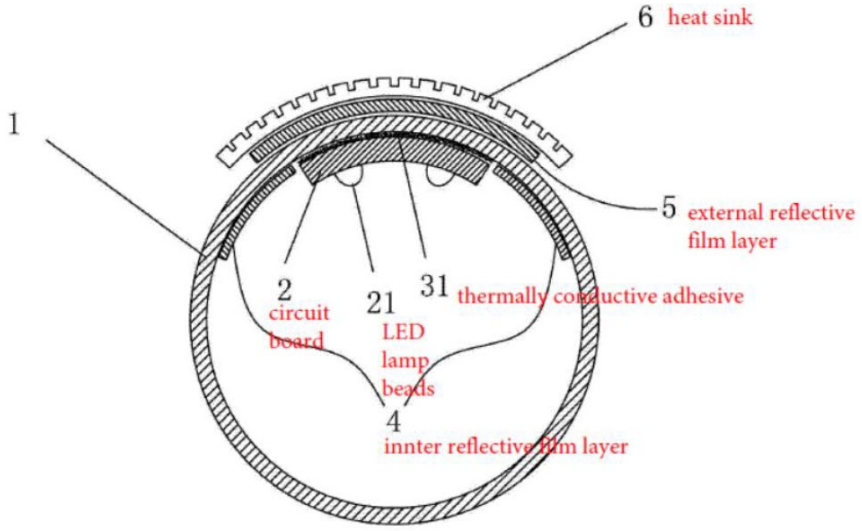


Figure 2

EX1015, FIG.2.

Jing teaches an embodiment in which the LED fluorescent lamp "is composed of . . . a plug with a driver arranged on both ends of the lamp tube 1 and electrically

connecting the circuit board 2 with the external power supply." EX1015, ¶[0027]. In another embodiment, "one end is an open end, [and] the other end is a closed LED horizontal insertion lamp 7, that is, the circuit board is installed into the lamp tube through the open end of the horizontal insertion lamp tube, and then the plug with the driver electrically connected to the external power supply is blocked on the open end, shown in Figure 6." *Id.*

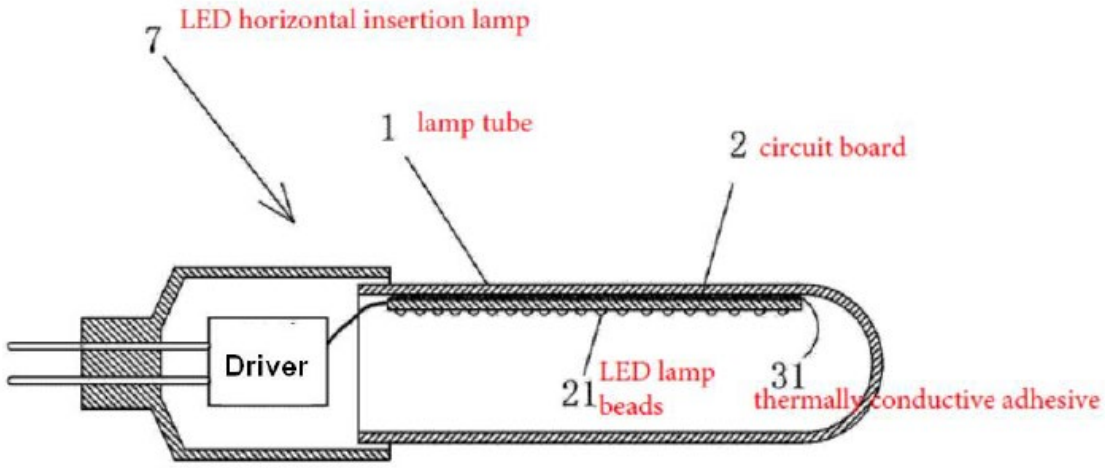


Figure 6

EX1015, FIG.6.

2. Motivation to combine

For the reasons discussed in Ground 1, a POSITA would have been motivated to combine Takahashi and Shimasaki.

For the reasons discussed in Ground 2, a POSITA would have been motivated to combine Guang and Shimasaki.

For the reasons discussed throughout Ground 3, a POSITA would have been motivated to combine Guang, Shimasaki, and Takahashi.

A POSITA would also have been motivated to combine Takahashi-Shimasaki (Ground 4), Guang-Shimasaki (Ground 5), or Guang-Shimasaki-Takahashi (Ground 6) with the mounting method for the LED light strip taught by Jing with a reasonable expectation of success. EX1002, ¶90-94.

