

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. IPR2023-00269

Patent 10,560,989

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

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	MANDATORY NOTICES	2
	A. Real Party in Interest (37 C.F.R. §42.8(b)(1))	2
	B. Related Matters (§42.8(b)(2))	2
	C. Lead and Back-Up Counsel (§42.8(b)(3))	2
	D. Service Information (§42.8(b)(4)).....	3
III.	GROUND FOR STANDING.....	3
IV.	STATEMENT OF PRECISE RELIEF REQUESTED FOR EACH CLAIM CHALLENGED	3
	A. Claims for Which Review Is Requested (§42.104(b)(1))	3
	B. Statutory Grounds of Challenge (§42.104(b)(2)).....	4
V.	THE GROUNDS IN THIS PETITION ARE NOT CUMULATIVE.....	5
VI.	LEVEL OF ORDINARY SKILL IN THE ART	6
VII.	FIELD OF TECHNOLOGY	6
	A. Fluorescent lamps.....	7
	B. Pre-heat process.....	8
	C. The Rise of LED lamps; issues with replacing fluorescent lamps with LED lamps	9
	D. Heat Dissipation	10
VIII.	'989 PATENT	11
	A. Overview	11
	B. Prior Art and Perceived Shortcomings.....	13
	C. '989 Patent's Asserted Improvement to Prior Art	14
	D. Prosecution History	14
	E. Claim Construction (37 C.F.R. § 42.104(b)(3)).....	15
	1. "electrically connected" / "electrically connecting"	15
	2. "disposed on an inner circumferential surface of the lamp tube"	16

IX.	REASONS FOR THE RELIEF REQUESTED UNDER 37 C.F.R. §§42.22(a)(2) and 42.104(b)(4)	16
A.	Ground 1 - Claims 1, 2, 4-6, 30, 31, 37, 88, and 90 are Obvious over Li in view of Ono	16
1.	Li	16
2.	Ono	18
3.	Motivation to Combine	20
4.	Modification of Li with Ono	25
5.	Element-by-Element Analysis	25
B.	Ground 2 - Claims 12-14 are Obvious over Li in view of Ono, and Xu	48
1.	Xu	48
2.	Motivation to Combine	50
3.	Modification of Li-Ono in view of Xu	53
4.	Element-by-Element Analysis	53
C.	Ground 3 - Claim 47 and 77 are Obvious over Li in view of Ono and Guang	56
1.	Guang	56
2.	Motivation to Combine	57
3.	Modification of Li-Ono in view of Guang	60
4.	Element-by-Element Analysis	61
D.	Ground 4 - Claims 84-86 are Obvious over Li in view of Ono and Zhang	66
1.	Zhang	66
2.	Motivation to Combine	67
3.	Modification of Li-Ono in view of Zhang	69

4.	Element-by-Element Analysis	70
E.	Ground 5 - Claims 5, 6, and 31 are Obvious over Li in view of Ono and Halliwell	74
1.	Halliwell.....	74
2.	Motivation to Combine	75
3.	Modification of Li with Ono and Halliwell	78
4.	Element-by-Element Analysis	79
X.	<i>FINTIV</i> FACTORS WEIGH AGAINST DISCRETIONARY DENIAL.....	82
XI.	CONCLUSION.....	83

PETITIONER'S EXHIBIT LIST

Exhibit	Shorthand	Description
1001	'989 Patent	U.S. Patent No. 10,560,989
1002	'989 File History	Prosecution History of U.S. Patent No. 10,560,989
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	Xu	Chinese Patent Publication 2802892Y to Xu Certified Translation
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	Zhang	U.S. Patent No. 10,104,723 to Zhang
1015	Halliwell	U.S. Patent No. 9,206,970 to Halliwell et al.
1016		Omitted

Exhibit	Shorthand	Description
1017	Litigation Scheduling Order	Scheduling Order, <i>Jiaying 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)

CLAIM LISTING

Claim	Limitation	Claim Language
1	1[p]	An LED tube lamp, comprising:
	1[a]	a tube having two ends;
	1[b]	an LED light strip attached to an inner circumferential surface of the tube;
	1[c]	a plurality of LED light sources mounted on the LED light strip;
	1[d]	a power supply module electrically connecting to the LED light strip and configured to drive the plurality of LED light sources; and
	1[e]	a first end cap and second end cap respectively attached at the two ends of the 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 tube and connecting to the 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 tube,
	1[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;
	1[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,

