

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. IPR2023-00675

Patent 10,897,801

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

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PETITIONER'S EXHIBIT LIST

Exhibit	Shorthand	Description
1001	'801 Patent	U.S. Patent No. 10,897,801
1002	'801 File History	Prosecution History of U.S. Patent No. 10,897,801
1003	Ackley	Declaration of Donald E. Ackley, Ph.D.
1004	Ackley CV	CV of Donald E. Ackley, Ph.D.
1005	Li	Chinese Patent Publication 103899939A to Li Certified Translation
1006	Ono	Japanese Patent Publication JP 2014-103000A to Ono et al. Certified Translation
1007	Guang	U.S. Patent No. 9,338,853 to Guang
1008	Miyamichi	U.S. Patent No. 8,779,679 to Miyamichi
1009	Shimasaki	U.S. Patent No. 8,833,965 to Shimasaki
1010	Liu	<i>LED Packaging for Lighting Applications – Design, Manufacturing and Testing</i> , Sheng Liu et al., Chemical Industry Press (2011)
1011	Garbowicz	U.S. Patent No. 5,616,990 to Garbowicz et al.
1012	Deng	Chinese Patent No. CN203797412U to Deng Certified Translation
1013	Draft Stipulation	Draft Stipulation of Invalidity Contentions, <i>Jiaxing Super Lighting Electric Appliance Co., Ltd. et al. v. Current Lighting Solutions, LLC d/b/a GE Current</i> , Civil Action No. 6:22-cv-00534-ADA (W.D. Tex. 2022)
1014	Esaki	U.S. Patent No. 8,872,437 to Esaki
1015	Burdalski	U.S. Patent No. 8,384,299 to Burdalski et al.
1016	Xu	Chinese Patent Publication 2802892Y to Xu Certified Translation

Exhibit	Shorthand	Description
1017	Litigation Scheduling Order	Scheduling Order, <i>Jiaxing Super Lighting Electric Appliance Co., Ltd. et al. v. Current Lighting Solutions, LLC d/b/a GE Current</i> , Civil Action No. 6:22-cv-00534-ADA (W.D. Tex. 2022)
1018	Kawabata	U.S. Patent No. 8,591,057 to Kawabata et al.
1019	Riedon	Rideon, <i>How Resistors Work</i> , (July 16, 2014) <i>available at</i> https://web.archive.org/web/20140717035916/ https://riedon.com/technical/a-resistance-primer
1020	Holec	U.S. Patent No. 8,007,286 to Holec et al.

CLAIM LISTING

Claim	Limitation	Claim Language
13	13[p]	An LED tube lamp, comprising:
	13[a]	a glass tube having two ends;
	13[b]	an LED light strip attached to an inner circumferential surface of the glass tube;
	13[c]	a plurality of LED light sources mounted on the LED light strip;
	13[d]	a power supply module electrically connecting to the LED light strip and configured to drive the plurality of LED light sources; and
	13[e1]	a first end cap and a second end cap respectively attached at the two ends of the glass tube, each of the first and second end caps comprising a lateral wall and an end wall, the lateral wall substantially being coaxial with the glass tube and connecting to the glass tube, the end wall substantially being perpendicular to an axial direction of the lateral wall and connecting to an end of the lateral wall away from the glass tube,
	13[e2]	wherein the end wall comprises an insulating portion made of an insulating material and at least one opening being on the end wall,
	13[f]	wherein the power supply module comprises a printed circuit board and a plurality of electronic components mounted on the printed circuit board, the printed circuit board comprises a first surface and a second surface opposite to and substantially parallel to the first surface, and the first surface and the second surface of the printed circuit board are substantially parallel with the axial direction of the lateral wall;

Claim	Limitation	Claim Language
	13[g1]	wherein at least some of the plurality of electronic components comprise a rectifying circuit having at least two input terminals and configured to rectify signal receiving from the at least two input terminals,
	13[g2]	at least one of the plurality of electronic components comprises a filtering circuit electrically connecting to the rectifying circuit;
	13[h]	wherein the plurality of electronic components comprise a resistor which is positioned close to the end wall of the first end cap and connecting to one of the input terminals of the rectifying circuit.
14	14	The LED tube lamp according to claim 13, wherein the LED light strip comprises two first soldering pads arranged at one end of the LED light strip and the two first soldering pads respectively electrically connect to two second soldering pads on the printed circuit board.
15	15	The LED tube lamp according to claim 14, wherein the printed circuit board is disposed on an end of the LED light strip.
16	16	The LED tube lamp according to claim 15, wherein the two first soldering pads are arranged on the end of the LED light strip on which the printed circuit board is disposed.
17	17	The LED tube lamp according to claim 15, wherein each of the end caps comprises two conductive pins connected to the insulating portion thereof, and the resistor is electrically connected between one of the two conductive pins and one of the input terminals of the rectifying circuit or between the two conductive pins.

Claim	Limitation	Claim Language
18	18[a]	The LED tube lamp according to claim 17, wherein the rectifying circuit comprises: a first full-wave bridge rectifying circuit, having two input terminals electrically connected to the two conductive pins of one of the end caps, respectively, and having a positive output terminal and a negative output terminal; and
	18[b]	a second full-wave bridge rectifying circuit, having two input terminals electrically connected to the two conductive pins of the other one of the end caps, respectively, and having a positive output terminal and a negative output terminal,
	18[c]	wherein the positive output terminals of the first and the second full-wave bridge rectifying circuits are electrically connected to each other, and the negative output terminals of the first and the second full-wave bridge rectifying circuits are electrically connected to each other.
19	19[a]	The LED tube lamp according to claim 18, wherein the filtering circuit comprises: an inductor, having an end electrically connected to the positive output terminals of the first and the second full-wave bridge rectifying circuits, and the other end regarding as one of the filtering output terminals;
	19[b]	a first capacitor, having an end electrically connected to the end of the inductor, and the other end electrically connected to the negative output terminals of the first and the second full-wave bridge rectifying circuits; and
	19[c]	a second capacitor, having an end electrically connected to the other end of the inductor, and the other end regarding as the other one of the filtering output terminals.

Claim	Limitation	Claim Language
20	20[a]	The LED tube lamp according to claim 17, wherein the rectifying circuit comprises: a full-wave bridge rectifying circuit, having two input terminals electrically connected to the two conductive pins of one of the end caps, respectively, and having a positive output terminal and a negative output terminal; and
	20[b]	a half-wave bridge rectifying circuit, having an input terminal electrically connected to one of the two conductive pins of the other one of the end caps, and having a positive output terminal and a negative output terminal,
	20[c]	wherein the positive output terminals of the full-wave bridge rectifying circuit and the half-wave bridge rectifying circuit are electrically connected to each other, and the negative output terminals of the full-wave bridge rectifying circuit and the half-wave bridge rectifying circuit are electrically connected to each other.
21	21	The LED tube lamp according to claim 20, wherein the filtering circuit comprises: a first capacitor, having an end electrically connected to the positive output terminals of the full-wave bridge rectifying circuit and the half-wave bridge rectifying circuit, and the other end electrically connected to the negative output terminals of the first and the second full-wave bridge rectifying circuits.
22	22[a]	The LED tube lamp according to claim 21, wherein the filtering circuit further comprises: an inductor, having an end electrically connected to the end of the first capacitor, and the other end regarding as one of the filtering output terminals; and

Claim	Limitation	Claim Language
	22[b]	a second capacitor, having an end electrically connected to the other end of the inductor, and the other end regarding as the other one of the filtering output terminals.
23	23	The LED tube lamp according to claim 21, wherein the filtering circuit further comprises: an EMI-reducing capacitor, coupled between the two conductive pins of one of the end caps.
24	24[a]	The LED tube lamp according to claim 17, wherein at least some of the electronic components form a driving circuit electrically connected to the filtering output terminals of the filtering circuit and have two driving output terminals electrically connected to the LED light strip; and further wherein the driving circuit comprise: a controller;
	24[b]	a diode, having an anode electrically connected to one of the filtering output terminals and one of the driving output terminals;
	24[c]	a switch, having a first terminal coupled to the other one of the filtering output terminals, a second terminal electrically connected to a cathode of the diode, and a control terminal coupled to the controller, wherein the switch is turned on or off in response to a signal received from the controller; and
	24[d]	an inductor, having an end electrically connected to the second terminal of the switch, and another end electrically connected to the LED light strip via the other one of the driving output terminals.
25	25	The LED tube lamp according to claim 24, wherein the electronic components forming the driving circuit further comprise: a capacitor, electrically connected between the driving output terminals.

I. INTRODUCTION

The '801 Patent describes an LED tube lamp including a power supply module integrated into an end cap of the tube lamp. EX1001, Abstract. The '801 Patent asserts that existing LED lamps had compatibility problems when used with an electronic ballast. *Id.*, 3:1-20. The patent purports to solve this problem by incorporating circuitry including a filtering circuit, a rectifying circuit, and a driving circuit into the power supply, the driving circuit including a controller, diode, switch, and inductor. *Id.*, 4:18-35. These circuits purportedly improved the compatibility of the LED lamp with lamp driving circuits including those with an electronic ballast. *Id.*, 76:59-63.

However, multiple prior art references, including Li, Ono, Guang, and Esaki described LED lamps that were compatible with an electronic ballast used in lamp-driving circuits. *See, e.g.*, EX1005, [0105]; EX1006, [0017], [0021]; EX1007, 5:55-64; EX1014, 1:64-67. These prior art LED lamps included the same types of circuitry—a rectifier circuit, a filtering circuit, and a driving circuit—as claimed in the '801 Patent. Accordingly, Li in combination with Ono, Holec, Guang, and/or Esaki renders obvious the challenged claims.

II. MANDATORY NOTICES

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

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

B. Related Matters (§42.8(b)(2))

The following proceedings involve the ’801 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*”); and

(2) *Jiaxing Super Lighting Elec. Appliance Co., Ltd. v. MaxLite, Inc.*, Case No. 2:19-cv-04047-PSG-MAA (C.D. Cal. May 27, 2021) (“*MaxLite Action*”).

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

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Petitioner consents to electronic service.

III. GROUNDS FOR STANDING

Pursuant to §42.104(a), Petitioner certifies that the '801 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 '801 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 13-25.

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

Claims 13-25 are invalid under §103 over these combinations of art:

Ground	Basis	Claims	Prior Art Combination
1	§103	13-17	Li (EX1005), Ono (EX1006), Holec (EX1020)
2	§103	18-23	Li, Ono, Holec, Guang (EX1007)
3	§103	24-25	Li, Ono, Holec, Esaki (EX1014)

Published July 2, 2014, Li is prior art under §102(a)(1).

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

Filed March 18, 2009, and issued August 30, 2011, Holec is prior art under §102(a)(1).

Filed December 3, 2012, published June 6, 2013, and issued October 28, 2014, Esaki is prior art under §102(a)(1).

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

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 '801 Patent has not been challenged in any prior IPR petition. As such, none of the discretionary factors set

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).

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 '801 Patent, the Examiner rejected claims 1 and 13 on the grounds of nonstatutory double patenting based on U.S. Patent No. 10,560,989, the parent to the '801 Patent. EX1002, 341/675. In response, PO disputed the double patenting rejection, but filed a terminal disclaimer to advance prosecution. *Id.*, 297-300/675. PO also added new claims 30-41. *Id.*, 290-292/675. The Examiner then issued a notice of allowance indicating “the prior arts of record fail to disclose or suggest wherein the end wall comprises an insulation portion made of an insulating material and at least one opening being on the end wall, as required by claims 1 and 13.” *Id.*, 44/675. There were no prior art rejections based on any prior art references including Li, Ono, Holec, Esaki, or Guang. Li, Holec, and Esaki were not before the Examiner during prosecution. Guang and Ono were among over 150 references submitted in IDSs during prosecution, but were not substantively addressed by the Examiner. *Id.*, 64/675, 322/675. 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 September 25, 2015²—the ’801 Patent’s earliest claimed priority date—would have had a bachelor’s degree in electrical engineering, or an equivalent field, as well as at least 1-2 years of academic or industry experience in lighting design, including knowledge of LEDs and related technology for driving LEDs. A POSITA with a higher level of education may have fewer years of academic or industry experience, or vice versa. EX1003, ¶25. A POSITA would have been familiar with the field of technology described in Section VII below. *Id.* The prior art and the ’801 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 ’801 Patent is directed to “an LED tube lamp and its components including the light sources, electronic components, and end caps.” EX1001, 1:59-62. In other words, the ’801 Patent discloses and claims certain aspects of an LED

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.

lamp that works with existing fluorescent lighting fixtures, and components thereof. EX1003, ¶26.

A. Fluorescent 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.” EX1007, 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. The electrical ballast “contains electronic components that control the current, preventing the current through the lamp from rising to the point that the lamp would burn out. Electronic ballasts use semiconductors to limit power to a fluorescent lamp.” *Id.*, 2:18-22. Some fluorescent lamps use magnetic ballasts instead of electronic ballast. EX1008, 1:24-29. A magnetic ballast can be as simple

as a series inductor or can further comprise a glow starter. *Id.*, Fig. 15a, 1:51-55. Alternatively, magnetic ballasts can be a rapid-start type. *Id.*, FIG. 15b, 1:56-59. A rapid-start magnetic ballast includes a transformer and additional resistors and capacitors such that the fluorescent lamp lights simultaneously with the filament pre-heat functionality. EX1003, ¶¶27-29.

B. Pre-heat process

“Fluorescent lamps often require that their filaments (electrodes) be preheated prior to lamp ignition.” EX1011, 1:12-13. “In lamps that require preheating, it is difficult to start a lamp when the filaments have not been sufficiently preheated.” *Id.*, 1:38-40. “Preheating is often controlled by an automatic switch commonly referred to as a starter.” *Id.*, 1:13-15. During preheating, “[c]urrent [] flows through the [starter’s] electrodes and lamp filaments heating the latter.” *Id.*, 1:25-26. “Once the filaments have been preheated, one or more large voltage pulses, generated by an ignitor, are applied to the fluorescent lamp filaments.” EX1011, 1:15-17; EX1003, ¶30.

“[A] rapid start ballast is used for fluorescent lamps having a filament (two electrode pin lamp) that is used for pre-heating before the lamp is started. A rapid start ballast applies voltage and heats the two electrode pins (the cathodes) simultaneously.” EX1007, 2:41-45. “A programmed-start ballast is a more advanced version of the rapid start ballast. ... [P]rogrammed-start [] provides precise

heating of lamp filaments and controls the pre-heat time before the startup voltage is applied, thereby reducing filament stress. The programmed-start ballast applies power to the filaments first, which allows the cathodes to preheat and then applies voltage to the lamps to strike an arc.” *Id.*, 2:51-58. In contrast, “[a]n instant start ballast does not preheat the electrodes, instead using a relatively high voltage (~600 V) to initiate the discharge arc.” EX1007, 2:30-32; EX1003, ¶31.

C. The Rise of LED lamps; issues with replacing fluorescent lamps with LED lamps

“[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.” EX1007, 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.” EX1007, 4:20-22; EX1003, ¶32.

LEDs for use in tube lamps were typically mounted in arrays on LED light strips made of various materials, including traditional printed circuit boards (PCBs) and flexible circuit boards or strips. *See, e.g.*, EX1009, 4:40-44; EX1003, ¶33. LED strips for LED tube lamps were arranged in numerous ways within the tube, such as adhered directly on an inner surface of the tube or mounted on an intermediate structure. *See, e.g.*, EX1005, [0097]; EX1006, [0016], FIG. 1; EX1003, ¶33. Ultimately, there were many known ways of disposing an LED strip within and on the inner surface of a lamp tube, each with the benefit of supporting and securing the

LED strip in place. EX1003, ¶33. A POSITA would have been familiar with manufacturing methods for LED strips. EX1009, Abstract, 5:45-6:40; EX1020, Abstract; EX1003, ¶33. Connecting LED light strips to a power supply using solder pads was also well-known. *See, e.g.*, EX1018, 11:6-61, FIGS. 7-9; EX1003, ¶33.

Replacing a traditional fluorescent lamp with an LED lamp requires a different driving circuit. EX1007, 5:12-15 (“Most LED fixtures drawing from AC wall receptacle power must have a driver circuitry that includes a power converter with at least a current-limiting resistor.”); EX1003, ¶34. This is because “[a] small change in voltage causes a large change in current. If the supplied voltage exceeds the LED’s forward voltage drop by a small amount, the current rating may be exceeded by a large amount, potentially damaging or destroying the LED. A solution is to use constant-current power supplies to keep the current below the LED’s maximum current rating.” EX1007, 5:7-12.

Because “a fluorescent tube lamp requires a means to limit current flow to prevent a self-destroying positive feedback loop[,] . . . ballasted fluorescent fixtures are ubiquitous in the lighting industry.” *Id.*, 5:27-31. “Replacing either an instant-start, shunted socket fluorescent lamp or a rapid-start non-shunted socket fluorescent lamp with a replacement LED tube and driver has previously required the ballast to be electrically detached or physically removed from the system, and the standard AC power wires to be attached directly to the driver’s circuitry.” *Id.*, 5:16-22. But

this can be expensive and time consuming. *Id.*, 5:22-26. Solutions existed allowing consumers to “plug an LED tube lamp into any size compatible fluorescent fixture (with or without ballast or shunt) and have the internal circuitry utilize the supplied energy to power the LED array.” *Id.*, 5:37-40. These solutions included “using direct line voltage to power a secondary LED power supply while bypassing ballasted input power or physically removing the ballast altogether,” “us[ing] back up battery power to supply the LED array,” and creating a “self-ballasted lamp.” EX1007, 5:40-45, 5:65-6:3; EX1003, ¶34.

D. Heat Dissipation

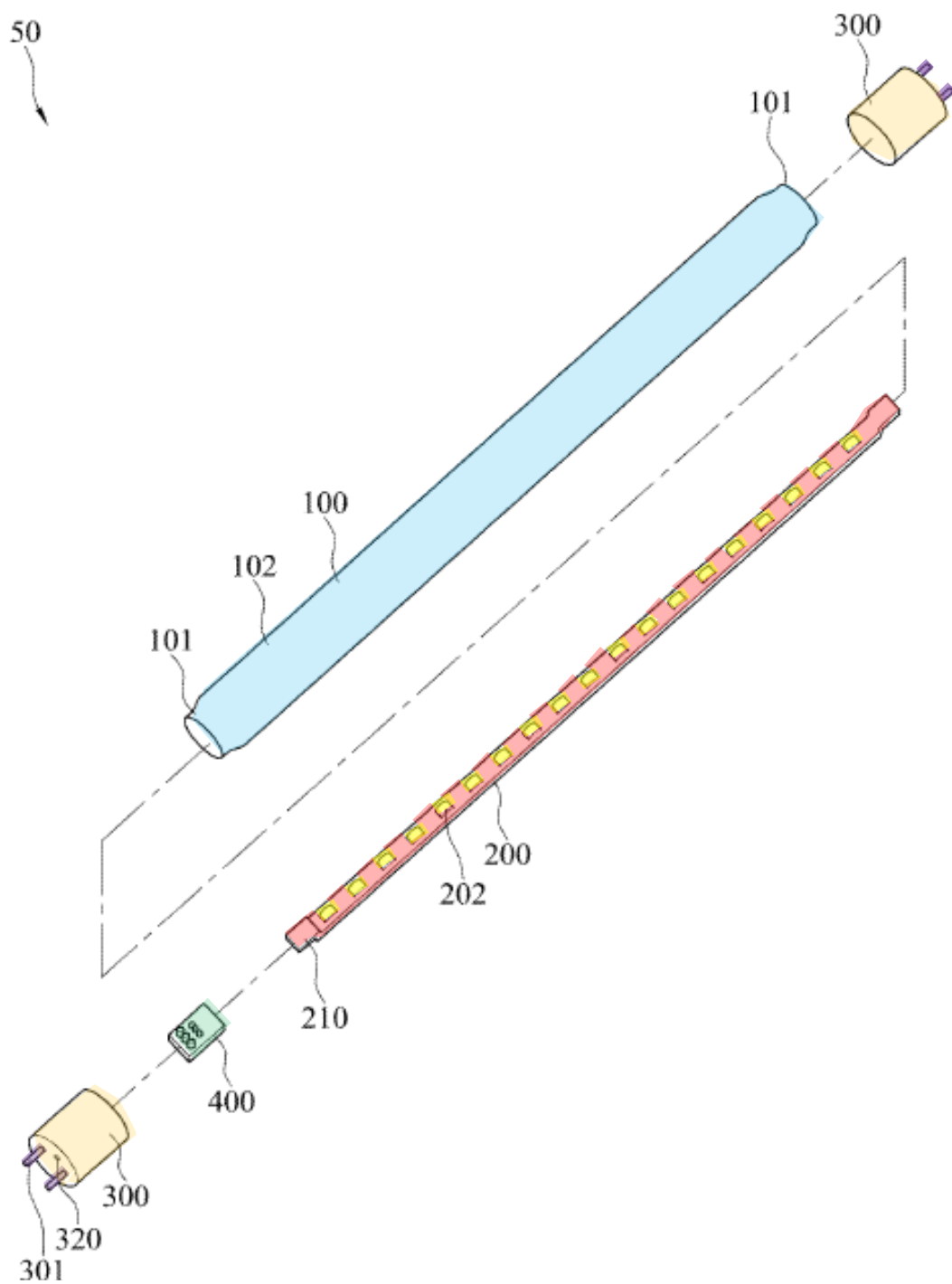
It was known that operation of an LED lamp generates heat, which, if not dissipated, can reduce performance and damage components of an LED lighting device. EX1010, 167/367, 201/367, 203/367. “Therefore, it is crucial to rapidly remove the heat and keep the junction temperature below a certain limit for the maintenance of performance.” *Id.*, 167/367. As such, a POSITA would have understood the importance of heat management in an LED lighting device. EX1003, ¶35.

