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 No. IPR2023-00980
Patent 9,945,520

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

TABLE OF CONTENTS

PETITIONER'S EXHIBIT LIST

Exhibit	Shorthand	Description
1001	'520 Patent	U.S. Patent No. 9,945,520
1002	'520 File History	Excerpts of Prosecution History of U.S. Patent No. 9,945,520
1003	Baker	Declaration of R. Jacob Baker, Ph.D.
1004	Baker CV	CV of R. Jacob Baker, Ph.D.
1005	Shimizu	Japanese Patent Publication JP 2014-154479A to Shimizu Certified Translation
1006	Ono	Japanese Patent Publication JP 2014-103000A to Ono Certified Translation
1007	Foo	PCT Publication No. WO2013/152485 A1 to Foo
1008	Wilcox	U.S. Patent No. 9,726,330 to Wilcox
1009	Holec	U.S. Patent No. 7,980,863 to Holec
1010	Leong	U.S. Patent No. 6,762,562 to Leong
1011	Levante	U.S. Patent No. 9,057,504 to Levante
1012	Li	U.S. Patent No. 8,262,250 to Li
1013	Kawabata	U.S. Patent No. 8,591,057 to Kawabata
1014	Sato	Japanese Patent Publication JP 2010-153579A to Sato Certified Translation
1015	Deng	Chinese Patent No. CN203797412U to Deng Certified Translation
1016	Liu	LED Packaging for Lighting Applications – Design, Manufacturing and Testing, Sheng Liu et al., Chemical Industry Press (2011)
1017	Guang	U.S. Patent No. 9,338,853 to Guang
1018	Draft Stipulation	Draft Stipulation of Invalidity Contentions
1019	Scheduling Order	Litigation Scheduling Order

Exhibit	Shorthand	Description
1020		Chinese Patent Publication 103899939A to Li Certified Translation
1021		U.S. Patent No. 9,271,354 to Takahashi

CLAIM LISTING

Claim	Limitation	Claim Language
1	1[p]	An LED tube lamp, comprising:
	1[a]	a glass tube covered by a heat shrink sleeve and having two end portions;
	1[b]	a plurality of LED light sources;
	1[c]	two end caps respectively sleeving the two end portions of the glass tube;
	1[d]	a power supply in one of the end caps or separately in both of the end caps; and
	1[e]	an LED light strip on an inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED light sources being on the LED light strip;
	1[f]	wherein each of the end caps comprises: an end wall; and
	1[g]	two conductive pins on the end wall.
2	2	The LED tube lamp according to claim 1, further comprising at least two openings on the end wall symmetric to each other with respect to a plane passing through the middle of a line connecting the two pins and perpendicular to the line connecting the two pins.
3	3	The LED tube lamp according to claim 2, wherein the at least two openings are on a surface of the end wall on which the two pins are disposed.
9	9	The LED tube lamp according to claim 1, wherein at least a part of the openings are arranged along an arc and spaced apart from each other.

Claim	Limitation	Claim Language
10	10[p]	An LED tube lamp, comprising:
	10[a]	a glass tube comprising an inner surface and an outer surface, at least part of the inner surface of the glass tube has a rough surface, the glass tube having two end portions;
	10[b]	a plurality of LED light sources;
	10[c]	two end caps respectively sleeving the two end portions of the glass tube;
	10[d]	a power supply in one of the end caps or separately in both of the end caps; and
	10[e]	an LED light strip on the inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED light sources being on the LED light strip.
11	11	The LED tube lamp according to claim 10, wherein the roughness of the rough surface is substantially from 0.1 to 40 μm.
12	12	The LED tube lamp according to claim 10, wherein each of the end caps comprises a plurality of openings thereon, and the two sets of the plurality of openings are symmetric to each other with respect to a virtual central axis of the end cap.
13	13	The LED tube lamp according to claim 12, wherein the plurality of openings dissipate heat resulted from the power supply.
16	16	The LED tube lamp according to claim 10, wherein the plurality of openings are separately in a shape of a circle.

Claim	Limitation	Claim Language
18	18	The LED tube lamp according to claim 12, wherein at least a part of the openings are arranged along an arc and spaced apart from each other.
19	19[p]	An LED tube lamp, comprising:
	19[a]	a glass tube having two end portions;
	19[b]	a plurality of LED light sources;
	19[c]	two end caps respectively sleeving the two end portions of the glass tube, each of the end caps comprising two pins and a plurality of openings, the two pins being on a surface of the end cap, the plurality of openings being on the surface of the end cap and divided into two sets, and the two sets of the openings being symmetric to each other with respect to a plane passing through the two pins;
	19[d]	a power supply disposed in at least one of the end caps; and
	19[e]	an LED light strip on an inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED light sources being on the LED light strip.
20	20	The LED tube lamp according to claim 19, wherein the power supply comprises a current-limiting element, and the plurality of openings dissipate heat resulted from the power supply.
22	22	The LED tube lamp according to claim 20, wherein the surface of the end cap is vertical to the length direction of the glass tube.
25	25	The LED tube lamp according to claim 20, wherein the plurality of openings are separately in a shape of a circle.

Claim	Limitation	Claim Language
28	28	The LED tube lamp according to claim 20, wherein at least a part of the openings are arranged along an arc and spaced apart from each other.
29	29[p]	An LED tube lamp, comprising:
	29[a]	a glass tube;
	29[b]	a plurality of LED light sources;
	29[c]	two end caps respectively at two opposite ends of the glass tube;
	29[d]	a power supply in one of the end caps or separately in both of the end caps; and
	29[e]	an LED light strip on an inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED light sources being on the LED light strip;
	29[f]	wherein each of the end caps comprises: an end wall;
	29[g]	two pins on the end wall; and
	29[h]	at least two openings on the end wall symmetric to each other with respect to a plane passing through the middle of a line connecting the two pins and perpendicular to the line connecting the two pins.
31	31	The LED tube lamp according to claim 1, wherein the LED light strip is a bendable circuit sheet.
32	32	The LED tube lamp according to claim 1, wherein the end cap comprises a metal part.
33	33	The LED tube lamp according to claim 10, wherein the LED light strip is a bendable circuit sheet.

Claim	Limitation	Claim Language
34	34	The LED tube lamp according to claim 10, wherein the end cap comprises a metal part.
35	35	The LED tube lamp according to claim 19, wherein the LED light strip is a bendable circuit sheet.
36	36	The LED tube lamp according to claim 19, wherein the end cap comprises a metal part.
37	37	The LED tube lamp according to claim 29, wherein the LED light strip is a bendable circuit sheet.
38	38	The LED tube lamp according to claim 29, wherein the end cap comprises a metal part.
39	39	The LED tube lamp according to claim 20, wherein the current-limiting element comprises a resistor, a capacitor, an inductor, or any combination thereof.
42	42	The LED tube lamp according to claim 19, wherein the power supply comprises a rectifying circuit and a filtering circuit disposed in at least one of the end caps, and the plurality of openings are for dissipating heat from the power supply.
44	44	The LED tube lamp according to claim 29, wherein the power supply comprises a current-limiting element disposed in at least one of the end caps, and the at least two openings are for dissipating heat from the power supply.
45	45	The LED tube lamp according to claim 44, wherein the current-limiting element comprises a resistor, a capacitor, an inductor, or any combination thereof.
47	47	The LED tube lamp according to claim 29, wherein the power supply comprises a rectifying circuit and a filtering circuit disposed in at least one of the end caps, and the at least two openings are for dissipating heat from the power supply.

Claim	Limitation	Claim Language
49	49	The LED tube lamp according to claim 19, wherein the power supply further comprises a circuit board with two second bond pads.
50	50	The LED tube lamp according to claim 49, wherein each of the second bond pads comprises a through-hole.
54	54	The LED tube lamp according to claim 19, wherein the light bar comprises two first bond pads at a first end.
58	58	The LED tube lamp according to claim 19, wherein the power supply comprises a printed circuit board and the light bar comprises a bendable circuit sheet.
59	59	The LED tube lamp according to claim 29, wherein the power supply further comprises a circuit board with two second bond pads.
60	60	The LED tube lamp according to claim 59, wherein each of the second bond pads comprises a through-hole.
64	64	The LED tube lamp according to claim 29, wherein the light bar comprises two first bond pads at a first end.
68	68	The LED tube lamp according to claim 29, wherein the power supply comprises a printed circuit board and the light bar comprises a bendable circuit sheet.

I. INTRODUCTION

Entitled "LED Tube Lamp," the '520 Patent is directed to "an LED tube lamp and its components thereof comprising LED light sources, a tube, electronic components, and end caps." EX1001, 1:17-20. To overcome the purported shortcomings of prior LED tube lamps, the '520 Patent proposes an LED tube lamp having a heat shrink sleeve over the glass tube, heat dissipating openings in the end caps on the LED tube lamp, and soldering pads so that the LED light strip is soldered directly to the power supply. *Id.*, 2:3-4, 3:6-13, 9:61-67, 10:48-62.

None of the '520 Patent's LED tube lamp components or their configuration were new. Ono, Holec, Leong, Foo, and Shimizu are all directed to LED tube lamps. Ono, Holec, and Leong discloses each structural component of independent claims 19 and 29, including the claimed light strip with a freely extending end portion that is directly soldered to the power supply. Foo further discloses the rough internal surface of the glass lamp tube of independent claim 10, and Shimizu discloses the heat shrink sleeve of independent claim 1.

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 (§42.8(b)(2))

The following proceeding involves the '520 Patent and may therefore affect, or be affected by, a decision in this proceeding:

(1) *Jiaxing Super Lighting Elec. Appliance Co., Ltd. v. Current Lighting Sols., LLC d/b/a GE Current*, Civil Action No. 6:22-cv-00534-ADA (W.D. Tex. May 24, 2022) ("*Current* Action").

(2) Lead and Back-Up Counsel (§42.8(b)(3))

Lead Counsel	Back-Up Counsel
Eagle H. Robinson (Reg. No. 61,361)	Arthur P. Licygiewicz (pending *pro hac vice*) Catherine J. Garza (Reg. No. 62,149)

C. Service Information (§42.8(b)(4))

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Petitioner consents to electronic service.

III. GROUNDS FOR STANDING

Pursuant to §42.104(a), Petitioner certifies that the '520 Patent is available for IPR, and that Petitioner is not barred or estopped from requesting an IPR on the

grounds identified in this Petition. The '520 Patent has not been subject to a previous FWD in an estoppel-based AIA proceeding.

IV. STATEMENT OF PRECISE RELIEF REQUESTED FOR EACH CLAIM CHALLENGED

A. Claims for Which Review Is Requested (§42.104(b)(1))

Petitioner requests review and cancellation of Claims 1-3, 9-13, 16, 18-20, 22, 25, 28, 29, 31-39, 42, 44, 45, 47, 49, 50, 54, 58-60, 64, and 68.

B. Statutory Grounds of Challenge (§42.104(b)(2))[1]

Claims 1-3, 9-13, 16, 18-20, 22, 25, 28, 29, 31-39, 42, 44, 45, 47, 49, 50, 54, 58-60, 64, and 68 are invalid under §103 over these combinations of art:

Ground	Basis	Claims	Prior Art Combination
1	§103	19, 20, 22, 25, 28, 29, 35-39, 42, 44, 45, 47, 49, 50, 54, 58-60, 64, and 68	Ono (EX1006), Holec (EX1009), Leong (EX1010)
2	§103	10-13, 16, 18, 33, 34	Ono, Holec, Leong, Foo (EX1007)
3	§103	1, 31, 32	Ono, Holec, Shimizu (EX1005),
4	§103	2, 3, 9	Ono, Holec, Shimizu, Leong

Published June 5, 2014, Ono is prior art under §102(a)(1).

Issued July 19, 2011, Holec is prior art under §102(a)(1).

[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).

Published October 17, 2013, Foo is prior art under §102(a)(1).

Issued July 13, 2004, Leong is prior art under §102(a)(1).

Published August 25, 2014, Shimizu 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 '520 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).

During prosecution of the '520 Patent, the Examiner rejected claims 1-10 and 13-34 as rendered obvious by the combination of Guang (US 2016/0081147) in view of Wilcox (US 2015/0176770), Leong-814 (US 2008/0290814), and Chen (US 2011/0038146). EX1002, 171/249, 177/249. The Examiner rejected claims 11-12 as rendered obvious by the combination of Guang, Wilcox, and Leong-814. EX1002, 175/249. In response, the applicant amended the independent claims to recite "a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply." EX1002, 64/249, 66-67/249, 69/249. Applicant argued that none of the asserted references disclosed this limitation. EX1002, 74-78/249. The Examiner then issued

a notice of allowance indicating "the prior art of record fails to teach, disclose or render obvious the applicant's invention as claimed, particularly the feature describing: an LED light strip on an inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED sources being on the LED light strip." EX1002, 34/249. There were no prior art rejections based on the Ono, Leong, Shimizu, Foo, and Holec references on which the below grounds rely. Ono, Foo, and Holec were not before the Examiner during prosecution. Shimizu and the application publication of Leong were among over 180 references submitted in IDSs during prosecution, but were not substantively addressed by the Examiner. EX1002, 204/249, 194/249.

Accordingly, discretionary denial under either of §§314(a) or 325(d) is not warranted.

VI. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art ("POSITA") as of November 6, 2014[2]—the '520 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

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

academic or industry experience in lighting design, including knowledge of LEDs and related technology for driving LEDs. A POSITA with a higher level of education may have fewer years of academic or industry experience, or vice versa. EX1003, ¶26. A POSITA would have been familiar with the field of technology described in Section VII below. *Id*. The prior art and the '520 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).

VII. FIELD OF TECHNOLOGY

The '520 Patent is directed to "an LED tube lamp and components thereof comprising the LED light sources, a tube, electronic components, and end caps." EX1001, 1:17-20. In other words, the '520 Patent discloses and claims certain aspects of an LED lamp that works with existing fluorescent lighting fixtures, and components thereof. EX1003, ¶29.

A. Fluorescent Lamps and the Rise of LED Lamps

"A fluorescent lamp consists of a glass tube filled with an inert gas (usually argon) at low pressure. On each side of the glass tube is an electrode. Electricity is passed through the gas, causing an arc of illumination." EX1017, 1:22-25. "Historically, fluorescent lamps use AC power, effectively meaning that the electrode that functions as the cathode switches back and forth." *Id*., 2:1-3.

"As electrical current forms an arc through the lamp, it ionizes a higher percentage of the tube's contained gas molecules. The more molecules that are ionized, the lower the resistance of the gas. If too many gas molecules are ionized, the resistance will drop to the point that an electrical short would occur." *Id*., 2:13-18. Therefore, a ballast is used with fluorescent lamps. "An electrical ballast is a device that [is] intended to limit the amount of current in an electric circuit." *Id*., 1:45-47. "The ballast is typically physically located in a box mounted near its lamp or lamps." *Id*., 1:63-65.

"[T]here has been over the past decade an enormous commercial move toward replacing both incandescent and fluorescent light fixtures with light-emitting diode (LED) lighting." *Id*., 4:13-16. "LEDs have advantages over those prior light sources: lower energy consumption, longer life, improved robustness, smaller size, and the ability to be switched on and off faster." *Id*., 4:20-22; EX1003, ¶¶30-32.

B. Bendable LED Light Strips Directly Soldered to Other Devices, Such as Power Supplies, Were Well-Known

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 with a freely extending end that connects to a power supply. EX1003, ¶¶33-34. For example, Wilcox teaches that "[t]he substrate 20 [with LEDs 10] may comprise a flex circuit 20a where the flex circuit 20a may comprise a flexible layer of a dielectric material such as a polyimide, polyester or

other material to which a layer of copper or other electrically conductive material is applied such as by adhesive." EX1008, 7:46-51. Levante likewise teaches that "[l]ight strips, such as flexible LED light strips, have become increasingly popular in various applications." EX1011, 1:38-40; EX1012, 1:22-24 ("The lighting strip devices can be made of flexible material to allow for applying the lighting devices along flat as well as contoured surfaces."). Similarly, Holec teaches that "the present invention is directed towards flexible lighting circuit boards and more directly towards flexible LED circuit boards." EX1009, 6:43-47, 1:19-26, 7:1-6, 11:23-65, Cl. 2. Kawabata also teaches that "LED bare chips 11" are mounted on a "flexible wiring substrate 34." EX1013, 22:13-50; *see also* EX1014, [0001] ("The present invention relates to a flexible LED substrate that is well-suited for making a long display.").

Connecting freely extending ends of flexible LED light strips to other devices directly using solder pads was also well-known. EX1009, 8:52-9:8, 12:52-59, FIGS. 8, 11a, 11b, 12, 13a, 13b; *see also* EX1011, 1:54-55 ("The end of the flexible LED light strip may be attached by soldering the LED light strip to the connector."); EX1003, ¶34. For example, Kawabata teaches "[t]he leads 51 are provided at ends of the power supply substrate 5 spaced in the longitudinal direction, with one end of each lead fixed to the power supply substrate 5 with solder while the other end of the lead soldered to a pad (not shown) provided on the mount surface 2a of the

substrate 2." EX1013, 11:41-50; *see also* EX1014, [0012] ("FIG. 3 is a plan view . . . where a plurality of LEDs 31 are mounted with substantially equal spacing on the flexible LED substrate. Lead wires of a power supply may be soldered to the power supply interconnection exposing portion 32 in order to connect the power supply for the LED lighting, or power supply cables may be connected to a connector 33."). A POSITA would have been familiar with manufacturing and connection methods for LED strips and other devices, such as power supplies. EX1003, ¶34.

C. Heat Dissipation Methods Were Well-Known

It was known that operation of an LED lamp generates heat, which, if not dissipated, can reduce performance and damage components of an LED lighting device. EX1016, 167/367, 201/367, 203/367. "Therefore, it is crucial to rapidly remove the heat and keep the junction temperature below a certain limit for the maintenance of performance." *Id.*, 167/367. A POSITA would have understood the importance of thermal management in an LED lighting device. EX1003, ¶35. A POSITA would also have been familiar with the use of vents or openings that can provide air flow through an LED lamp to dissipate heat. EX1003, ¶36. For example, Deng teaches using air vents for heat dissipation "on the end faces of the end covers 10 according to the power and heat output of the LEDs 32." EX1015, [0037], cl. 10.