Claim	Limitation	Claim Language
	1[g2]	at least one of the plurality of electronic components comprises a filtering circuit electrically connecting to the rectifying circuit,
	1[h]	wherein the plurality of electronic components comprise a resistor which is positioned closest to the end wall of the first end cap and connecting to one of the input terminals of the rectifying circuit;
	1[i]	wherein the end wall comprises a first portion made of an insulating material.
2	2[a]	The LED tube lamp according to claim 1, wherein each of the end caps comprises at least one conductive pin connected to the first portion, and
	2[b]	the resistor is electrically connected between the conductive pin and one of the input terminals of the rectifying circuit.
4	4	The LED tube lamp according to claim 1, wherein each of the end caps comprises two conductive pins connected to the first portion, and the resistor is electrically connected between the two conductive pins.
5	5	The LED tube lamp according to claim 1, wherein the end wall comprises at least one opening.
6	6	The LED tube lamp according to claim 5, wherein the resistor is positioned closest to the opening.
12	12	The LED tube lamp according to claim 1, wherein at least some of the electronic components form a first circuit electrically connected between the rectifying circuit and the filtering circuit and causes a delay before the LED tube lamp lights up.

Claim	Limitation	Claim Language
13	13	The LED tube lamp according to claim 12, wherein the electronic components forming the first circuit comprises a capacitor configured to be charged when an AC driving signal is provided to the LED tube lamp and cause the LED tube lamp to conduct when voltage of the capacitor exceeds a threshold trigger voltage.
14	14	The LED tube lamp according to claim 12, wherein the LED tube lamp is delayed to light up by 0.1 to 3 seconds.
30	30[p]	An LED tube lamp, comprising:
	30[a]	a tube having two ends;
	30[b]	an LED light strip attached to an inner circumferential surface of the tube;
	30[c]	a plurality of LED light sources mounted on the LED light strip;
	30[d]	a power supply module electrically connecting to the LED light strip and configured to drive the plurality of LED light sources; and
	30[e]	a first end cap and second end cap respectively attached at two ends of the 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 tube and connecting to the 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 tube,

Claim	Limitation	Claim Language
	30[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;
	30[g1]	wherein at least some of the electronic components comprise a rectifying circuit having at least two input terminals and configured to rectify signal receiving from the input terminals,
	30[g2]	at least one of the electronic components comprises a filtering circuit electrically connected to the rectifying circuit,
	30[h]	wherein the plurality of electronic components comprise a capacitor which is positioned closest to the end wall of the first end cap;
	30[i]	wherein the end wall comprises a first portion made of an insulating material.
31	31	The LED tube lamp according to claim 30, wherein the end wall comprises at least one opening.
37	37	The LED tube lamp according to claim 30, wherein the capacitor connects between the input terminals of the rectifying circuit.
47	47[a]	The LED tube lamp according to claim 4, 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

Claim	Limitation	Claim Language
	47[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,
	47[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.
77	77[a]	The LED tube lamp according to claim 30, wherein the rectifying circuit comprises: a first full-wave bridge rectifying circuit, having two input terminals electrically connected to two conductive pins of one of the first and the second end caps, respectively, and having a positive output terminal and a negative output terminal; and
	77[b]	a second full-wave bridge rectifying circuit, having two input terminals electrically connected to two conductive pins of the other one of the first and the second end caps, respectively, and having a positive output terminal and a negative output terminal,
	77[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.
84	84	The LED tube lamp according to claim 30, wherein at least some of the electronic components form a filament-simulating circuit configured to conduct current during a preheat process when the LED tube lamp is powered by a ballast.

Claim	Limitation	Claim Language
85	85	The LED tube lamp according to claim 84, wherein the filament-simulating circuit comprises: a second capacitor, coupled between the two conductive pins of one of the first and the second end caps.
86	86	The LED tube lamp according to claim 85, wherein the filament-simulating circuit further comprises: a resistor, coupled to the second capacitor in parallel.
88	88	The LED tube lamp according to claim 1, wherein the tube is a glass tube.
90	90	The LED tube lamp according to claim 30, wherein the tube is a glass tube.

I. INTRODUCTION

The '989 Patent describes an LED tube lamp including a power supply module integrated into an end cap of the tube lamp. EX1001, Abstract. The '989 Patent asserts that existing LED lamps had compatibility problems when used with an electronic ballast. *Id.*, 3:6-8. The patent purports to solve this problem by incorporating different circuits into the power supply, including a rectifier circuit, a filtering circuit, an LED module, and a ballast-compatible circuit. *Id.*, 5:13-15. These circuits purportedly improved the compatibility of the LED lamp with lamp driving circuits including those with an electronic ballast. *Id.*, 72:54-57.