A POSITA would have been motivated to look for examples of LED lamps using structures that could reduce manufacturing cost. EX1002, ¶¶29, 33, 36, 90, 94. Jing describes one such approach. EX1002, ¶87. Jing describes an LED lamp that results in reduced manufacturing cost for the LED tube, higher luminance, and better heat performance. EX1015, ¶¶[0006], [0018], [0032]. Specifically, Jing describes that a "structure that directly fixes the circuit board onto the inner wall of the lamp tube through the fixing layer ***omits the metal bracket used to fix the circuit board in the LED fluorescent lamp tube in the prior art, and greatly reduces the manufacturing cost*** of the LED fluorescent lamp." EX1015, Summary. Importantly, Jing shows that a POSITA would have been aware of benefits from having an intervening structure for disposing LEDs within a lamp tube (e.g., heat dissipation, supporting the LED light strip) and would have still recognized that in some instances reducing costs is more important than utilizing these benefits. EX1002, ¶92.

A POSITA would have understood that Takahashi fixes its LED module 10 onto base platform 330 "with an adhesive, "(EX1006, 7:65-8:4; EX1002, ¶93) and that Guang attaches its LED array 22 to the lamp tube with LED array holder 22 (EX1007, ###; EX1002, ¶94). Similarly, a POSITA would have been motivated to modify Takahashi's or Guang's LED tube lamp to use Jing's adhesive to securely attach the LED strip to the LED tube inner surface with the predictable result of reduced manufacturing costs and increased luminance. EX1002, ¶93-94. It would have been obvious to a POSITA to try attaching the LED strip with Jing's adhesive with an LED tube lamp because a POSITA would have expected this implementation to be successful in stably attaching the LED strip to the tube while reducing manufacturing costs. *Id.*

3. Modifications based on Jing

For the reasons explained above in §IX.D.2, Jing in combination with each of Takahashi-Shimasaki (Ground 1), Guang-Shimasaki (Ground 2), and Guang-Shimaski-Takashi (Ground 3) rendered obvious LED lamps similar to those discussed in Grounds 1-3 but having the LED strip attached to the lamp tube via an adhesive. For brevity, only limitation 1[d] and claim 13 are discussed below, but the other claims and limitations discussed in Grounds 1-3 remain part of Grounds 4-6 and are met as in Grounds 1-3.

4. Element-by-Element Analysis

(a) *Limitations 1[p]-1[c], 1[e]*

Ground 4: Limitations 1[p]-1[c] and 1[e] are obvious based on Ground 1. *See* §§IX.A.5(a)-IX.A.5(f).

Ground 5: Limitations 1[p]-1[c] and 1[e] are obvious based on Ground 2. *See* §§IX.B.4(a)-IX.B.4(f).

(b) *Limitation 1[d]*

As explained for Limitation 1[d], §IX.A.5(a), in Ground 1, Takahashi-Shimasaki renders obvious an LED light strip disposed on an inner circumferential surface of the lamp tube by either Takahashi's base platform 330 or Shimasaki's attachment member 52.

As explained for Limitation 1[d], §IX.B.4(e), in Ground 2, Guang-Shimasaki renders obvious an LED light strip disposed on an inner circumferential surface of the lamp tube by either Guang's LED holder 22 or Shimasaki's attachment member 52.

To the extent PO argues that the "LED light strip disposed on an inner circumferential surface of the lamp tube" requires more direct attachment of the LED light strip to the inner surface of the lamp tube, such as by an adhesive, each of Takahashi-Shimasaki and Guang-Shimasaki in further view of Jing render obvious

adhering an LED strip directly to the interior circumferential tube surface for the reasons explained in Sections IX.D.2-IX.D.3.

Jing discloses that "one to three rows of light strips composed of LED lamp beads 21 are welded" on circuit board 2. EX1015, ¶[0027]. "The circuit board 2 extends from one end of the lamp tube 1 to the other end." EX1015, ¶[0028]. Further, "circuit board 2 is fixedly connected with the inner wall of the lamp tube 1; similarly, when the circuit board 2 is made of flexible PCB, the circuit board 2 can be fixedly connected with the inner wall of the lamp tube 1 through the fixing layer 3. This structure can fix the circuit board 2 onto the inner wall of the lamp tube 1 without using the tube bracket, thereby greatly reducing the manufacturing cost of the LED fluorescent lamp." EX1015, ¶[0028].