VIII. '801 PATENT

Entitled “LED Tube Lamp,” the '801 Patent is directed to an LED tube lamp and associated circuitry used to power the lamp. EX1001, Abstract.

A. Overview

The '801 Patent describes an LED tube lamp including a [blue] tube 100 with two ends. *Id.*, 98:59-62. Inside the tube is a [red] LED light strip 200 onto which multiple [yellow] LED lights 202 are mounted. *Id.*, 98:62, 98:67-99:1. An [orange] end cap 300 is attached to each tube end, and has an end wall 320 made of insulating material (*id.*, 98:63-64, 106:21-25) from which [purple] conductive pins extend. *Id.*, 99:34-36. Inside at least one end cap is a [green] power supply. EX1001, 99:2-6; EX1003, ¶51.



EX1001, FIG. 67; EX1003, ¶52.³

³ All colorized figures herein are annotated.

The [blue] power supply 400, shown below, can be a module disposed in end cap 300, onto which electronic components are mounted. EX1001, 101:62-63. The electronic components include components such as rectifying circuits, filtering circuits, resistors, capacitors, inductors, and integrated circuits. *Id.*, 3:66-4:4, 120:33-37.

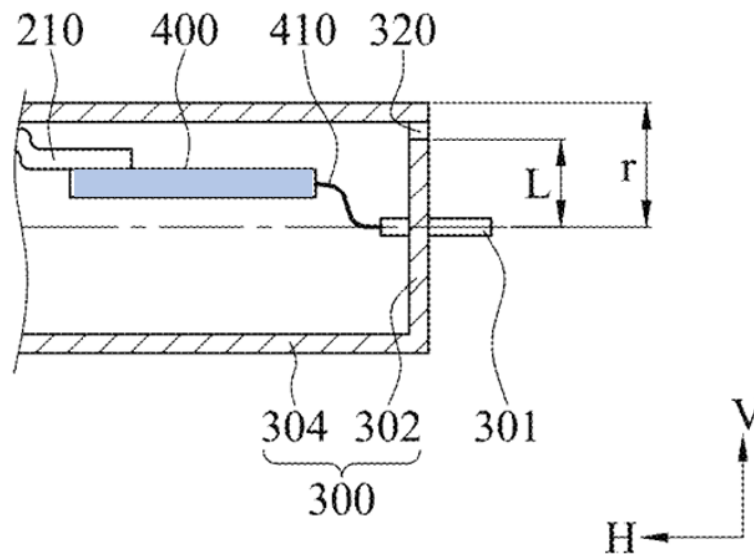


FIG.69

EX1001, FIG. 69; *see also* EX1001, FIG. 83; EX1003, ¶¶53-54.

B. Prior Art and Perceived Shortcomings

The '801 Patent describes prior art LED lamps and associated drawbacks. EX1001, 1:66-3:20. Specifically, insufficient heat dissipation lead to high temperatures and performance degradation. *Id.*, 2:53-56. Further, LED lamps use a DC driving signal, but traditional fluorescent lamps use low-frequency, low-voltage AC signals. *Id.*, 2:57-67. Simple rectification is generally insufficient to achieve

compatibility for LED lamps in a fluorescent fixture because traditional LED driving circuits cannot support filament detection tests used in program-start ballasts, and electrical ballasts caused “problems of overvoltage and overcurrent or undervoltage and undercurrent.” *Id.*, 2:62-3:20; EX1003, ¶55.

C. ’801 Patent’s Asserted Improvement to Prior Art

To overcome the purported shortcomings, the ’801 Patent proposes an LED tube lamp having a power supply including a rectifying circuit and filtering circuit. *Id.*, 3:66-4:4. The rectifying circuit is configured to rectify the external driving signal to produce a rectified signal. *Id.*, 43:35-37. The filtering circuit is connected to the rectifying circuit and configured to produce a filtered signal. EX1001, 41:50-52; EX1003, ¶56.

D. Prosecution History

The ’801 Patent issued from U.S. Patent Application No. 16/743,526, filed on January 15, 2020. On June 15, 2020, the Examiner rejected claims 1 and 13 on the grounds of nonstatutory double patenting based on U.S. Patent No. 10,560,989, the parent to the ’801 Patent. EX1002, 341/675. In response, PO disputed the double patenting rejection, but filed a terminal disclaimer to advance prosecution. *Id.*, 297-300/675. PO also added new claims 30-41. *Id.*, 290-292/675. The Examiner then issued a notice of allowance indicating “the prior arts of record fail to disclose or suggest wherein the end wall comprises an insulation portion made of an insulating

material and at least one opening being on the end wall, as required by claims 1 and 13.” *Id.*, 44/675.

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. “electrically connected” / “electrically connecting”

The term “electrically connected” should be construed as “connected through wires or other intervening electrical components.” “Electrically connected” is found in claims 17-25. “Electrically connecting” is found in claim 13.

A POSITA would have understood that “electrically connected” does not require a direct connection, *i.e.*, with no intervening electrical components or modules. The ’801 Patent itself confirms this construction. Specifically, the ’801 Patent distinguishes between “electrically connected” and “directly electrically connected”:

As used herein, items described as being “electrically connected” are configured such that an electrical signal can be passed from one item to the other. . . . Moreover, items that are “directly electrically connected,” to each other are electrically connected through one or more passive elements, such as, for example, wires, pads, internal electrical lines, resistors, etc. As such, directly electrically connected

components do not include components electrically connected through active elements, such as transistors or diodes.

EX1001, 16:13-28; EX1003, ¶¶75-76.

2. “attached to an inner circumferential surface of the glass tube”

Petitioner does not believe this term needs explicit construction, but notes that the specification expressly indicates that the term “attached to” is broad enough to cover both direct contact or through “intervening elements.” *See, e.g.*, EX1001, 30:46-56; EX1003, ¶77.

3. “coupled”

Petitioner does not believe this term needs explicit construction, but notes that the specification uses the terms “coupled” and “connected” interchangeably. *See, e.g.*, EX1001, 15:13-25; EX1003, ¶78.

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

A. Ground 1 - Claims 13-17 are Obvious over Li in view of Ono and Holec

1. Li

Li is titled “LED Fluorescent Lamp and Installation Method Thereof.” Li describes an LED lamp having a [red] glass inner tube 11 and a [green] glass outer tube 12. EX1005, Abstract, [0089]. Inside the inner tube is a [purple] substrate 310 onto which multiple LEDs 320 are affixed. *Id.*, Abstract, [0095]. Each end of the glass tube is enclosed by an [blue] end cap 21, 22. *Id.*, [0088], [0092]. The end caps

include connective pins 211, 221 for receiving electricity from a light fixture. *Id.*, [0092]. The LED lamp also includes an [orange] drive circuit module 330 “arranged at [one or] two ends of the substrate 310.” *Id.*, [0100], [0108]. The drive circuit module is electrically connected to both the LEDs on the substrate and the connective pins and provides power to the LEDs. *Id.*, [0101].

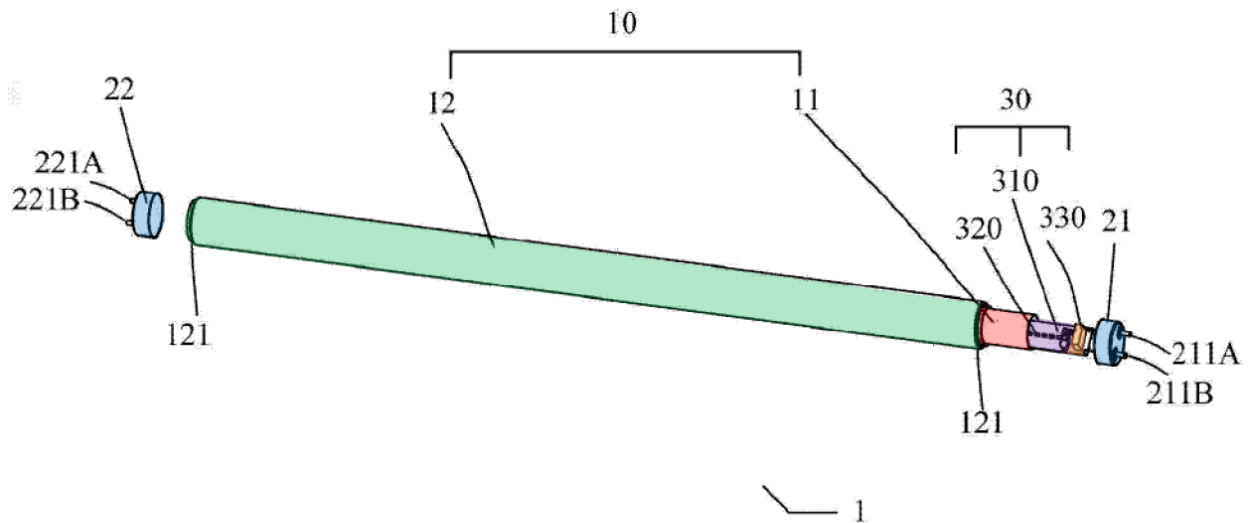
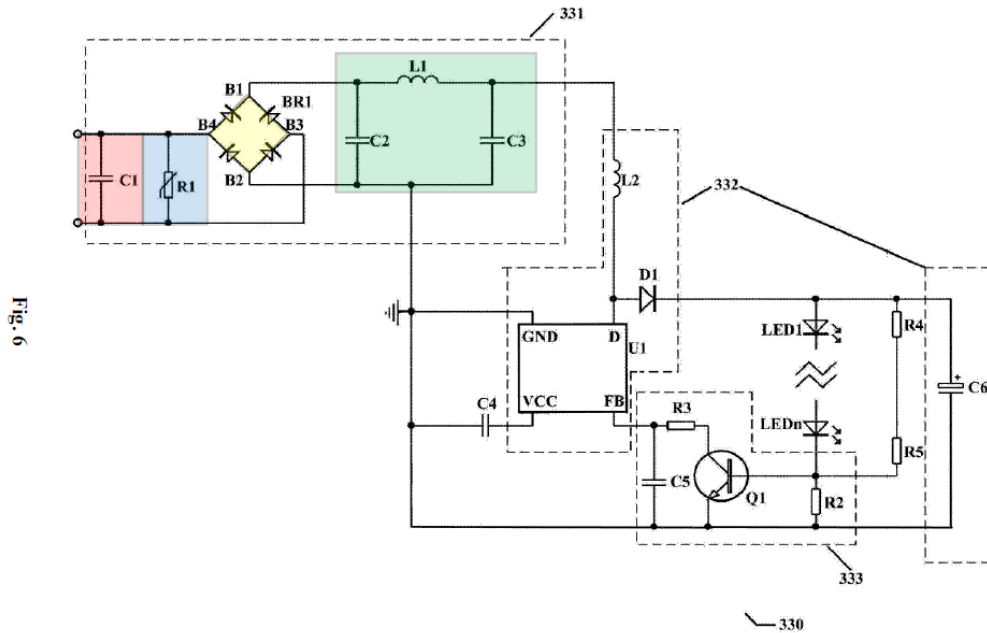


Fig. 1

EX1005, FIG. 1; EX1003, ¶¶36-37.

Li describes the drive circuit module as making the LED lamp compatible with conventional fixtures. EX1005, [0092], [0113]. The drive circuit module

includes a [red] capacitor and [blue] varistor⁴ electrically coupled across the conductive pins, a [yellow] bridge rectifier unit, and a [green] filter unit. *Id.*, [0112-0113].



EX1005, FIG. 6; EX1003, ¶38.

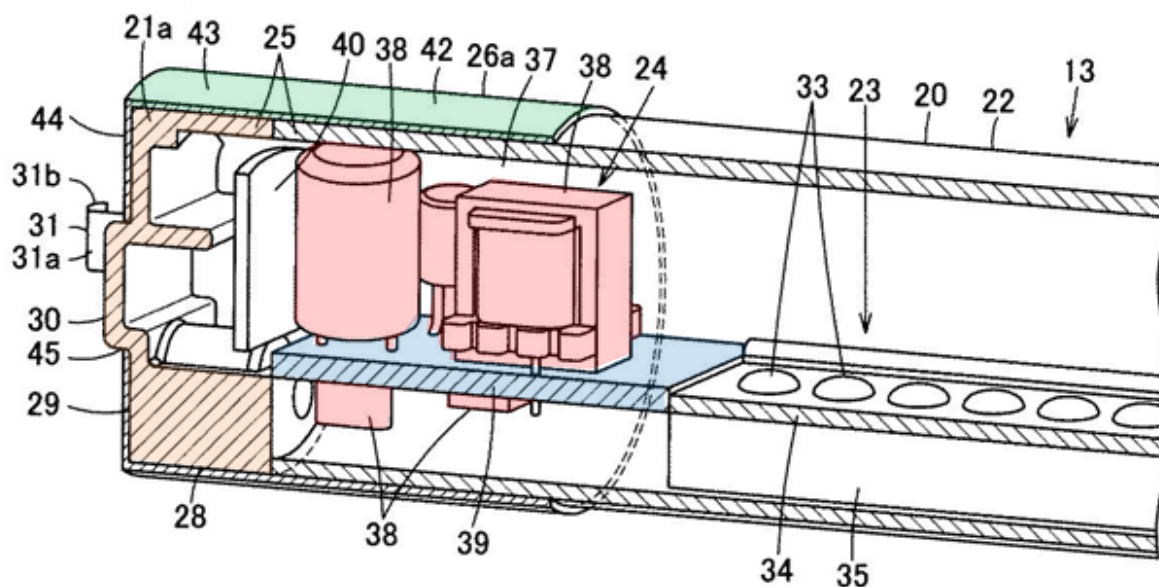
2. Ono

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

⁴ A POSITA would have understood that the “varistor” disclosed in Li is a voltage-dependent resistor, meaning the resistance of the varistor depends on the applied voltage. EX1003, ¶38.

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 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.*

[Fig. 1]



EX1006, FIG. 1; EX1003, ¶¶39-40. 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.* 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, [0019]; EX1003, ¶41.

3. *Holec*

Holec is titled “Circuit Boards Interconnected By Overlapping Plated Through Holes Portions.” 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.” EX1020, 2:35-41. As such, Holec discloses a method for interconnecting printed circuit boards in LED applications. EX1020, 1:26-34; EX1003, ¶¶42-43.

Specifically, Holec describes overlapping circuit boards to provide an interconnection. EX1020, 9:25-26. This allows a direct connection between two circuit boards. *Id.*, 9:45-65. Specifically, a [red] top board 16 includes conductive pads 7 and a [green] bottom board 12 includes conductive pads 8. *Id.*, 9:47-50. The conductive pads 7 and the conductive pads 8 are soldered directly to one another.

Id. In this way, the top board 16 and bottom board 12 are electrically connected.

Id., 9:3-9.

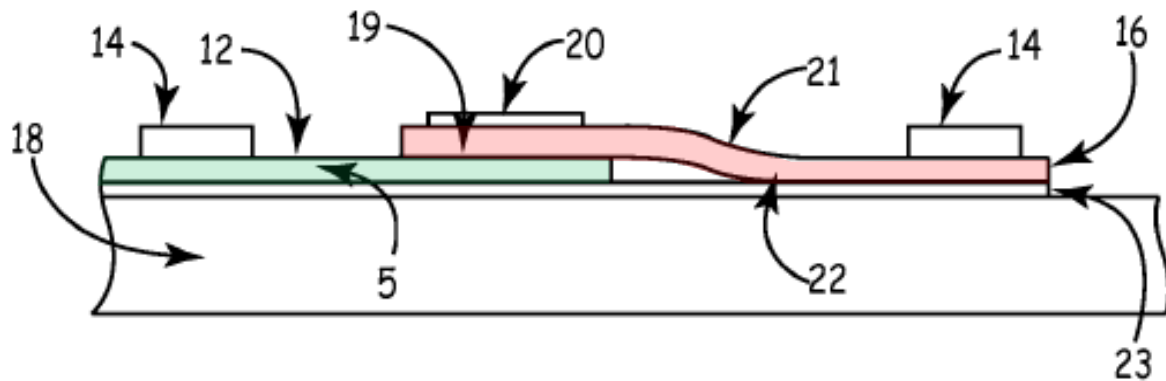


FIG. 5

EX1020, FIG. 5; EX1003, ¶44;

Figures 2b and 3 illustrate the conductive pads on each board. Figure 2b shows a bottom view of the top circuit board and [yellow] conductive pads 7. EX1020, 8:63-65. Figure 3 shows a top view of the bottom circuit boards with [blue] conductive pads 8 that “are designed to match the geometry and locations of the bottom side connection pads 7.” *Id.*, 9:3-6.

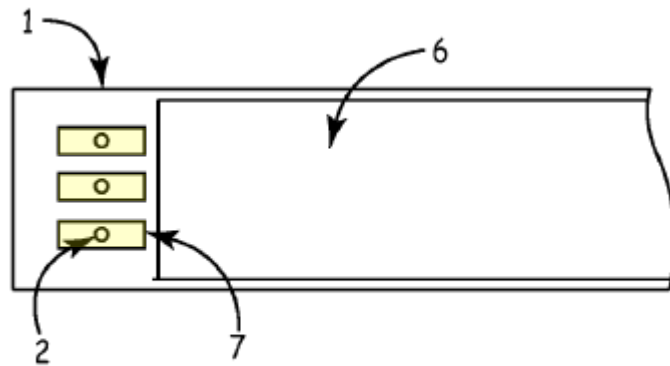


FIG. 2b

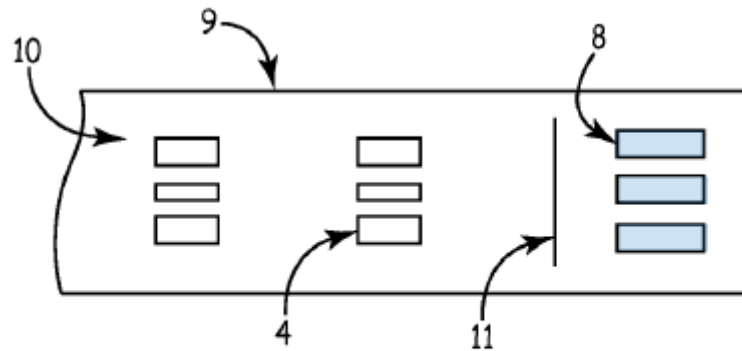


FIG. 3

Id., FIGs. 2b, 3; EX1003, ¶45.

4. Motivation to Combine

Li discloses an LED lamp including a drive circuit that makes the LED lamp compatible with fluorescent fixtures. EX1005, [0092], [0113]. The drive circuit includes various electronic components, such as capacitors, diodes, inductors, and resistors, installed on a PCB. EX1005, [0082], [0117]; EX1003, ¶79.

Li teaches placing the drive circuit module 330 (power supply) arranged at one or two ends of the substrate 310 (LED light strip) within the tube body 10 (EX1005, Abstract, [0100], [0108]), but provides limited detail, saying only that substrate 310 (PCB) of the drive circuit can be adhered to an inner surface of inner tube 11 (*id.*, [0097], [0082]). Li also explains that the structure of the drive circuit can be “modular,” but does not provide details of how to implement such modularity. EX1005, Abstract, [0082]; EX1003, ¶79. And Li recognizes the need to dissipate heat, doing so through the use of substrate 310 material “with excellent thermal conductivity and infrared radiation performance.” EX1005, [0096].

To understand how to implement Li’s drive circuit at the end of substrate 310 within the LED tube, a POSITA would have been motivated to look elsewhere for the details Li omits. EX1003, ¶80. Ono provides an example of installing capacitors, resistors, and other electronic components of an LED drive circuit on a PCB at the end of a LED lamp tube. *Id.* Specifically, Ono describes a circuit board with electronic components such as capacitors and inductors mounted on one surface, and resistors and switches mounted on another surface. EX1006, [0017]; EX1003, ¶80. 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.*, [0083], FIG. 1). EX1003, ¶80.

Additionally, Holec describes how to manufacture a circuit for an LED lamp and connect the circuits together. EX1020, Abstract, 1:26-34. Specifically, Holec describes that “two fully assembled circuit boards 12, 16 are joined together.” *Id.*, 9:13-14. Each of circuit boards 12, 16 included conductive pads 8, 7 such that “a connection 19 is made by either welding or soldering the conductive pads 7 from the top board 16 to the bottom board conductive pads 8 on the bottom board 12.” *Id.*, 9:47-50.

Improved Reliability. A POSITA would have been motivated to configure the ends of Li’s lamp—including the physical format of its circuit on a PCB—with the insulator end caps within a non-combustible cover like Ono’s for several independent reasons. For example, a POSITA would have been motivated to use Ono’s lamp-end configuration to implement Li’s instruction to configure its drive circuit on the end of a PCB within Li’s tube body 10 (EX1005, Abstract, [0082], [0100], [0108]; EX1003, ¶82) and to achieve the improved reliability and efficiency characteristics disclosed by Ono (EX1006, [0042]). EX1003, ¶82. Ono explains that “by forming the insulator 25 from the end portion of the tube 20 and the cap 21a, a *separate insulating member*⁵ *is not required*, the number of parts can be reduced, and assembly is *more efficient*.” EX1006, [0030]. Additionally, Ono

⁵ All emphasis added unless otherwise indicated.

explains that “because [its] non-combustible cover 26a has a lighting circuit covering portion 42 that covers the periphery of the lighting circuit 24, . . . covering the periphery of the lighting circuit 24, which is susceptible to heat damage, with the non-combustible cover 26a creates a *reliable non-combustible structure*.” *Id.*, [0031]. Thus, a POSITA would have been motivated to implement Ono’s lamp-end structure—the physical format of Li’s circuit on a dual-sided circuit board, and its insulator end caps—to reduce the number of parts and improve the efficiency of assembly, as well as to improve safety due to the inclusion of a reliable non-combustible structure surrounding the power circuit. EX1003, ¶82.