However, multiple prior art references, including Li, Ono, Miyamichi, Xu, Guang, and Halliwell 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; EX1008, 4:24-39; EX1009, 5/36; EX1015, 1:60-2:13. These prior art LED lamps included the same types of circuitry—a rectifier circuit, a filtering circuit, an LED module, and a ballast-compatible circuit—as claimed in the '989 Patent. Accordingly, Li in combination with Ono, Guang, Miyamichi, Xu, and/or Halliwell 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 ’989 Patent and may therefore affect, or be affected by, a decision in this proceeding:

(1) *Jiaxing Super Lighting Electric Appliance Co., Ltd. et al. v. Current Lighting Solutions, LLC d/b/a GE Current*, Civil Action No. 6:22-cv-00534-ADA (W.D. Tex. 2022) (“*Current Action*”); and

(2) *Jiaxing Super Lighting Electric Appliance Co., Ltd. et al. v. MaxLite, Inc.*, Case No. 2:19-cv-04047 (C.D. Cal.) (“*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 '989 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 '989 Patent has not been subject to a previous FWD in an estoppel-based AIA proceeding.

IV. STATEMENT OF PRECISE RELIEF REQUESTED FOR EACH CLAIM CHALLENGED

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

Petitioner requests review and cancellation of Claims 1, 2, 4-6, 12-14, 30, 31, 37, 47, 77, 84-86, 88, and 90.

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

Claims 1, 2, 4-6, 12-14, 30, 31, 37, 47, 77, 84-86, 88, and 90 are invalid under §103 over these combinations of art:

Ground	Basis	Claims	Prior Art Combination
1	§103	1, 2, 4-6, 30, 31, 37, 88, 90	Li (EX1005), Ono (EX1006)
2	§103	12-14	Li, Ono, Xu (EX1009)
3	§103	47, 77	Li, Ono, Guang (EX1007)
4	§103	84-86	Li, Ono, Zhang (EX1014)
5	§103	5, 6, 31	Li, Ono, Halliwell (EX1015)

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

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

Published August 2, 2006, Xu is prior art under §102(a)(1).

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

Filed October 16, 2013, Zhang is prior art under §102(a)(2).

Filed February 13, 2013, Halliwell is prior art under §102(a)(2).

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).

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 '989 Patent has not been challenged in any prior IPR petition. As such, none of the discretionary factors set forth in *General Plastic* apply to this Petition. *See General Plastic Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, at 15-16 (PTAB Sept. 6, 2017) (Paper 19) (precedential).

During prosecution of the '989 Patent, the Examiner rejected claims 1, 16, 19-20, 34, and 42-43 under 35 U.S.C. §102 based on Chen (US2010/0277918) and objected to claims 2-15, 17-18, 21-33, 35-41, and 44-52. EX1002, 397-401/600. PO filed a response that cancelled claims 1, 16, 19, 34, and 43; rewrote claims 2, 21, and 35 in independent form; and added new claims 53-96. *Id.*, 471-488/600. The Examiner then issued a notice of allowance indicating “the prior arts of record fail to disclose or suggest **wherein the end wall comprises a first portion made of an insulating material**, as required in amended claims 1, 21, and 35” and renumbered claim 2 to claim 1, claim 21 to claim 17, claim 35 to claim 28, and claims 53-96 to claims 47-90. *Id.*, 509-515/600. However, there were no prior art rejections based on Li, Ono, Xu, Halliwell, Zhang, or Guang. Li, Ono, Xu, and Halliwell were not before the Examiner during prosecution. U.S. Application Publications that ultimately issued as Guang and Zhang were among over 150 references submitted

in IDSs during prosecution. *Id.*, 333-354/600. 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 28, 2014²—the ’989 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 person of ordinary skill in the art with a higher level of education may have fewer years of academic or industry experience, or vice versa. EX1003, ¶21. A POSITA would have been familiar with the field of technology described in Section VII below. *Id.* The prior art and the ’989 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 ’989 Patent is directed to “an LED tube lamp and its components including the light sources, electronic components, and end caps.” EX1001, 1:57-

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.

60. In other words, the '989 Patent discloses and claims certain aspects of an LED lamp that works with existing fluorescent lighting fixtures, and components thereof. EX1003, ¶22.

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 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 used magnetic ballasts

instead of electronic ballast. EX1008, 1:24-29. A magnetic ballast can be as simple as series inductor, or can further comprise a glow starter. EX1008, Fig. 15a, 1:51-55. Alternatively, magnetic ballasts can be a rapid-start type. EX1008, 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, ¶¶23-25.