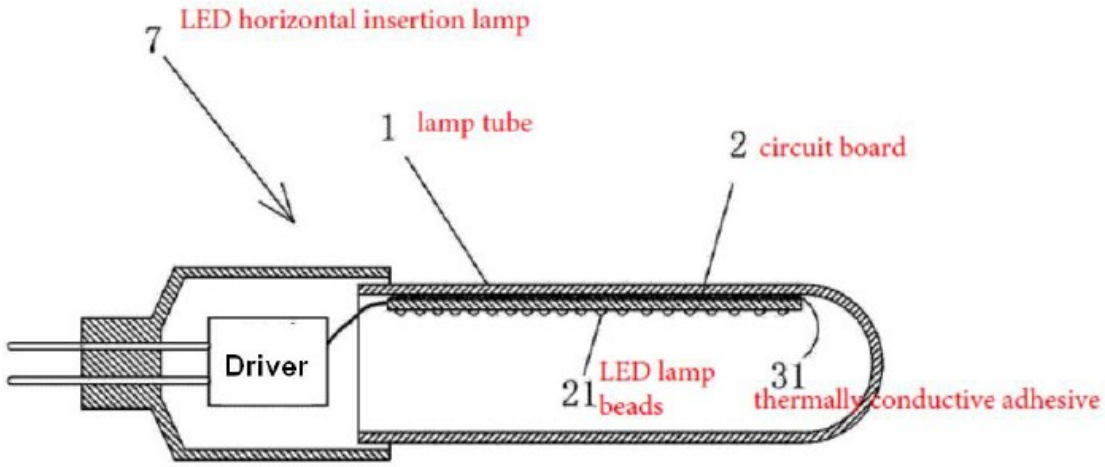


Figure 6

EX1015, FIG.6. Shown in FIG. 2 below, Jing further illustrates that circuit board 2 (LED light strip) is attached to the inner surface of lamp tube 1 using "thermally

conductive adhesive (31), which is silicone, acrylic acid vinegar or epoxy resin." EX1015, ¶¶[0010], [0026], [0030].

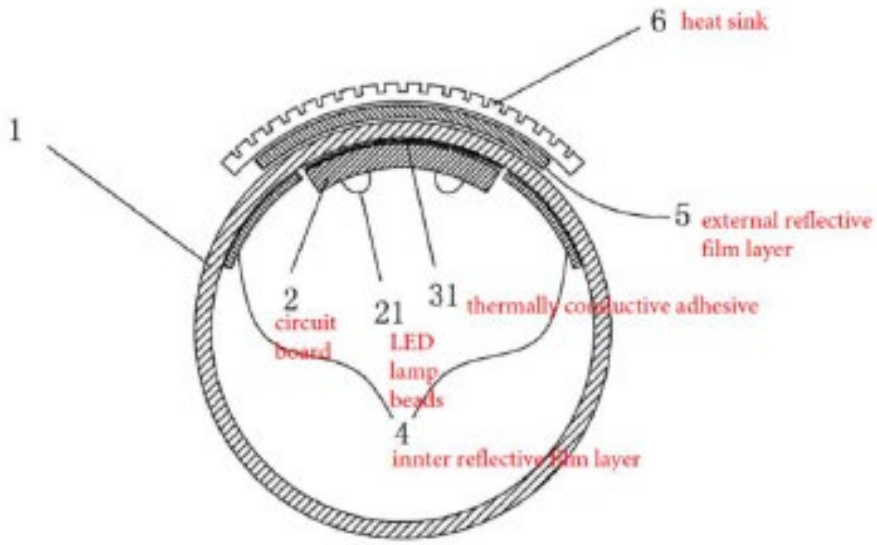


Figure 2

EX1015, FIG.2

(c) *Claim 13*

As explained related to Claim 13, §IX.A.5(l), in Ground 1, the Takahashi-Shimasaki combination teaches an LED light strip attached to an inner surface of the lamp tube by either Takahashi's base platform 330 or Shimasaki's attachment member 52. As explained related to Claim 13, §IX.B.4(j), in Ground 2, the Guang-Shimasaki combination teaches an LED light strip disposed on an inner circumferential surface of the lamp tube by either Guang's LED holder 22 or Shimasaki's attachment member 52.

To the extent PO argues that the "LED light strip attached to an inner surface of the lamp tube" requires direct attachment of the LED light strip to the inner surface of the lamp tube, this limitation is rendered obvious by Jing as discussed related to Limitation 1[d], §IX.D.4(a) above. As such, Jing discloses an LED light strip attached on an inner surface of lamp tube 1. EX1015, FIGS.2, 6.

(d) *Claims 2, 6, 9-11, 14, and 15*

The limitations of claims 2, 6, 9-11, 14, 15 are rendered obvious based on the following:

Claim	Ground 4	Ground 5	Ground 6
2	*See* Claim 2, Ground 1, §IX.A.5(g)	*See* Claim 2, Ground 2, §IX.B.4(g)	
6	*See* Claim 6, Ground 1, §IX.A.5(h)	*See* Claim 6, Ground 2, §IX.B.4(h)	
9	*See* Claim 9, Ground 1, §IX.A.5(i)	*See* Claim 9, Ground 2, §IX.B.4(i)	
10	*See* Claim 10, Ground 1, §IX.A.5(j)		*See* Claim 10, Ground 3, §IX.C.3(a)
11	*See* Claim 11, Ground 1, §IX.A.5(k)		*See* Claim 11, Ground 3, §IX.A.5(k)
14	*See* Claim 14, Ground 1, §IX.A.5(m)	*See* Claim 14, Ground 2, §IX.B.4(k)	
15	*See* Claim 15, Ground 1, §IX.A.5(n)	*See* Claim 15, Ground 2, §IX.B.4(l)	

E. Grounds 7-12 – Obvious Further in View of Takagami

Ground 7: Claims 2, 29-34, 36, and 39-41 are obvious over Ground 1 plus Takigami.