Simplified Manufacturing. A POSITA would have been motivated to implement Ono’s end cap configuration in Li’s lamp to simplify manufacturing of Li’s lamp with insulative end caps. *Id.*, ¶¶83-84. Li describes that an objective of its invention is “a simple manufacturing process.” EX1005, [0006]. Ono explains that “by forming the insulator 25 from the end portion of the tube 20 and the cap 21a, a *separate insulating member is not required*, the number of parts can be reduced, and assembly is *more efficient*.” EX1006, [0030]. Thus, a POSITA would have been motivated to implement Ono’s known end cap structure to reduce the number of parts and improve the efficiency of assembly with a reasonable expectation of success. EX1003, ¶84.

For similar reasons, a POSITA would have been motivated to implement Holec's manufacturing techniques to understand how to join the Li-Ono drive circuit PCB to the substrate 310 of the light strip to ensure that electricity from the drive circuit was supplied to the LEDs on the light strip. EX1003, ¶81. Both Li and Ono describe a PCB at the end of an LED light strip, but do not describe how the PCB 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 PCBs. EX1003, ¶81. Holec describes joining two circuit boards together by soldering together conductive pads on each board. EX1020, 9:13-14, 9:47-50. Holec describes that using the disclosed manufacturing techniques that "is desirable for several reasons, not only for ease of assembly, but also for the structure, appearance and reliability of the connection." EX1020, 5:5-7. Thus, a POSITA would have been motivated to use Holec's manufacturing process to improve manufacturing efficiency and reliability, a goal of both Li and Ono. EX1005, [0006], [0029]; EX1006, [0030-0031].

Obvious to Try. Moreover, a POSITA would have found it obvious to try implementing Ono's PCB structure with Li's drive circuit because there were a finite number of identified, predictable solutions a POSITA would have pursued. EX1003, ¶83. For example, Li teaches that the "strip substrate" where the driver circuit is mounted is preferably a "double-sided printed circuit board." EX1005, [0021]. Li

further describes that “[t]he driver power supply module 330 can adopt circuits with various topological structures[]” *Id.*, [0109]. Ono likewise describes a double-sided PCB with electronic components such as capacitors and inductors mounted on one surface, and resistors and switches mounted on another surface. EX1006, [0017]; EX1003, ¶83. A POSITA would have recognized a design need for implementing Li’s drive circuit—that was not fully described in Li—and would have looked to Ono’s PCB structure that also taught a double-sided PCB but with a particular arrangement of components. EX1003, ¶83. In doing so, a POSITA would have expected this implementation to be successful and yield predictable results based on the stability of the technology and straight-forward implementation of the technology in Ono. *Id.*

Similarly, a POSITA would have found it obvious to try implementing Holec’s circuit board joining techniques to join Li’s LED light strip to the Li-Ono drive circuit. *Id.*, ¶87. Li teaches that “the components of the drive circuit module 330 are arranged at two ends of the substrate 310,” but does not disclose how to accomplish this arrangement. EX1005, [0100]. Holec discloses a soldering method for joining two circuit boards. EX1020, Abstract. Li’s drive circuit and substrate are examples of PCBs. EX1003, ¶83. A POSITA would have recognized a design need for attaching Li’s drive circuit to the substrate—that was not fully described in Li—and would have looked to Holec’s joining method that also taught joining circuit

boards in an LED lamp. *Id.*, ¶87. In doing so, a POSITA would have expected this implementation to be successful and yield predictable results based on the stability of the technology and straight-forward implementation of the technology in Holec. *Id.*

Simple Substitution. A POSITA would have understood that the substitution of (1) Ono's known PCB structure for Li's drive circuit; (2) Ono's insulating end-caps for Li's end covers; and (3) Holec's joining method to join the PCBs of the drive circuit and LED light strip would have predictable results. *Id.*, ¶86. As discussed above, Li describes a double-sided PCB that is preferably used for its drive circuit (EX1005, [0021]) and Ono describes that its lighting circuit 24 is a double-sided PCB with a particular configuration of well-known components (EX1006, [0017]). EX1003, ¶86. Because both Li's drive circuit and Ono's lighting circuit 24 serve the same function of providing power to LEDs using a double-sided PCB, (EX1006, [0017]; EX1005, [0082]), a POSITA would have understood that Ono's teachings of arranging components on a double-sided PCB could be used to implement Li's drive circuit. EX1003, ¶86. Similarly, both Li and Ono describe end caps to enclose the end of a glass tube and provide external electrical connection. EX1006, [0013]; EX1005, Abstract. Thus, a POSITA would have understood that the simple substitution of Ono's PCB structure and end caps for Li's drive circuit and end covers would have predictable results. EX1003, ¶86. Further, Li's drive

circuit (including Ono's PCB structure) and Li's LED substrate are both circuit boards that need to be joined. *Id.*, ¶87. Because Holec also describes joining circuit boards in an LED lamp, a POSITA would have understood that the simple substitution of Holec's joining methods could be used in the Li-Ono lamp. *Id.*

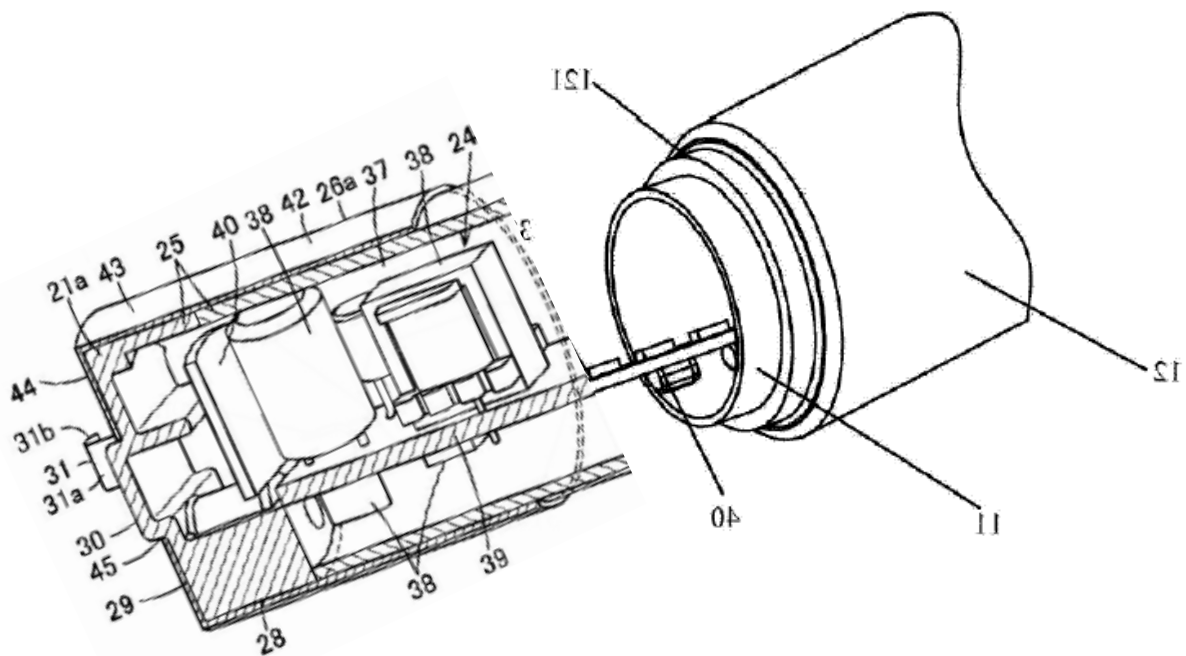
Expectation of Success. A POSITA would have reasonably expected success in implementing Ono's lamp-end configuration in the ends of Li's LED lamp. *Id.*, ¶85. First, Ono successfully implements its own lamp-end configuration in an identical application, *i.e.*, an LED lamp bulb for replacement of a conventional fluorescent bulb. *Id.* And Ono's structure, which uses a dual-sided PCB, is also consistent with the express teachings of Li, namely that Li also teaches that "[p]referably, . . . the strip substrate is a[] . . . double-sided printed circuited board [PCB]." EX1005, [0021]. Ultimately, a POSITA would have understood that Ono's lamp-end configuration could readily be incorporated into Li's LED lamp. EX1003, ¶¶86-87. The technology for installing electronic components on a PCB was well developed, and such an installation would have been a straight-forward implementation of known technology. *Id.* As such, a POSITA would have reasonably expected to be successful in making the combination. *Id.*

Additionally, a POSITA would have reasonably expected to be successful in using Holec's joining method with Li-Ono's circuit boards. *Id.*, ¶88. Holec successfully implements its joining method in the same application—LED lamps.

Id., ¶87. And the technology for using soldering joints in circuit boards was well understood and such use in the Li-Ono lamp would have been a straight-forward implementation of known technology. *Id.*

5. *Modification of Li with Ono and Holec*

The Li-Ono-Holec LED lamp includes Li's LED lamp with Ono's lighting circuit PCB and insulated end caps. EX1003, ¶¶ 89-115.



Li FIG. 3
(Modified per Li-Ono-Holec)

EX1005, FIG. 3; EX1006, FIG. 1; EX1003, ¶89.

Ono's lighting circuit PCB is connected to Li's LED substrate using Holec's method of soldering circuit board sections together.

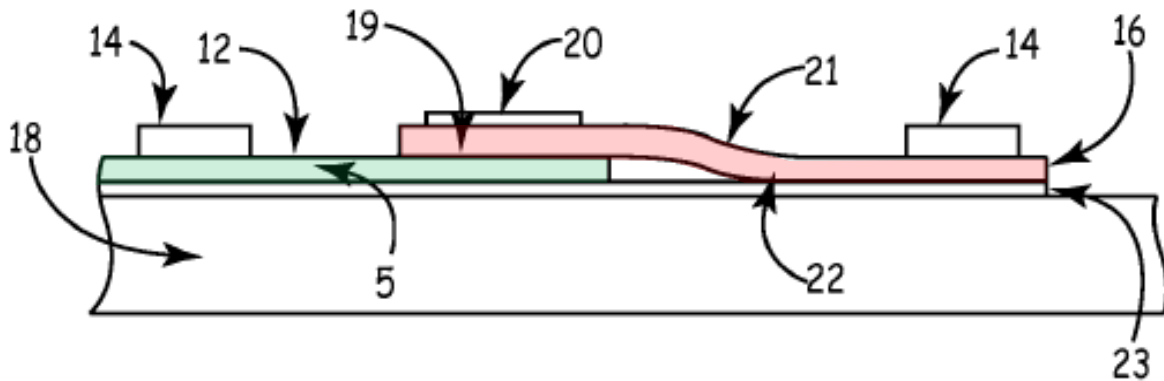


FIG. 5

EX1020, FIG. 5; EX1003, ¶90.

6. Element-by-Element Analysis

(a) Limitation 13[p]

Li-Ono-Holec renders obvious an LED tube lamp. EX1003, ¶91. Li describes an “LED fluorescent lamp 1 shown in Fig. 1 comprises a tube body 10, a pair of end covers 21 & 22 located at two ends of the tube body 10, and an LED driver power supply 30 located inside the tube body 10,” as shown in Figure 1.

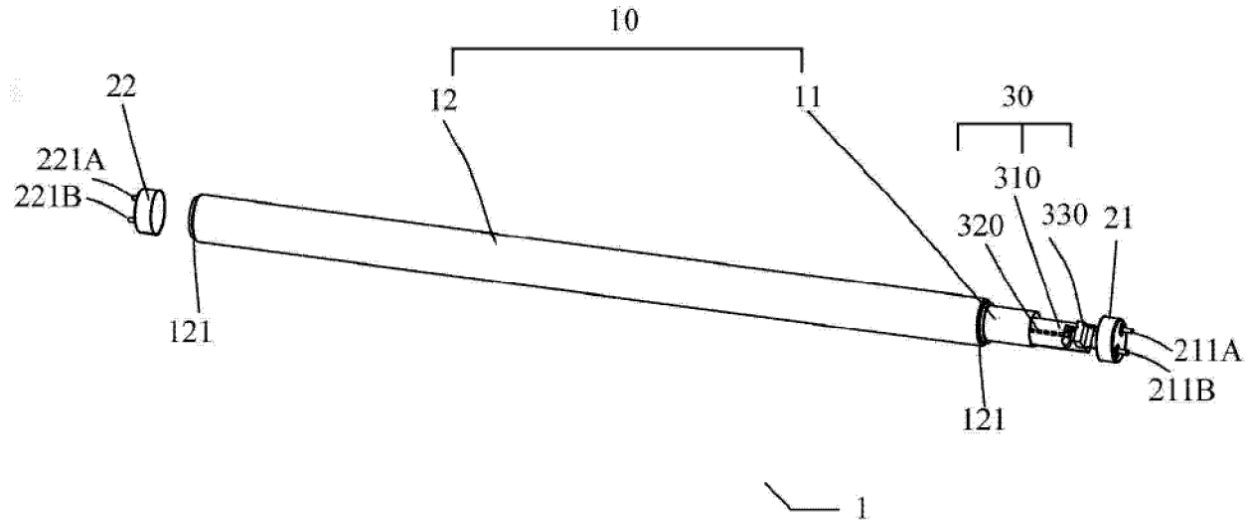


Fig. 1

EX1005, [0088]; FIG. 1; EX1003, ¶91.

(b) *Limitation 13[a]*

Li-Ono-Holec renders obvious a glass tube with two ends. EX1003, ¶92. The LED lamp tube body “comprises an [red] inner tube 11 and an [green] outer tube 12 sleeved outside the inner tube 11 and they may be made of a glass material,” as shown in Figure 1, and both the inner and outer tubes have ends.

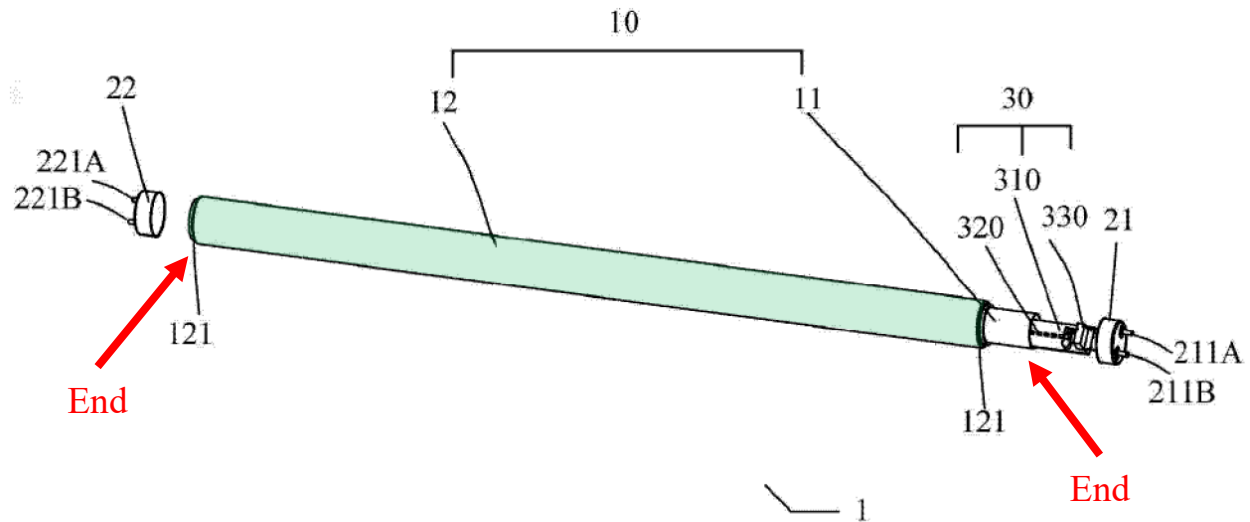


Fig. 1

EX1005, [0089], FIG. 1; EX1003, ¶92.

(c) Limitation 13[b]

Li-Ono-Holec renders obvious an LED light strip inside the glass tube. EX1003, ¶93. Inside Li's [red] inner glass tube is "a plurality of LED units 320 are arranged longitudinally along the [purple] substrate 310." EX1005, [0098]. "The substrate 310 of the LED power supply 30 is fixed to the inside of the inner tube 11" using "a silicone-like adhesive, for example." *Id.*, [0097].

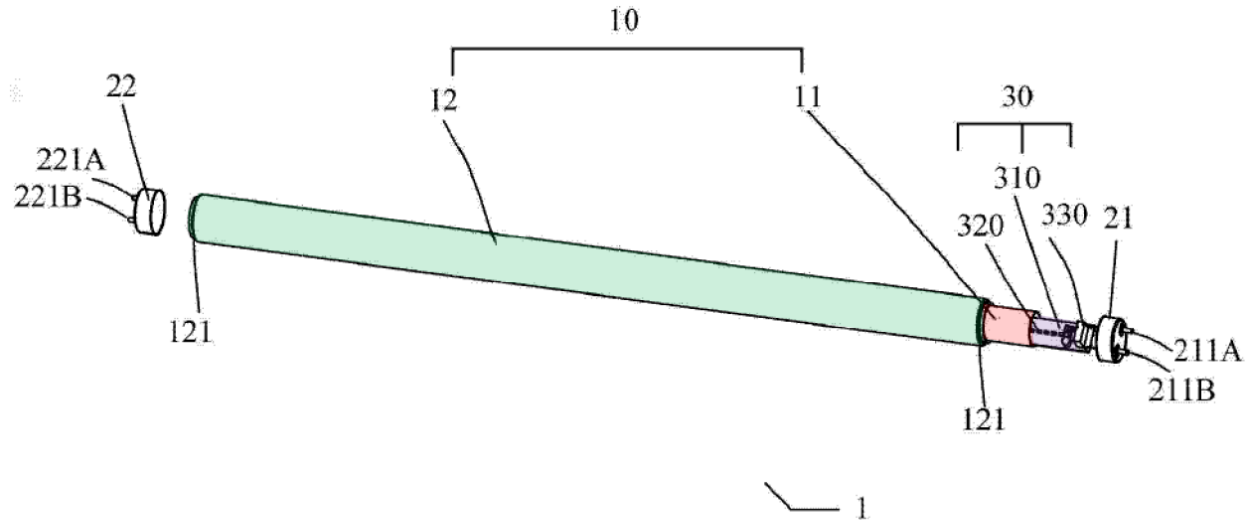
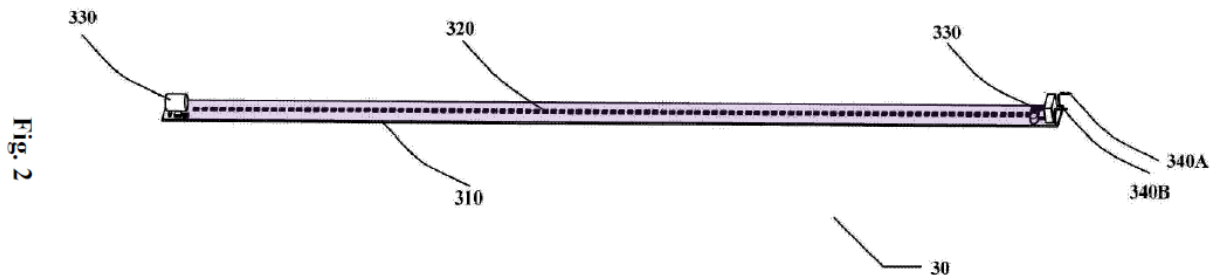


Fig. 1

EX1005, FIG. 1; EX1003, ¶93.

(d) Limitation 13[c]

Li-Ono-Holec renders obvious multiple LED light sources mounted on the LED light strip. EX1003, ¶94. Li's substrate includes "a plurality of LED units 320 [] arranged longitudinally along the [purple] substrate 310."



EX1005, [0098], FIG. 2; EX1003, ¶94.

(e) *Limitation 13[d]*

Li-Ono-Holec renders obvious a power supply connected and providing power to the LED light sources. EX1003, ¶95. Li's LED lamp includes an [orange] LED drive circuit module. EX1005, Abstract. The “drive circuit module, which is arranged at one or two ends of the strip substrate and electrically connected to the LED units and the plugs.” *Id.*

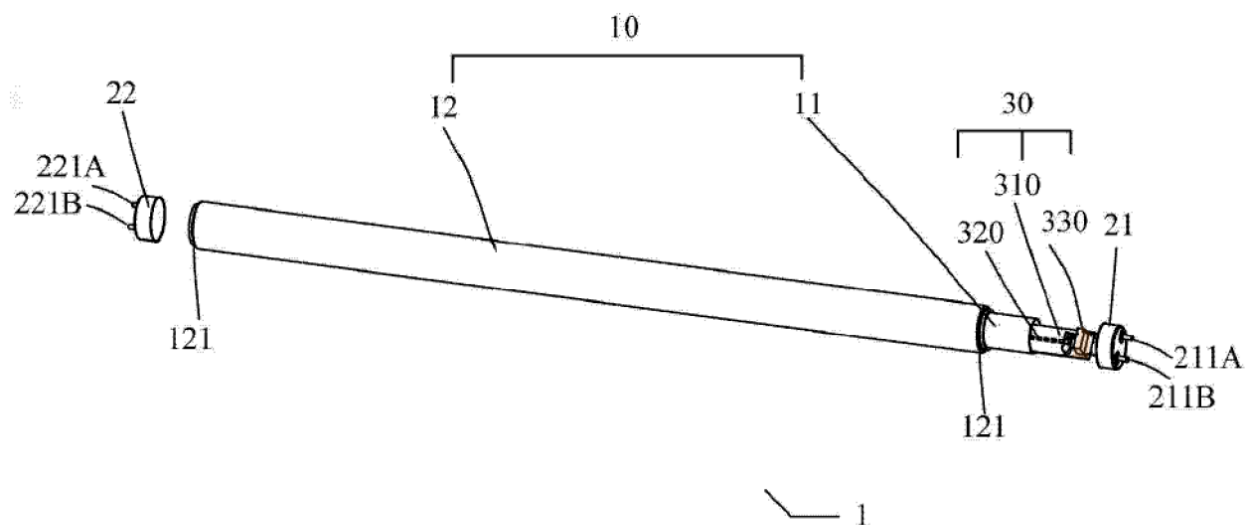


Fig. 1

EX1005, FIG. 1; EX1003, ¶95.