D. Heat Shrink Sleeves for LED Tubes Was Well-Known

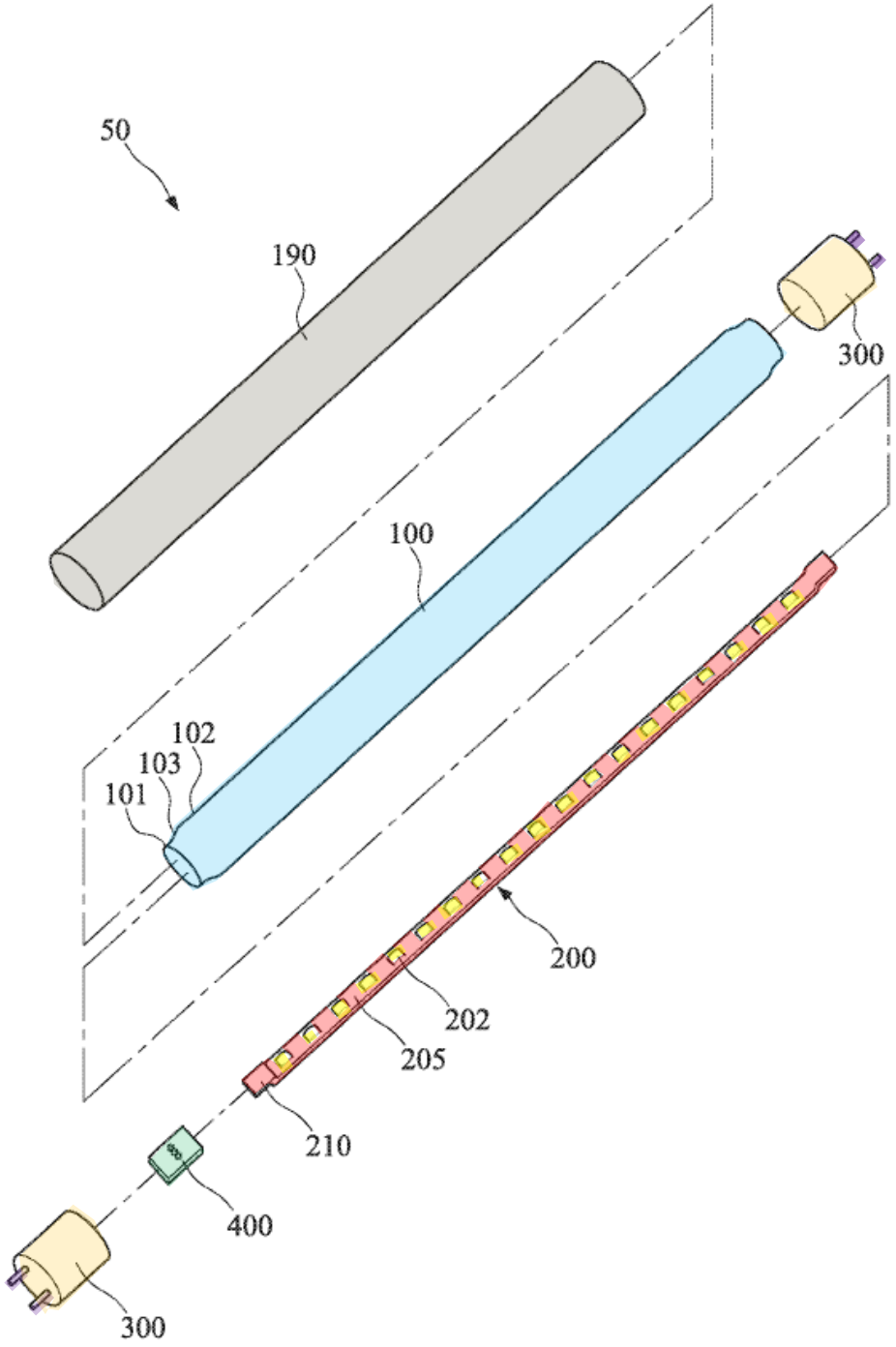
LED tube lamps often included an exterior heat shrink sleeve to prevent shattering the glass tube in the event the tube is damaged. EX1005, [0010]; EX1003, ¶37. For example, Shimizu teaches that "[t]he outer periphery of the glass tube 2 is covered with a translucent milky white heat-shrinkable tube 9." EX1005, [0017]. Shimizu's heat shrink sleeve aids in the "dispersion of heat" and also "prevents scattering of broken shards when the glass tube 2 is damaged." *Id*., [0010], [0017], [0022]-[0024]. Wilcox similarly teaches that the outside surface of a tube 2 has a diffusing layer 14 made from a cylindrical PET film tube. EX1008, 6:43-44, 6:57-60. The PET tube is heat shrunk to the exterior of the tube 2 and provides "a shatterproof coating in addition to providing additional diffusion." *Id*., 6:59-66.

VIII. '520 PATENT

Entitled "LED Tube Lamp," the '520 Patent is directed to an LED tube lamp and the assembly of components of the lamp. EX1001, Abstract.

A. Overview

The '520 Patent describes an LED tube lamp including a [blue] tube 100 with two ends. *Id*., 9:30-32, 5:5-9, 5:12-15. A [gray] heat shrink sleeve 190 covers the outer surface of the tube 100. *Id*., 9:30-32. Inside the tube is a [red] LED light strip 200 onto which multiple [yellow] LED lights 202 are mounted. *Id*., 5:51-52. An [orange] end cap 300 is attached to each tube end. *Id*., 5:12-15. Inside at least one end cap is a [green] power supply 400. *Id*., 5:52-53.



EX1001, FIG. 6; EX1003, ¶55.[3]

[3] All colorized figures herein are annotated.

Each of the end caps 300 includes an end wall and [purple] conductive pins 301 protruding from the end wall. EX1001, 12:16-20. The end wall also includes openings 304 to provide heat dissipation. *Id*., 12:4-8.

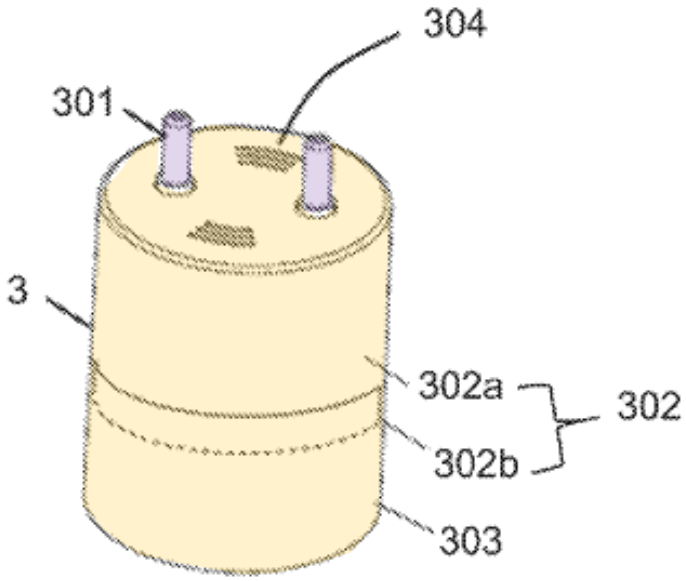


FIG. 16

The [green] power supply 400 can be a module disposed in end cap 300, onto which electronic components 430 are mounted. *Id*., 9:52-57. The power supply 400 and the [red] light strip 205 include [blue] soldering pads a and b, respectively. *Id*., 10:16-25. The power supply 400 and the light strip 205 are connected together by soldering the pads a and b together. *Id*., 10:38-40.

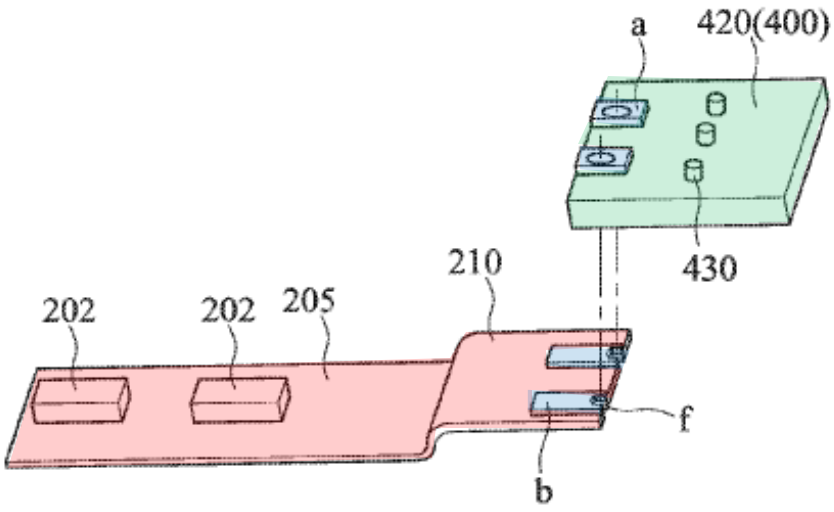


FIG.7

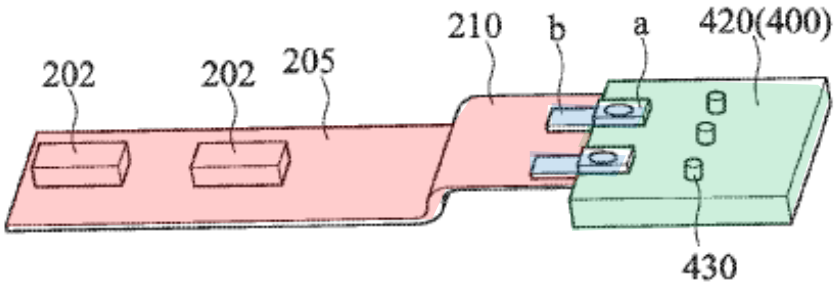


FIG.8

Id., FIGs. 7-8.

B. Prior Art and Perceived Shortcomings

The ’520 Patent describes prior art LED lamps and associated drawbacks. EX1001, 1:24-59. Specifically, prior art LED lamps include a rigid substrate for the LED light strip that can be damaged yet the tube lamp remains straight even if partially ruptured or broken, resulting in a potentially dangerous situation for users.

Id., 1:40-45. Further, the rigid substrate in a prior art LED lamp is typically connected to the end camps using wire bonding. *Id*., 1:46-48. The wires maybe easily damaged or broken during manufacturing, transportation, and usage which will disable the lamp. *Id*., 1:48-51. Finally, as electro-optical conversion efficiency increases, the heat generated by the LEDs increases and prior art lamps did not include ventilating holes for dissipating heat. *Id*., 1:52-56.

C. ’520 Patent’s Asserted Improvement to Prior Art

To overcome the purported shortcomings, the ’520 Patent proposes an LED tube lamp having a heat shrink sleeve over the glass tube, heat dissipating openings in the end caps on the LED tube lamp, and soldering pads so that the LED light strip is soldered directly to the power supply. *Id.*, 2:3-4, 3:6-13, 9:61-67, 10:48-62.

D. Prosecution History

During prosecution of the ’520 Patent, the Examiner rejected claims 1-10 and 13-34 as rendered obvious by the combination of Guang in view of Wilcox, Leong-814, and Chen. EX1002, 171/249, 177/249. The Examiner rejected claims 11-12 as rendered obvious by the combination of Guang, Wilcox, and Leong-814. EX1002, 175/249. In response, the applicant amended the independent claims to recite “a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply.” EX1002, 64/249, 66-67/249, 69/249. Applicant argued that none of the asserted

referenced disclosed this limitation. EX1002, 74-78/249. The Examiner then issued a notice of allowance indicating "the prior art of record fails to teach, disclose or render obvious the applicant's invention as claimed, particularly the feature describing: an LED light strip on an inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED sources being on the LED light strip." EX1002, 34/249.

E. 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. "an LED light strip on [the] an inner surface of the glass tube"

Petitioner does not believe this term needs explicit construction, but notes that the specification and claims indicate that the term "on" is broad enough to cover both direct contact and through intervening elements. *See, e.g.*, EX1001, 6:35-38 ("In another alternative embodiment, the dielectric layer can be omitted, in which the wiring layer is ***directly***[4] bonded to the inner circumferential surface of the glass tube 100."); *see also id.*, FIG. 4 (illustrating reflective film 120 between LED light

[4] All emphasis added unless otherwise noted.

strip 200 and inner surface 100a of glass tube 100), 8:61-9:19, 3:18-19 ("FIG. 4 illustrates a part of cross section of FIG. 2 along line B-B'"), FIG. 2; EX1003, ¶100. The claims additionally expressly recite "directly" when a direct bonding or connection is required. EX1001, Cl. 1, 10, 19, and 29; EX1003, ¶100.

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

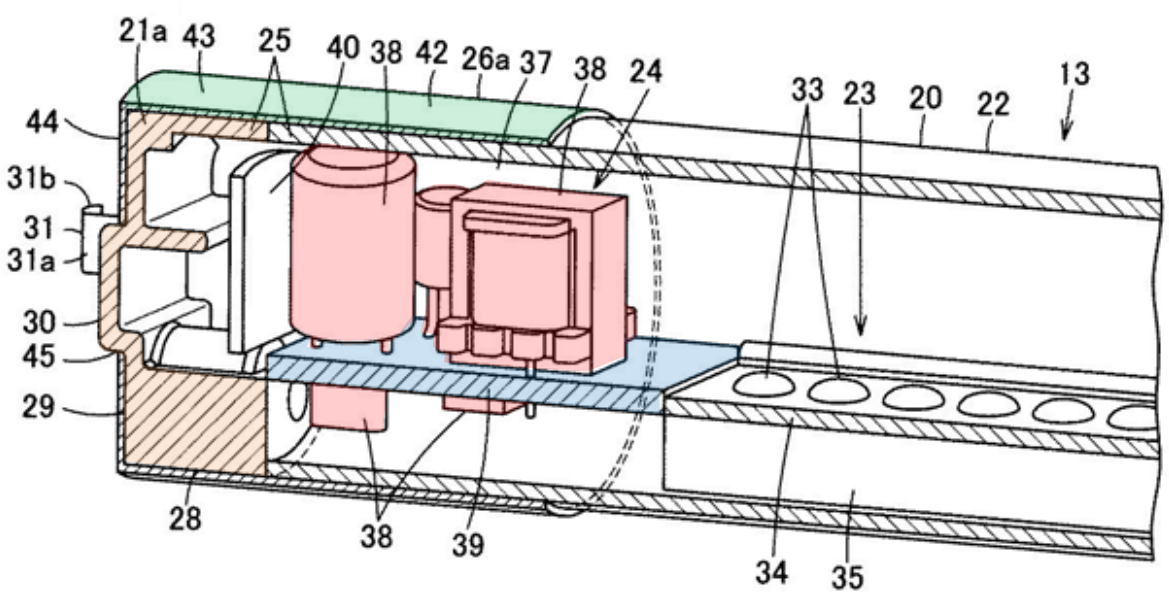
A. Ground 1 - Claims 19, 20, 22, 25, 28, 29, 35-39, 42, 44, 45, 47, 49, 50, 54, 58-60, 64, and 68 Are Obvious Over Ono in view of Holec and Leong

1. Ono

Ono is titled "Straight Tube Lamp and Lighting Device." Ono's "straight tube lamp 13 includes a light source unit 23 having light emitting elements 33, a lighting circuit 24 for lighting the light emitting elements 33, and a lamp unit 22 housing the light source unit 23 and the lighting circuit 24." EX1006, [Solution]. "The lamp unit 22 includes a straight tube 20 that is at least partially translucent, and a cap 21a disposed on one end of the tube 20." *Id.* The tube 20 may be made of "glass or a ceramic." *Id*., [0032].

Ono's "lighting circuit 24 is covered with an [orange] insulator 25, and the lighting circuit 24 is covered with a [green] non-combustible cover 26a via the insulator 25." *Id.*, [Solution].

[Fig. 1]



Id., FIG. 1. Ono's lighting circuit 24 "is housed inside the tube 20 on one end in a lighting circuit housing portion 37 between the light source unit 23 housed inside the tube 20 and the cap 21a attached to one end of the tube 20." *Id.*, [0017]. "The lighting circuit 24 has a [blue] circuit board 39 on which a plurality of [red] electronic components 38 have been mounted." *Id.* Specifically, "[l]ead components such as capacitors and inductors are mounted on the mounting surface of the circuit board 39, and surface mounted components such as resistors and switching elements are mounted on the wiring pattern surface." *Id.* Additionally, Ono explains that a non-combustible cover 26a extends over cap 21a and circuit 24 to "prevent external heat damage when the electronic components 38 in the lighting circuit 24 experience excessive heat due to aging, etc., and the end of the tube body

20 and the cap 21a have been damaged by the heat." EX1006, [0027]; EX1003, ¶¶40-42, 104.

2. Holec

Holec is titled "Printed Circuit Boards Flexible Interconnect Design." Holec notes that for some LED applications, "it is advantageous to have interconnections between circuit boards which are highly reliable, carry significant levels of current or voltage without loss, are protected from mechanical damage and shorting, allow various shapes and geometries of connection and are easy and efficient to apply." EX1009, 2:28-35. Holec further teaches that "the present invention is directed towards flexible lighting circuit boards and more directly towards ***flexible [e.g., bendable] LED circuit boards***." EX1009, 6:43-47, 1:19-26, 7:1-6, 11:23-65, Cl. 2. As such, Holec discloses a method for interconnecting printed circuit boards in LED applications where at least one board is a flexible LED circuit board. EX1009, 1:19-26; EX1003, ¶¶46-51.

Specifically, Holec describes overlapping circuit boards to provide an interconnection. EX1009, 8:50-52. This allows a direct connection between two circuit boards. *Id*., 8:52-9:8. As shown in FIG. 8, a [red] top board 6 or 13 includes conductive pads and a [green] bottom board 5 or 39 includes conductive pads. *Id*., 8:50-9:8, 12:52-59, FIGS. 8, 11a, 11b, 12, 13a, 13b. The conductive pads are soldered directly to one another with overlapping joints 26 with one board having a

vertical step offset 41 at its freely extending end. *Id*., 9:26-28, 12:52-59; EX1003, ¶¶49-50. In this way, the top board 6 or 13 and bottom board 5 or 39 are electrically connected. EX1009, 8:52-9:8, 12:52-59, cl. 1 ("the second circuit board having … a metal pad able to couple to the first circuit board in an overlapping fashion when solder is passed through the plated through hole such that the bottom surface of the first circuit board is coupled to the top surface of the second circuit board."), cl. 2 ("wherein the circuit boards are flexible and have a radius"); EX1003, ¶¶49-50.

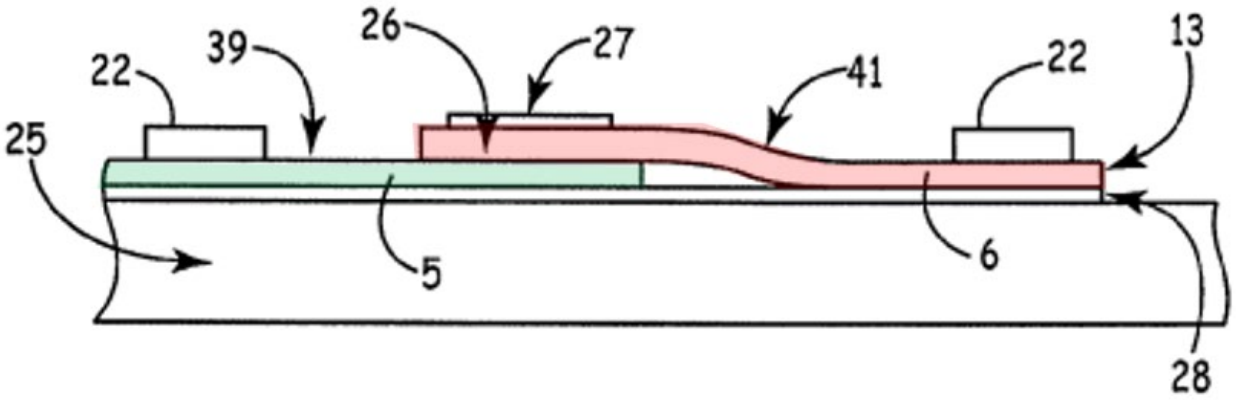


FIG. 8

EX1009, FIGS. 8 and 14; EX1003, ¶¶49-50.