Ground 8: Claims 2, 29-34, 36, and 39 are obvious over Ground 2 plus Takigami.

Ground 9: Claims 40 and 41 are obvious over Ground 3 plus Takigami.

Ground 10: Claims 2, 29-34, 36, and 39-41 are obvious over Ground 4 plus Takigami.

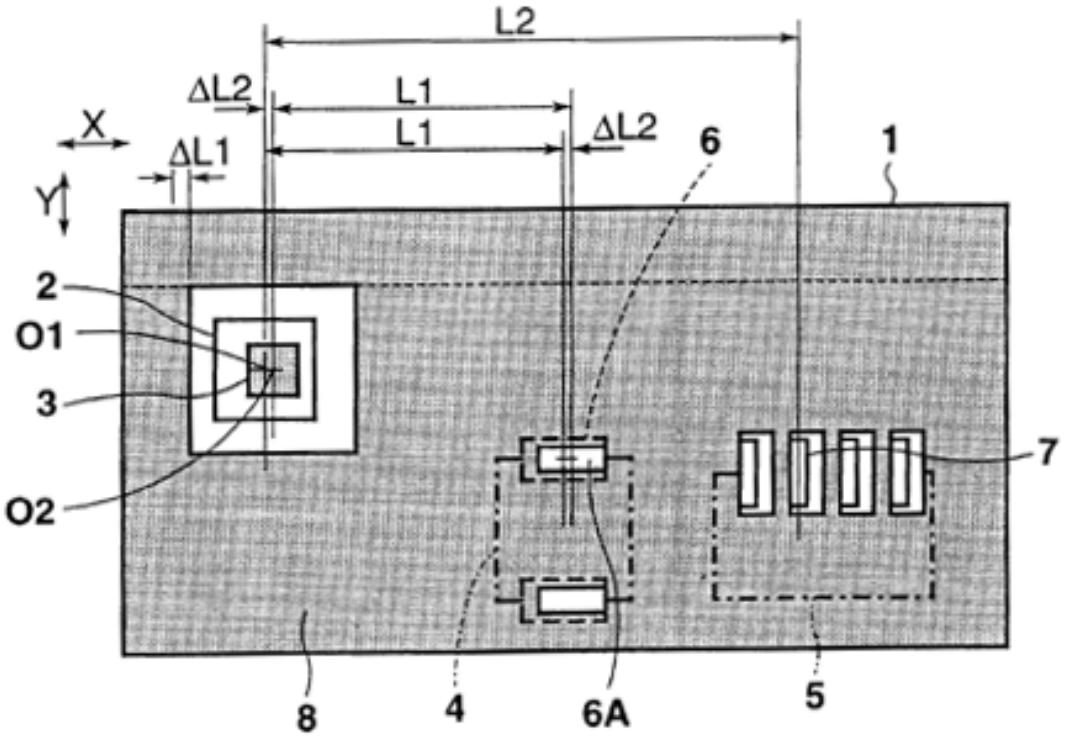
Ground 11: Claims 2, 29-34, 36, and 39-41 are obvious over Ground 5 plus Takigami.

Ground 12: Claims 40 and 41 are obvious over Ground 6 plus Takigami.

1. Takigami

Takigami is titled "Printed Circuit Board with Resist Coating Defining Reference Marks." Takigami discloses that a printed circuit board (PCB) can include "a mark which is used as a recognition of an origin [reference point] for mounting by a mounter." . EX1008, FIG.2, 1:5-7. Takigami further discloses that a resist layer 8 (i.e., solder resist) applied to the PCB includes gaps (openings) around mark 2 and lands 6, 7(i.e., portions of the PCB where devices are to be mounted). EX1008, 1:14-30, 3:29-59. Takigami explains that mounting errors may occur if the resist is applied over areas of the PCB where devices are to be mounted (EX1008, FIGS.3A, 3B, 1:51-2:34) and discloses a technique for overcoming such errors, namely by including a second mark 3, made of resist and formed over, without

covering mark 2, which can be used as a second origin or reference point. EX1008, FIGS.1 and 4, 3:9-5:44.



EX1008, FIG.1.

Takigami teaches "[a] printed circuit board includes a first mark 2 formed by a thin conductor, a second mark 3 formed by a resist 8, a land 6 which is partially coated by the resist 8 and a land 7 which is not coated by the resist 8." EX1008, Abstract. In FIG.1, Takigami teaches that "outside of the first mark 2 made of the thin conductor, the resist 8 is coated on an area sufficiently apart from a circumference of the first mark 2 so as to avoid the first mark 2 with an extremely sufficient clearance." EX1008, 3:55-59. Similarly, Takigami teaches the second mark 3 made of resist 8 is coated on a central area of the first mark 2 while enough

of a gap is assured between the central area and a circumference of the first mark 2." EX1008, 3:45-51. The gaps thus form an opening in the resist around second mark 3. EX1008, FIG.1; EX1002, ¶96. Takigami also teaches "it is possible to form the second mark 3 completely apart from the first mark 2." EX1008, 5:1-5.