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.” *Id.*, 1:15-17; EX1003, ¶26.

“[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.” *Id.*, 2:30-32; EX1003, ¶27.

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.

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, ¶¶28-29. 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.” EX1007, 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.” EX1007, 5:16-22. But this can be expensive and time consuming. EX1007, 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.” EX1007, 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, ¶29.

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

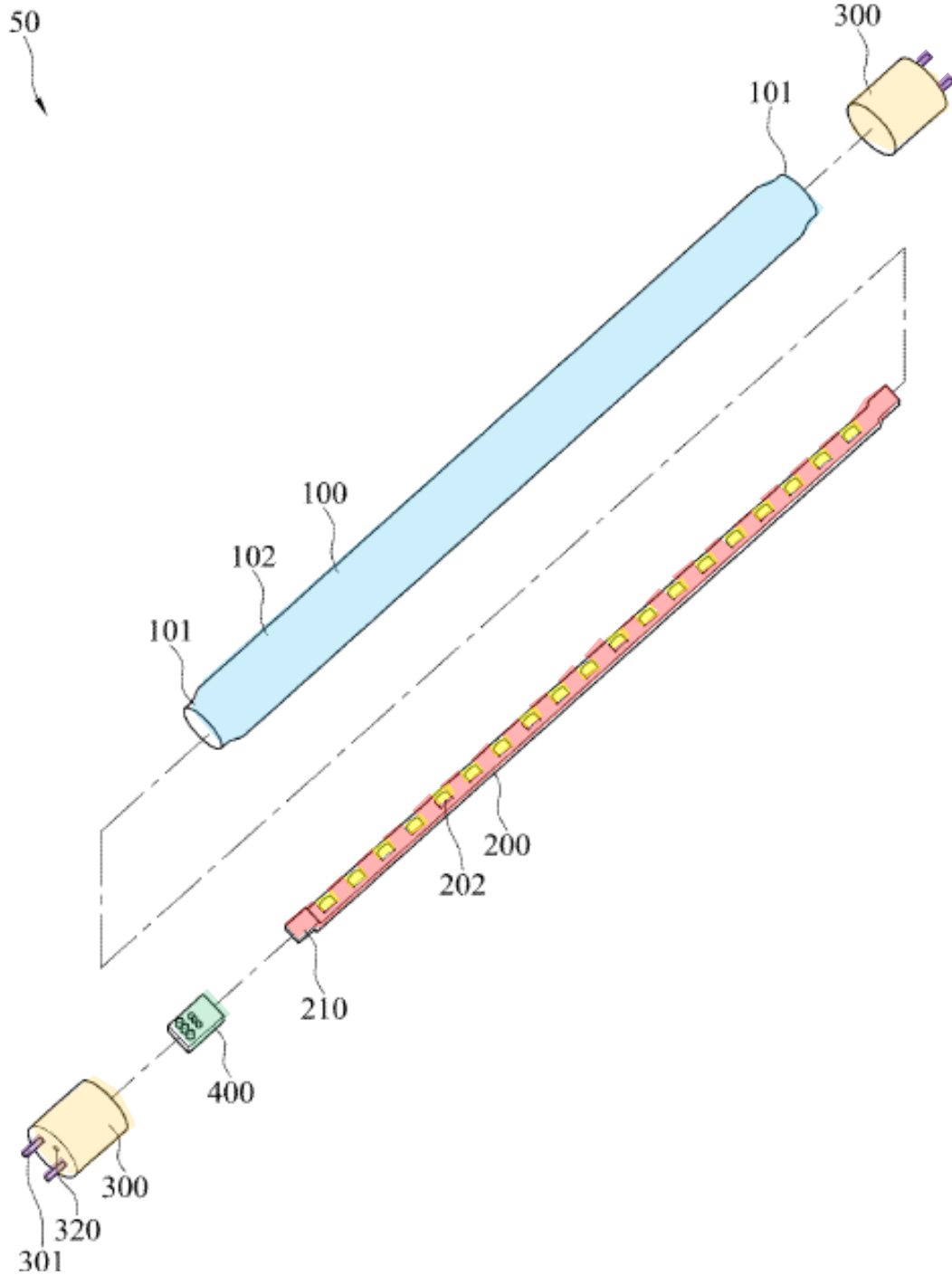
device. EX1010, 167/367, 201/367, 203/367. “Therefore, it is crucial to rapidly remove the heat and keep the junction temperature below a certain limit for the maintenance of performance.” EX1010, 167/367. As such, a POSITA would have understood the importance of heat management in an LED lighting device. EX1003, ¶30. Additionally, it was also known to include openings in the end caps, such as to reduce pressure or heat within the tube. *See, e.g.*, EX1012, ¶[0037], FIGS. 1 and 3.