FIGS. 11a, 11b, 12, 13a, and 13b further illustrate the conductive pads on boards 13 and 5, including [green] conductive pads 30, 31, 33, and 38 that include through holes 1, [yellow] LEDs 22, and [blue] integrated circuits 36. EX1009, 8:40-

9:17, 9:26-28, 9:38-41, 10:48-54, 11:13-22, 11:60-63, FIGS. 11a, 11b, 12, 13a, and 13b.

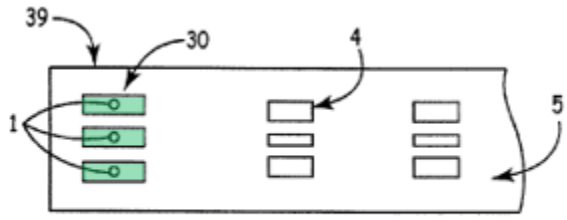


FIG. 11a

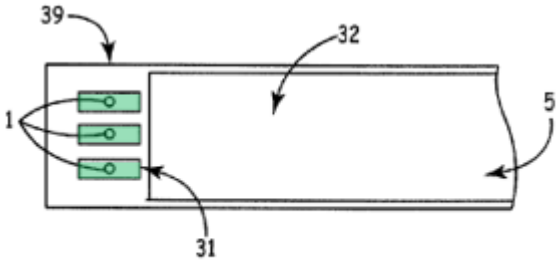


FIG. 11b

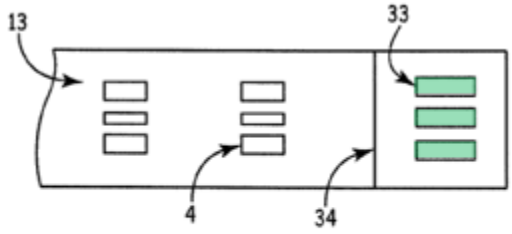


FIG. 12

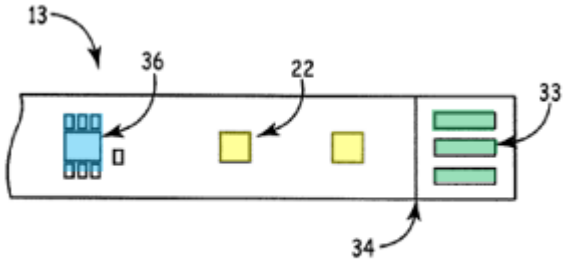


FIG. 13a

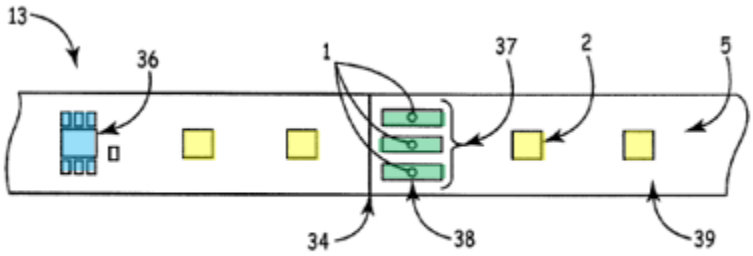


FIG. 13b

EX1009, FIGS. 11a, 11b, 12, 13a, and 13b; EX1003, ¶51.

3. Leong

Leong is titled "Tubular Housing with Light Emitting Diodes." Leong's tube lamp 124 includes a [blue] "elongated tubular housing 142." EX1010, 30:23-27.

"LED lamp 124 further includes a pair of [orange] opposed lamp base end caps 150A and 150B." *Id*., 30:30-32.

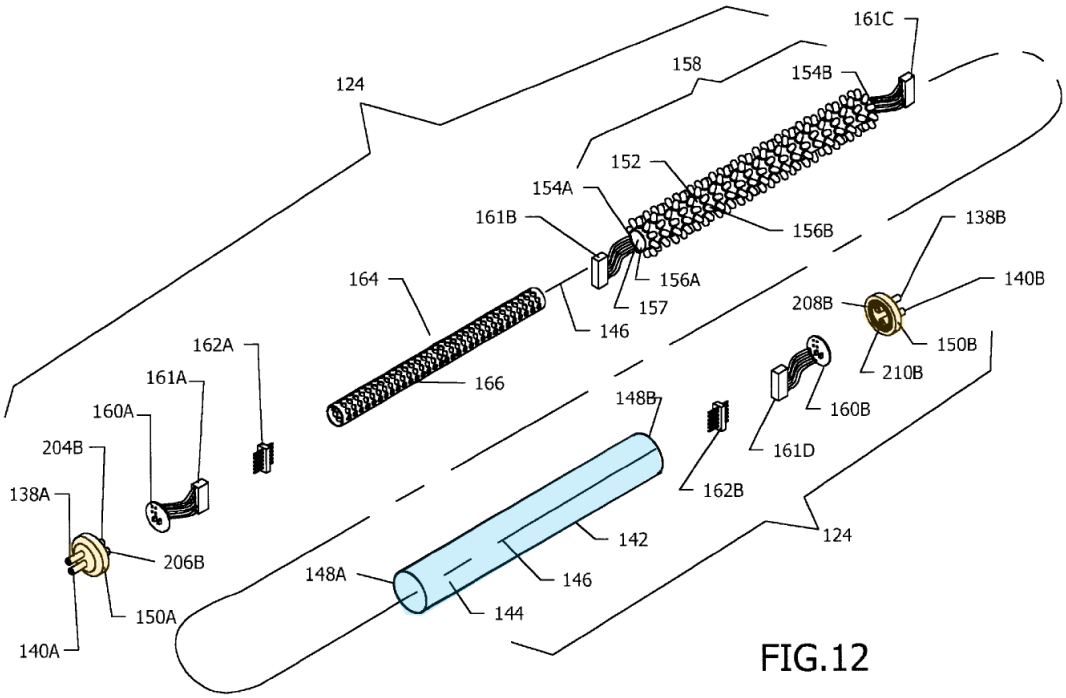


FIG.12

EX1010, FIG. 12; EX1003, ¶¶52-54.

The base end caps 150A, 150B include bi-pin electrical contacts 138A, 140A extending through the end caps. EX1010, 40:32-36. The end caps 150A, 150B also include two vent holes 224A, 224B in vertical alignment with the center line 146 of the end caps. *Id*., 40:41-43.

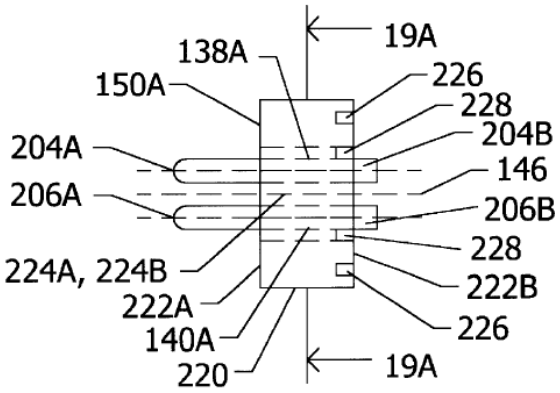


FIG. 19

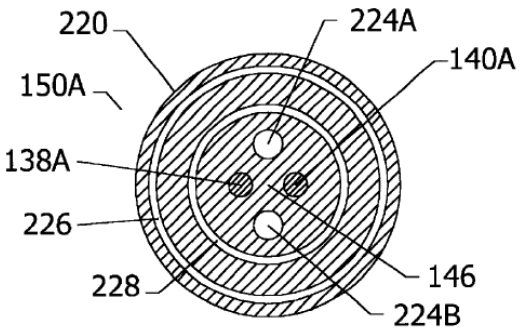


FIG. 19A

EX1010, FIGS. 19, 19A; EX1003, ¶54.

4. Motivation to Combine Ono and Holec

Ono discloses an LED lamp including a glass tube, light sources on a light strip, end caps, and a power supply as lighting circuit 24. EX1006, [Solution]. Additionally, Ono's lighting circuit 24 provides an example of installing capacitors, resistors, and other electronic components on a circuit board at the end of a LED lamp tube. *Id*., [0017]. Specifically, Ono describes a circuit board 39 with electronic components such as capacitors and inductors mounted on one surface, and resistors and switches mounted on another surface. EX1006, [0017]; EX1003, ¶¶42, 101. Ono teaches that circuit board 39 with lighting circuit 24 is mounted flush with board 34 with light emitting element 33. EX1006, [0017], [0016], FIG. 1. A cap 21a is then disposed at the end of the tube 20 (EX1006, [0017]), and a non-combustible cover 26a disposed over cap 21a and an end portion of tube 20 (*id.*, [0019], FIG. 1). EX1003, ¶101.

However, Ono omits details regarding connecting lighting circuit 24 and light source unit 23. EX1003, ¶102. To understand how to connect Ono's lighting circuit at the end of light source unit 23 within the LED tube, a POSITA would have been motivated to look elsewhere for the details Ono omits. EX1003, ¶¶102-103, 106-107; *see* §VII.B. Holec provides this detail in disclosing how to manufacture flexible circuit boards for an LED lamp and connect circuit boards directly together. EX1009, Abstract, 1:19-26. Specifically, Holec describes that two boards can be directly joined together in an "overlapping fashion." *Id*., 3:15-24, 6:30-41, 7:54-61, 8:50-9:28, 11:1-22, 12:52-59, Cl. 1; *see also* §VII.B.

Improved Mechanical Strength and Integrity of Electrical Connection. A POSITA would have been motivated to implement Holec's flexible circuit boards and direct connection to a power supply circuit board, to improve mechanical strength and integrity of electrical connections therebetween. Holec itself teaches using flexible circuit boards to allow the board to "conform to normal variations of board thickness, solder height, and mechanical mounting height differences" and improve assembly and "mechanical strength and integrity of the electrical connection." EX1009, 11:52-60; 2:28-43; EX1003, ¶102.

Obvious to Try. A POSITA would have found it obvious to try implementing Holec's flexible circuit board and circuit board joining techniques to join Ono's lighting circuit and light source unit. EX1003, ¶106. Ono teaches that "[t]he lighting

circuit 24 has a circuit board 39 on which a plurality of electronic components 38 have been mounted." EX1006, [0017]. And separately "[t]he light source unit 23 includes ... a board 34 with a mounting surface on which the plurality of light emitting elements 33 have been mounted." *Id*., [0016]. Holec discloses a soldering method for joining two circuit boards. EX1009, Abstract. A POSITA would have recognized a design need for attaching Ono's lighting circuit to the light source unit—that was not described in Ono—and would have looked to Holec's joining method for at least one flexible circuit board that also taught joining circuit boards in an LED lamp. EX1003, ¶106. In doing so, a POSITA would have expected this implementation to be successful and yield predicable results based on the stability of the technology and straight-forward implementation of the technology in Holec. *Id*.

Simplified Manufacturing. A POSITA would have been motivated to implement Holec's manufacturing techniques to understand how to join the Ono lighting circuit board to the light source unit to ensure that electricity from the lighting circuit was supplied to the LEDs on the light strip. EX1003, ¶107. Ono describes a lighting circuit at the end of an LED light strip, but does not describe how the lighting circuit and LED light strip are connected to one another. Therefore, a POSITA would have been motivated to look to other references that teach how to connect circuits. EX1003, ¶¶102-103, 106-107. Holec describes joining two circuit

boards together by soldering together conductive pads on each board. EX1009, Abstract, 8:50-9:14, 9:47-55. Holec describes that using the disclosed manufacturing techniques that "reduce manufacturing, installation, and assembly costs." EX1009, 2:48-50. Thus, a POSITA would have been motivated to use Holec's manufacturing process to improve manufacturing efficiency and reliability, a goal of Ono. EX1006, [0030-0031], [0046]; EX1009. 1:42-44, 1:62-64, 2:28-50, 11:55-65, 12:20-30; EX1003, ¶107; *see also* §VII.B.

Expectation of Success. A POSITA would have reasonably expected success in implementing Holec's flexible circuit board and circuit board joining techniques to join Ono's lighting circuit and light source unit. EX1003, ¶106. First, Holec successfully implements its joining technique in an identical application, *i.e.*, "flexible lighting circuit boards and more directly towards ***flexible [e.g., bendable] LED circuit boards***." EX1009, 6:43-47. A POSITA would have understood that Holec's joining technique readily be incorporated into Ono's LED lamp. EX1003, ¶106; *see also* §VII.B. The technology for circuit board joining techniques was well developed, and such an installation would have been a straight-forward implementation of known technology. EX1003, ¶106. As such, a POSITA would have reasonably expected to be successful in making the combination. EX1003, ¶106-107; *see also* §VII.B.

5. Motivation to Combine Ono-Holec with Leong

Ono also teaches the use of a heat dissipator with the light source unit 23 to mitigate heat related damage. EX1006, [0016]. Ono also recognizes that the lighting circuit 24 disposed at the end of the lamp tube can "experience excessive heat" that results in "heat damage." *Id*., [0027], [0031], [0042]. While Ono recognizes the negative effects of heating in an LED lamp, it only discloses methods of dispersing the heat throughout the glass tube and mitigating heat damage on the exterior of the glass tube. *Id*., [0016], [0027], [0031], [0042]; EX1003, ¶104. A POSITA would have recognized that while dispersing heat within the glass tube and mitigating exterior damage are useful, there are additional advantages to dissipating heat out of ends of the lamp tube. EX1003, ¶105. Therefore, a POSITA would have been motivated to look elsewhere for a solution that describes dissipating heat out of the LED lamp. EX1003, ¶105. Leong provides a solution for cooling the interior of an LED lamp by dissipating heat to the outside environment using vent holes in end caps. EX1010, 7:67-8:4, 8:54-58, 9:58-62; EX1003, ¶105.

Improved Cooling and Airflow. A POSITA would have been motivated to include Leong's holes in Ono's end caps to improve cooling and airflow as disclosed by Leong itself (EX1010, 7:67-8:4, 8:54-58, 9:58-62). Doing so would have directly benefited Ono's recognized concerns with dispersing heat to mitigate damage to the tube. *See, e.g.*, EX1006, [0016], [0027], [0031], [0042]; EX1003, ¶¶105, 108.

Obvious to try. A POSITA would have found it obvious to try implementing Leong's end cap openings with Ono's LED lamp because there were a finite number of identified, predictable solutions a POSITA would have pursued. EX1003, ¶108. For example, Ono teaches the use of a heat dissipator interposed between the light source unit 23 and the inner surface of the glass tube to mitigate heat related damage. EX1006, [0016]. Leong likewise describes "[o]ptional support member 164, which may be made of a heat conducting material, can operate as a heat sink to draw heat away from LED circuit board 152 ... to the center of elongated housing 142 and thereby dissipating the heat at the two ends 148A and 148B of tubular wall 144." EX1010, 31:26-36. The heat is then vented through the "[t]wo cylindrical parallel vent holes 224A and 224B" in the end walls of Leong's end caps. *Id*., 40:41-43. A POSITA would have recognized a design need for implementing Ono's heat dissipator to channel heat away from the LEDs and would have looked to Leong's end cap openings to dissipate the heat out of the lamp. EX1003, ¶108; *see also* §VII.C. In doing so, a POSITA would have expected this implementation to be successful and yield predicable results based on the stability of the technology and straight-forward implementation of the technology in Leong. EX1003, ¶108.

Improved Safety. A POSITA would further have been motivated to use Leong's openings in the end caps to implement Ono's teaching of improved safety

and minimized damage through heat dissipation. EX1006, [0031], [0042]; EX1010, 7:61-8:4, 8:50-58, 9:58-62; EX1003, ¶109.

Cost-effective Improvement. A POSITA would have been motivated to implement Leong's openings in the end caps in Ono's lamp to not increase the cost of Ono's lamp while improving heat dissipation properties of Ono's lamp. EX1003, ¶110. Ono describes that an objective of its invention is to reduce heat damage. EX1006, [0016], [0027], [0031], [0042]. A POSITA would have understood that adding openings to the Ono end caps, as taught in Leong, would have not had any material impact on the cost of the Ono LED lamp. Therefore, a POSITA would have been motivated to implement Leong's known end cap openings to improve air flow and heat dissipation in the LED lamp without increasing the cost of the lamp. EX1010, 7:67-8:4, 8:54-58, 9:58-62; EX1003, ¶110.

Simple Substitution. A POSITA would have understood that the substitution of Leong's known end caps with openings to provide heat dissipation and air flow for Ono's end caps would have predictable results. EX1003, ¶111. As discussed above, Ono describes end caps at each end of a glass tube of an LED tube lamp and Leong also describes end caps 150A/150B at each end of a tubular wall (EX1010, 30:36-39, FIG. 12). EX1003, ¶111. Because both Ono's end caps and Leong's end caps serve the same function of providing conductive pins to allow the LED lamps to be installed in a light fixture, a POSITA would have understood that Leong's

teachings of openings in an end cap could be used to facilitate Ono's heat dissipation mechanism. EX1003, ¶111.

Expectation of Success. A POSITA would have reasonably expected success in implementing Leong's end cap openings in the end caps of Ono's LED lamp. EX1003, ¶112. First, Leong successfully implements its own end cap configuration in an identical application, *i.e.*, an LED lamp bulb for replacement of a conventional fluorescent bulb. EX1010, FIGS. 11, 12, 19, 19A. Ultimately, a POSITA would have understood that Leong's end cap openings could readily be incorporated into Ono's LED lamp. EX1003, ¶112; *see also* §VII.C. The technology for end caps on a tubular LED lamp was well developed, and such an installation would have been a straight-forward implementation of known technology. EX1003, ¶112. As such, a POSITA would have reasonably expected to be successful in making the combination. EX1003, ¶112; *see also* §VII.C.

6. Modification of Ono with Holec and Leong

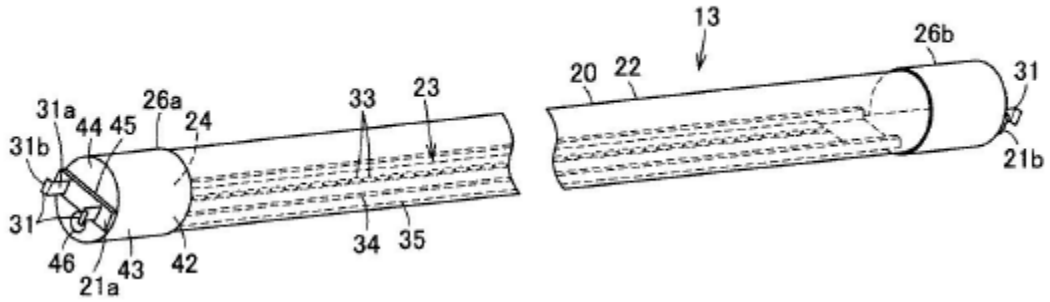
The Ono-Holec-Leong LED lamp includes Ono's LED lamp with the lighting circuit 34 connected with light source unit 23 using the flexible circuit board and overlapping joining method of Holec, with Leong's openings in the end caps. EX1003, ¶113.