2. Motivation to Combine & Further Modification

For the reasons of Ground 1, a POSITA would have been motivated to incorporate openings in the resist layer (protective layer) of Takahashi-Shimasaki.

For the reasons of Ground 2, a POSITA would have been motivated to incorporate solder pads and a resist layer with openings exposing areas for mounting LED light sources and solder pads on the Guang-Shimasaki LED strip.

For the reasons of Ground 3, a POSITA would have been motivated to incorporate Takahashi's diffusion film into the Guang-Shimasaki LED lamp.

For the reasons of Grounds 4-6, a POSITA would have been motivated to further modify Takahashi-Shimasaki and Guang-Shimasaki in view of Jing to directly adhere the LED light strip to the inner circumferential tube surface.

A POSITA would also have been motivated to further modify each of Takahashi-Shimasaki (Ground 7), Guang-Shimasaki (Ground 8), Guang-Shimasaki-Takahashi (Ground 9), Takahashi-Shimasaki-Jing (Ground 10), Guang-Shimasaki-Jing (Ground 11), and Guang-Shimasaki-Takahashi-Jing (Ground 12) to include the

reference/recognizing marks and openings therefore, as taught by Takigami, with a reasonable expectation of success. EX1002, ¶¶98-106.

Recognizing Mark: Takigami's recognizing or reference mark "enables proper mounting of devices, on the printed circuit board" despite variances in manufacturing processes. EX1008, 1:5-12; 4:32-35.

Corresponding Openings: Takigami teaches a "first mark 2" that is detected by a "mounter" when "resist 8 is coated on an area ***sufficiently apart*** from the circumference of the first mark 2 so as to avoid the first mark 2 with an extremely sufficient clearance" (EX1008, 3:12-16, 3:55-59, 3:64-65)—i.e., an opening in the resist.

A POSITA would have been familiar with LED manufacturing and would have understood the benefits of incorporating Takigami's marks 2 and corresponding openings in a resist (protective layer) to expose [recognizing] mark 2 into the LED strip of any of the combinations of Grounds 1-6. EX1002, ¶¶100, 105. This would have been a known use of existing technology to improve manufacture of LED lamps, as explicitly taught by Takagami. EX1002, ¶¶100, 105. A POSITA would have reasonably expected that incorporating a recognizing mark and corresponding resist-layer opening onto an LED strip would enable a mounter to mount electrical devices to a circuit board more accurately. EX1002, ¶¶100, 105. Therefore, a POSITA would have been motivated to use the recognizing mark with

an opening in a protective layer disclosed by Takigami in an LED lamp as taught by Takahashi and Shimasaki. *Id.*

A POSITA would have understood that positioning the recognizing mark in alignment with the LED light source lands and adjacent to solder pads on an end of the LED strip would enable the recognizing mark to be recognized as an origin/reference such that the mounter device would only need to move in a single dimension or direction to place or mount each of the LED light sources (e.g., by shifting over), simplifying manufacturing. EX1002, ¶100, 105. Other benefits would include reducing the cost of manufacturing the LED strip and providing a more energy-efficient LED tube lamp. EX1002, ¶¶32, 36, 102, 106. Accordingly, a POSITA would have been motivated to incorporate a recognizing mark in an opening in the protective layer to take advantage of these benefits. EX1002, ¶102, 106.

3. Element-by-Element Analysis

(a) ***Claim 2***

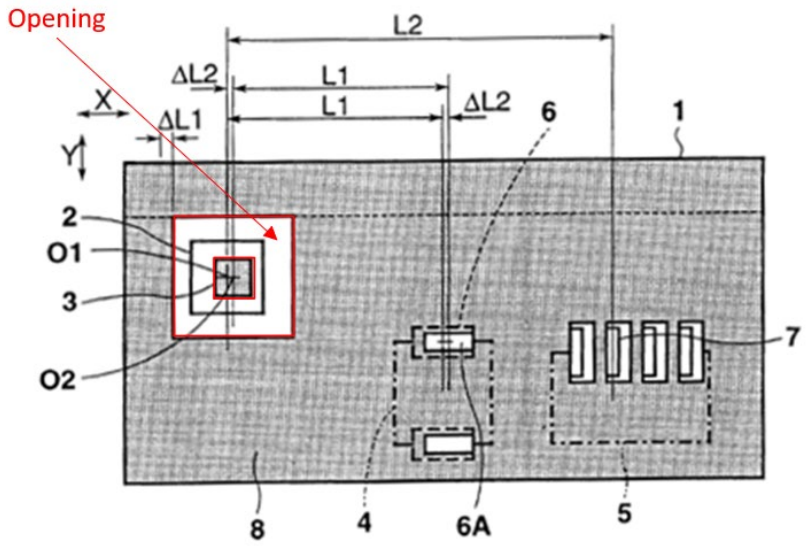
As explained in §§IX.A.5(a)-IX.A.5(f), IX.D.4(a)-IX.D.4(b) above related to Limitations 1[p]-1[e] in Grounds 1 and 4, Takahashi-Shimasaki and Takahashi-Shimasaki-Jing render obvious Claim 1. As explained in §§IX.A.5(g), IX.D.4(d) above related to Claim 2 in Grounds 1 and 4, the Takahashi-Shimasaki and

Takahashi-Shimasaki-Jing combinations teach a third opening in the protective layer adjacent to the two second openings, where the third opening is for a third solder pad.