VIII. ’989 PATENT

Entitled “LED Tube Lamp,” the ’989 Patent is directed to an LED tube lamp and associated circuitry used to power the lamp. EX1001, Abstract.

A. Overview

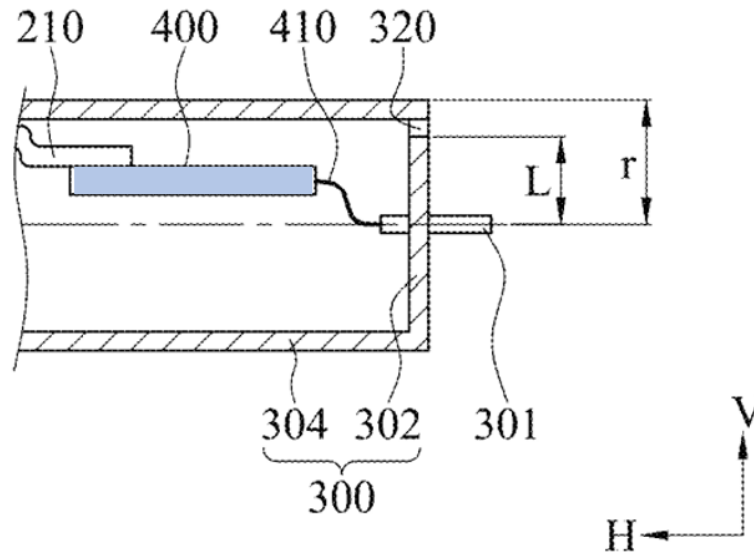
The ’989 Patent describes an LED tube lamp including a [blue] tube 100 with two ends. *Id.*, 98:1-6. Inside the tube is a [red] LED light strip 200 onto which multiple [yellow] LED lights 202 are mounted. *Id.*, 98:9-10. An [orange] end cap 300 is attached to each tube end, and has an end wall 320 made of insulating material (*id.*, 98:5-6, 105:29-32) from which [purple] conductive pins extend. *Id.*, 98:43-45. Inside at least one end cap is a [green] power supply. *Id.*, 98:9-15; EX1003, ¶46.



EX1001, FIG. 67; EX1003, ¶47.

The [blue] power supply 400, shown below, can be a module disposed in end cap 300, onto which electronic components are mounted. *Id.*, 101:5-14. The electronic components include components such as rectifying circuits, filtering

circuits, resistors, capacitors, inductors, and integrated circuits. *Id.*, 4:13-15, 5:13-15.



Id., FIG. 69; *see also id.*, FIG. 83; EX1003, ¶¶48-49.³

B. Prior Art and Perceived Shortcomings

The '989 Patent describes prior art LED lamps and associated drawbacks. EX1001, 1:64-3:19. Specifically, insufficient heat dissipation lead to high temperatures and performance degradation. *Id.*, 2:17-25, 2:48-54. Further, LED lamps use a DC driving signal, but traditional fluorescent lamps use low-frequency, low-voltage AC signals. *Id.*, 2:55-60. Simple rectification is generally insufficient to achieve compatibility for LED lights in a fluorescent fixture because traditional

³ All colorized figures herein are annotated.

LED driving circuits cannot support filament detection tests used in program-start ballasts, and electrical ballasts caused problems of overvoltage and over current or under voltage and under current. *Id.*, 2:61-3:19; EX1003, ¶50.

C. '989 Patent's Asserted Improvement to Prior Art

To overcome the purported shortcomings, the '989 Patent proposes an LED tube lamp having a power supply including a rectifying circuit and filtering circuit. EX1001, 5:13-15. The rectifying circuit is configured to rectify the external driving signal to produce a rectified signal. *Id.*, 5:15-17. The filtering circuit is connected to the rectifying circuit and configured to produce a filtered signal. *Id.*, 5:17-19; EX1003, ¶51.