7. Element-by-Element Analysis

(a) *Limitation 19[p]*

Ono-Holec-Leong renders obvious an LED tube lamp. EX1003, ¶114. Ono discloses a "straight tube lamp 13 includes a light source unit 23 having light emitting elements 33, a lighting circuit 24 for lighting the light emitting elements 33, and a lamp unit 22 housing the light source unit 23 and the lighting circuit 24." EX1006, [Solution].

[Fig. 2]

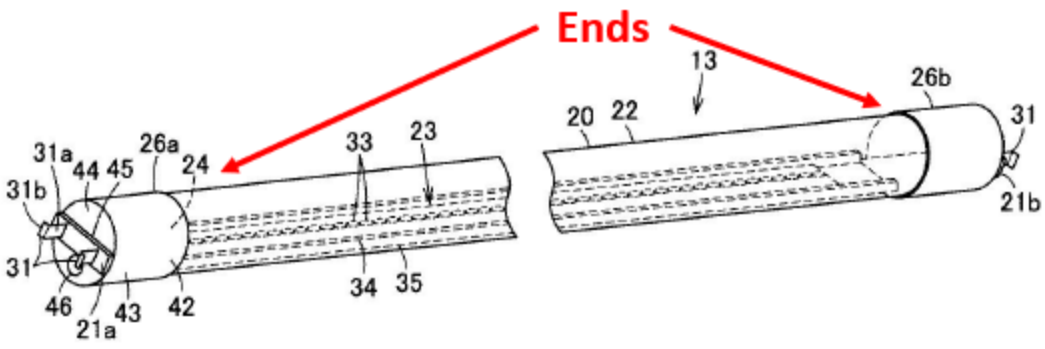


Id., FIG. 2.

(b) *Limitation 19[a]*

Ono-Holec-Leong renders obvious a glass tube having two end portions. EX1003, ¶115. Ono teaches that "[t]he lamp unit 22 includes a straight tube 20 that is at least partially translucent, and a cap 21a disposed on one end of the tube 20." EX1006, [Solution]. The straight tube 20 may be made of "glass or a ceramic." *Id*., [0032].

[Fig. 2]

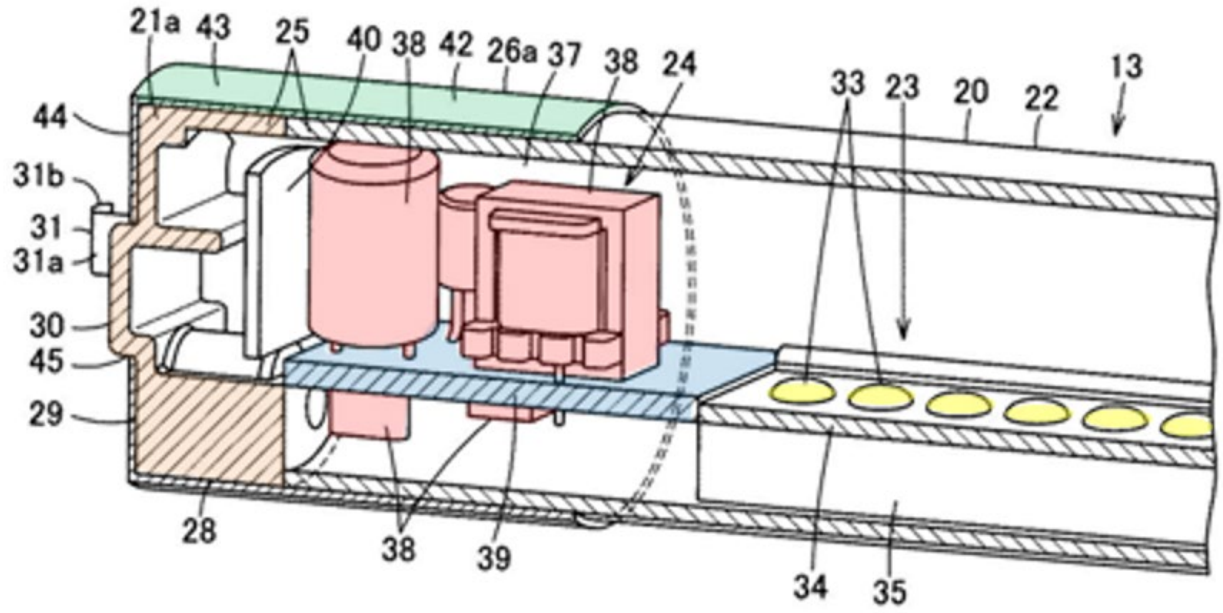


Id., FIG. 2.

(c) *Limitation 19[b]*

Ono-Holec-Leong renders obvious a plurality of LED light sources. EX1003, ¶116. Ono discloses a "light source unit 23 includes a plurality of [yellow] light emitting elements 33 such as LED elements or EL elements, a board 34 with a mounting surface on which the plurality of light emitting elements 33 have been mounted,." EX1006, [0016].

[Fig. 1]



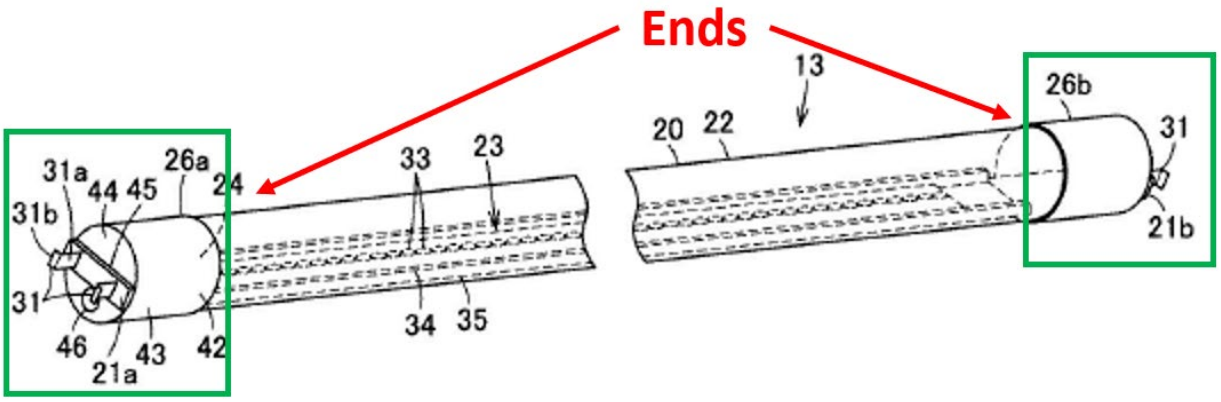
Id., FIG. 1.

(d) *Limitation 19[c]*

Ono-Holec-Leong renders obvious two end caps respectively sleeving the two end portions of the glass tube, each of the end caps comprising two pins and a plurality of openings, the two pins being on a surface of the end cap, the plurality of openings being on the surface of the end cap and divided into two sets, and the two sets of the openings being symmetric to each other with respect to a plane passing through the two pins. EX1003, ¶¶117-121.

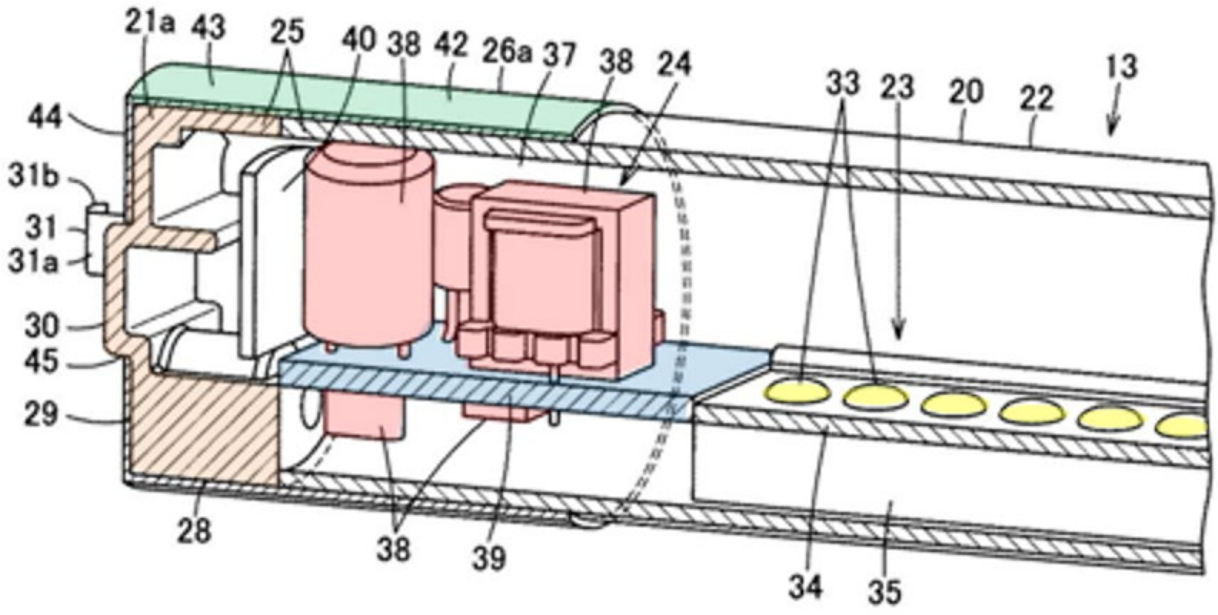
First, Ono teaches two end caps ([green] non-combustible covers/caps 26a, 26b with caps 21a/21b) sleeving the ends of the glass tube (straight tube 20).

[Fig. 2]



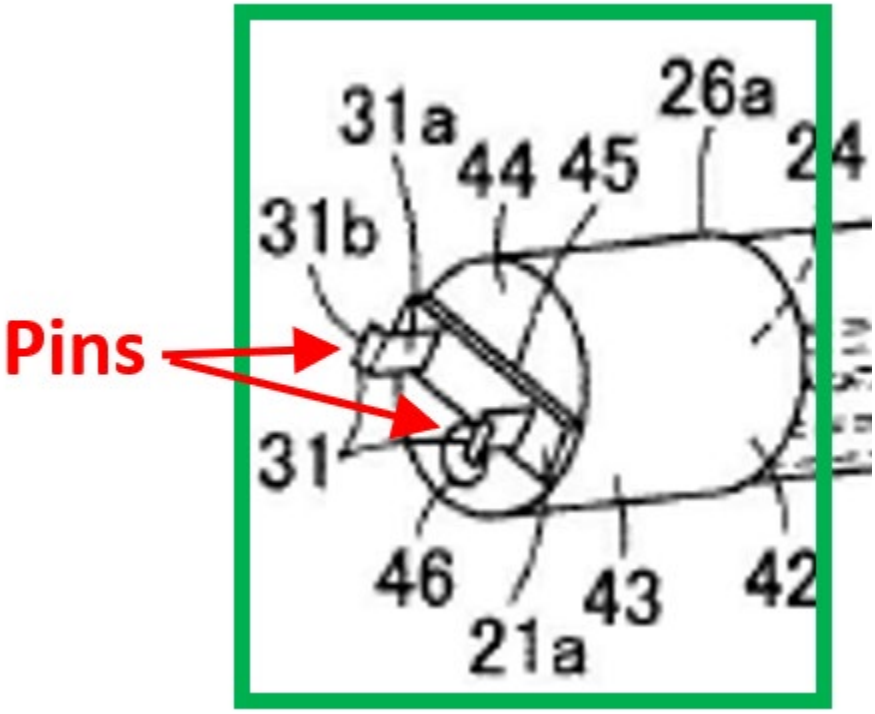
EX1006, FIG. 2. Ono's "lighting circuit 24 is covered with an insulator 25, and the lighting circuit 24 is covered with a [green] non-combustible cover 26a via the insulator 25." *Id.*, [Solution].

[Fig. 1]



Id., FIG. 1.

Ono further teaches that "a pair of terminals 31 protrude in parallel from the caps 21a, 21b at both ends," and are thus on the surface of the end wall of the end cap as shown in excerpted FIG. 2 below. EX1006, [0020].



EX1006, FIG. 2; EX1003, ¶119. Alternatively, Leong discloses bi-pin electrical contacts 138A and 140A on the surface of the end wall of the end cap as shown in FIGS. 19 and 19A below. EX1010, 40:30-41:25, FIGS. 19, 19A.

Leong discloses that its end caps 150A, 150B include two vent holes 224A, 224B (two sets[5]) that are symmetric to each other with respect with the center line 146 of the end caps. EX1010, 40:41-43. As explained above, Leong's vent holes

[5] A set does not itself require multiple openings, *e.g.*, a unitary set.

224A, 224B are incorporated into the Ono's end cap. §IX.A.6. As shown in the figure below, the vent holes 224A, 224B are symmetric to each other with respect to the plane passing through the middle of a line connecting the two pins.

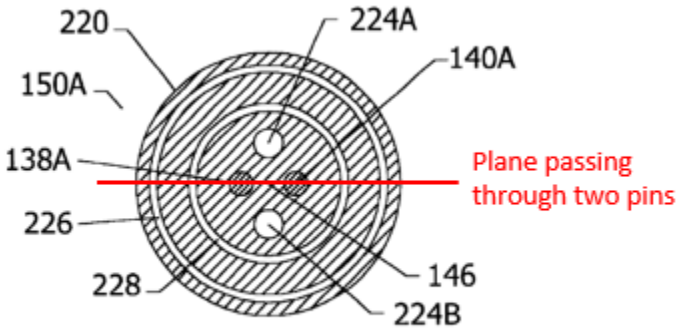


FIG. 19A

EX1010, FIG. 19A; EX1003, ¶120.

The vent holes 224A, 224B are also on the surface of the end caps. The vent holes 224A, 224B "are defined between end walls 222A and 222B." EX1010, 40:41-43. As shown in FIG. 19A above and FIG. 19 below, end walls 222A and 222B are the surfaces of the end wall of the end cap. Therefore, the vent holes 224A, 224B are on the surface of the end wall. EX1003, ¶121. This is the same end wall that includes the conductive pins. EX1003, ¶121.

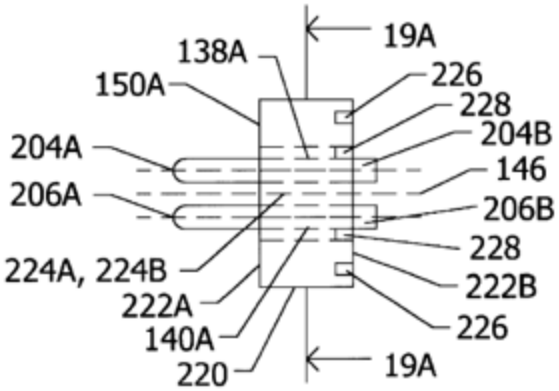


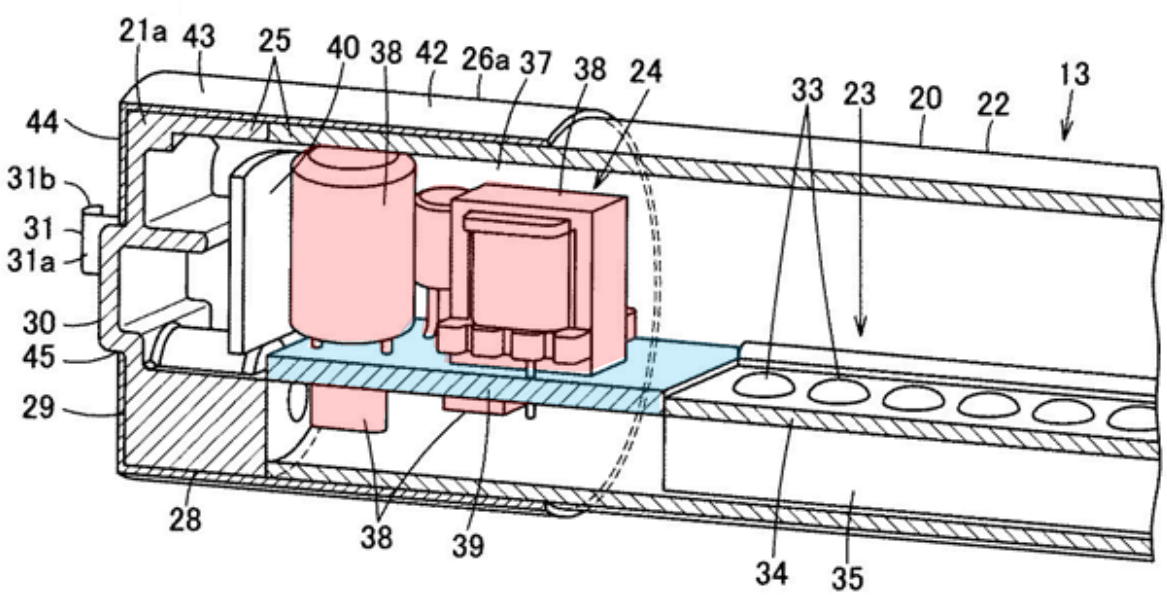
FIG. 19

EX1010, FIG. 19; EX1003, ¶121. Moreover, as discussed in §VII.C, heat dissipation methods using vent holes in end caps was well-known.

(e) *Limitation 19[d]*

Ono-Holec-Leong renders obvious a power supply disposed in at least one of the end caps. EX1003, ¶¶122-123. Ono describes "a lighting circuit 24 for lighting the light emitting elements 33." EX1006, [Solution].

[Fig. 1]



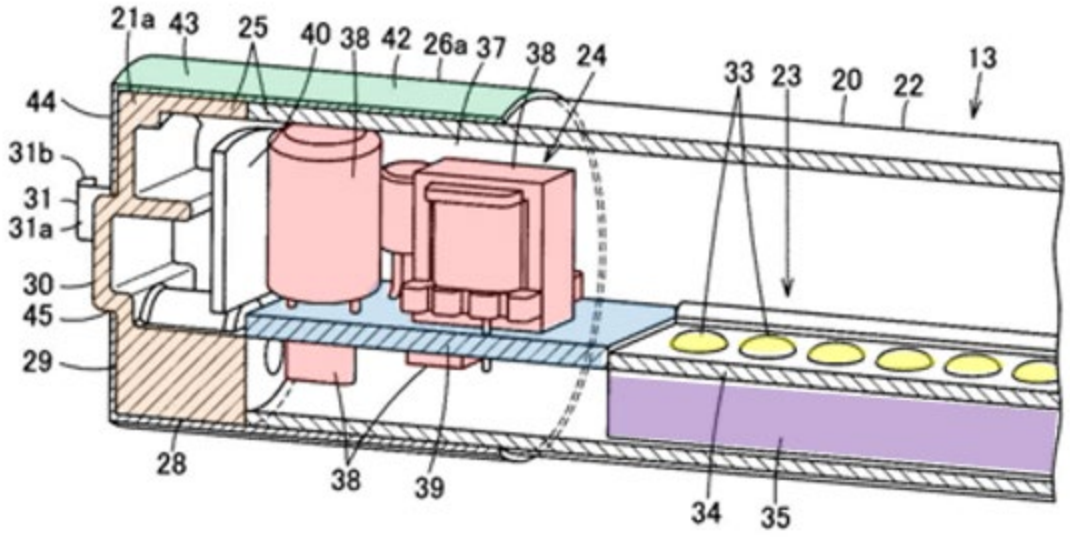
EX1006, FIG. 1; EX1003, ¶¶122-123.