As explained in §§IX.B.4(a)-IX.B.4(f), IX.D.4(a)-IX.D.4(b) above related to Limitations 1[p]-1[e] in Grounds 2 and 5, Guang-Shimasaki and Guang-Shimasaki-Jing render obvious Claim 1. As explained in §§IX.B.4(g), IX.D.4(d) above related to Claim 2 in Grounds 2 and 5, the Guang-Shimasaki and Guang-Shimasaki-Jing combinations teach a third opening in the protective layer adjacent to the two second openings, where the third opening is for a third solder pad.

To the extent PO argues that the "third opening" is related to a different structure (*see, e.g.,* EX1001, 3:44-48 (exposing a through hole on the LED strip), 4:60-62 (exposing a recognizing mark on the LED strip)), Takahashi-Shimasaki (Ground 7), Guang-Shimasaki (Ground 8), Takahashi-Shimasaki-Jing (Ground 10), or Guang-Shimasaki-Takahashi-Jing (Ground 11) in view of Takigami rendered obvious a third opening in a protective layer adjacent to two second openings for the reasons explained in Section IX.E.2 above. Takigami discloses coating a PCB with (solder) resist 8 (protective layer) and leaving openings in the resist. EX1008, 3:11-59. In FIG.1 below, Takigami discloses that "the resist 8 is coated on an area sufficiently apart from the circumference of the first mark 2 [recognizing mark] so as to avoid the first mark 2." EX1008, 3:55-59.

FIG. 1



EX1008, FIG.1. First mark 2 is a recognizing mark because "[b]efore devices 4, 5 are mounted, the mounter detects the center O1 of the first mark 2" to provide orientation for placement of devices 4, 5. EX1008, 3:64-65.

(b) ***Limitations 29[p]-29[f], 29[h]***

Grounds 7, 10: *See* Limitation 1[p]-1[e], §§IX.A.5(a)-IX.A.5(f).

Grounds 8, 11: *See* Limitation 1[p], §§IX.B.4(a)-IX.B.4(f).

(c) *Limitation 29[g]*

For the reasons explained in Section IX.E.2, each of Takahashi-Shimasaki, Guang-Shimasaki, Takahashi-Shimasaki-Jing, and Guang-Shimasaki-Jing, in further view of Takigami, renders obvious the inclusion of recognizing marks in the connecting region, and corresponding openings in the resist/protective layer.

As discussed above related to Claim 2, §IX.E.3(a), Takigami teaches a recognizing mark arranged on the connecting region. In FIG.1 above, Takigami teaches a first mark 2 that is recognized by a device mounter to determine proper placement of electrical components:

> (1) Before devices 4, 5 are mounted, ***the mounter detects the center O1 of the first mark 2*** made of the thin conductor and the center O2 of the second mark 3 made of the resist 8 from an output signal of a Sensor Such as a CCD camera.
> (2) Then, the mounter initially mounts the device 4 at the distance L1 apart from the center O2 of the Second mark 3 made of the resist 8, and next ***mounts the device 5 at the distance L2 apart from the center O1 of the first mark 2*** made of the thin conductor. On the other hand, the mounter initially mounts the ***device 5 at the distance L2 apart from the center O1 of the first mark 2*** made of the thin conductor, and next mounts the device 4 at the distance L1 apart from the center O2 of the Second mark 3 made of the resist 8.

EX1008, 3:64-4:10. First mark 2 is a "recognizing mark" because it is the same as described in the '125 Patent as a "recognizing mark." In FIG.25 below, the '125

Patent explains that "positioning opening 'd' may also be provided . . . to allow an automatic soldering machine to quickly recognize the position of the soldering pads 'b'." EX1001, 33:20-33; FIG.25.