D. Prosecution History

The '989 Patent issued from U.S. Patent Application No. 15/339,221, filed on April 2, 2019. On June 7, 2019, the Examiner issued a non-final office action rejecting claims 1, 16, 19-20, 34, and 42-43 and objecting to claims 2-15, 17-18, 21-33, 35-41, and 44-52. EX1002, 397-401/600. On September 6, 2019, the Patent Owner filed a response that cancelled claims 1, 16, 19, 34, and 43 and rewrote claims 2, 21, and 35 in independent form. Claim 2 was also amended to recite “an LED light strip attached to an inner circumferential surface of the tube” instead of “an LED light strip disposed inside the tube.” *Id.*, 471-479/600. The Patent Owner added new claims 53-96. *Id.*, 480-488/600. On September 25, 2019, the Examiner

issued a notice of allowance indicating “the prior arts of record fail to disclose or suggest wherein the end wall comprises a first portion made of an insulating material, as required in amended claims 1, 21, and 35” and renumbered claim 2 to claim 1, claim 21 to claim 17, claim 35 to claim 28, claim 53 to claim 47, and claim 83 to claim 77. *Id.*, 509-515/600.

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 1, 2, 4, 12, 30, 47, and 77.

A POSITA would have understood that “electrically connected” does not require a direct connection, i.e., with no intervening electrical components or modules. The ’989 Patent itself confirms this construction. Specifically, the ’989 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, 15:19-34; EX1003, ¶¶74-75.

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

Petitioner does not believe this term needs explicit construction, but notes that the specification expressly indicates that the term “on” is broad enough to cover both direct contact or through “intervening elements.” *See, e.g.*, EX1001, 29:49-59; EX1003, ¶76.

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

A. Ground 1 - Claims 1, 2, 4-6, 30, 31, 37, 88, and 90 are Obvious over Li in view of Ono

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, 212 for receiving electricity from a light fixture. *Id.*,

[0092]. The LED lamp also includes a [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].