Ono's lighting circuit "is housed inside the tube 20 on one end in a lighting circuit housing portion 37 between the light source unit 23 housed inside the tube 20 and the cap 21a attached to one end of the tube 20." EX1006, [0017]. "The lighting circuit 24 has a [blue] circuit board 39 on which a plurality of [red] electronic components 38 have been mounted." *Id.* Specifically, "[l]ead components such as capacitors and inductors are mounted on the mounting surface of the circuit board 39, and surface mounted components such as resistors and switching elements are mounted on the wiring pattern surface." *Id*.

(f) *Limitation 19[e]*

Ono-Holec-Leong renders obvious an LED light strip on an inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED light sources being on the LED light strip. EX1003, ¶¶124-127. Inside Ono's glass tube 20 is a "[l]ight source unit 23 [that] includes a plurality of [yellow] light emitting elements 33 such as LED elements or EL elements, a board 34 with a mounting surface on which the plurality of [yellow] light emitting elements 33 have been mounted." EX1006, [0016]. The light source unit 23 on an inner surface of glass tube 20 via "[purple] heat dissipator 35 bonded to the opposite side of the board 34 from the mounting surface." *Id*.

[Fig. 1]



Id., FIG. 1.

The light source unit 23 and lighting circuit 24 are connected using Holec's circuit board connection method. Holec describes overlapping circuit boards to provide an interconnection. EX1009, 8:52-9:8. This allows a direct connection between two circuit boards. *Id*. In Holec, a [red] top board 6 or 13 includes conductive pads and a [green] bottom board 5 or 39 includes conductive pads. *Id*., 8:50-9:8, 12:52-59, FIGS. 8, 11a, 11b, 12, 13a, 13b. The conductive pads are soldered directly to one another with overlapping joints 26 with one board having a vertical step offset 41 at is freely extending end. *Id*., 9:26-28, 12:52-59; EX1003, ¶125. In this way, the top board and bottom board are electrically connected. EX1009, 8:52-9:8, 12:52-59, cl. 1, 2.

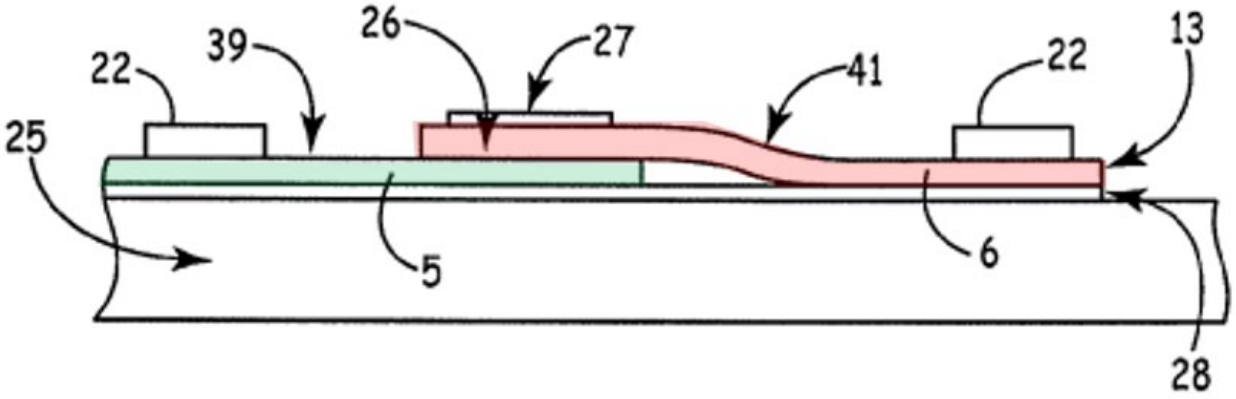


FIG. 8

Id., FIG. 8; EX1003, ¶125.

Holec additionally teaches the use of flexible circuit boards, such as "flexible LED circuit boards," that include a freely extending end portion, shown in the purple box below, that would connect in an overlapping joint to Ono's lighting circuit 24. EX1009, 6:43-47, 1:19-26, 7:1-6, 11:23-65, Cl. 2; EX1003, ¶126.

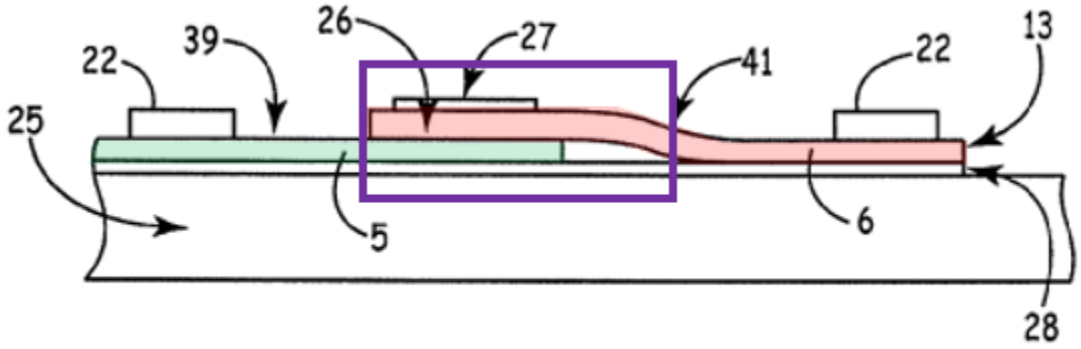


FIG. 8

EX1009, FIG. 8.

In the Ono-Holec-Leong combination, both the board 34 of the light source unit 23 and board 39 of the lighting circuit 24 include at least two conductive pads, as described in Holec and shown in FIGS. 11a, 11b, 12, 13a, and 13b below in green.

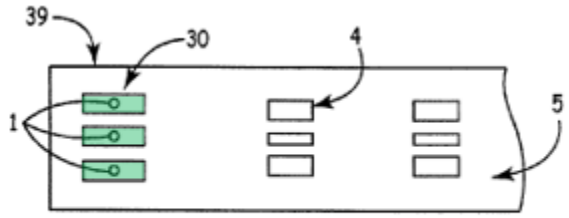


FIG. 11a

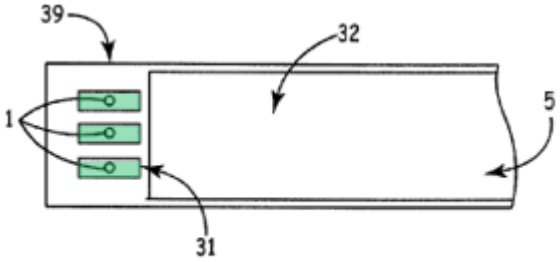


FIG. 11b

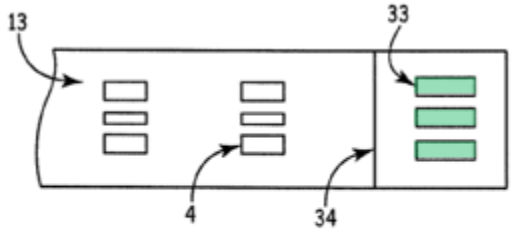


FIG. 12

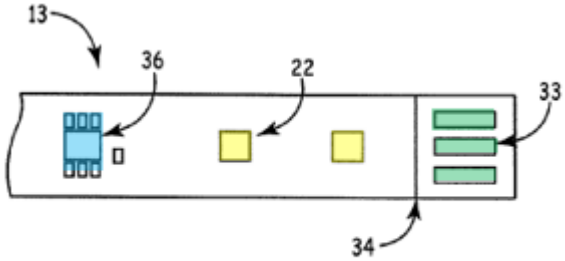


FIG. 13a

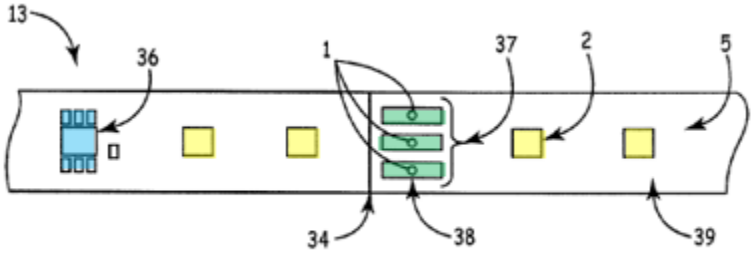


FIG. 13b

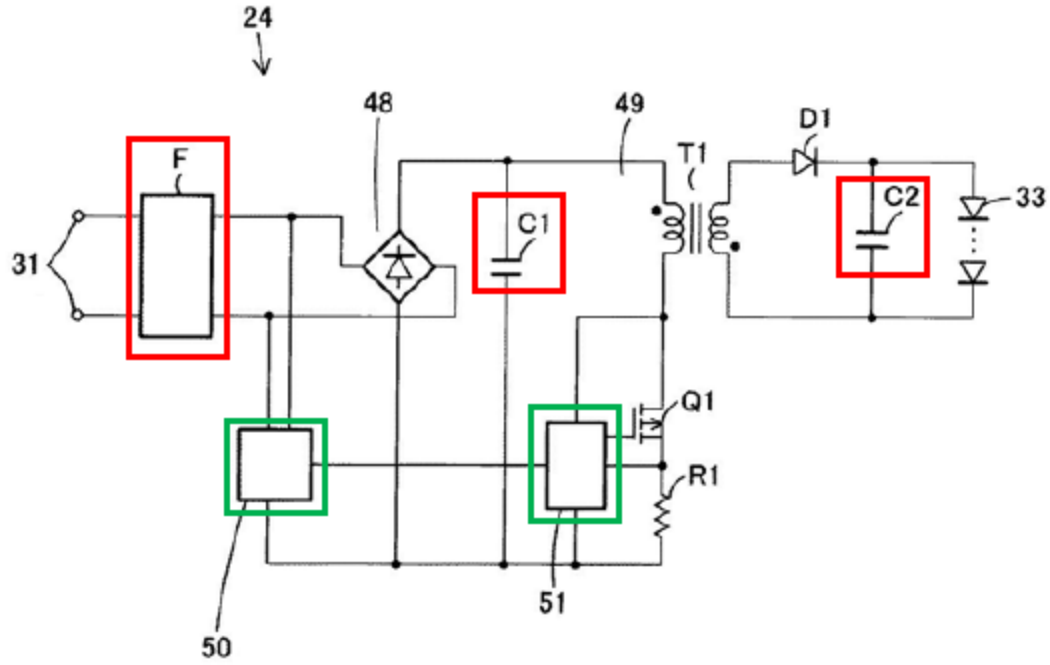
EX1009, 1a, 11b, 12, 13a, and 13b; EX1003, ¶127. Solder is used to couple the conductive pads on each board such that the LED light strip and power supply circuit board are electrically connected. EX1009, 8:50-9:14, 9:47-55; EX1003, ¶127.

Moreover, as discussed in §VII.B, bendable circuit sheets (that would have a freely extending end) used for mounting LEDs and directly soldered to other devices, such as a power supply board, was well-known.

(g) *Claim 20*

Ono-Holec-Leong renders obvious an power supply that includes a current limiting elements and the openings dissipate heat from the power supply. EX1003, ¶¶128-129. As shown in FIG. 3 below, Ono teaches its lighting circuit 24 includes a [red] noise filter F, [red] smoothing capacitor C1, and/or [red] electrolytic capacitor C2 that limit current. EX1006, [0021]; EX1003, ¶128. Further, [green] detecting means 50 and control means 51 detect the type of current provided and ***does not operate*** the lighting means 49 if the power is direct current power or "if the frequency is not that of the commercial alternating current power supply" and thus, also ***limit*** current. EX1006, [0022], [0023]; EX1003, ¶128.

[Fig. 3]



48: Rectifying means
49: Lighting means
50: Power supply type detecting means or frequency detecting means
51: Control means

Additionally, Leong discloses that its end caps 150A, 150B include two vent holes 224A, 224B that operate to "dissipate[e] the heat at the two lamp base ends." EX1010, 7:61-8:4, 8:50-58, 9:58-62, 7:16-19, 20:19-24, 26:25-30. Heat is drawn away "from LED circuit board 152 ***including the circuitry for LED array 158*** to the center of elongated housing 142 and thereby dissipating the heat at the two ends 148A and 148B of tubular wall 144." EX1010, 31:26-36, *see also id.*, 7:16-19 ("Desirably, the two base end caps of the retrofitting LED lamp have apertures therein to allow air to pass through into and out from the interior of the main outer tubular housing and integral electronic circuitry."), 46:26-27, 46:42-44, 50:14-16,

52:32-35, 52:49-51. A POSITA would understand that Leong's "circuitry for LED array 158" would include a power supply such as Ono's lighting circuit 24 disposed in the end cap near the vent holes 224a/224b of Leong. EX1003, ¶129.

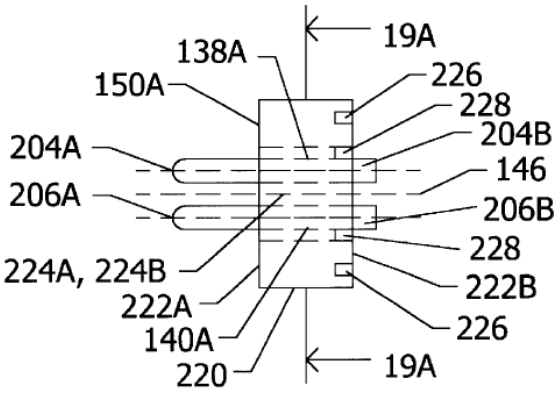


FIG. 19

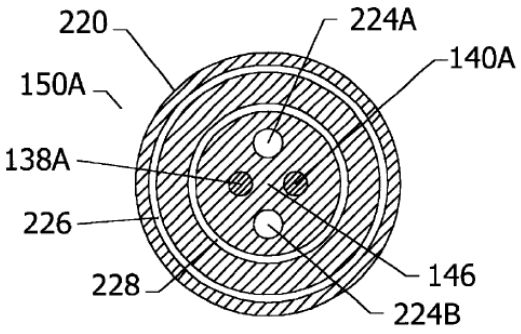


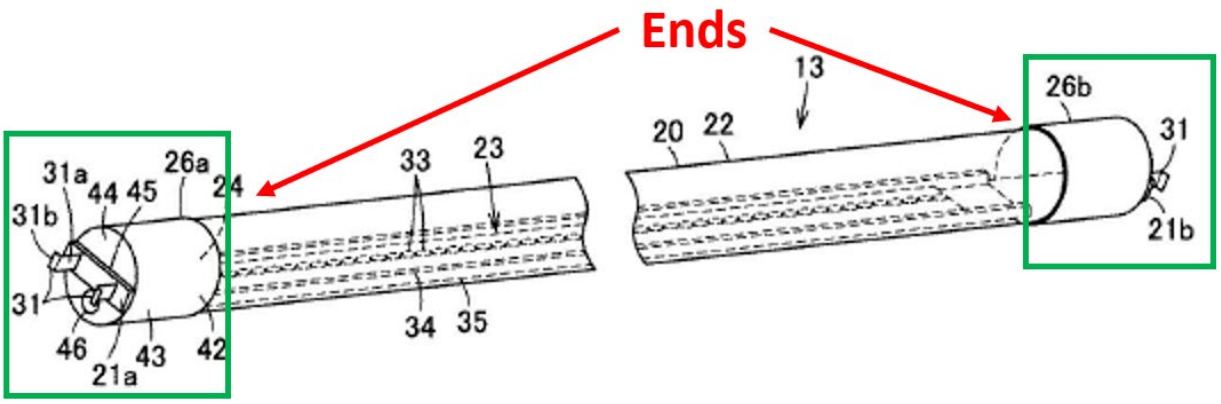
FIG. 19A

EX1010, FIGS. 19, 19A; EX1003, ¶129.

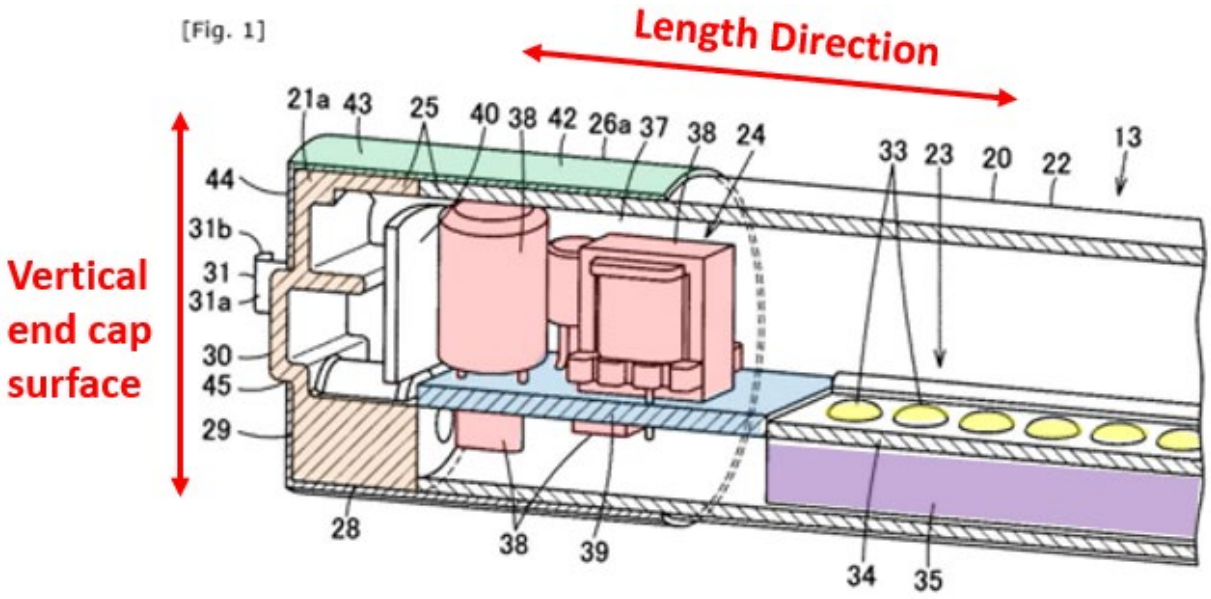
(h) ***Claim 22***

Ono-Holec-Leong renders obvious the surface of the end cap is vertical to the length direction of the glass tube. EX1003, ¶130. Ono teaches non-combustible covers 26a/26b disposed over caps 21a/21b that have surface that is vertical to length of glass tube 20.

[Fig. 2]



[Fig. 1]



EX1006, FIGS. 1, 2; EX1003, ¶130.

(i) *Claim 25*

Ono-Holec-Leong renders obvious multiple openings in the shape of a circle. EX1003, ¶131. Leong discloses that its end caps 150A, 150B include two vent holes 224A, 224B that are "cylindrical"/circular in shape as shown in FIGS. 19 and 19A below.