The drive circuit module is “connected between an alternating current (AC) or direct current (DC) power supply outside the lighting device and the light emitting diode as a light source, and is used to provide the required current or voltage (e.g., constant current, constant voltage or constant power) to the light emitting diode.”

EX1005, [0082]; EX1003, ¶96.

(f) *Limitation 13[e1]*

Li-Ono-Holec renders obvious end caps attached to each end of the glass tube, each having lateral and end walls. EX1003, ¶97. Li's LED lamp includes [blue] end caps 21 and 22. EX1005, FIG. 1. "[T]he end covers 21 and 22 [] enclose the two ends of the inner tube 11." *Id.*, [0092]. Each end cap has a lateral wall substantially coaxial with the tube and an end wall perpendicular to the axial direction of the lateral wall. EX1005, [00092]; EX1003, ¶97. The end wall is positioned away from the glass tube.

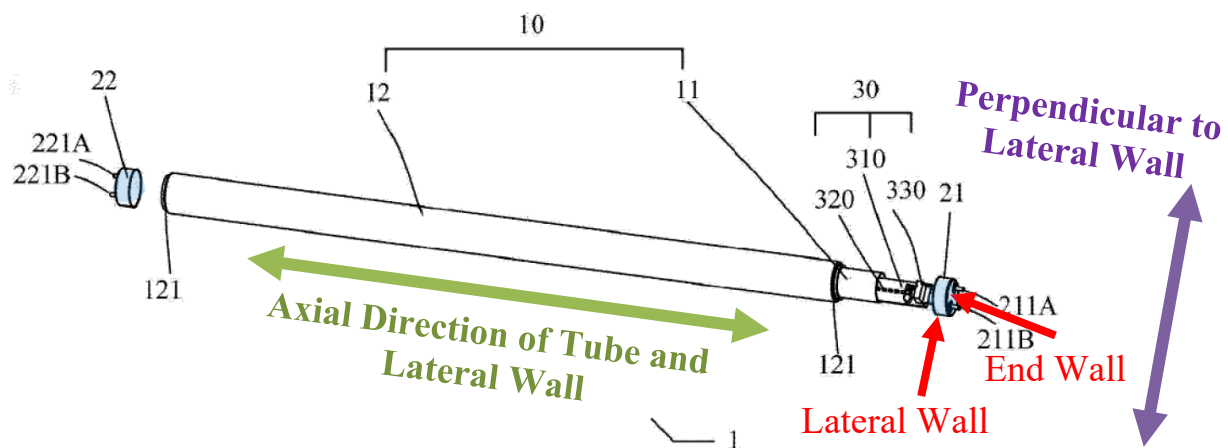


Fig. 1

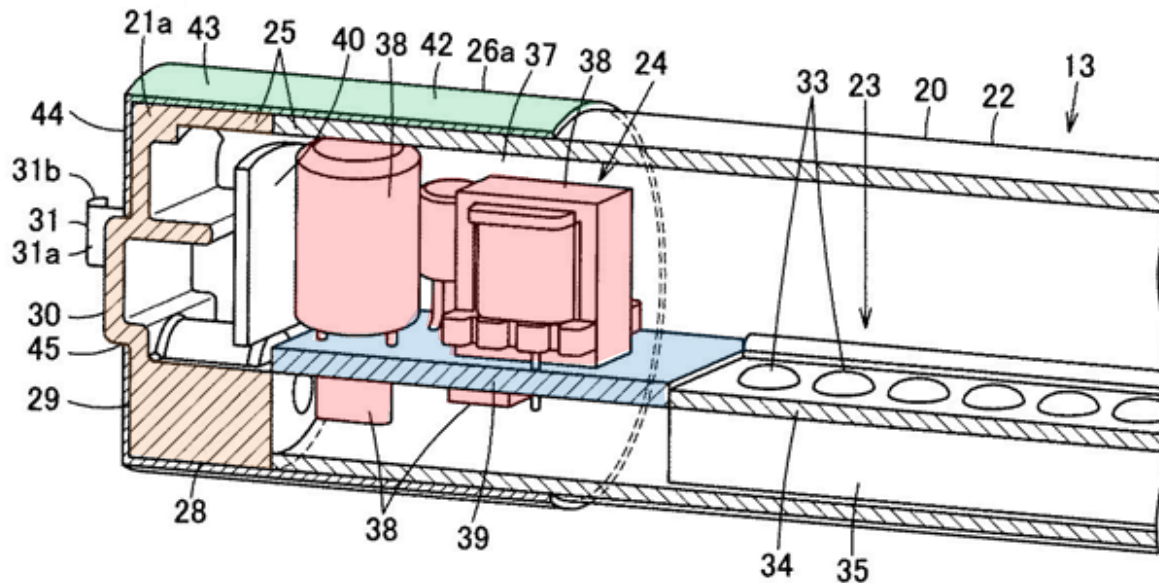
EX1005, Abstract, FIGs. 1-2; EX1003, ¶97.

Ono similarly describes a cap 21a formed of a resin insulating material. EX1006, [0018], [0030]; *see also* EX1006, [0041]-[0044], FIGS. 1, 7; EX1003, ¶98. The 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.”

EX1006, [Solution].

[Fig. 1]



EX1006, FIG. 1; EX1003, ¶98.

(a) Limitation 13[e2]

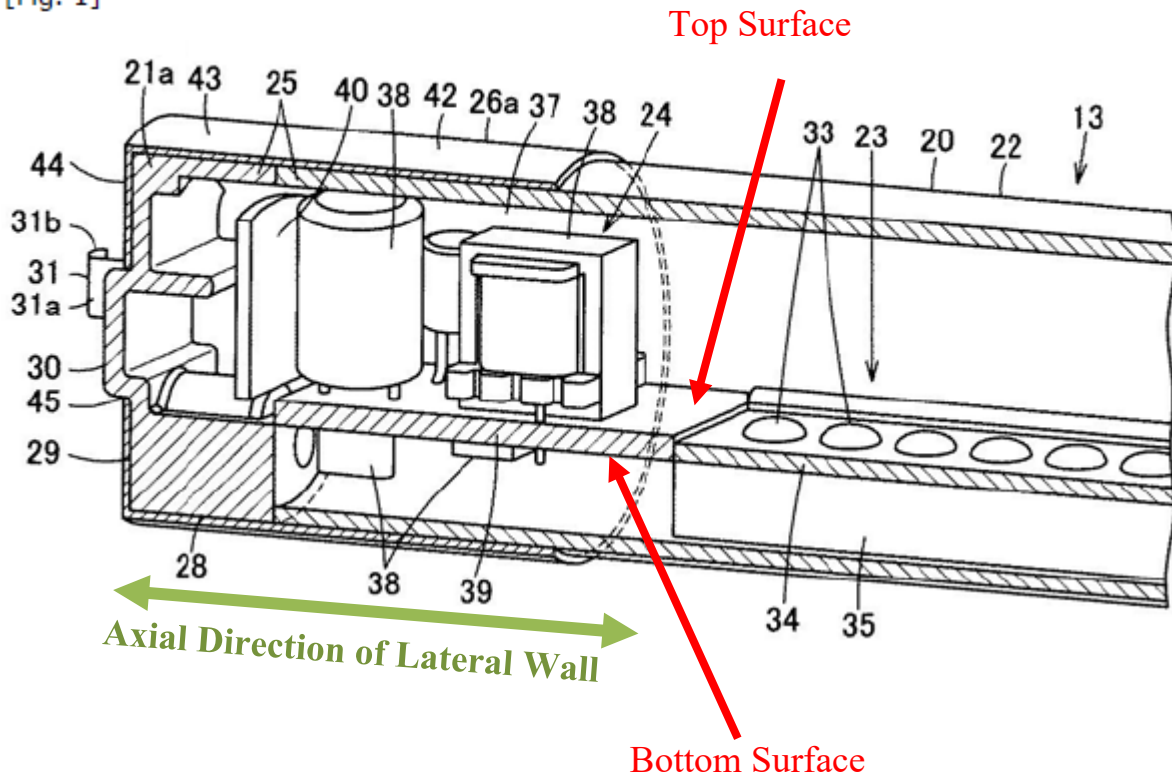
Li-Ono-Holec renders obvious an end wall made of an insulating material. EX1003, ¶99. Li is silent on the material that forms end caps 21 and 22. As explained in Section IX.A.5, a POSITA would have been motivated to look to other LED lighting references, such as Ono, to determine the materials that could be used as end caps. *Id.* Ono describes a cap 21a formed of a resin material. EX1006, [0018]. The resin material is an insulating material. EX1006, [0018], [0030]; *see also* EX1006, [0041]-[0044], FIGS. 1, 7; EX1003, ¶99.

(b) *Limitation 13[f]*

Li-Ono-Holec renders obvious a power supply formed of a PCB having two parallel surfaces on which electronic components are mounted and positioned parallel with the axial direction of the lateral wall of the end cap. EX1003, ¶100. Li discloses an LED drive circuit module 330 but does not describe the physical structure of the drive circuit. *Id.* As explained above in Section IX.A.4, a POSITA would have been motivated to look to Ono to understand the physical implementation of the circuits described in Li. *Id.*, ¶101. Ono describes a lighting circuit 24 that “has a circuit board 39 on which a plurality of electronic components 38 have been mounted. Lead 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.” EX1006, [0017].

As shown in Figure 1, Ono’s PCBs have a top and bottom surface parallel to each other. EX1006, FIG. 1; EX1003, ¶102. The PCB is arranged substantially parallel with the axial direction of the lateral wall of the end cap.

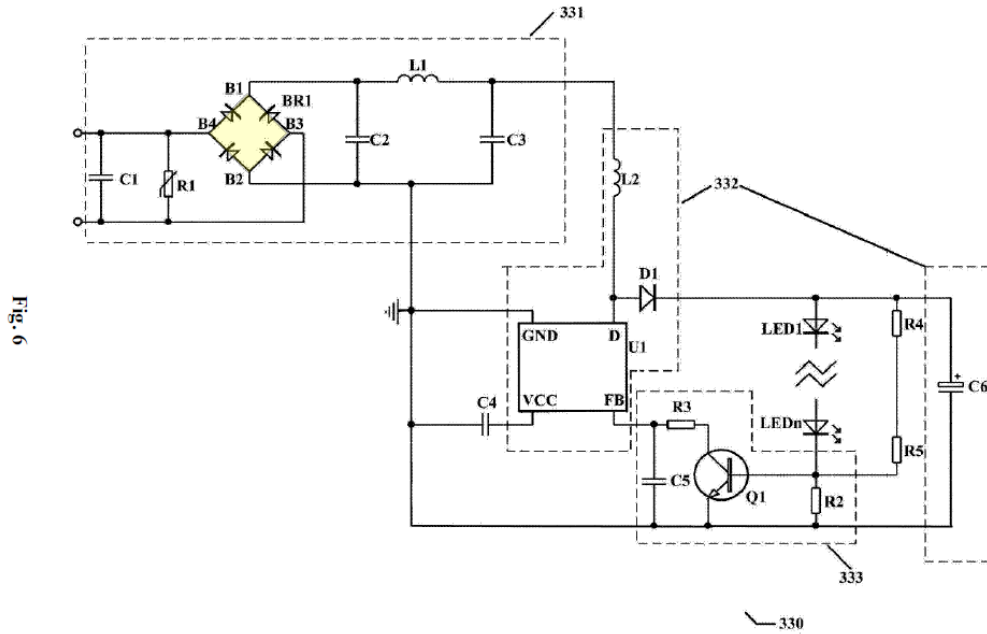
[Fig. 1]



EX1006, FIG. 1; EX1003, ¶102.

(c) *Limitation 13[g1]*

Li-Ono-Holec renders obvious a rectifying circuit with two input terminals configured to rectify the signal received at the input terminals. EX1003, ¶103. Li describes that the drive circuit 330 includes “a [yellow] full-wave bridge rectifier BR1.” EX1005, [0113]. A POSITA would have understood that the bridge rectifier BR1 rectifies the signal input into its input terminals. EX1003, ¶103 (citing EX1015).



EX1005, [0113], FIG. 6; EX1003, ¶103.

(d) Limitation 13[g2]

Li-Ono-Holec renders obvious a filtering circuit electrically connected to the rectifying circuit, under the proper construction of “electrically connected.” EX1003, ¶104; *see* Section VIII.E.1. Li describes that the drive circuit 330 includes a [green] filter circuit formed of an inductor L1 and capacitors C2 and C3.

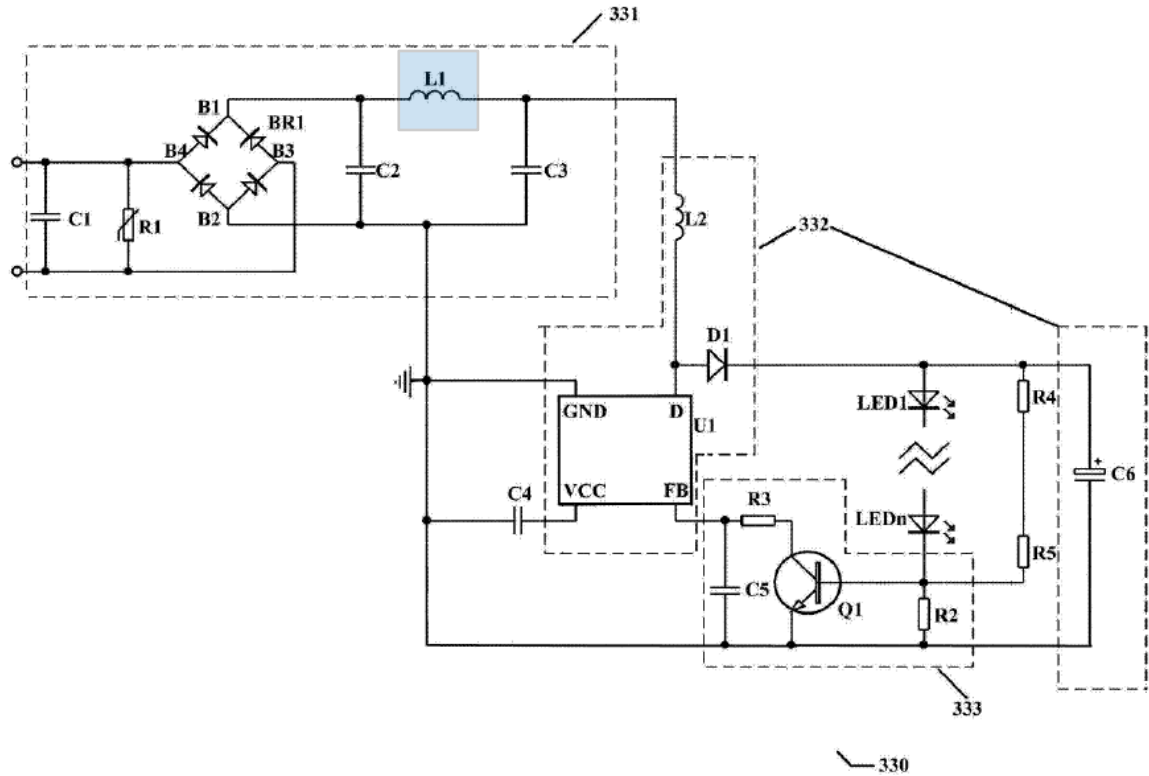


EX1005, [0113], FIG. 6; EX1003, ¶104.

(e) *Limitation 13[h]*

Li-Ono-Holec renders obvious a resistor located closest to the end wall of an end cap and connected to an input of the rectifying circuit. EX1003, ¶105. Li describes a varistor R1 located between the AC inputs of the drive circuit 330. EX1005, [0115]. A POSITA would have understood the AC input of the drive circuit to be the conductive pins in the end wall at one end of the tube lamp and thus varistor R1 is close to the end wall. EX1003, ¶105. The varistor R1 is also connected to an input of the rectifying circuit, specifically to input terminals B3 and B4 of the full bridge rectifier BR1.

Fig. 6



EX1005, [0115], FIG. 6; EX1003, ¶105.

The location of the varistor R1 closest to the end wall of the end cap is confirmed by Ono. Ono describes a lighting circuit including “a circuit board 39 on which a plurality of electronic components 38 have been mounted.” EX1006, [0017]. Ono’s resistors are located on the bottom side of the PCB 39. EX1006, [0017] (“[S]urface mounted components such as resistors and switching elements are mounted on the wiring pattern surface.”); EX1003, ¶106. Ono’s capacitors are located on the top of the PCB 39. EX1006, [0017] (“Lead components such as capacitors and inductors are mounted on the mounting surface of the circuit board 39”); EX1003, ¶106. Therefore, when Li’s drive circuit is implemented in a PCB as

described by Ono, the capacitor C1 is mounted on the top of the PCB and varistor R1 is mounted on the bottom and a POSITA would have understood that both the capacitor C1 and the varistor R1 are located closest to the end wall of the end cap. EX1003, ¶106.

Finally, a POSITA would have understood that it would be advantageous to place the resistor, a heat-generating element, near the end cap to dissipate heat created by the resistor to both cool the resistor and mitigate the impact the heat generated by the resistor on other components of the PCB. *Id.*, ¶107.

(f) Claim 14

Li-Ono-Holec renders obvious an LED light strip with two first soldering pads arranged at one end of the LED light strip, the two first soldering pads respectively electrically connect to two second soldering pads on the printed circuit board. *Id.*, ¶108. Holec describes overlapping circuit boards to provide an interconnection. *Id.*, 9:25-26. This allows a direct connection between two circuit boards. *Id.*, 9:45-65. Specifically, a [red] top board 16 includes conductive pads 7 and a [green] bottom board 12 includes conductive pads 8. *Id.*, 9:47-50. The conductive pads 7 and the conductive pads 8 are soldered directly to one another. *Id.* In this way, the top board 16 and bottom board 12 are electrically connected. *Id.*, 9:3-9.

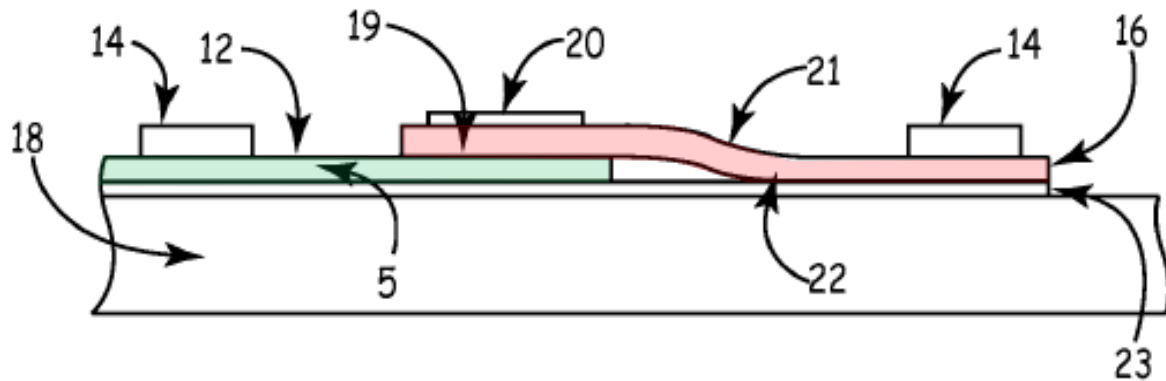


FIG. 5

Id., FIG. 5; EX1003, ¶108.

In Li-Ono-Holec, the LED light strip is formed of a substrate onto which LEDs are attached. EX1005, [0098]. And, as explained above, the power supply is formed on a PCB. *See* Section IX.A.6(b), *supra* (Limitation 13[f]). Both the LED light strip and the power supply's PCB include conductive pads, as described in Holec. EX1003, ¶109. Solder is used to couple the conductive pads on each board such that the LED light strip and power supply PCB are electrically connected. *Id.*, ¶109.

(g) Claim 15

Li-Ono-Holec renders obvious a power supply PCB disposed on an end of the LED light strip. *Id.*, ¶110. Li's LED lamp includes an [orange] LED drive circuit module 330. EX1005, Abstract. The "drive circuit module, [] is arranged at one or

two ends of the strip substrate and electrically connected to the LED units and the plugs.” *Id.*

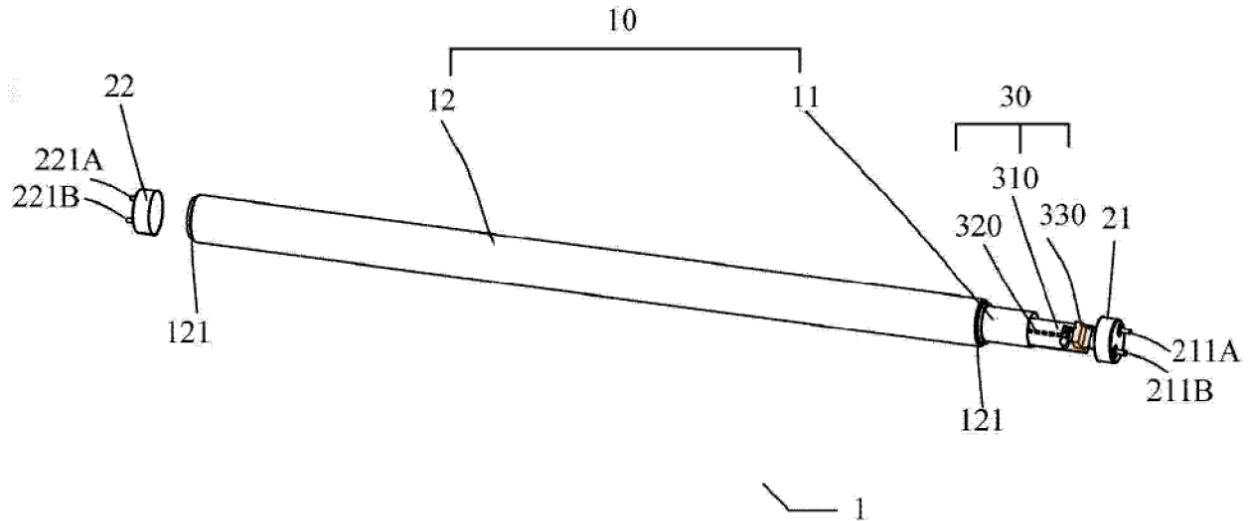


Fig. 1

EX1005, FIG. 1; EX1003, ¶110. As explained above, the power supply is a PCB. See Section IX.A.6(b), *supra* (Limitation 13[f]).