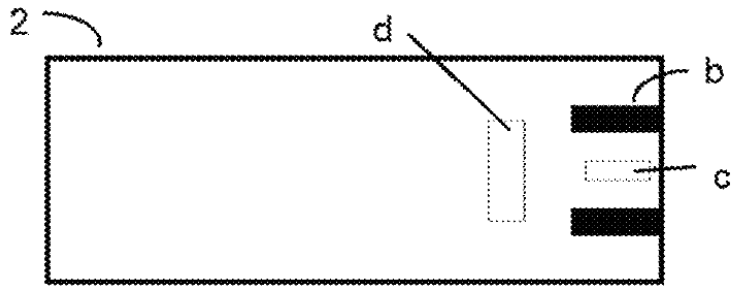
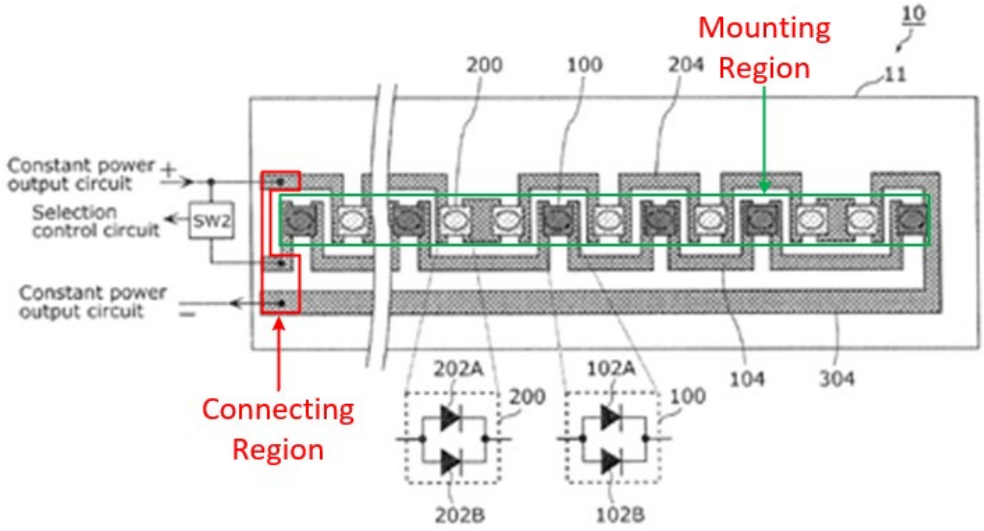


Fig. 25

Further, as also shown in FIG.1 and based on the purpose of first mark 2, it is arranged on the connecting region, *e.g.*, region with "two soldering pad arranged" (*see* Limitation 29[f]).

As explained above in Limitation 1[d], §IX.A.5(e), Takahashi teaches an LED light strip having a mounting region and a connecting region, where a plurality of LED light sources are mounted on the mounting region and at least two solder pads are arranged on the connecting region, in FIG.4 below.

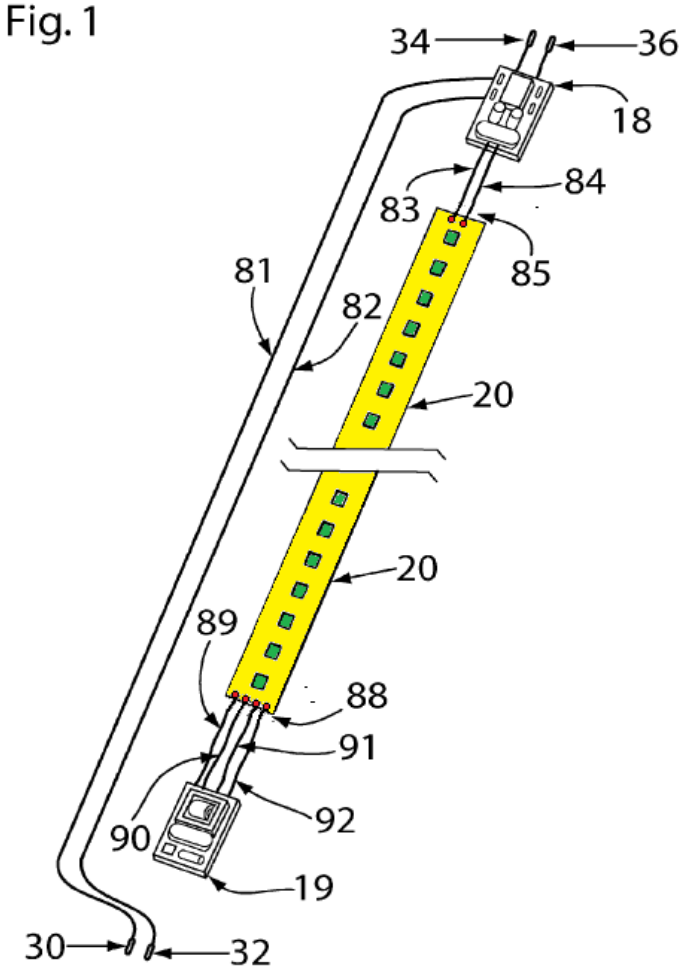
FIG. 4



A POSITA would have understood that a recognizing mark could be arranged on the connecting region shown in FIG.4 above, and would have been motivated to position the recognizing mark in the connecting region to simplify programming of the mounter with respect to mounting each of the LEDs to the LED strip. EX1002, ¶101. For example, FIG.4 illustrates that each of the LED light sources are arranged in a row and are approximately evenly spaced. *Id.* A recognizing mark arranged on the connecting region would enable a POSITA to program the mounter to move incremental distances in a single direction or dimension (e.g., left to right in FIG.4) to mount each of the LEDs (e.g., mount LED_1 at location (X_{1n},Y), mount LED_2 at location (X_{2n},Y), and so on, where *n* represents the incremental distance to move the mounter between mounting each LED). *Id.*

As explained above in Limitation 1[d], §IX.B.4(e), Guang-Shimisaki teaches an LED light strip having a mounting region and a connecting region, where a plurality of LED light sources are mounted on the mounting region and at least two solder pads are arranged on the connecting region, shown in modified FIG.1 below.