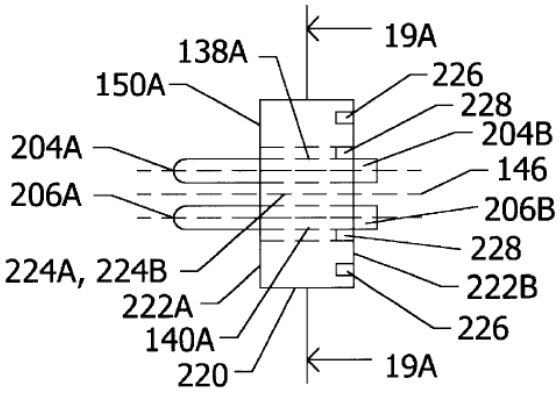


FIG. 19

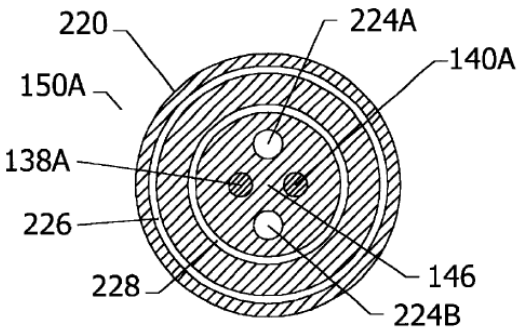


FIG. 19A

EX1010, 40:30-41:15, FIGS. 19, 19A; EX1003, ¶131.

(j) *Claim 28*

Ono-Holec-Leong renders obvious an LED tube lamp where the openings are arranged along an arc and spaced apart from each other. EX1003, ¶132. Leong discloses that its end caps 150A, 150B include two vent holes 224A, 224B in vertical alignment with the center line 146 of the end caps. EX1010, 40:41-43. As explained above, Leong's vent holes 224A, 224B are incorporated into the Ono's end cap. Section IX.A.6. As shown in FIG. 19A below, the vent holes 224A, 224B are arranged along an arc and are spaced apart from each other:

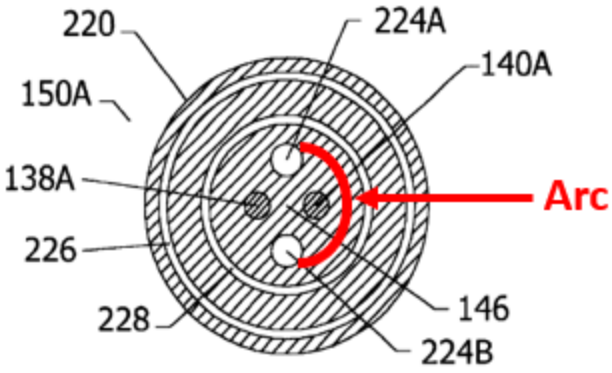


FIG. 19A

EX1010, FIG. 19A; EX1003, ¶132.

(k) ***Limitation 29[p]***

Ono-Holec-Leong renders obvious an LED tube lamp. EX1003, ¶133; §IX.A.7(a) (limitation 19[p]).

(l) ***Limitation 29[a]***

Ono-Holec-Leong renders obvious a glass tube. EX1003, ¶134; §IX.A.7(b) (limitation 19[a]).

(m) ***Limitation 29[b]***

Ono-Holec-Leong renders obvious a plurality of LED light sources. EX1003, ¶135; §IX.A.7(c) (limitation 19[b]).

(n) ***Limitation 29[c]***

Ono-Holec-Leong renders obvious two end caps respectively at two opposite ends of the glass tube. EX1003, ¶136; §IX.A.7(d) (limitation 19[c]).

(o) ***Limitation 29[d]***

Ono-Holec-Leong renders obvious a power supply in one of the end caps or separately in both of the end caps. EX1003, ¶137; §IX.A.7(e) (limitation 19[d]).

(p) ***Limitation 29[e]***

Ono-Holec-Leong renders obvious an LED light strip on an inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED light sources being on the LED light strip. EX1003, ¶138; §IX.A.7(f) (limitation 19[e]).

(q) ***Limitation 29[f]***

Ono-Holec-Leong renders obvious each of the end caps including an end wall. EX1003, ¶139; §IX.A.7(d) (limitation 19[c]).

(r) ***Limitation 29[g]***

Ono-Holec-Leong renders obvious two pins on the end wall. EX1003, ¶140; §IX.A.7(d) (limitation 19[c]).

(s) ***Limitation 29[h]***

Ono-Holec-Leong renders obvious at least two openings on the end wall symmetric to each other with respect to a plane passing through the middle of a line connecting the two pins and perpendicular to the line connecting the two pins. EX1003, ¶141; §IX.A.7(d) (limitation 19[c]). Leong further discloses that its end caps 150A, 150B include at least two vent holes 224A, 224B that are symmetric to

each other with respect to a plane passing through the middle of a line connecting the two pins and perpendicular to the line connecting the two pins. EX1010, 40:41-43.

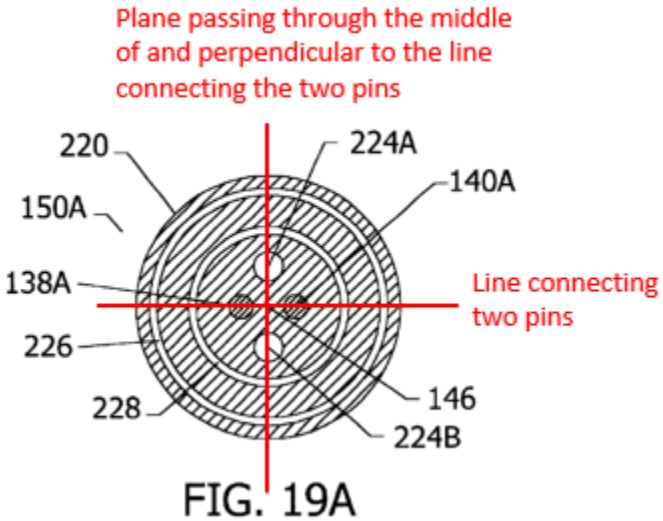


FIG. 19A

EX1010, FIG. 19A; EX1003, ¶141. As explained above, Leong's vent holes 224A, 224B are incorporated into the Ono's end cap. §IX.A.6.

(t) *Claim 35*

Ono-Holec-Leong renders obvious an LED light strip that is a bendable circuit sheet. EX1003, ¶142. Holec teaches that "the present invention is directed towards flexible lighting circuit boards and more directly towards ***flexible [e.g., bendable] LED circuit boards***." EX1009, 6:43-47, 1:19-26, 7:1-6, 11:23-65, Cl. 2.; EX1003, ¶142. Moreover, as discussed in §VII.B, bendable circuit sheets used for mounting LEDs were well-known.

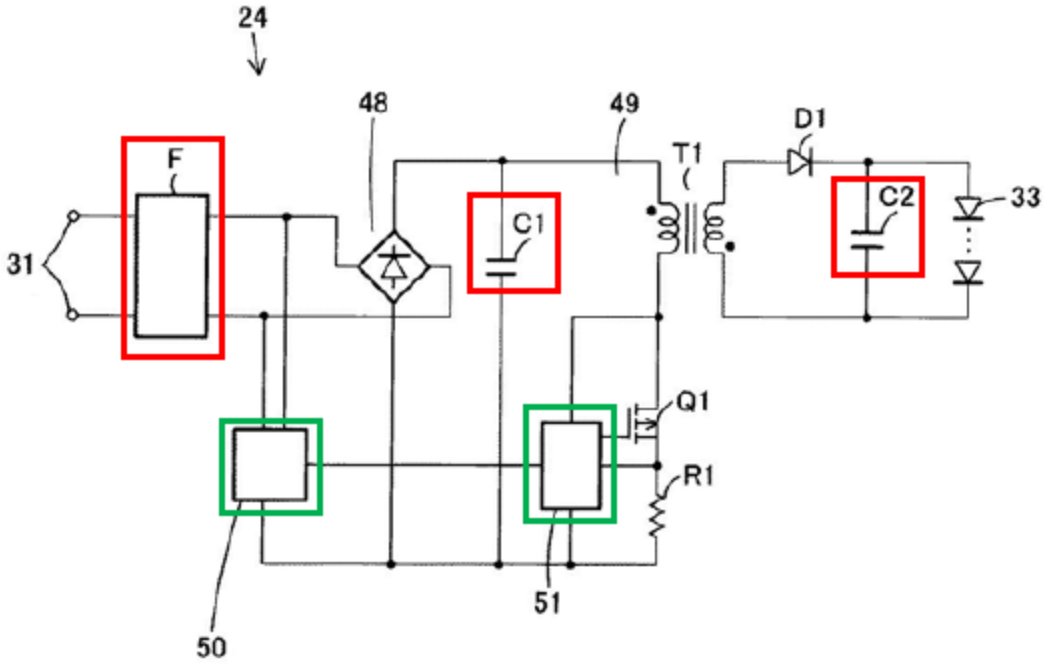
(u) *Claim 36*

Ono-Holec-Leong renders obvious an end cap that includes a metal part. EX1003, ¶143. Ono teaches that "non-combustible covers 26a, 26b are made of a metal material such as aluminum or a steel plate." EX1006, [0019], [0039], Cl. 5; EX1003, ¶143.

(v) *Claim 39*

Ono-Holec-Leong renders obvious a current-limiting element comprises a resistor, a capacitor, an inductor, or any combination thereof. EX1003, ¶146. As discussed in §IX.A.7(g) (claim 20) and shown in FIG. 3 below, Ono teaches its lighting circuit 24 includes a [red] smoothing capacitor C1 and/or [red] electrolytic capacitor C2 and/or resistor R1 that limit current. EX1006, [0021]; EX1003, ¶146. A capacitor or resistor limits current. EX1003, ¶146.

[Fig. 3]



48: Rectifying means
49: Lighting means
50: Power supply type detecting means or frequency detecting means
51: Control means

EX1006, FIG. 3; EX1003, ¶146.

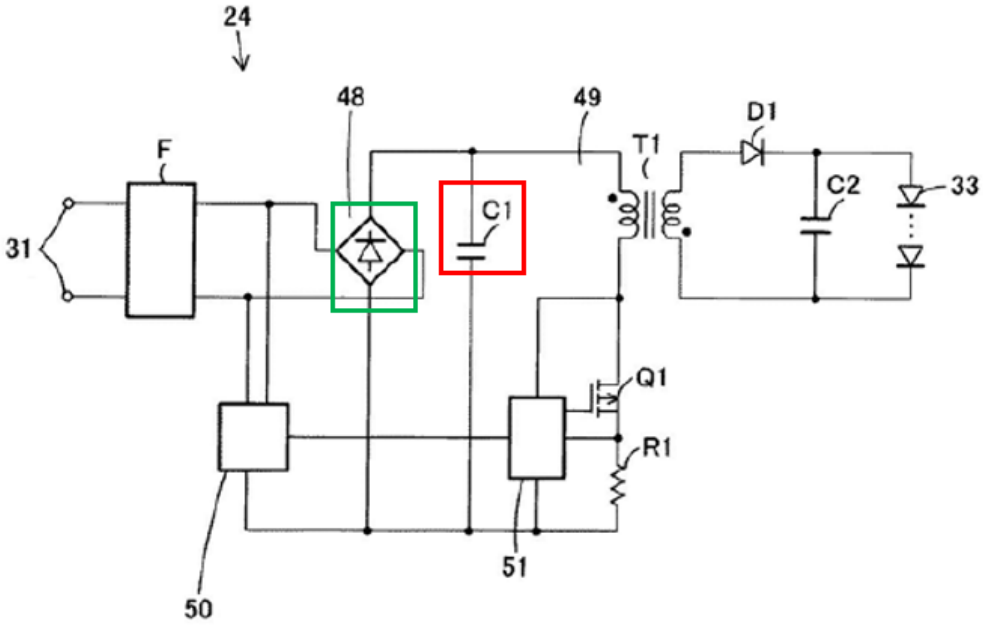
(w) *Claim 42*

Ono-Holec-Leong renders obvious a power supply with a rectifying circuit and a filtering circuit disposed in at least one of the end caps, and the plurality of openings are for dissipating heat from the power supply. EX1003, ¶¶147-148. As discussed in §IX.A.7(e) (limitation 19[d]), Ono teaches lighting circuit 24 is disposed in a cap 21a with non-combustible covers 26a. And as discussed in §IX.A.7(g) (claim 20), Leong's end caps 150A, 150B include two vent holes 224A, 224B that operate to "dissipate[e] the heat at the two lamp ends 148A and 148B"

including heat "from LED circuit board 152 ***including the circuitry for LED array 158***." EX1010, 31:26-36, 8:50-58.

Ono further teaches that lighting circuit 24 includes a rectifying circuit, as [green] rectifying means 48, and a filtering circuit, as [red] smoothing capacitor C1: "the input end of a rectifying means 48 is connected to the pair of terminals 31 in cap 21a via a noise filter circuit F, ***a smoothing capacitor C1*** is connected to the output end of the rectifying means 48, and a lighting means 49 is connected to the ***smoothing capacitor C1*** to convert the rectified and smoothed power supply voltage to a predetermined direct current output and supply the output to the light emitting elements 33." EX1006, [0021]. A POSITA would understand that smoothing capacitor C1 is a filtering circuit. EX1003, ¶148.

[Fig. 3]



48: Rectifying means
49: Lighting means
50: Power supply type detecting means or frequency detecting means
51: Control means

EX1006, FIG. 3; EX1003, ¶148.

(x) *Claim 49*

Ono-Holec-Leong renders obvious a power supply including a circuit board with two second bond pads. EX1003, ¶¶152-154. Ono's light source unit 23 and lighting circuit 24 are connected using Holec's circuit board connection method.

Holec describes overlapping circuit boards to provide an interconnection. EX1009, 8:50-9:8. This allows a direct connection between two circuit boards. *Id.*. In Holec, a [red] top board 6 or 13 includes conductive pads and a [green] bottom board 5 or 39 includes conductive pads. *Id.*, 8:50-9:8, 12:52-59, FIGS. 8, 11a, 11b,

12, 13a, 13b. The conductive pads are soldered directly to one another with overlapping joints 26. *Id*., 9:26-28, 12:52-59; EX1003, ¶153.

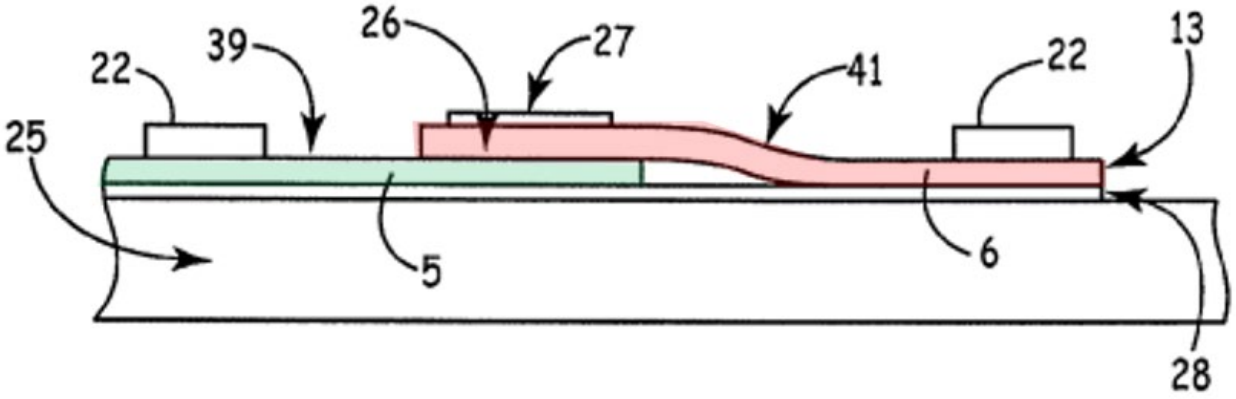


FIG. 8

Id., FIG. 8; EX1003, ¶153.

In the Ono-Holec-Leong combination, both the board 34 of the light source unit 23 and board 39 of the lighting circuit 24 include at least two conductive pads, as described in Holec and shown in FIGS. 11a, 11b, 12, 13a, and 13b below in green.

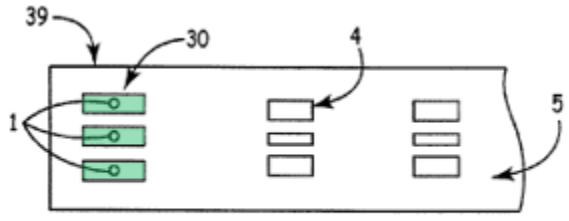


FIG. 11a

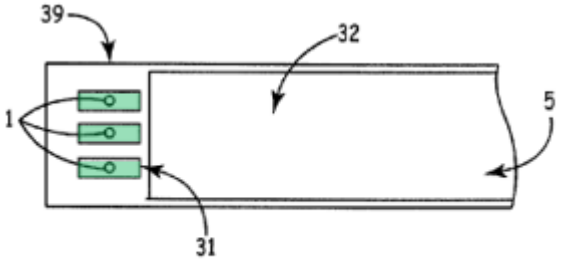


FIG. 11b

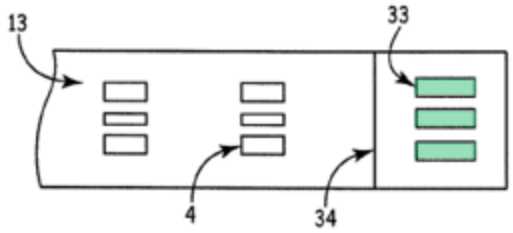


FIG. 12

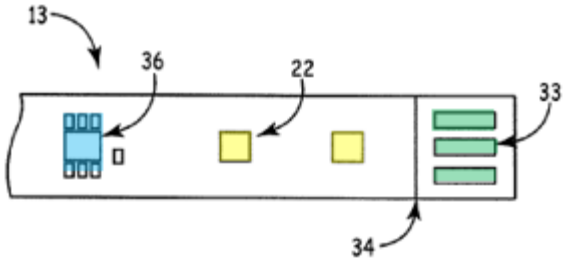


FIG. 13a

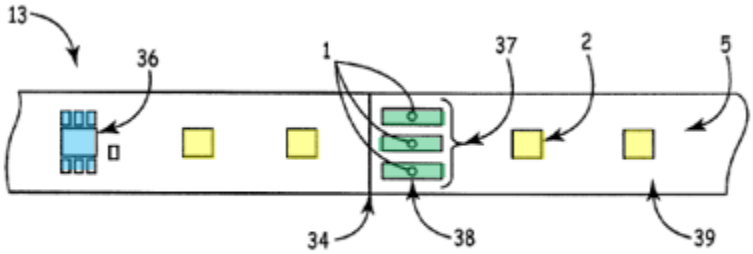


FIG. 13b

EX1009, 1a, 11b, 12, 13a, and 13b; EX1003, ¶154. Solder is used to couple the conductive pads on each board such that the LED light strip and power supply circuit board are electrically connected. EX1003, ¶154.

(y) *Claim 50*

Ono-Holec-Leong renders obvious that the power supply's second bond pads include a through-hole. EX1003, ¶155. As shown in FIGS. 11a, 11b, and 13b above, Holec teaches that "a plated through hole[s] 1" can be used to provide connection between the overlapping boards. EX1009, 8:50-67, Abstract, Cl. 1, 8; EX1003, ¶155.