Further, when the power supply PCB is joined to the light strip, the conductive pads on the power supply PCB are directly soldered to the conductive pads on the light strip such that the power supply PCB is disposed on the end of the light strip. See Section IX.A.6(f), *supra* (Claim 14); EX1003, ¶111.

(h) Claim 16

Li-Ono-Holec renders obvious the two first soldering pads being arranged on the end of the LED light strip on which the PCB is disposed. EX1003, ¶112. As

explained above, the LED light strip is electrically connected to the power supply PCB via conductive pads (“soldering pads”). *See* Section IX.A.6(f) (Claim 14).

In the Li-Ono-Holec lamp, the conductive pads are on one end of Li’s LED light strip such that they are near the power supply PCB. EX1003, ¶113. For example, as shown in Holec, the conductive pads on each board are positioned on the ends of the boards such that the ends of the boards overlap slightly to make the connection between the boards when the conductive pads are joined using solder. EX1020, 9:45-12; *see also id.*, claim 1 (“each circuit board comprising a distal end having a first electrically conductive pad located on a top of the circuit board”).

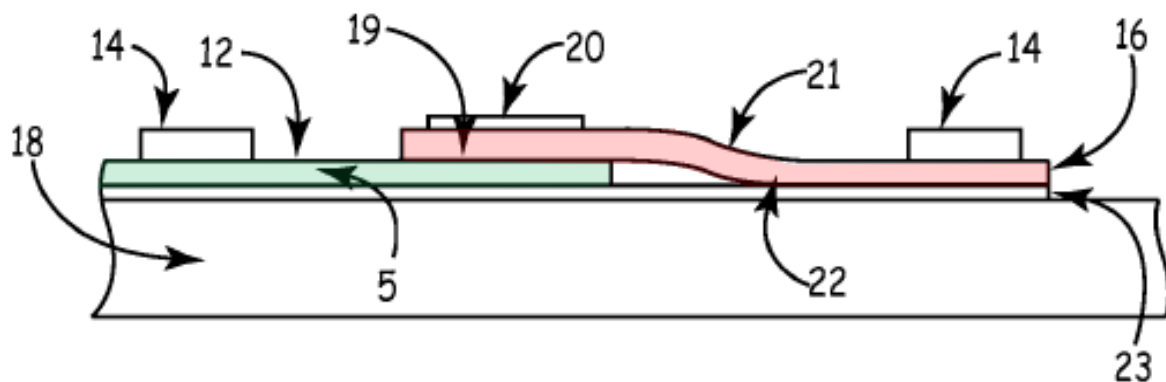


FIG. 5

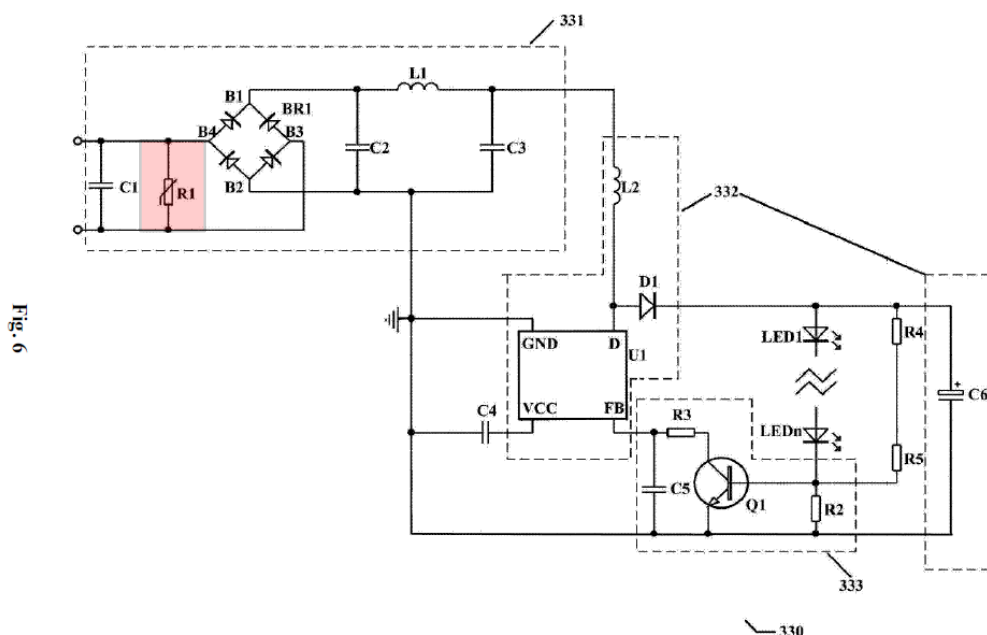
Id., FIG. 5; EX1003, ¶112.

(i) Claim 17

Li-Ono-Holec renders obvious each end cap including two conductive pins connected to the insulating portion of the end cap and the resistor electrically

connected between one of the two conductive pins and one of the input terminals of the rectifying circuit or between the two conductive pins. *Id.*, ¶114. Li describes electrode pins 340A/340B at one end of the LED lamp and electrode pins 350A/350B at the other end of the lamp. EX1005, [0100-0101]. These pins extend through the end cap and couple to external AC power. *Id.* Additionally, as explained above, the end wall of the end cap of the Li-Ono-Holec lamp is made of an insulating material such as a resin. *See* Section IX.A.6(a), *supra* (Limitation 13[e2]).

Li describes a [red] varistor R1 located between the AC inputs of the drive circuit 330. EX1005, [0115]. A POSITA would have understood the AC input of the drive circuit to be the conductive pins 340A/340B or 350A/350B in the end wall. EX1003, ¶114. Li also describes that varistor R1 connects to the circuitry that forms the input of the rectifying circuit, specifically to input terminals B3 and B4.



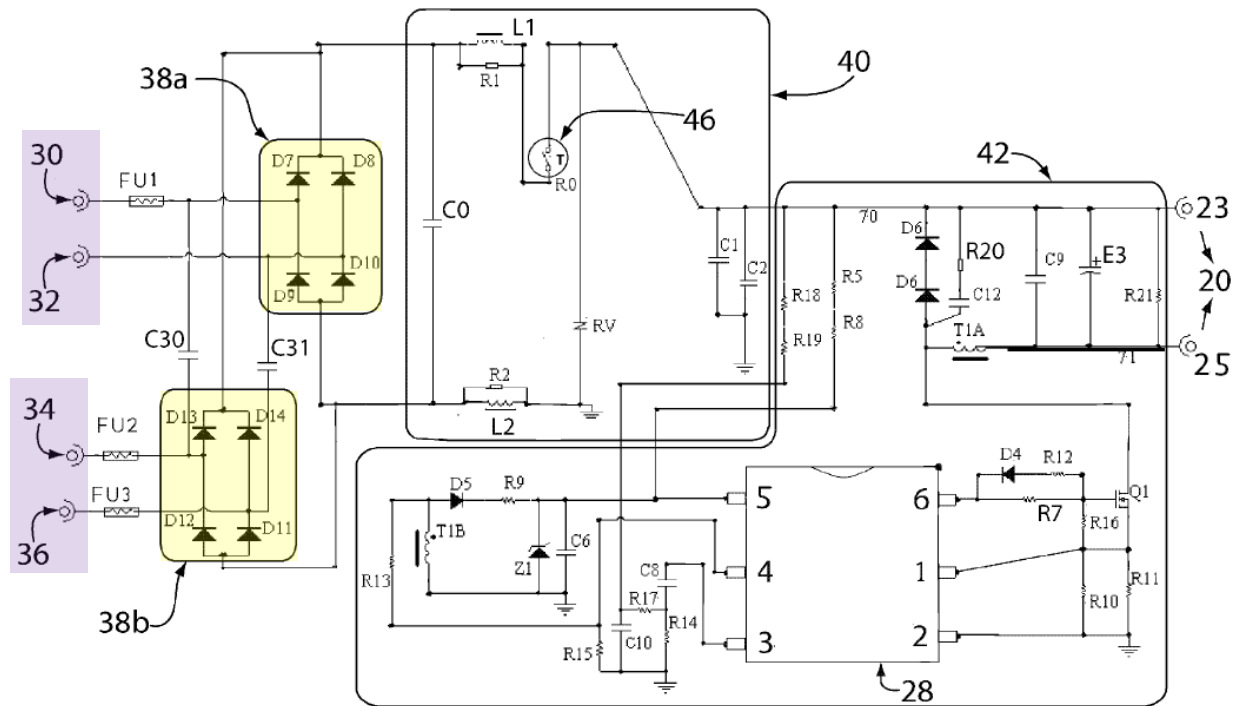
EX1005, [0115], FIG. 6; EX1003, ¶115.

B. Ground 2 - Claims 18-23 are Obvious over Li in view of Ono, Holec, and Guang

1. *Guang*

Guang is titled “LED Tube Driver Circuitry for Ballast and Non-Ballast Fluorescent Tube Replacement.” Guang discloses “[a]n LED lamp tube and driver circuit that is direct replacement for fluorescent tubes with or without ballasts, that works with standard AC high voltage current input, with high frequency pulse current input, or with lower voltage input.” EX1007, Abstract. Guang’s power management circuitry includes two [yellow] rectifier circuits 38a and 38b, each attached to a set of [purple] conductive pins, 30/32 and 34/36. *Id.*, 9:2-8. “Each of the first and second rectifier circuits 38a and 38b has four diodes, which each pass electrical current in only one direction.” *Id.*, 9:28-30.

Fig. 2



EX1007, FIG. 2; EX1003, ¶¶46-47.

2. Motivation to Combine

As explained in Section IX.A.6 for Ground 1, Li-Ono-Holec renders obvious claims 13-17. A POSITA would have also been motivated to further modify Li-Ono-Holec with Guang for each of several independent reasons. EX1003, ¶¶116-145.

Li teaches a pair of pins 340A and 340B on one end of the tube lamp that are connection to an external AC power source. EX1005, [0100]. Li also teaches an optional embodiment with a second pair of pins 350A and 350B on the opposite end of the tube lamp. *Id.*, [0101]. Including the optional pins 350A/350B, “can greatly

facilitate installation of the LED fluorescent lamp.” *Id.*, [0102]. Li further describes a drive circuit module on each end of the tube lamp connected to the pins 340A/340B and 350A/350B, respectively. *Id.*, [0100-0101]. But Li describes that when the lamp is installed in a lamp holder, one side is connected to a live line while the other is shorted. *Id.*, [0105]. Further, when describing the drive circuit module of Figure 6, Li explains that it is a “schematic circuit diagram of a drive circuit module contained in the LED driver power supply shown in Fig. 2” and Figure 2 illustrates the embodiment without the optional pins 350A/350B. *Id.*, [0111]. Therefore, a POSITA would have been motivated to modify the drive circuit module of Figure 6 such that it includes optional pins 350A/350B and would have been motivated to include two bridge rectifying circuits, like those disclosed in Guang, so that both sets of pins in the Li LED lamp can be used—*i.e.*, so that operability of the replacement bulb would not depend on orientation of the bulb in a given lamp fixture. EX1003, ¶117.

A POSITA would have understood that different types of lamp holders existed and it would have been desirable to have both ends of the LED lamp able to receive power. EX1007, 8:57-67 (referring to Figure 2 “showing how power can be supplied through either or both pairs of electrode pins”); EX1003, ¶118. By incorporating aspects of Guang’s power management circuitry into Li-Ono-Holec, a POSITA could have recognized the benefits provided by Guang. EX1003, ¶119. Specifically,

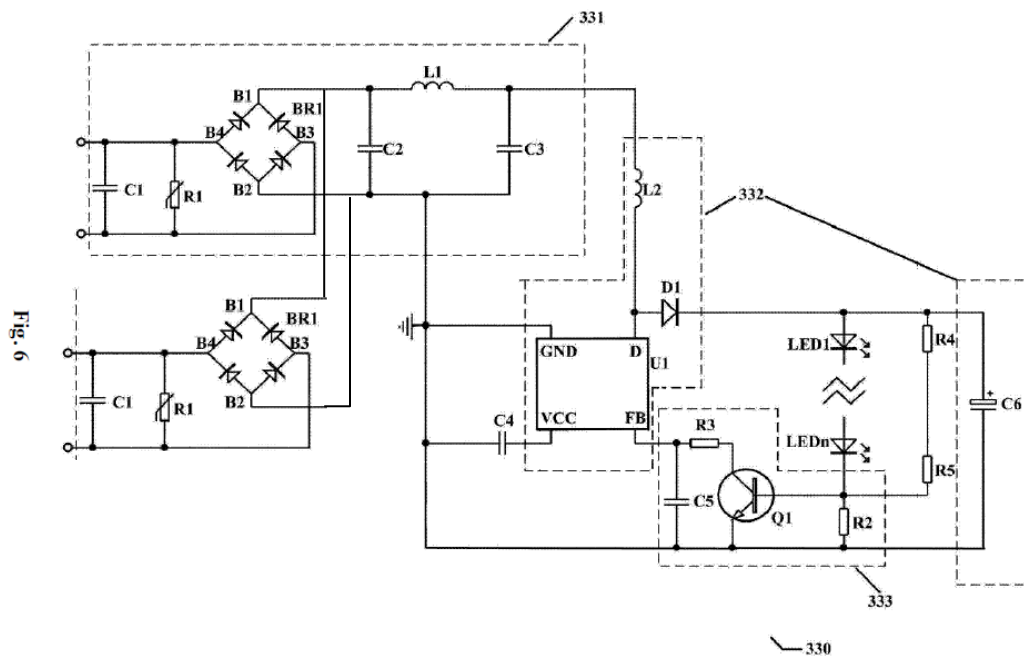
Guang's "driver circuit is versatile in handling a variety of electrical current conditions present among various fluorescent lamp fixtures" including "whether the socket is shunted or non-shunted;" whether the lamp fixture "has a ballast delivering modified AC current to the socket, whether there is bare line voltage (e.g., 110V AC) present at the socket, or whether there is an AC-DC transformer already wired into the fixture for a previous LED conversion." EX1007, 9:51-10:11. The arrangement of Guang's diodes in its rectifier circuit also "allows that the electrode pins from which the input power is received can be any two of the tube's four electrode pins" *Id.* A POSITA would have understood that by integrating the diodes from Guang's rectifier circuit into Li-Ono-Holec by placing a bridge rectifier circuit at each set of conductive pins, the compatibility of the LED lamp with conventional lamp holders would have been increased. EX1003, ¶119.

Li already discloses a bridge rectifier circuit, BR1, in the drive power module. EX1005, [0115]. A POSITA would have expected that including a second bridge rectifier circuit at a second set of pins would be successful because to do so was an implementation of known components already existing in the drive power module in exactly the same way, just at another, second location. EX1003, ¶120. No other changes to the circuit would be required as both bridge rectifier circuits are connected to the downstream portions of the drive circuit, *i.e.*, the filtering circuit, DC-DC boost conversion unit 332, and feedback unit 333. *Id.*

Finally, a POSITA would have reasonably expected to successfully incorporate a second bridge rectifying circuit into Li-Ono-Holec's LED lamp, at least because bridge rectifying circuits were known in the art, and because Guang successfully uses them in the same field—*i.e.*, rectifying circuits for LED lamps. EX1007, 9:2-21; EX1003, ¶120.

3. Combined Li-Ono-Holec-Guang Tube Lamp

Modification of Li-Ono-Holec to include the two bridge rectifying circuits, as described by Guang, would supplement the single bridge rectifying circuit of Li. EX1003, ¶121. This modification would allow a bridge rectifying circuit to be electrically connected to each set of conductive pins located on opposite sides of the LED tube lamp. *Id.*



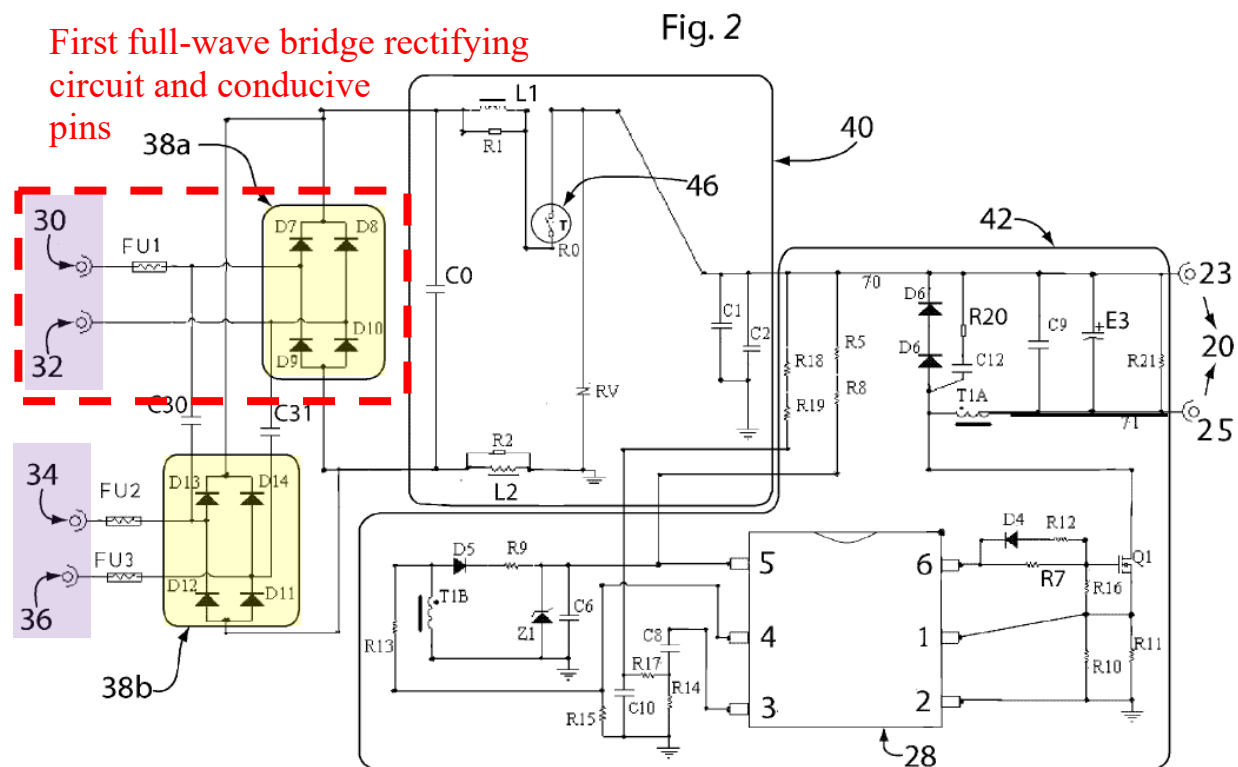
(Modified per Li-Ono-Holec-Guang)

EX1005, FIG. 6; EX1007, FIG. 2; EX1003, ¶121.

4. *Element-by-Element Analysis*

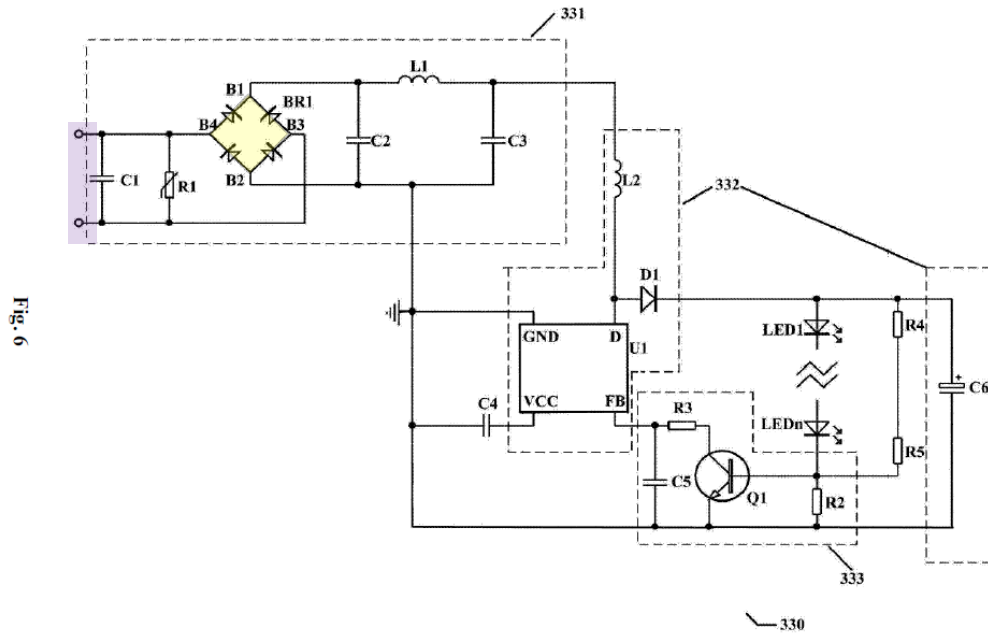
(a) *Limitation 18[a]*

Li-Ono-Holec-Guang renders obvious a first full-wave bridge rectifying circuit, with positive and negative output terminals, connected to one set of conductive pins. EX1003, ¶122. Guang describes a [yellow] full-wave bridge rectifying circuit 38a connected to a [purple] set of conductive pins 30, 32.