Fig. 1



A POSITA would have understood that a recognizing mark could be arranged on the connecting region shown in FIG.1 above, and would have been motivated to position the recognizing mark in the connecting region to simplify programming of the mounter with respect to mounting each of the LEDs to the LED strip. EX1002,

¶105. For example, FIG.1 illustrates that each of the LEDs are arranged in a row and approximately evenly spaced. A recognizing mark arranged on the connecting region would enable a POSITA to program the mounter to move incremental distances in a single direction (e.g., left to right in FIG.1) to mount each of the LEDs (e.g., mount LED_1 at location (X_{1n},Y), mount LED_2 at location (X_{2n},Y), and so on, where *n* represents the incremental distance to move the mounter between mounting each LED). EX1002, ¶105.

(d) *Claim 31*

As discussed above for Claim 2 and Limitation 29[g], §§IX.E.3(a), IX.E.3(c), Takigami teaches a recognizing mark at a third opening in the protective layer.

(e) *Claims 30, 32-34, 36, and 39-41*

The limitations of claims 30, 32-34, 36, and 39-41 are rendered obvious based on the following:

Claim	Ground 7, 10	Ground 8, 11	Grounds 9, 12
30	*See* Limitation 1[e], Ground 1, §IX.A.5(f)	*See* Limitation 1[e], Ground 2, §IX.B.4(f)	
32	*See* Claim 13, Ground 1, §IX.A.5(l)	*See* Claim 13, Ground 2, §IX.B.4(j)	
33	*See* Claim 14, Ground 1, §IX.A.5(m)	*See* Claim 14, Ground 2, §IX.B.4(k)	
34	*See* Claim 15, Ground 1, §IX.A.5(n)	*See* Claim 15, Ground 2, §IX.B.4(l)	

Claim	Ground 7, 10	Ground 8, 11	Grounds 9, 12
36	*See* Claim 6, Ground 1, §IX.A.5(h)	*See* Claim 6, Ground 2, §IX.B.4(h)	
39	*See* Claim 9, Ground 1, §IX.A.5(i)	*See* Claim 9, Ground 2, §IX.B.4(i)	
40	*See* Claim 10, Ground 1, §IX.A.5(j)		*See* Claim 10, Ground 3, §IX.C.3(a)
41	*See* Claim 11, Ground 1, §IX.A.5(k)		*See* Claim 11, Ground 2, §IX.C.3(b)

X. FINTIV FACTORS WEIGH AGAINST DISCRETIONARY DENIAL

Factor 1 is neutral. A stay has not been requested or denied.

Factor 2 weighs in favor of institution. Trial is currently scheduled for April 17, 2024. EX1024. However, the Litigation involves 11 patents and the median time-to-trial for the Western District of Texas is 28.3 months,[8] meaning trial likely will not occur until at least October 2024—about 4 months after a decision here.

Factor 3 weighs in favor of institution. The Litigation is in its early stages. PO filed its original complaint on May 24, 2022, and amended its complaint in September to add patents. Markman is not scheduled to occur until April 19, 2023, and fact discovery does not open until April 20, 2023. EX1024.

[8] https://www.uscourts.gov/statistics/table/na/federal-court-management-statistics/2022/06/30-2

Factor 4 weighs in favor of institution. If the IPR is instituted, Petitioner will stipulate not to rely on the same grounds in the Litigation. EX1016.

Factor 5. The parties are the same.

Factor 6 weighs in favor of institution. This petition is promptly filed well-within the 12-month statutory period and, for the reasons explained above, the merits of the proposed grounds are meritorious and compelling.[9]

XI. CONCLUSION

For the above reasons, claims 1, 2, 6, 9-15, and 29-34, 36, and 39-42 of the '125 Patent are invalid under §103(a), and institution is appropriate.

Dated: December 14, 2022

Respectfully submitted,

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Lead Counsel for Petitioner

[9] *See* https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(a)(i), the undersigned certifies that this Paper—exclusive of the table of contents, mandatory notices under § 42.8, certificate of service, and this certificate of word count—includes 13,992 words.

/Eagle H. Robinson/
Eagle H. Robinson (Reg. No. 61,361)

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e) and 37 C.F.R. § 42.105(a), the undersigned certifies that on December 14, 2022, a complete copy of this Petition for *Inter Partes* Review, Petitioner's power of attorney, and all exhibits were served on Patent Owner at the correspondence addresses of record listed below by USPS Priority Mail:

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