(z) *Claim 54*

Ono-Holec-Leong renders obvious an LED light strip with two first bond pads at a first end. EX1003, ¶¶156-157; §IX.A.7(x) (claim 49). Ono's light source unit

23 and lighting circuit 24 are connected using Holec's circuit board connection method. Holec describes overlapping circuit boards to provide an interconnection. EX1009, 8:50-9:8. This allows a direct connection between two circuit boards. *Id*.. In Holec, a [red] top board 6 or 13 includes conductive pads and a [green] bottom board 5 or 39 includes conductive pads. *Id*., 8:50-9:8, 12:52-59, FIGS. 8, 11a, 11b, 12, 13a, 13b. The conductive pads are soldered directly to one another with overlapping joints 26. *Id*., 9:26-28, 12:52-59; EX1003, ¶156.

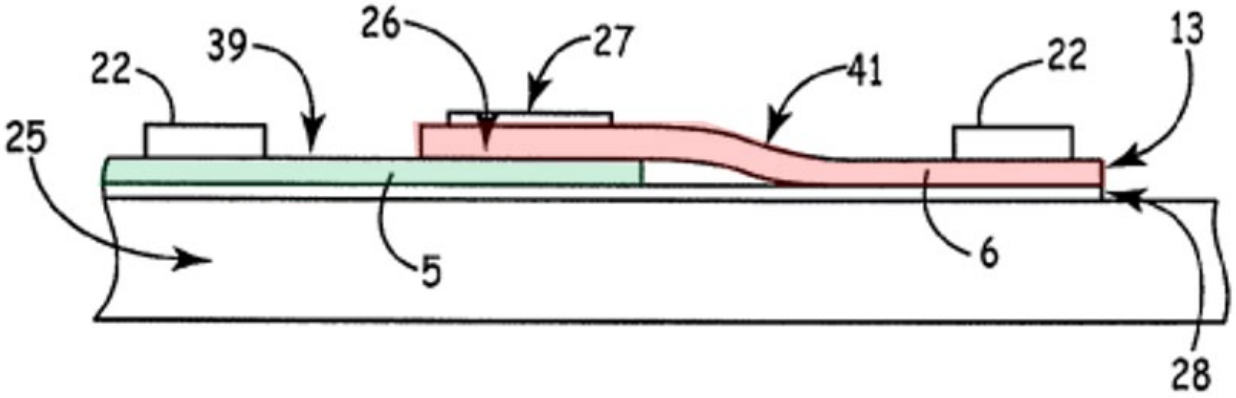


FIG. 8

Id., FIG. 8; EX1003, ¶156.

In the Ono-Holec-Leong combination, both the board 34 of the light source unit 23 and board 39 of the lighting circuit 24 include at least two conductive pads, as described in Holec and shown in FIGS. 11a, 11b, 12, 13a, and 13b below in green.

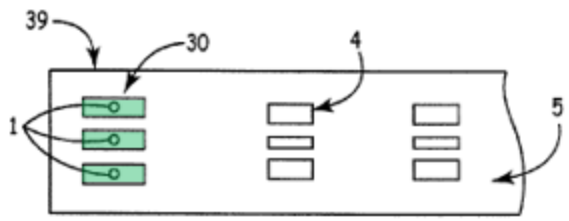


FIG. 11a

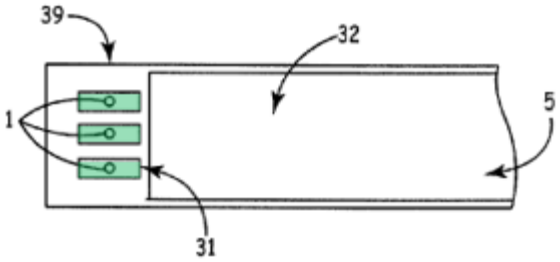


FIG. 11b

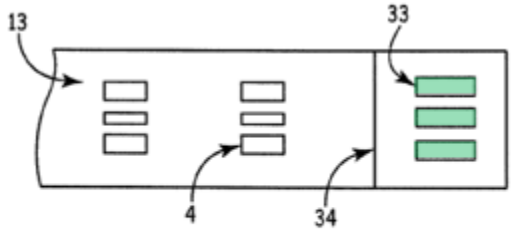


FIG. 12

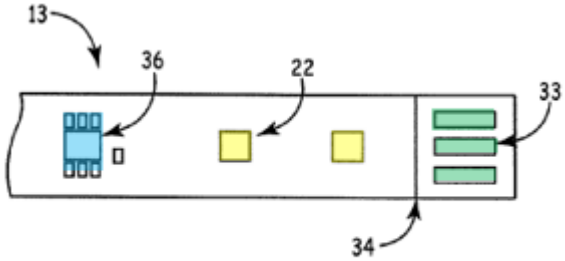


FIG. 13a

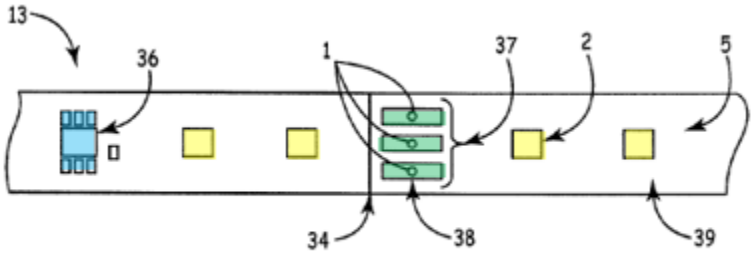


FIG. 13b

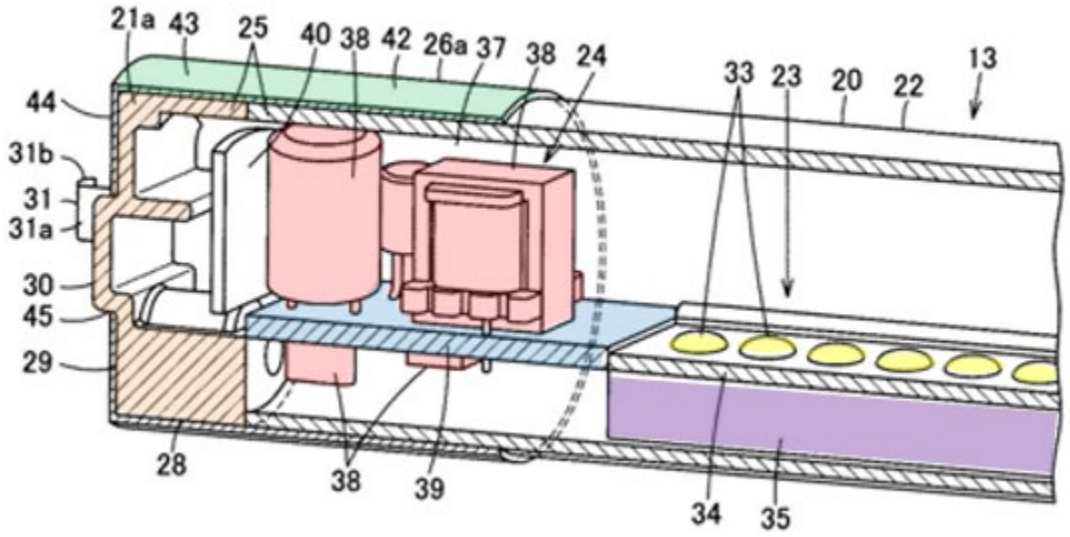
EX1009, 1a, 11b, 12, 13a, and 13b; EX1003, ¶157. Solder is used to couple the conductive pads on each board such that the LED light strip and power supply circuit board are electrically connected. EX1003, ¶157.

(aa) ***Claim 58***

Ono-Holec-Leong renders obvious that the power supply comprises a printed circuit board and the light bar comprises a bendable circuit sheet. EX1003, ¶¶158-159. Ono teaches that "[t]he lighting circuit 24 has a [blue] ***circuit board 39*** on

which a plurality of [red] electronic components 38 have been mounted." EX1006, [0017]. Specifically, "[l]ead components such as capacitors and inductors are mounted on the mounting surface of the circuit board 39, and surface mounted components such as resistors and switching elements are mounted on the wiring pattern surface." *Id*.

[Fig. 1]



Id., FIG. 1; EX1003, ¶158.

Holec further teaches that the use of bendable circuit sheets specifically for LED circuit boards: "the present invention is directed towards flexible lighting circuit boards and ***more directly towards flexible LED circuit boards***." EX1009, 6:43-47, 1:19-26, 7:1-6, 11:23-65, Cl. 2; EX1003, ¶159.

(bb) ***Claims 37, 38, 44, 45, 47, 59, 60, 64, and 68***

The limitations of claims 37, 38, 44, 45, 47, 59, 60, 64, and 68 are rendered obvious based on the following:

Claim/Limitation	Reference
37	*See* Claim 35, §IX.A.7(t); EX1003, ¶144
38	*See* Claim 36, §IX.A.7(u); EX1003, ¶145
44	*See* Claim 20, §IX.A.7(g); EX1003, ¶149
45	*See* Claim 39, §IX.A.7(v); EX1003, ¶150
47	*See* Claim 42, §IX.A.7(w); EX1003, ¶151
59	*See* Claim 49, §IX.A.7(x); EX1003, ¶160
60	*See* Claim 50, §IX.A.7(y); EX1003, ¶161
64	*See* Claim 54, §IX.A.7(z); EX1003, ¶162
68	*See* Claim 58, §IX.A.7(aa); EX1003, ¶163

B. Ground 2 - Claims 10-13, 16, 18, 33, and 34 are Obvious Over Ono-Holec-Leong and Further in View of Foo

1. Foo

Foo is titled "LED Light Tube For Use In Fluorescent Light Fixture." Foo discloses an "LED light tube 100 comprises a [blue] casing 10, a heat sink 20, [red] a circuit board 30, a [yellow] plurality of LED light sources 40, and two [orange] end caps 50." EX1007, 6:11-14. "The inner surface of the casing 10 may be constructed to have a surface roughness of smaller than 0.8μm to enhance the reflectance and reflux of the light." *Id*., 10:18-20.

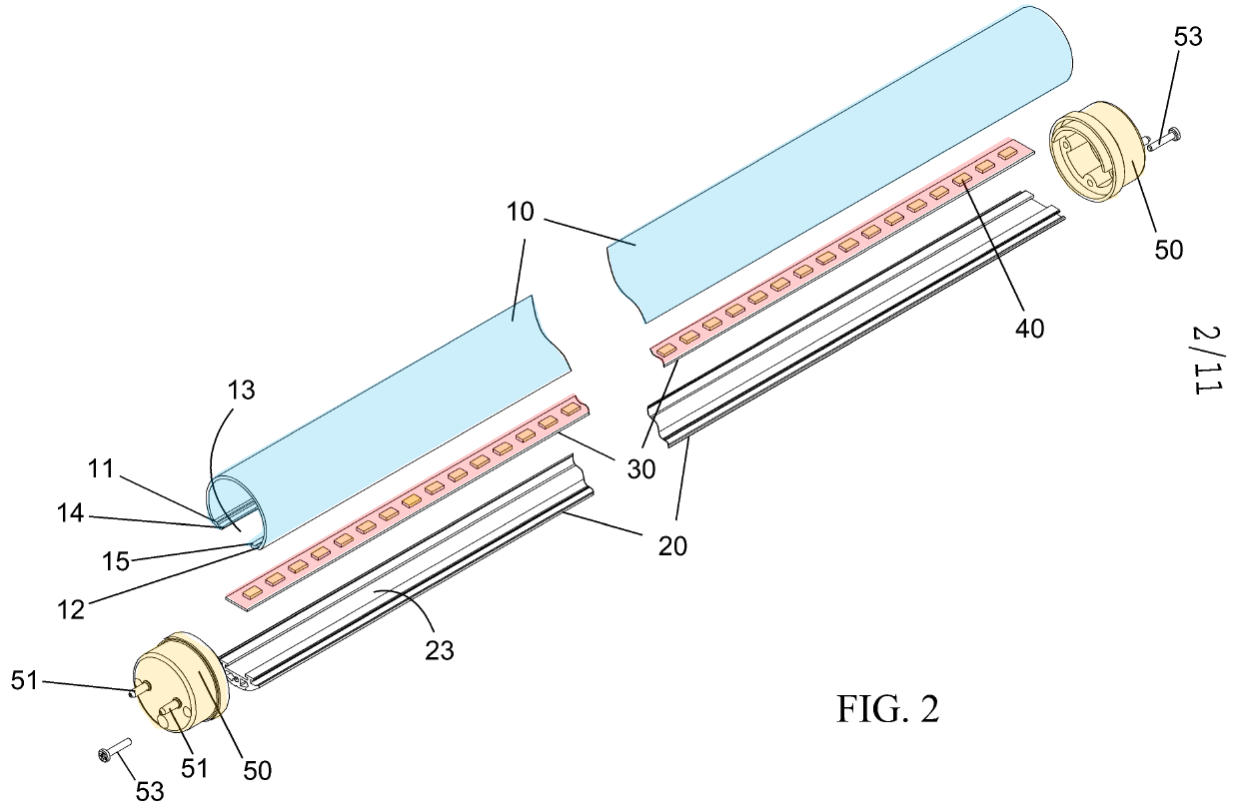


FIG. 2

EX1007, FIG. 2; EX1003, ¶¶43-45.

2. Motivation to Combine

As explained in §§IX.A.4-IX.A.6 for Ground 1, a POSITA would have been motivated to combine Ono, Holec, and Leong for multiple reasons.

A POSITA would also have been motivated to combine Ono-Holec-Leong with the surface roughness taught by Foo with a reasonable expectation of success for several reasons. EX1003, ¶¶164-167.

Ono teaches that tube 20 is "translucent" at least "in the direction of light emission." EX1006, [0014], [Solution] [0002], [0007], [0013], [0032], Cl. 1. Leong similarly teaches that the LED tube "can be diffused or can be coated with a white

translucent film to create a more dispersed light output similar to present fluorescent lamps." EX1010, 7:7-10. Leong's housing "is made of a translucent material such as plastic or glass and preferably having a diffused coating." *Id*., 19:13-17, 30:27-29, 45:49-56, 51:58-63. Ono and Leong do not specify the type of coating or roughness of the coating that improves light emission and diffusion. A POSITA therefore would have been motivated to look elsewhere for specifics. EX1003, ¶165.

Similarly, Foo discloses that "[b]y selecting a material having an appropriate combination of light diffusion, transmission and reflection characteristics, the casing can produce an evenly-distributed illumination along the length of the tube with high luminous efficiency." EX1007, 3:17-22. Foo also teaches that "advantageously the material is constructed to have a surface roughness smaller than 0.8μm ...." *Id*.

Incorporating Foo's material with specific roughness characteristics would have been a known use of existing technology to provide capability for LED lamps. EX1003, ¶167. A POSITA would have been familiar with the uses and characteristics of rough films and treatments to improve evenness of light distribution and also to improve lighting performance in LED tube lamps. *Id*. (citing EX1020, [0018], [0090]; EX1021, 7:18-45, EX1008, 6:33-43). As such, a POSITA that would have selected a material to provide a rough surface on the interior surface of the LED lamp would have had had a reasonable expectation that such an implementation would be successful. EX1003, ¶167. Accordingly, a POSITA

would have been motivated to use the surface roughness disclosed by Foo in an LED lamp as taught by Ono, Holec, and Leong. EX1003, ¶167.

3. Modification of Ono-Holec-Leong with Foo

Combining the LED tube lamp of Ono-Holec-Leong with the surface roughness of Foo, would produce an LED lamp tube (e.g., the LED lamp of Ono) that includes at least a plurality of light sources (e.g., light emitting elements 33), a glass lamp tube with two end caps and a power supply in an end cap (e.g., lighting circuit 24). EX1003, ¶¶168-169. A light strip with a freely extending end would be directly soldered to the power supply (e.g., shown by the boards associated with light source unit 23 and lighting circuit 24 of Ono or flexible circuit boards of Holec soldered in the overlapping manner of Holec). EX1003, ¶169. A portion of an inner surface of the glass lamp tube would be covered by a rough surface having a roughness from 0.1 to 40 μm, as taught by Foo. EX1003, ¶169.

4. Element-by-Element Analysis

(a) ***Limitation 10[p]***

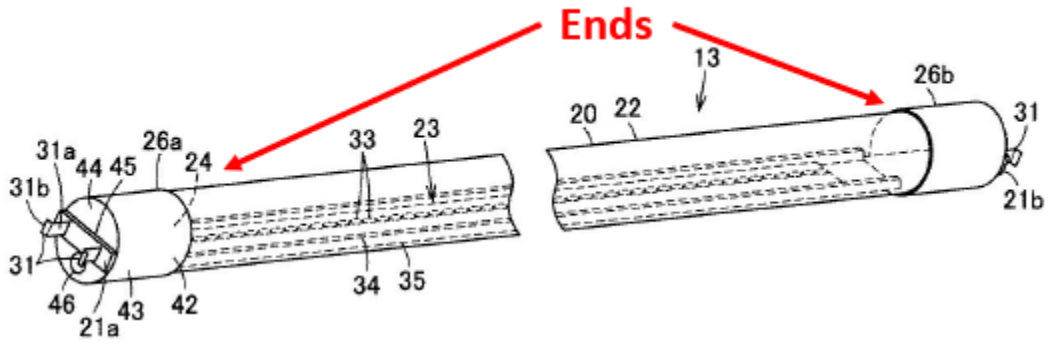
Ono-Holec-Leong-Foo renders obvious an LED tube lamp. EX1003, ¶170; §IX.A.7(a) (limitation 19[p]).

(b) ***Limitation 10[a]***

Ono-Holec-Leong-Foo renders obvious a glass tube comprising an inner surface and an outer surface, at least part of the inner surface of the glass tube has a rough surface, the glass tube having two end portions. EX1003, ¶¶171-172. Ono

teaches that "[t]he lamp unit 22 includes a straight tube 20 that is at least partially translucent, and a cap 21a disposed on one end of the tube 20." EX1006, [Solution]. The straight tube 20 may be made of "glass or a ceramic." *Id*., [0032].

[Fig. 2]



Id., FIG. 2. A POSITA would have understood the outer periphery of the glass tube 20 to be "an outer surface" and the inner periphery to be "an inner surface." EX1003, ¶171.

Foo discloses that the "inner surface of the casing 10 may be constructed to have a surface roughness of smaller than 0.8μm to enhance the reflectance and reflux of the light." EX1007, 10:18-20. In the Ono-Holec-Leong-Foo tube lamp, the inner surface of Ono's tube 20 would have a rough surface as disclosed by Foo. EX1003, ¶172.

(c) *Limitation 10[b]*

Ono-Holec-Leong-Foo renders obvious a plurality of LED light sources. EX1003, ¶173; §IX.A.7(c) (limitation 19[b]).

(d) ***Limitation 10[c]***

Ono-Holec-Leong-Foo renders obvious two end caps respectively sleeving the two end portions of the glass tube. EX1003, ¶174; §IX.A.7(d) (limitation 19[c]).

(e) ***Limitation 10[d]***

Ono-Holec-Leong-Foo renders obvious a power supply in one of the end caps or separately in both of the end caps. EX1003, ¶175; §IX.A.7(e) (limitation 19[d]).

(f) ***Limitation 10[e]***

Ono-Holec-Leong-Foo renders obvious an LED light strip on the inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED light sources being on the LED light strip. EX1003, ¶176; §IX.A.7(f) (limitation 19[e]).