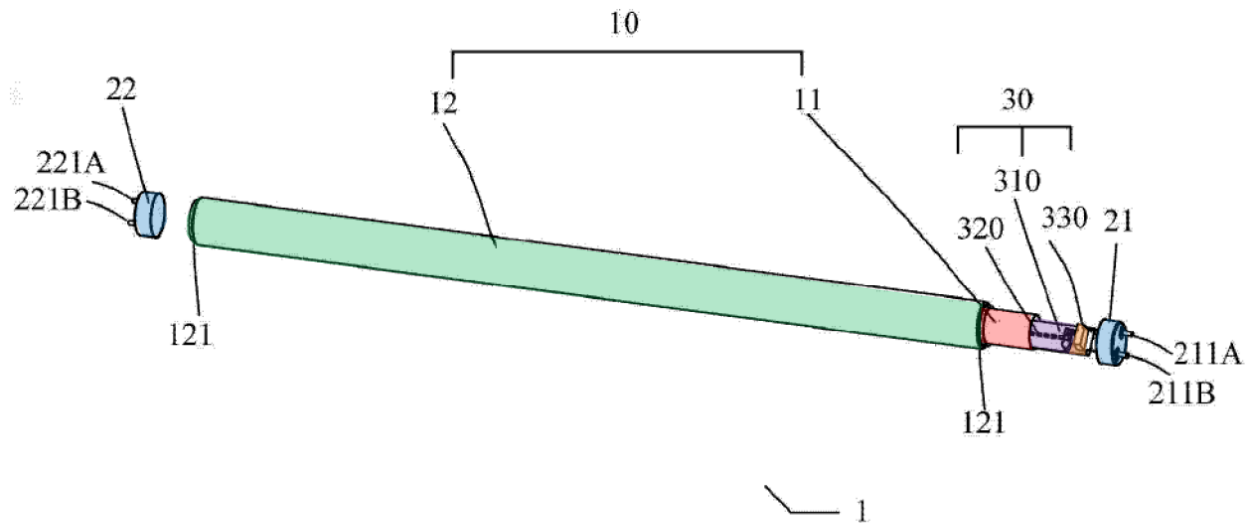


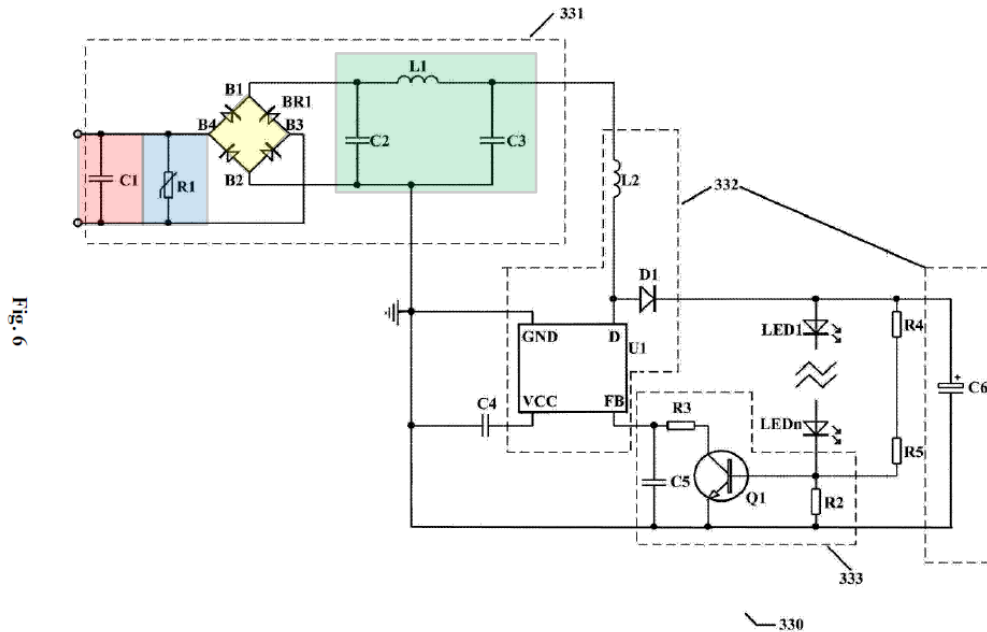
Fig. 1

Id., FIG. 1; EX1003, ¶32.

Li describes the drive circuit module as making the LED lamp compatible with conventional lighting fixtures. *Id.*, [0092], [0113]. The drive circuit module includes a [red] capacitor and [blue] varistor⁴ electrically coupled across 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, ¶33.

conductive pins, a [yellow] bridge rectifier unit, and a [green] filter unit. *Id.*, [0112-0113].

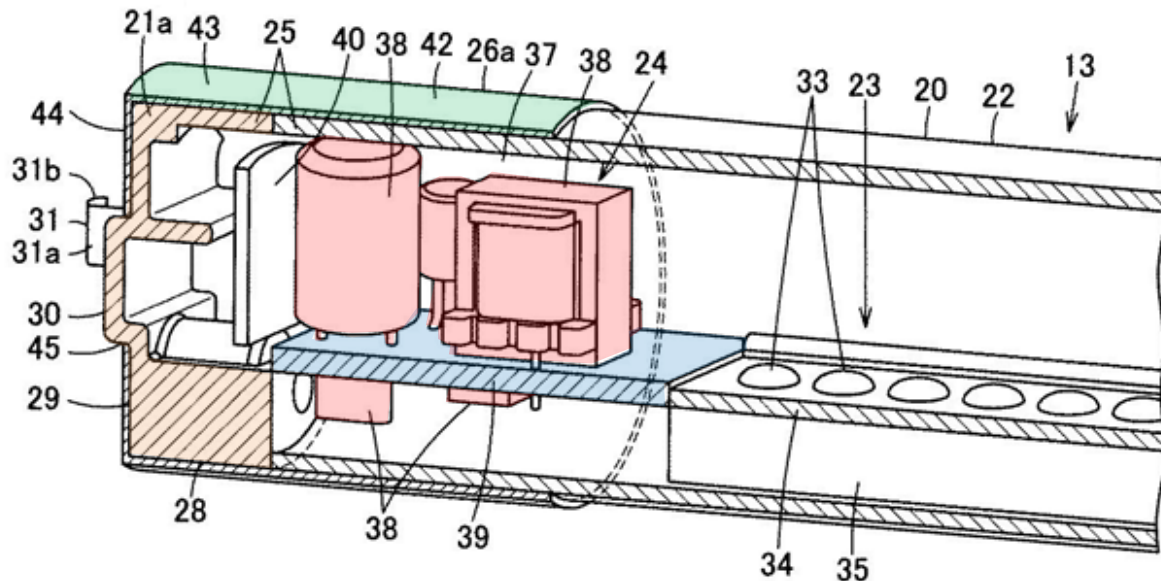


Id., FIG. 6; EX1003, ¶33.

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 light source unit 23 and the lighting circuit 24. 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. 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]



Id., FIG. 1; EX1003, ¶35. 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.” *Id.*, [0017]. “The lighting circuit 24 has a [blue] circuit board 39 on which a plurality of [red] electronic components 38 have been mounted.” *Id.* Specifically, “[l]ead components such as capacitors and inductors are mounted on the mounting surface of the circuit board 39, and surface mounted components such as resistors and switching elements are mounted on the wiring pattern surface.” *Id.* Additionally, Ono explains that a non-combustible cover 26a extends over cap 21a and circuit 24 to “prevent external heat damage when the electronic components 38 in the lighting circuit 24 experience excessive heat due to aging, etc., and the end of the tube body 20 and the cap 21a have been damaged by the heat.” *Id.*, [0019]; EX1003, ¶36.