EX1007, 9:2-8, FIG. 2; EX1003, ¶122. Full-wave bridge rectifying circuit 38a has positive and negative output terminals. EX1007, 9:39-50.

Likewise, Li discloses a [yellow] full-wave bridge rectifying circuit, BR1, connected to a [purple] set of conductive pins, and has output positive terminal B1 and output negative terminal B2.



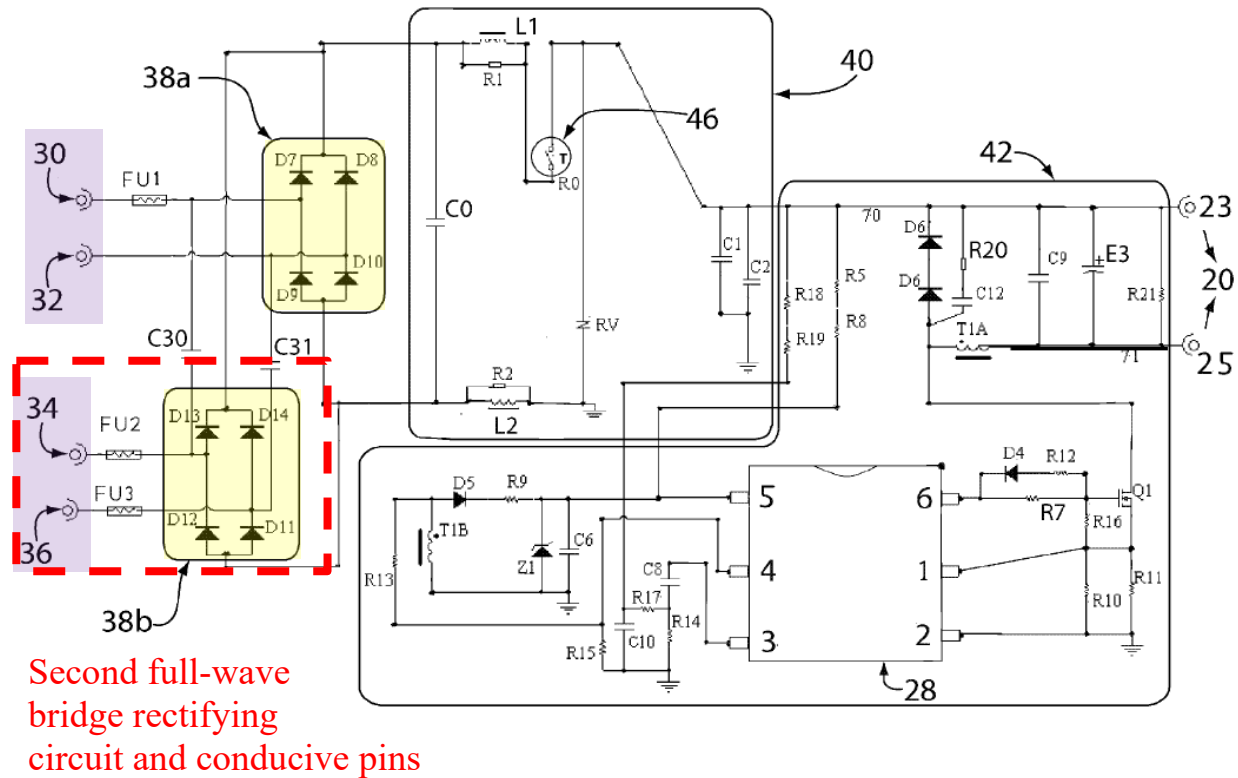
EX1005, [0113], FIG. 6; EX1003, ¶123.

(b) Limitation 18[b]

Li-Ono-Holec-Guang renders obvious a second full-wave bridge rectifying circuit, with positive and negative output terminals, connected to the other set of conductive pins. EX1003, ¶124. While Li does not disclose a second full-wave bridge rectifying circuit, Li does disclose a second set of conductive pins. EX1005, [0101]. As explained above, it would have been obvious to a POSITA to include Guang's second full-wave bridge rectifying circuit connected to Li's second set of conductive pins. See Section IX.B.2; EX1003, ¶124. Specifically, Guang describes

a [yellow] full-wave bridge rectifying circuit connected to a [purple] set of conductive pins and positive and negative output terminals.

Fig. 2

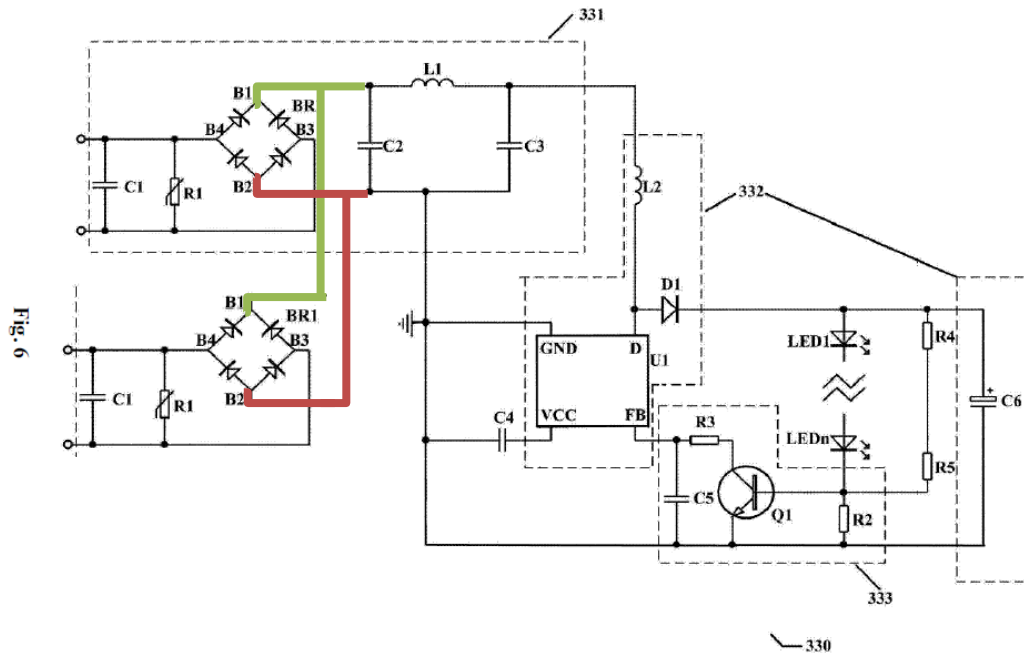


EX1007, 9:2-8, 9:28-30, 9:39-50, FIG. 2; EX1003, ¶124.

(c) *Limitation 18[c]*

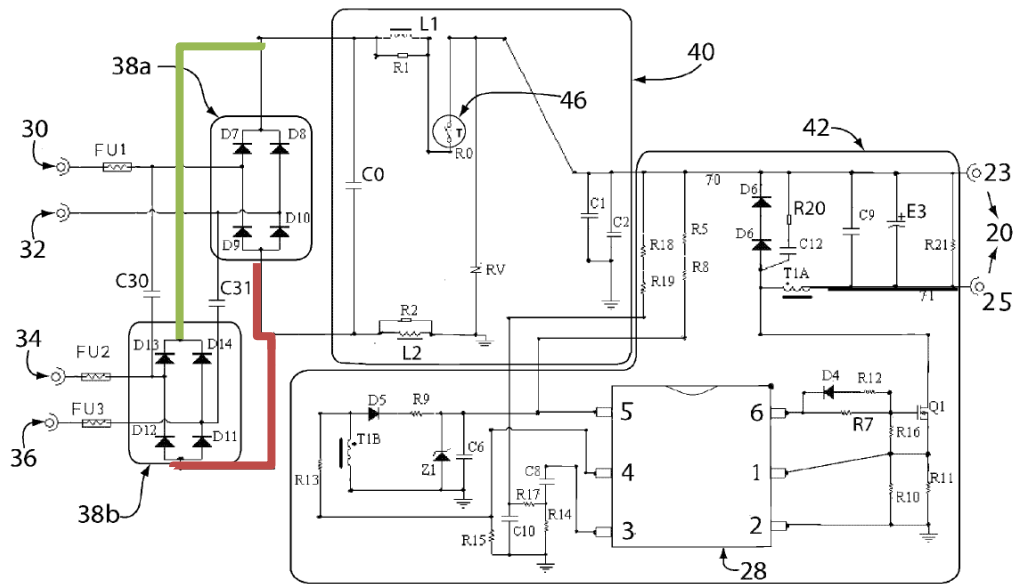
Li-Ono-Holec-Guang renders obvious a circuit where the positive output terminals of the two full-wave bridge rectifying circuits are electrically connected and the negative output terminals of the two full-wave bridge rectifying circuits are electrically connected. EX1003, ¶125. In Li-Ono-Holec-Guang, the [green] positive output terminals of both full-wave bridge rectifying circuits are connected to the part

of the circuit near inductor L1 and capacitor C2. *Id.*, ¶125. The [red] negative output terminals are connected in close proximity to capacitor C2. *Id.* Thus, the positive and negative outputs of each full-wave bridge rectifying circuit are electrically connected.

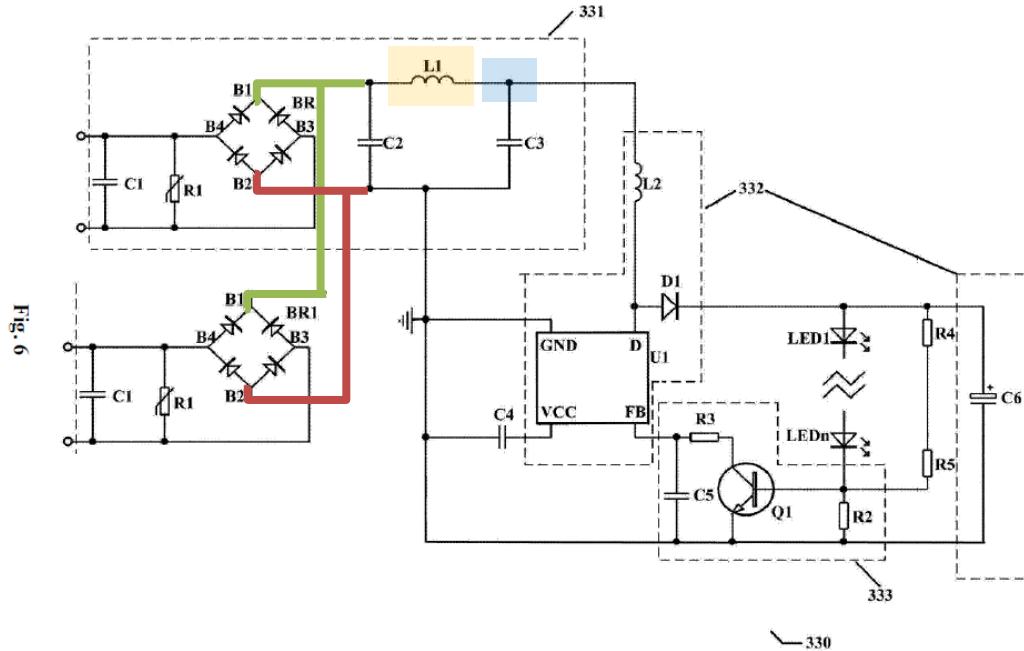


EX1005, FIG. 6 (as modified by Guang); EX1003, ¶¶125-126. This arrangement is confirmed by Guang, which shows, in Figure 2, the [green] positive output terminals of each diode bridge electrically connected and the [red] negative output terminals of each diode bridge electrically connected.

Fig. 2



part of the π -shaped filtering circuit and the output of the inductor L1 is the [blue] output of the filtering circuit. EX1005, [0115]; EX1003, ¶128.



EX1005, FIG. 6 (as modified by Guang); EX1003, ¶128.

(e) *Limitation 19[b]*

Li-Ono-Holec-Guang renders obvious a first capacitor having one end electrically connected to the end of the inductor, and the other end electrically connected to the negative output terminals of the first and second full-wave bridge rectifying circuits. EX1003, ¶129.

Li discloses a [purple] capacitor C2 connected to one end of the inductor L1. EX1005, [0113], [0115], FIG. 6. Additionally, the capacitor C2 is connected to the negative output terminal B1 of the full-wave bridge rectifying circuits. EX1005, [0115]; EX1003, ¶130.



EX1005, FIG. 6 (as modified by Guang); EX1003, ¶131.

(f) *Limitation 19[c]*

Li-Ono-Holec-Guang renders obvious a second capacitor having one end electrically connected to the other end of the inductor and the other end is the other filtering output terminal. EX1003, ¶132.

Li discloses a [purple] capacitor C3 connected to one end the inductor L1—the opposite end of the inductor from which the capacitor C2 is connected. EX1005, [0113], [0115], FIG. 6. Additionally, the output of the capacitor C3 is the [blue] output of the π -shaped filtering circuit. EX1005, [0115]; EX1003, ¶132.



EX1005, FIG. 6 (as modified by Guang); EX1003, ¶133.

(a) *Limitation 20[a]*

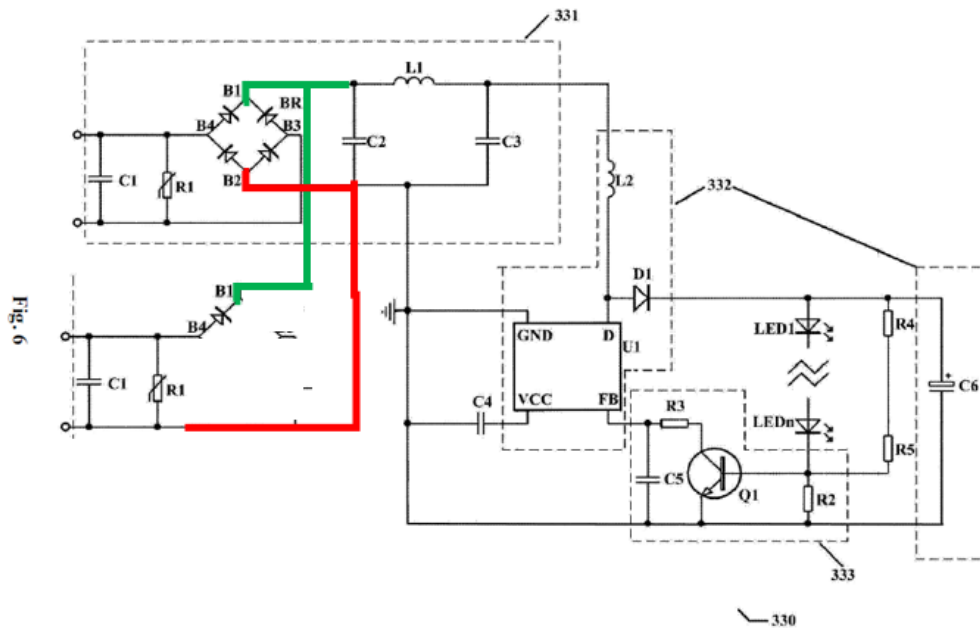
Li-Ono-Holec-Guang describes a full-wave bridge rectifying circuit having two input terminals electrically connected to the two conductive pins of one of the end caps, respectively, and having a positive output terminal and a negative output terminal. EX1003, ¶134; Section IX.B.4(a) (limitation 18[a]).

(b) *Limitation 20[b]*

Li-Ono-Holec-Guang renders obvious a half-wave bridge rectifying circuit having an input terminal electrically connected to one of the two conductive pins of the other one of the end caps, and positive and negative output terminals. EX1003, ¶135.

As explained above, Li-Ono-Holec-Guang discloses a second full-wave bridge rectifying circuit. *See* Section IX.B.4(b) (limitation 18[b]), *supra*. Additionally, Li discloses that the bridge rectifier BR1 is depicted as a full-wave bridge rectifier, but “half-wave rectification is also usable.” EX1005, [0114]. A POSITA would have understood that one of the full-wave bridge rectifying circuits could be replaced with a half-wave bridge rectifying circuit, as expressly stated by Li. EX1003, ¶135. To the extent PO may argue that Li’s explicit suggestion to use half-wave rectification is insufficient, a POSITA would have found it obvious to try replacing one of the full-wave bridge rectifying circuits with a half-wave bridge rectifying circuit because a POSITA would have had a finite number of available solutions for rectifying the signal from the conductive pins. EX1003, ¶135. A POSITA would have had only three options from which to choose: two full-wave bridge rectifying circuits, two half-wave bridge rectifying circuits, or one full-wave and one half-wave bridge rectifying circuits. *Id.* Li explicitly treats full- and half-wave rectification as interchangeable, and it therefore would have been obvious to a POSITA to try each of these options with a reasonable expectation that any of the three would have yielded only predictable results and have been successful. *Id.*

Li-Ono-Holec-Guang with a half-wave bridge rectifying circuit is shown below.

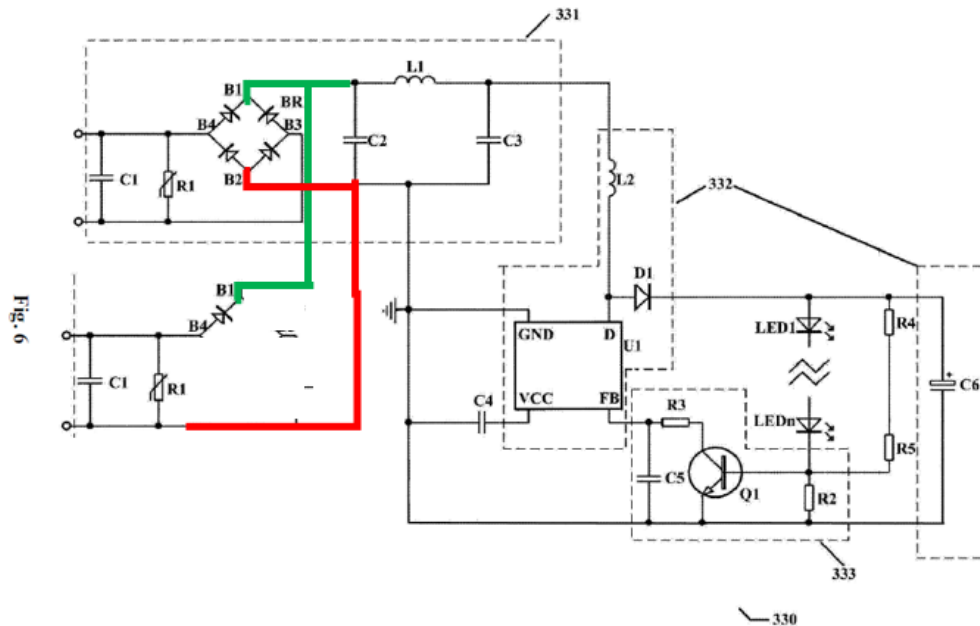


EX1005, FIG. 6 (as modified by Guang); EX1003, ¶136.

(c) *Limitation 20[c]*

Li-Ono-Holec-Guang renders obvious a circuit where the positive output terminals of the full-wave bridge rectifying circuit and the half-wave bridge rectifying circuit are electrically connected to each other, and the negative output terminals of the full-wave bridge rectifying circuit and the half-wave bridge rectifying circuit are electrically connected to each other. EX1003, ¶137. In Li-Ono-Holec-Guang, the [green] positive output terminals of the full-wave bridge rectifying circuit and the half-wave bridge rectifying circuit are connected to the circuit near inductor L1 and capacitor C2. *Id.* The [red] negative output terminals are connected in close proximity to capacitor C2. *Id.* Thus, the positive and negative

outputs of the full-wave bridge and the half-wave bridge rectifying circuits are electrically connected.



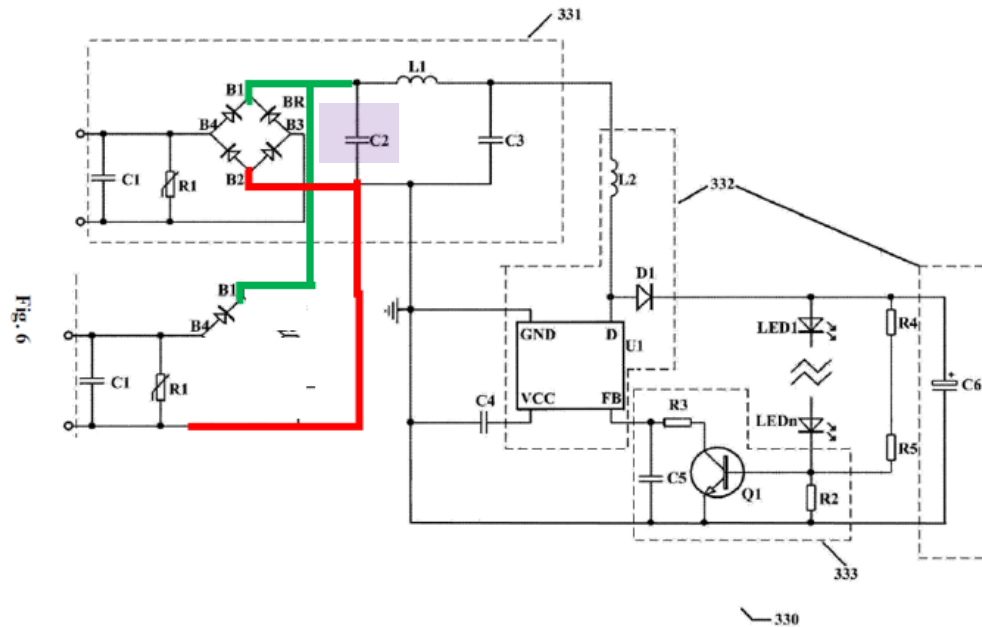
EX1005, FIG. 6 (as modified by Guang); EX1003, ¶137.