(g) ***Claim 11***

Ono-Holec-Leong-Foo renders obvious a glass tube with an inner surface having a roughness of the rough surface is substantially from 0.1 to 40 μm. EX1003, ¶177. Foo discloses that the "inner surface of the casing 10 may be constructed to have a surface roughness of smaller than 0.8μm to enhance the reflectance and reflux of the light." EX1007, 10:18-20. In the Ono-Holec-Leong-Foo tube lamp, the inner surface of Ono's tube 20 would have a surface roughness of smaller than 0.8μm, which is within the range recited in Claim 11. EX1003, ¶177.

(h) *Claim 12*

Ono-Holec-Leong-Foo renders obvious each of the end caps comprises a plurality of openings thereon, and the two sets of the plurality of openings are symmetric to each other with respect to a virtual central axis of the end cap. EX1003, ¶178; §IX.A.7(d) (limitation 19[c]). Leong further discloses that its end caps 150A, 150B include two vent holes 224A, 224B that are symmetric to each other with respect to central line 146 (e.g., virtual axis of the end cap). EX1010, 40:30-41:9.

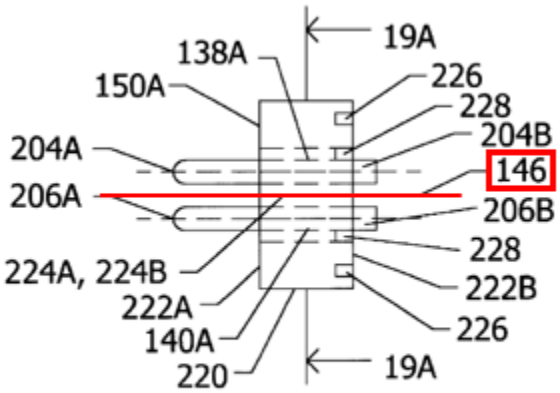


FIG. 19

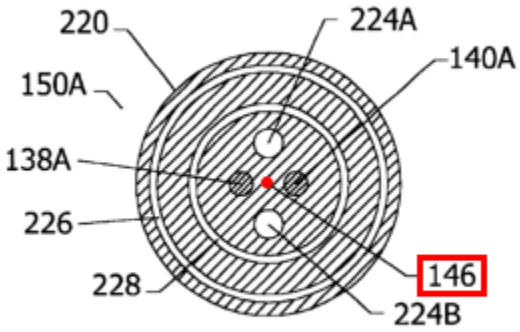


FIG. 19A

EX1010, FIGS. 19, 19A; EX1003, ¶178. As explained above, Leong's vent holes 224A, 224B are incorporated into the Ono's end cap. §IX.A.6.

(i) *Claims 13, 16, 18, 33, and 34*

The limitations of claims 13, 16, 18, 33, and 34 are rendered obvious based on the following:

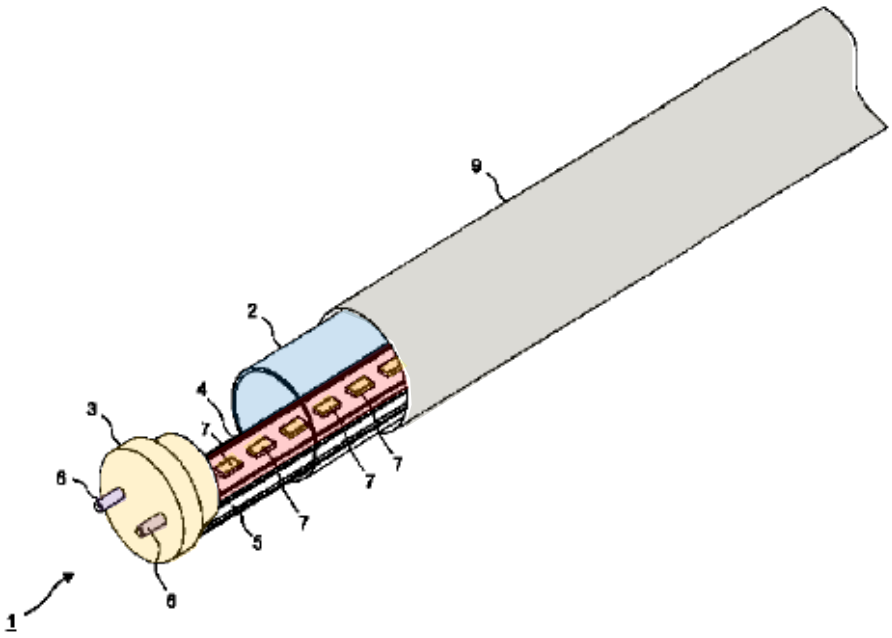
Claim	Reference
13	*See* Claim 42, Ground 1, §IX.A.7(w); EX1003, ¶179
16	*See* Claim 25, Ground 1, §IX.A.7(i); EX1003, ¶180

Claim	Reference
18	*See* Claim 28, Ground 1, §IX.A.7(j); EX1003, ¶181
33	*See* Claim 35, Ground 1, §IX.A.7(k) EX1003, ¶182
34	*See* Claim 36, Ground 1, §IX.A.7(u); EX1003, ¶183

C. Ground 3 - Claims 1, 31, and 32 Are Obvious Over Ono-Holec and Further in View of Shimizu

1. Shimizu

Shimizu is titled "LED lamp." The lamp "has a [blue] glass tube 2 that forms a cylinder." EX1005, [0012]. "Both ends of the glass tube 2 are closed by [orange] caps 3." *Id*., [0013]. "The cap 3 has a power supply terminal 6." *Id*., [0014]. "The [red] substrate 4 is structured through laying out a large number of [yellow] LED elements 7 on a wiring board, for example, and mounting a lighting circuit (omitted from the drawings) for driving the LED elements 7 so as to emit light." *Id*., [0016]. "The outer periphery of the glass tube 2 is covered with a [gray] translucent milky white heat-shrinkable tube 9." *Id*., [0017].



EX1005, FIG. 1; EX1003, ¶¶38-39.

2. Motivation to Combine

As explained in §IX.A.4 for Ground 1, a POSITA would have been motivated to combine Ono and Holec for multiple reasons.

A POSITA would also have been motivated to combine Ono-Holec with the heat shrink sleeve taught by Shimizu with a reasonable expectation of success for several reasons. EX1003, ¶¶184-188.

Ono teaches an LED tube that is directed to minimizing damage, including heat damage. EX1006, [0005]. Ono also teaches that tube 20 is "translucent" at least "in the direction of light emission." EX1006, [0014], [Solution] [0002], [0007], [0013], [0032], Cl. 1. Holec is directed to minimizing mechanical damage within an LED tube. EX1009, 5:17-24, 9:26-28. Shimizu discloses an LED lamp including

a heat shrinkable sleeve to improve heat dispersion, improved diffusion of light, and prevent shattering the glass tube in the event the tube is damaged. EX1005, [0010]. A POSITA would have been motivated to look at other options for dispersing heat, diffusing light, and minimizing damage in the event an LED tube shatters. EX1003, ¶185.

Obvious to Try. A POSITA would have found it obvious to try implementing Shimizu's heat shrink sleeve with Ono's LED tube because there were a finite number of identified, predictable solutions a POSITA would have pursued. EX1003, ¶186. Shimizu discloses that by using a heat shrink sleeve "dispersion of emitted light and dispersion of heat in an LED lamp can be achieved inexpensively using a glass tube, and safety can be guaranteed in relation to damage to the glass tube." EX1005, [0010], [0022]-[0024]. "The heat-shrinkable tube 9 causes the light emitted from the LED element 7 to be diffused." *Id*., [0017]. Ono describes an LED tube structure designed to "prevent external heat damage" and improve light emission. EX1006, [0027]; EX1003, ¶186. A POSITA would have recognized a design need for implementing Shimizu's heat shrink sleeve to Ono's LED tube for both the dispersion of heat and diffusion of emitted light. EX1003, ¶186. A POSITA would have expected this implementation to be successful and yield predicable results based on the stability of the technology and straight-forward implementation of the technology in Shimizu. *Id*.; *see also* §VII.D.

Improved Safety. A POSITA would have been motivated to include Shimizu's heat shrink sleeve onto Ono's LED lamp to reduce damage due to heat and shattering of the LED tube. EX1003, ¶187. Ono teaches improved safety and minimized damage through heat dissipation. EX1006, [0031], [0042]. Shimizu's heat shrink sleeve aids in the "dispersion of heat" and also "prevents scattering of broken shards when the glass tube 2 is damaged." EX1005, [0010], [0017], [0022]-[0024]. Accordingly, a POSITA would have been motivated to include Shimizu's heat shrink sleeve on Ono's LED tube to improve overall safety of the LED tube. EX1003, ¶187.

Expectation of Success. A POSITA would have reasonably expected success in implementing Shimizu's heat shrink sleeve on Ono's LED lamp. EX1003, ¶188. First, Shimizu successfully implements its own heat shrink sleeve configuration in an identical application, *i.e.*, an LED lamp bulb for replacement of a conventional fluorescent bulb. *Id.* Ultimately, a POSITA would have understood that Shimizu's heat shrink sleeve could readily be incorporated into Ono's LED lamp. EX1003, ¶188. The technology for heat shrink sleeves on a tubular LED lamp was well developed, and such an installation would have been a straight-forward implementation of known technology. EX1003, ¶188. As such, a POSITA would have reasonably expected to be successful in making the combination. EX1003, ¶188.

3. Modification of Ono-Holec with Shimizu

The Ono-Holec-Shimizu LED lamp includes Ono's LED lamp with the heat shrink sleeve of Shimizu installed on the outer surface. EX1003, ¶189.

4. Element-by-Element Analysis

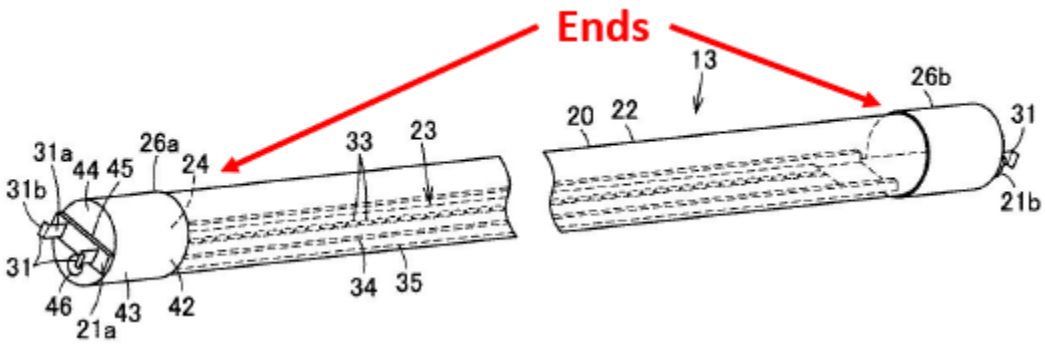
(a) *Limitation 1[p]*

Ono-Holec-Shimizu renders obvious an LED tube lamp. EX1003, ¶190; §IX.A.7(a) (limitation 19[p]).

(b) *Limitation 1[a]*

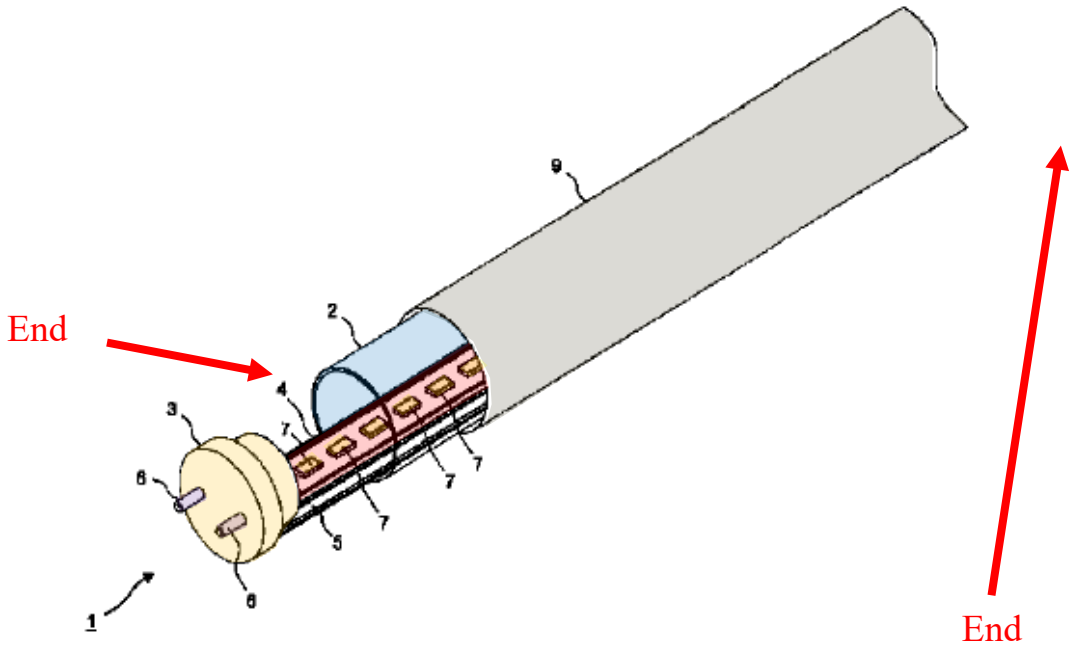
Ono-Holec-Shimizu renders obvious a glass tube covered by a heat shrink sleeve and having two end portions. EX1003, ¶¶191-192. Ono teaches that "[t]he lamp unit 22 includes a straight tube 20 that is at least partially translucent, and a cap 21a disposed on one end of the tube 20." EX1006, [Solution]. The straight tube 20 may be made of "glass or a ceramic." *Id*., [0032].

[Fig. 2]



Shimizu describes "[a]n LED lamp, comprising: a [blue] glass tube that forms a cylinder," as shown in Figure 1, and the tube has ends. EX1005, Cl. 1; *see also*

id., [0008], [0012], [0013] ("Both ends of the glass tube 2 are closed by caps 3"). "The outer periphery of the glass tube 2 is covered with a [gray] translucent milky white heat-shrinkable tube 9." EX1005, [0017].



EX1005, FIG. 1; EX1003, ¶192. Moreover, as discussed in §VII.D, using heat shrink sleeves with LED tube lamps was well-known.

(c) *Limitation 1[b]*

Ono-Holec-Shimizu renders obvious a plurality of LED light sources. EX1003, ¶193; §IX.A.7(c) (limitation 19[b]).

(d) *Limitation 1[c]*

Ono-Holec-Shimizu renders obvious two end caps respectively sleeving the two end portions of the glass tube. EX1003, ¶194; §IX.A.7(d) (limitation 19[c]).

(e) ***Limitation 1[d]***

Ono-Holec-Shimizu renders obvious a power supply in one of the end caps or separately in both of the end caps. EX1003, ¶195; §IX.A.7(e) (limitation 19[d]).

(f) ***Limitation 1[e]***

Ono-Holec-Shimizu renders obvious an LED light strip on the inner surface of the glass tube forming a freely extending end portion at one end along a longitudinal direction of the glass tube, the freely extending end portion directly soldered to the power supply, the plurality of LED light sources being on the LED light strip. EX1003, ¶196; §IX.A.7(f) (limitation 19[e]).

(g) ***Limitation 1[f]***

Ono-Holec-Shimizu renders obvious each of the end caps including an end wall. EX1003, ¶197; §IX.A.7(d) (limitation 19[c]).

(h) ***Limitation 1[g]***

Ono-Holec-Shimizu renders obvious each of the end caps including two conductive pins on the end wall. EX1003, ¶198; §IX.A.7(d) (limitation 19[c]).

(i) ***Claim 31***

Shimizu-Ono-Holec renders obvious an LED light strip that is a bendable circuit sheet. EX1003, ¶199; §IX.A.7(t) (claim 35).

(j) ***Claim 32***

Shimizu-Ono-Holec renders obvious an end cap that includes a metal part. EX1003, ¶200; §IX.A.7(u) (claim 36).

D. Ground 4 - Claims 2, 3, and 9 Are Obvious Over Ono-Holec-Shimizu and Further in View of Leong

1. Motivation to Combine

As explained in §§IX.A.4-IX.A.6 for Ground 1, a POSITA would have been motivated to combine Ono, Holec, and Leong for multiple reasons.

As explained in §§IX.C.2-IX.C.3 for Ground 3, a POSITA would have been motivated to combine Ono, Holec, and Shimizu for multiple reasons.

A POSITA would also have been motivated to combine Ono-Holec-Shimizu with vent holes taught by Leong with a reasonable expectation of success for similar reasons. EX1003, ¶201.

2. Modification of Ono-Holec-Shimizu with Leong

The Ono-Holec-Shimizu-Leong LED lamp includes Ono's LED lamp with vent holes in the end caps as taught by Leong. EX1003, ¶202.

3. Element-by-Element Analysis

(a) *Claim 2*

Ono-Holec-Shimizu-Leong renders obvious an LED tube lamp including at least two openings on the end wall symmetric to each other with respect to a plane passing through the middle of a line connecting the two pins and perpendicular to the line connecting the two pins. EX1003, ¶203; §IX.A.7(d) (limitation 19[c]) and §IX.A.7(s) (limitation 29[h]).

(b) *Claim 3*

Ono-Holec-Shimizu-Leong renders obvious an LED tube lamp including at least two openings that are on a surface of the end wall on which the two pins are disposed. EX1003, ¶204; §IX.A.7(d) (limitation 19[c]).

(c) *Claim 9*

Ono-Holec-Shimizu-Leong renders obvious an LED tube lamp where the openings are arranged along an arc and spaced apart from each other. EX1003, ¶205; §IX.A.7(j) (claim 28).

X. *FINTIV* FACTORS WEIGH AGAINST DISCRETIONARY DENIAL

Factor 1 is neutral. Petitioner has filed a motion to stay the Litigation pending a ruling on its motion to transfer venue, but the court has not yet ruled.

Factor 2 is neutral or weighs only slightly against institution. Trial is currently scheduled for April 17, 2024. EX1019. However, the Litigation involves 11 patents and the median time-to-trial for the Western District of Texas is 28.3 months,[6] meaning a first trial likely will not occur until at least October 2024—only 2 months before a decision here. Moreover, given that the Litigation currently includes 11 patents, time-to-trial is highly likely to exceed the *median*, and the

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

Litigation is highly likely to be split into multiple trials extending over a period of additional months.

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 2022 to add patents, including the '520 Patent. Markman has been delayed until June 8, 2023, and fact discovery is ongoing, having only opened on April 20, 2023. EX1019.

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. EX1018.

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 following service of PO's amended complaint adding the '520 Patent and, for the reasons explained above, the merits of the proposed grounds are meritorious and compelling.[7]

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

XI. CONCLUSION

For the above reasons, Claims 1-3, 9-13, 16, 18-20, 22, 25, 28, 29, 31-39, 42, 44, 45, 47, 49, 50, 54, 58-60, 64, and 68 are invalid under §103.

Dated: May 31, 2023

Respectfully submitted,

/Eagle H. Robinson/
Eagle H. Robinson

Lead Counsel for Petitioner

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 11,267 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 May 31, 2023, 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 FedEx®:

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