(d) Claim 21

Li-Ono-Holec-Guang describes that the filtering circuit includes a first capacitor having one end electrically connected to the positive output terminals of the full-wave bridge rectifying circuit and the half-wave bridge rectifying circuit, and the other end electrically connected to the negative output terminals of the first and the second full-wave bridge rectifying circuits. EX1003, ¶138; Section IX.B.4(b) (limitation 18[b]).

Li discloses a [purple] capacitor C2 connected to the inductor L1. EX1005, [0113], [0115]. The capacitor C2 is connected to one end the inductor L1. *Id.*, FIG.

6. Additionally, the capacitor C2 is connected to the negative output terminal of the full-wave and half-wave bridge rectifying circuits. EX1005, [0115]; EX1003, ¶¶139-140.



EX1005, FIG. 6 (as modified by Guang); EX1003, ¶140.

(e) Limitation 22[a]

Li-Ono-Holec-Guang describes an inductor having an end electrically connected to the end of the first capacitor, and the other end is one of the filtering output terminals. EX1003, ¶141; Section IX.B.4(d) (limitation 19[a]).

(f) Limitation 22[b]

Li-Ono-Holec-Guang describes a second capacitor having an end electrically connected to the other end of the inductor, and the other end is the other one of the filtering output terminals. EX1003, ¶142; Section IX.B.4(f) (limitation 19[c]).

(a) *Claim 23*

Li-Ono-Holec-Guang renders obvious a filtering circuit including an EMI-reducing capacitor coupled between the two conductive pins of one of the end caps. EX1003, ¶143. Li describes electrode pins 340A and 340B electrically connected to plugs 211A and 211B on [blue] end cap 21.

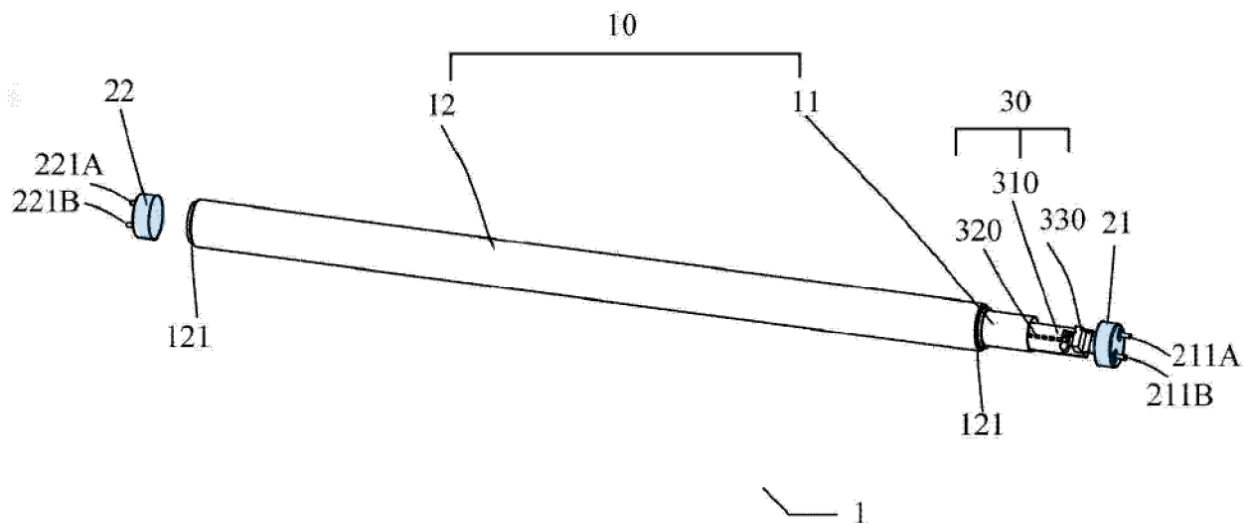


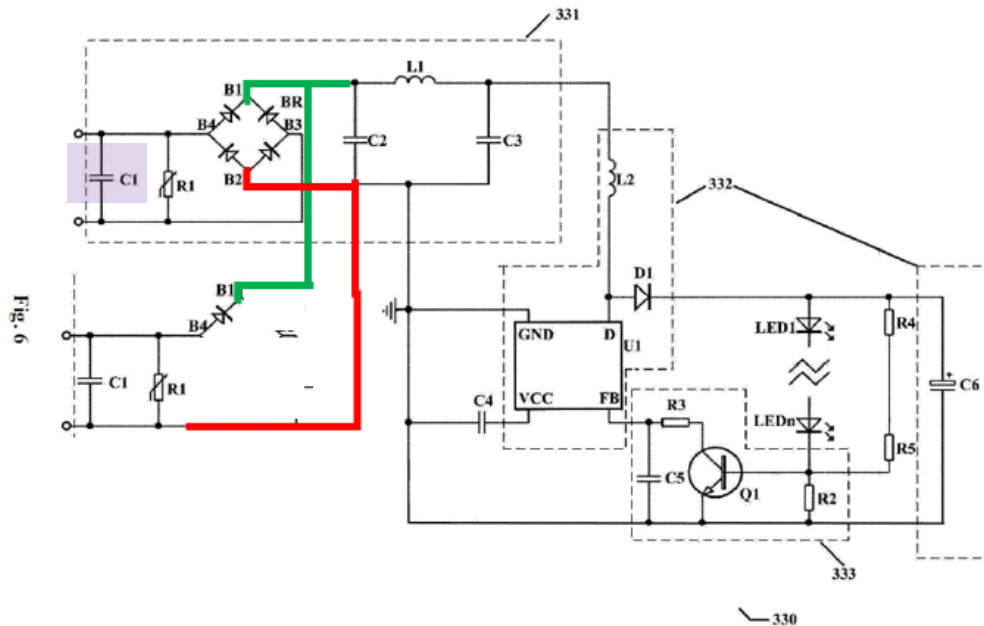
Fig. 1

EX1005, [0100], FIG. 1; EX1003, ¶143.

Li describes a [purple] capacitor C1 located between the AC inputs of the drive circuit 330. Li discloses that “[t]he filter capacitors C1, C2 & C3, the varistor R1 and the inductor L1 constitute an EMI filter circuit.” EX1005, [0113]. A POSITA would have understood the AC input of the drive circuit to be the conductive pins in the end wall at one end of the tube lamp and thus the capacitor

C1 is between the conductive pins of the end wall of the end cap and reduces EMI.

EX1003, ¶¶144-145.



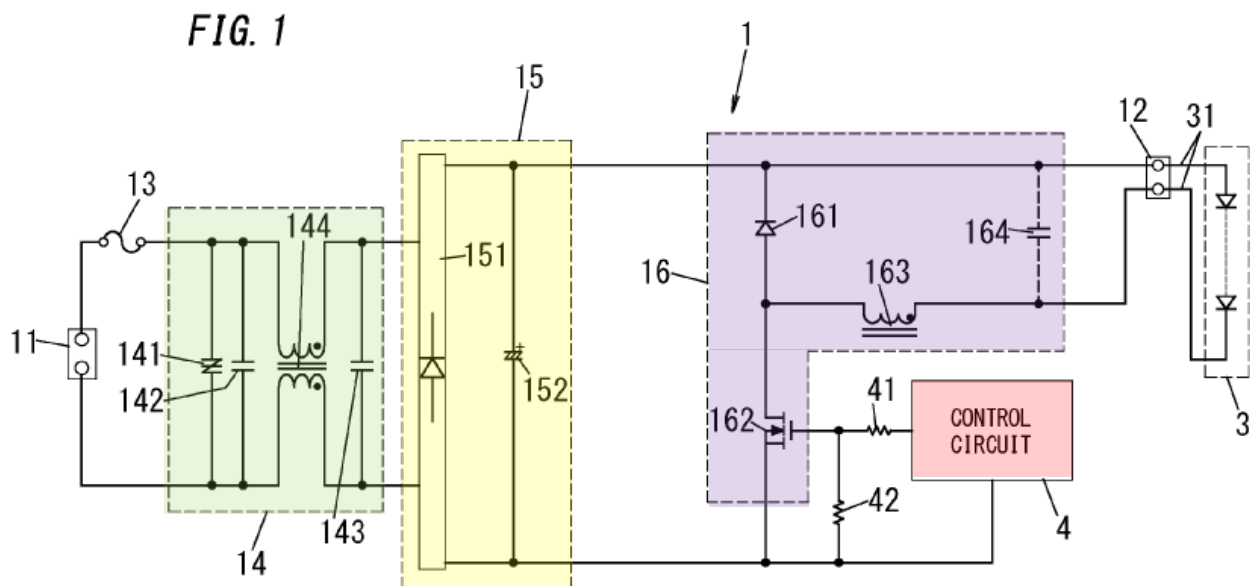
EX1005, FIG. 6 (as modified by Guang); EX1003, ¶144.

C. Ground 3 - Claims 24-25 are Obvious over Li in view of Ono, Holec, and Esaki

1. Esaki

Esaki is titled “Lighting Apparatus and Illuminating Fixture With The Same.” Esaki relates “to a lighting apparatus capable of dimming a semiconductor light emitting element and an illuminating fixture with the same.” EX1014, 1:6-10; EX1003, ¶48. To accomplish the disclosed dimming functionality, Esaki discloses a power supply for an LED lamp with “a switching regulator including a switching element; and a control circuit configured to adjust a switching frequency and on-duration of the switching element in accordance with a dimming ratio.” EX1014,

Abstract. The power supply includes a [green] filter circuit 14, a [yellow] DC power supply circuit including a rectifier 151 and a smoothing capacitor 152. *Id.*, 4:66-5:4, 5:17-19. The power supply further includes a [purple] step-down chopper circuit 16 including a diode 161, a switching element 162, an inductor 163, and an output capacitor 164. *Id.*, 5:35-41, 5:50-54. Finally, the power supply includes the [red] control circuit 4 that controls the step-down chopper circuit 16. *Id.*, 5:59-62.



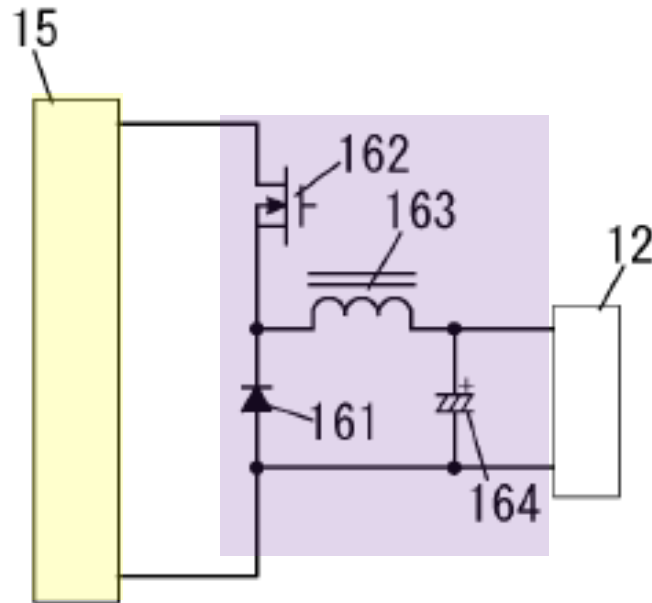
EX1014, FIG. 1; EX1003, ¶49.

Esaki describes different configurations for step-down chopper circuit 16. *Id.*, 4:35-42. In one configuration, the step-down chopper circuit is arranged such that the anode of the diode 161 is connected to the output of power supply circuit 15, the switching element 162 and the inductor 163 are connected to the cathode of the diode

161, and the inductor 163 is connected to the output 12 of the power supply circuit.

EX1014, 25:64-26:6, FIG. 16.

FIG. 16



EX1014, FIG. 16; EX1003, ¶50.

2. Motivation to Combine

As explained in Section IX.A.6 for Ground 1, Li-Ono-Holec renders obvious claims 13-17. A POSITA would have also been motivated to further modify Li-Ono-Holec in view of Esaki for several reasons. EX1003, ¶¶146-166.

Li acknowledges that the driver power supply module shown in Li's Fig. 6 "can also integrate circuits for other functions, such as a dimming control circuit." EX1005, [0136]. However, all that Li discloses about the contemplated dimming control circuit is that "[t]hese circuits can be integrated with the driver controller in

the same semiconductor die or packaged chip, or these circuits can be provided separately in the form of a semiconductor die or packaged chip, or some or all of these circuits can be combined together and provided in the form of a semiconductor die or packaged chip.” *Id.* A POSITA would have recognized the benefit of incorporating this additional function and would have been motivated to look to other disclosures that describe the structure and operation of a dimming control circuit for use in LED lamps. EX1003, ¶147 (citing EX1016, 3/36).

Esaki is directed to “a lighting apparatus capable of widening a dimming range of a light source load with a relatively simple configuration.” EX1014, 1:65-67. Esaki describes implementing the lighting apparatus in an LED lighting system. *Id.*, 4:50-56. A POSITA would have recognized that consumers desired convenience and dimmable LED lamps and would have sought to provide those capabilities in the LED lamp described by Li-Ono-Holec. EX1003, ¶148.

Specifically, Esaki describes a step-down chopper circuit 16 controlled by a control circuit 4. EX1014, 5:59-62. The control circuit 4 turns on and off the switching element 162 of the step-down chopper circuit 16 to output the driving signal to the LED lamp based on the dimming ratio of the switching element 162. EX1014, 6:1-12; EX1003, ¶149. Using a combination of a control circuit and a switching circuit like Esaki’s step-down chopper circuit would have predictably

achieved the benefits of dimming functionality in the Li-Ono-Holec LED lamp. EX1003, ¶149.

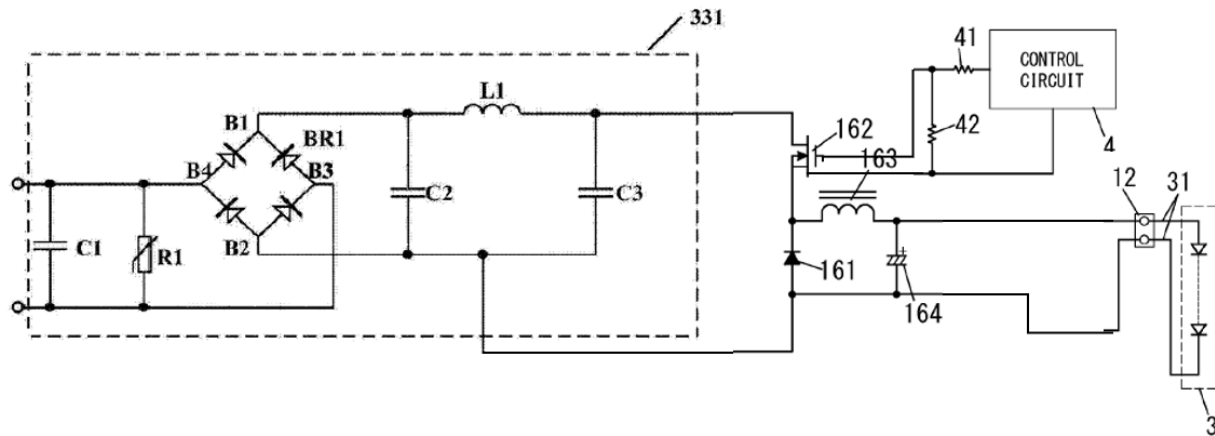
Incorporating Esaki's dimming capability in Li-Ono-Holec would have been a known use of existing technology to provide the capability in LED lamps. *Id.*, ¶150. A POSITA would have been familiar with the use of switches and control circuits to control the transmission of current to downstream components such that the brightness of an LED lamp is changed according to a dimming ratio. EX1014, 6:58-67; EX1003, ¶149. Thus, when a POSITA implemented Esaki's control circuit and step-down chopper circuit in Li-Ono-Holec, the POSITA would have had a reasonable expectation that such an implementation would have successfully allowed the LED lamp to be dimmed. EX1003, ¶149.

Finally, a POSITA would have reasonably expected to successfully incorporate dimming functions into Li-Ono-Holec's LED lamp, at least because such dimming circuits were known in the art, and because Esaki successfully uses them in the same field—*i.e.*, dimming functions for LED lamps. EX1014, 4:50-65; EX1003, ¶150.

3. Combined Li-Ono-Holec-Esaki Tube Lamp

Modification of Li-Ono-Holec to implement Esaki's dimming functionality using Esaki's control circuit and step-down chopper circuit would leave Li-Ono-

Holec essentially unchanged, only adding Esaki's circuitry between Li-Ono-Holec's π -shaped filter loop and boost conversion unit 332. EX1003, ¶151.



Li FIG. 6
(Modified per Li-Ono-Holec-Esaki)

4. *Element-by-Element Analysis*

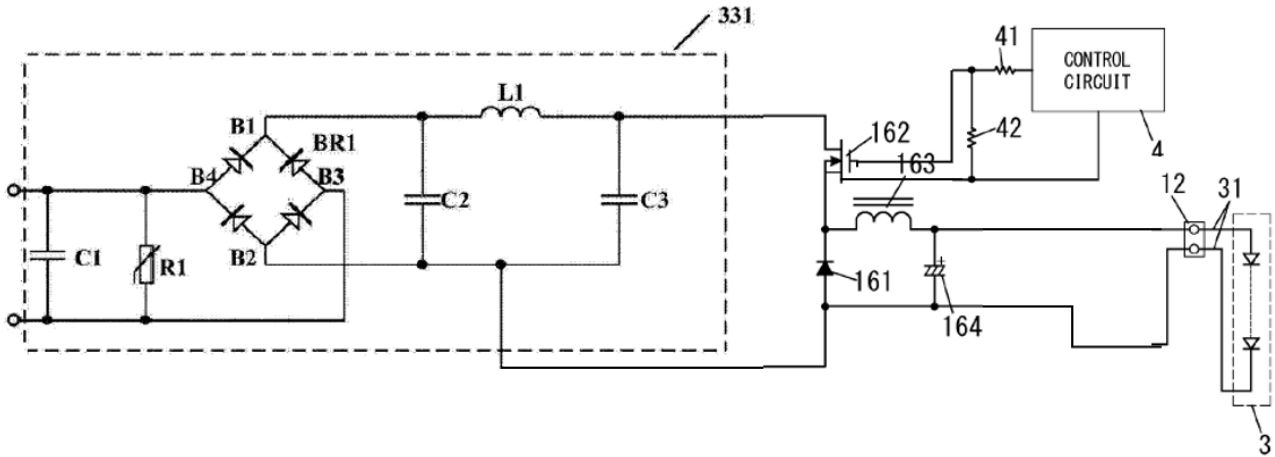
(a) *Limitation 24[a]*

Li-Ono-Holec-Esaki renders obvious that at least some of the electronic components form a driving circuit electrically connected to the filtering output terminals of the filtering circuit, having two driving output terminals electrically connected to the LED light strip, and including a controller. EX1003, ¶152. As described above in Section IX.C.2, a POSITA would have been motivated to include the control circuit and step-down chopper circuit described in Esaki in the Li-Ono-Holec LED lamp to provide a dimming function in the LED lamp. *Id.*

Li discloses that a driver power supply module 330 is electrically connected to LEDs on a substrate (the “LED light strip”) through “the wiring on the substrate

310, thereby providing a constant current and/or voltage to the LED units.” EX1005, [0099]. The driver power supply module 330 includes a boost conversion unit 332 that “is electrically connected to the bridge rectifier filter unit 331, the feedback unit 333 and the LED loads LED1-LEDn (i.e., the plurality of LED units 320 coupled in series in the LED driver power supply shown in Fig. 2), steps up the pulsating voltage output from the rectifier filter unit 331 to a desired voltage and current level and supplies it to the LED load.” *Id.*, [0116]. Therefore, Li’s boost conversion unit 332 is a driving circuit connected to the output of the filtering circuit. EX1003, ¶153. A POSITA would have also understood that Li’s boost conversion unit 332 must be connected to output terminals that are connected to the LED light strip because to supply power to the LED loads the boost conversion unit 332 must be electrically connected to the LED loads via output terminals. *Id.*

Esaki discloses a control circuit. EX1014, 4:66-5:4. The control circuit acts as a controller because it “adjust[s] a switching frequency and on-duration of the switching element 162 in accordance with the dimming ratio.” EX1014, 5:62-65; EX1003, ¶154. In the Li-Ono-Holec-Esaki lamp, the control circuit is part of the driving circuit connected between the filtering circuit and the LED loads. EX1003, ¶154.



EX1005, FIG. 6 (as modified by Esaki).

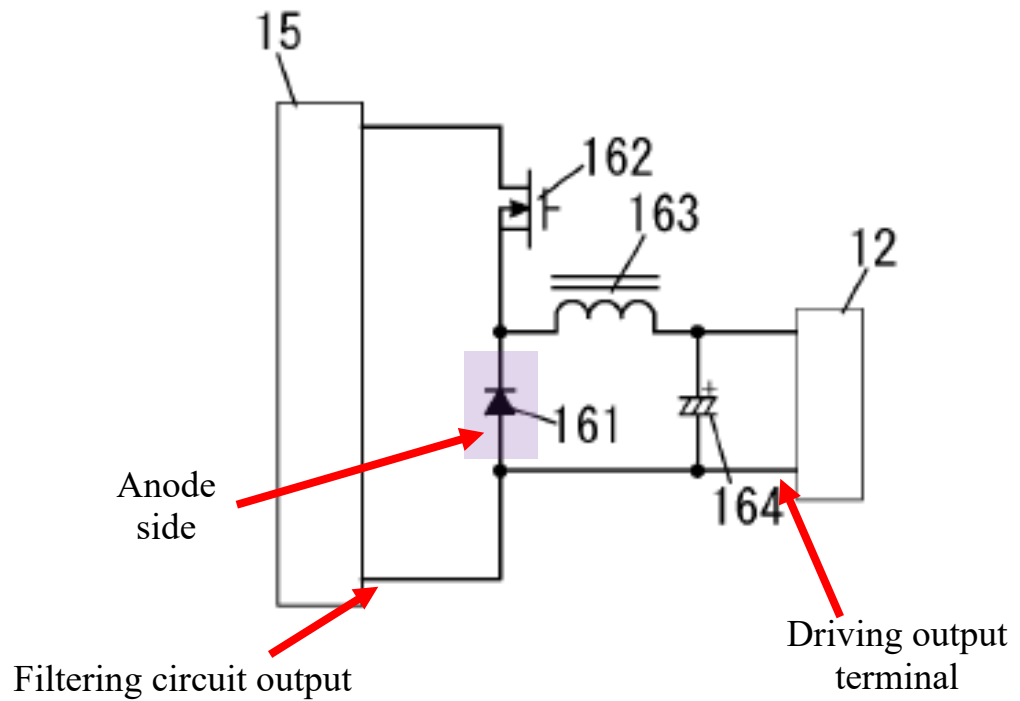
(b) *Limitation 24[b]*

Li-Ono-Holec-Esaki renders obvious a diode having an anode electrically connected to one of the filtering output terminals and one of the driving output terminals. EX1003, ¶155. As described above in Section IX.C.2, a POSITA would have been motivated to include the control circuit and step-down chopper circuit described in Esaki in the Li-Ono-Holec LED lamp to provide a dimming function in the LED lamp. *Id.*

Esaki discloses that the step-down chopper circuit 16 includes a [purple] diode 161. EX1014, 5:35-41. In the configuration of FIG. 16, the anode of the diode 161 is connected to the output of the DC power supply circuit 15 which contains a smoothing capacitor. *Id.*, 5:29-31. A POSITA would have understood that the smoothing capacitor acts as a filter. EX1003, ¶156. Additionally, the anode of the

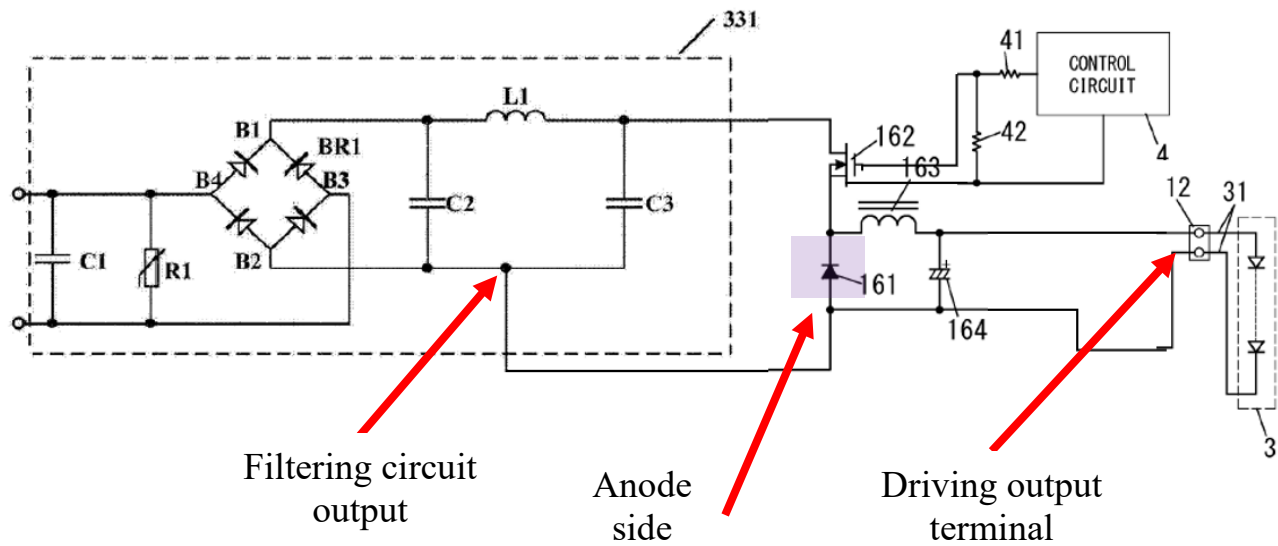
diode is connected to one of the driving output terminals. EX1014, FIG. 16, EX1003, ¶156.

FIG. 16



EX1014, FIG. 16.

In Li-Ono-Holec-Esaki, the anode of the diode 161 is also connected to an output of the π -shaped filter loop and a driving output terminal.



EX1005, FIG. 6; EX1014, FIG. 16; EX1003, ¶157.

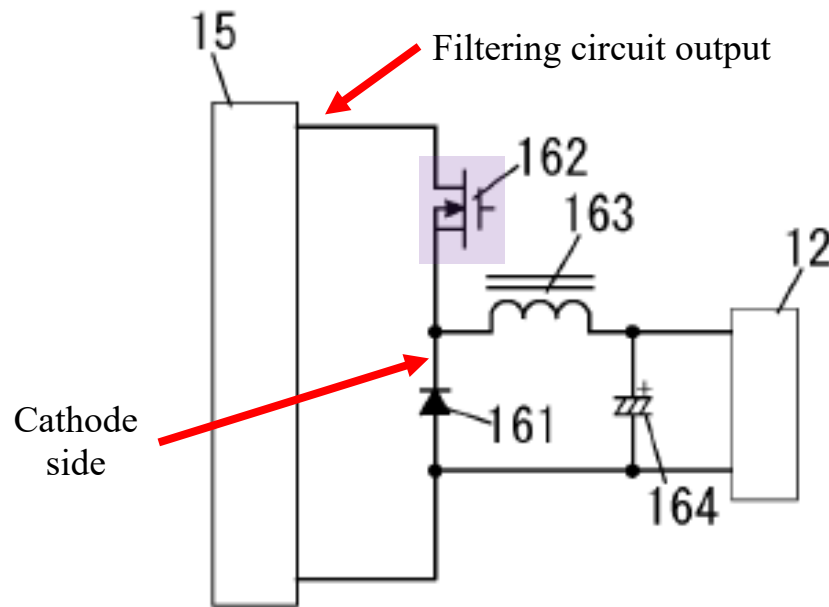
(c) *Limitation 24[c]*

Li-Ono-Holec-Esaki renders obvious a switch having a first terminal coupled to the other one of the filtering output terminals, a second terminal electrically connected to a cathode of the diode, and a control terminal coupled to the controller, and that the switch is turned on or off in response to a signal received from the controller. EX1003, ¶158. As described above in Section IX.C.2, a POSITA would have been motivated to include the control circuit and step-down chopper circuit described in Esaki in the Li-Ono-Holec LED lamp to provide a dimming function in the LED lamp. *Id.*

Esaki's step-down chopper circuit 16 includes the [purple] switching element 162. EX1014, 5:35-41. The switching element 162 is connected to the cathode side

of the diode 161 and the other output (not the one connected to the diode 161) of the DC power supply circuit 15 which contains a smoothing capacitor. *Id.*, 5:29-31. A POSITA would have understood that the smoothing capacitor acts as a filter. EX1003, ¶159.

FIG. 16

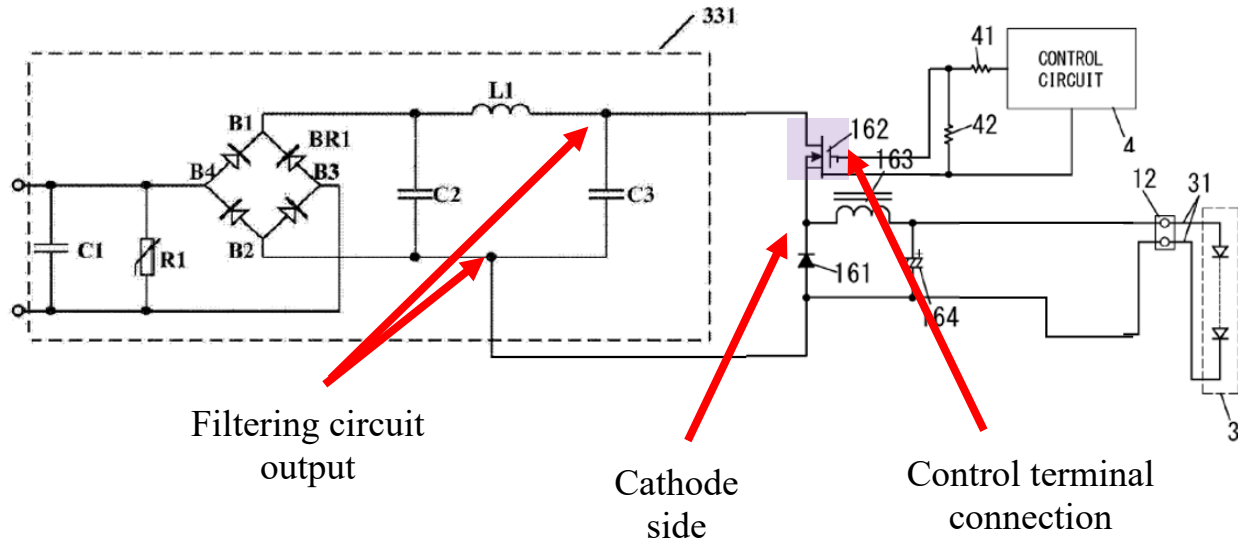


EX1014, FIG. 16.

In Li-Ono-Holec-Esaki, the switching element 162 is also connected to control circuit 4 via the switching element 162's control terminal. *Id.*, 5:59-6:8, 6:34-40; EX1003, ¶160. This connection allows the control circuit 4 to turn on and off the switching element 162. EX1014, 6:1-3; EX1003, ¶160. Specifically, the control circuit 4 "suppl[ies] a gate signal (driving signal) between a gate and a source

of the switching element 162, thereby turning the switching element 162 on and off.”

EX1014, 6:5-8.



EX1005, FIG. 6; EX1014, FIG. 16; EX1003, ¶160.

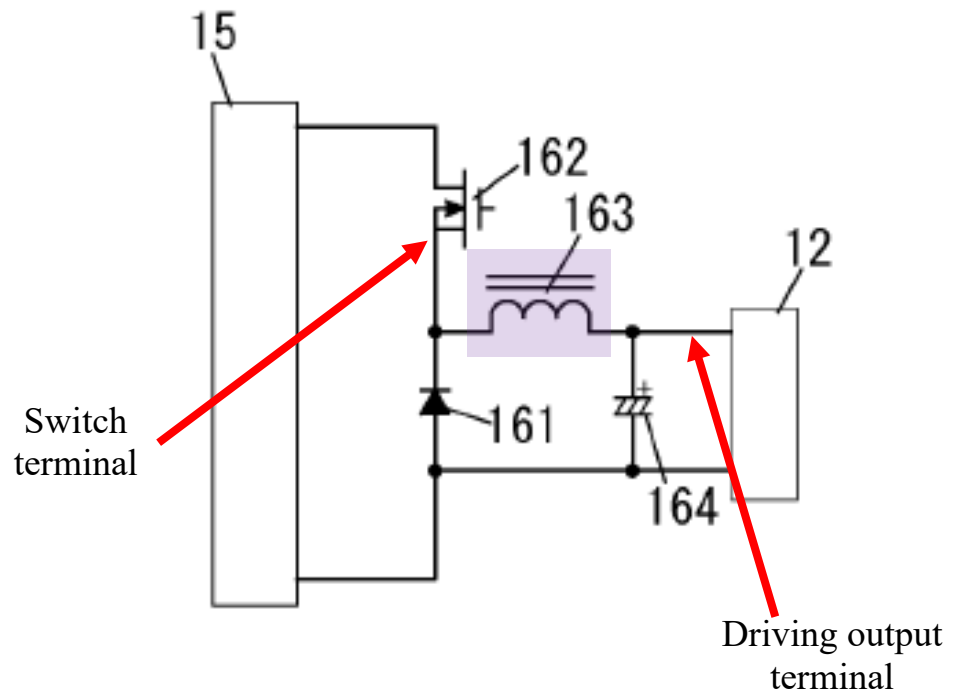
(d) Limitation 24[d]

Li-Ono-Holec-Esaki renders obvious an inductor having one end electrically connected to the second terminal of the switch and another end electrically connected to the LED light strip via the other one of the driving output terminals. EX1003, ¶161. As described above in Section IX.C.2, a POSITA would have been motivated to include the control circuit and step-down chopper circuit described in Esaki in the Li-Ono-Holec LED lamp to provide a dimming function in the LED lamp. *Id.*

Esaki’s step-down chopper circuit 16 includes the [purple] inductor 163. EX1014, 5:35-41. One end of the inductor 163 is connected to a switch terminal of

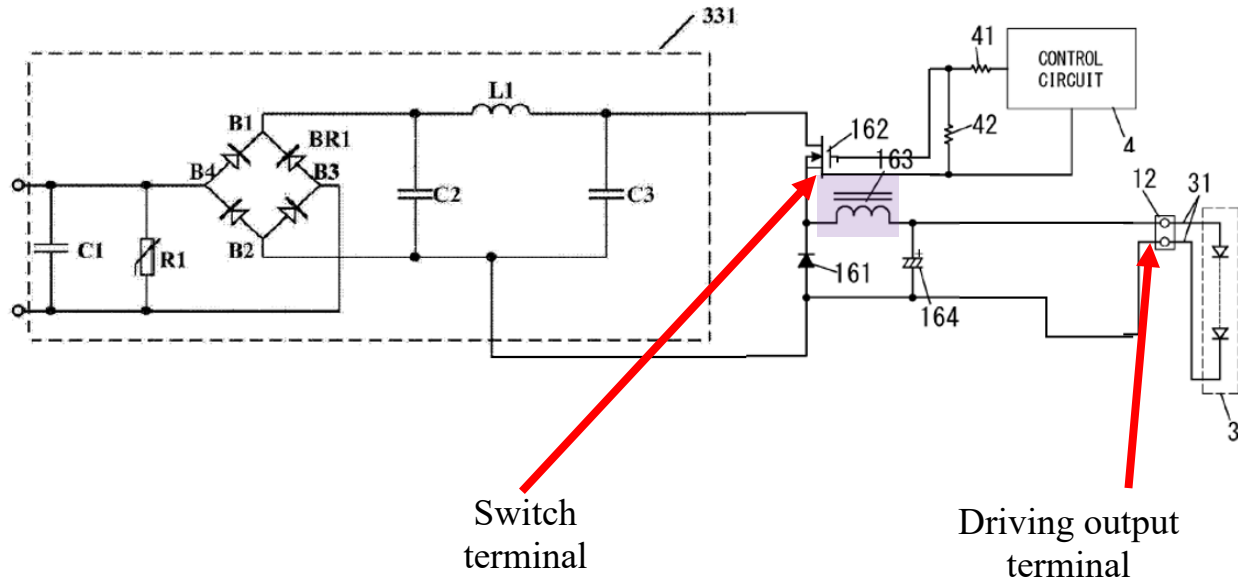
the switching element 162 (the same switch terminal that is coupled to the cathode of the diode) and the other end is connected to a driving output terminal. *Id.*

FIG. 16



EX1014, FIG. 16; EX1003, ¶162.

In Li-Ono-Holec-Esaki, the inductor 163 is connected to the switch terminal between the switch terminal and the cathode of the diode 161 and to the driving output terminal connected to the LED loads.



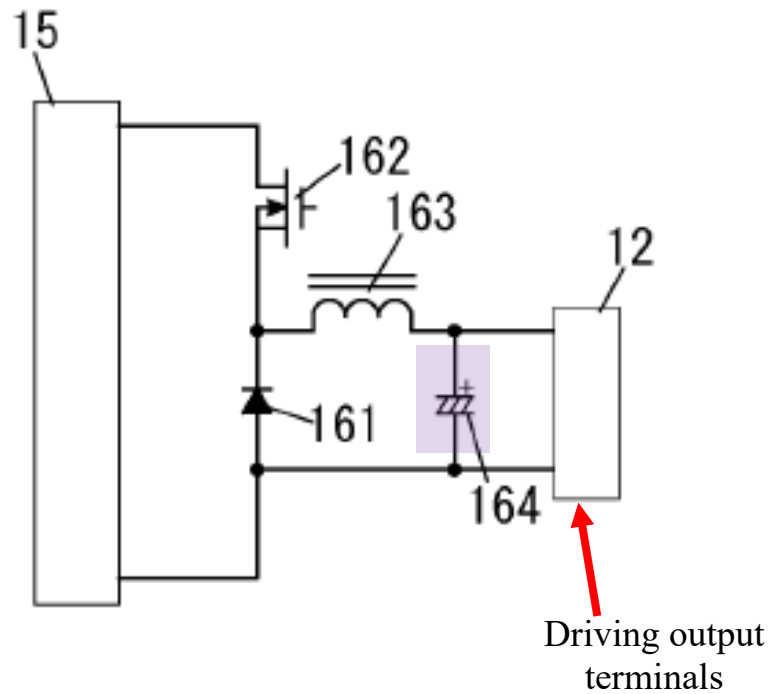
EX1005, FIG. 6; EX1014, FIG. 16; EX1003, ¶163.

(e) *Claim 25*

Li-Ono-Holec-Esaki renders obvious a driving circuit including a capacitor electrically connected between the driving output terminals. EX1003, ¶164. As described above in Section IX.C.2, a POSITA would have been motivated to include the control circuit and step-down chopper circuit described in Esaki in the Li-Ono-Holec LED lamp to provide a dimming function in the LED lamp. *Id.*

Esaki discloses that the step-down chopper circuit 16 also includes a [purple] output capacitor 164. EX1014, 5:50-51. “The output capacitor 164 is connected between output terminals thereof (between both terminals of the output connector 12).” *Id.*, 5:52-54.

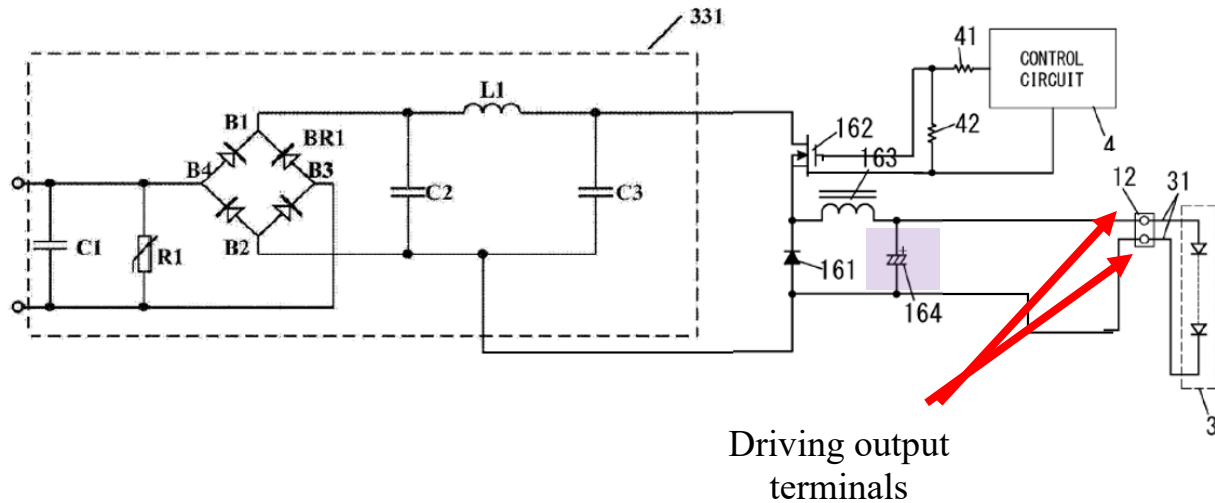
FIG. 16



EX1014, FIG. 16; EX1003, ¶165.

Li-Ono-Holec-Esaki also includes the [purple] capacitor C6 connected in parallel with the LED load and the output terminals that drive the LED load.

EX1005, [0119].



EX1005, FIG. 6; EX1014, FIG. 16; EX1003, ¶166.

X. *FINTIV* FACTORS WEIGH AGAINST DISCRETIONARY DENIAL

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

Factor 2 weighs in favor of institution. Trial is currently scheduled for April 17, 2024. EX1017. However, the Litigation involves 11 patents and the median time-to-trial for the Western District of Texas is 28.3 months,⁶ meaning trial likely will not occur until at least October 2024—about 1 months *after* a decision here.

Factor 3 weighs in favor of institution. The Litigation is in its early stages. PO filed its original complaint on May 24, 2022, and amended its complaint

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

in September to add patents. *Markman* is not scheduled to occur until April 19, 2023, and fact discovery does not open until April 20, 2023. *Id.*

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. EX1013.

Factor 5. The parties are the same.

Factor 6 weighs in favor of institution. This petition is promptly filed well within the 12-month statutory period and, for the reasons explained above, the merits of the proposed grounds are meritorious and compelling.⁷

XI. CONCLUSION

For the above reasons, Claims 13-25 are invalid under §103(a).

Dated: March 8, 2023

Respectfully submitted,

/Eagle H. Robinson/
Eagle H. Robinson

Lead Counsel for Petitioner

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

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(a)(i), the undersigned certifies that this Paper—exclusive of the table of contents, mandatory notices under § 42.8, certificate of service, and this certificate of word count—includes 11,654 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 March 8, 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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