3. *Motivation to Combine*

Li discloses an LED lamp including a drive circuit that makes the LED lamp compatible with fluorescent light 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, ¶77.

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 (printed circuit board) 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, ¶77. 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, ¶78. Ono provides an example of installing capacitors, resistors, and other electronic components of an LED drive circuit on a printed circuit board (“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, ¶78. 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, ¶78.

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 each of 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, ¶79) and to achieve the improved safety characteristics disclosed by Ono (EX1006, [0042]). EX1003, ¶79. 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]. Additionally, Ono 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 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, ¶79.

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. EX1003, ¶81. 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, ¶81.

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, ¶80. 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, ...” EX1005, [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, ¶80. 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, ¶80. 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.*

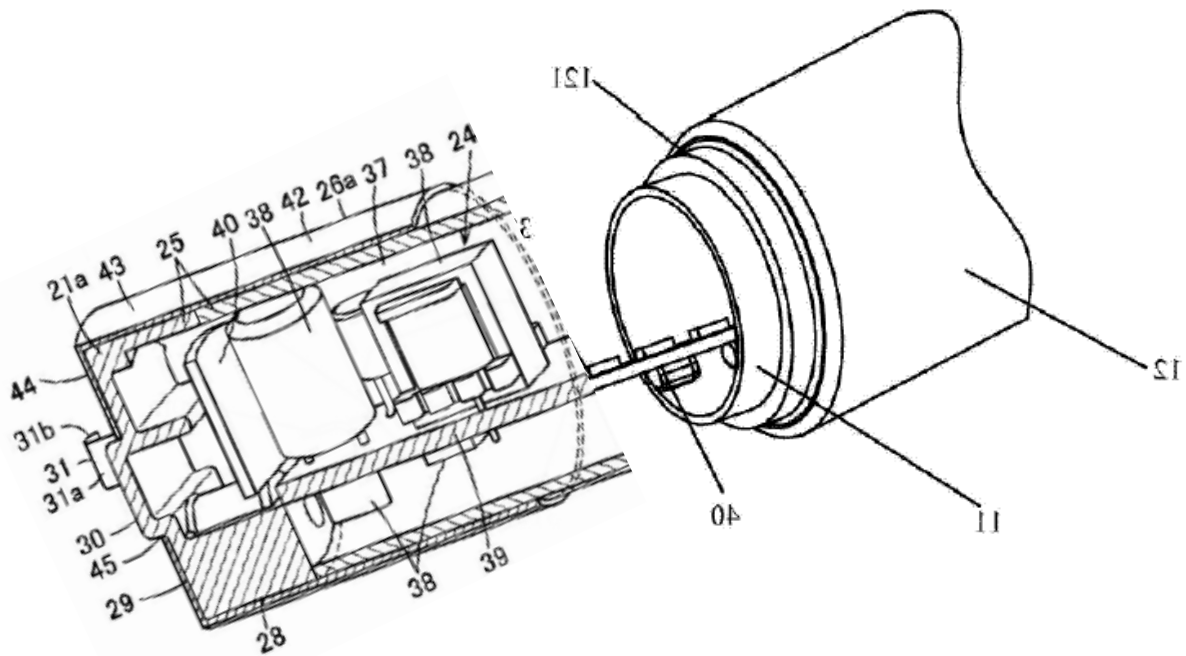
Simple Substitution. A POSITA would have understood that the substitution of (1) Ono’s known PCB structure for Li’s drive circuit and (2) Ono’s insulating end-caps for Li’s end covers would have predictable results. EX1003, ¶82. As discussed above, Li describes a double-sided PCB that is preferably used 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, ¶82. 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, ¶82. 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, ¶82.

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. EX1003, ¶83. 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 an ... 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, ¶83. 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.*

4. *Modification of Li with Ono*

The Li-Ono LED lamp includes Li's LED lamp with Ono's lighting circuit PCB and insulated end caps. EX1003, ¶84.



Li FIG. 3
(Modified per Li-Ono)

EX1005, FIG. 3; EX1006, FIG. 1; EX1003, ¶84.

5. *Element-by-Element Analysis*

(a) *Limitation 1[p]*

Li-Ono renders obvious an LED tube lamp. EX1003, ¶85. As explained in Section IX.A.1, 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.

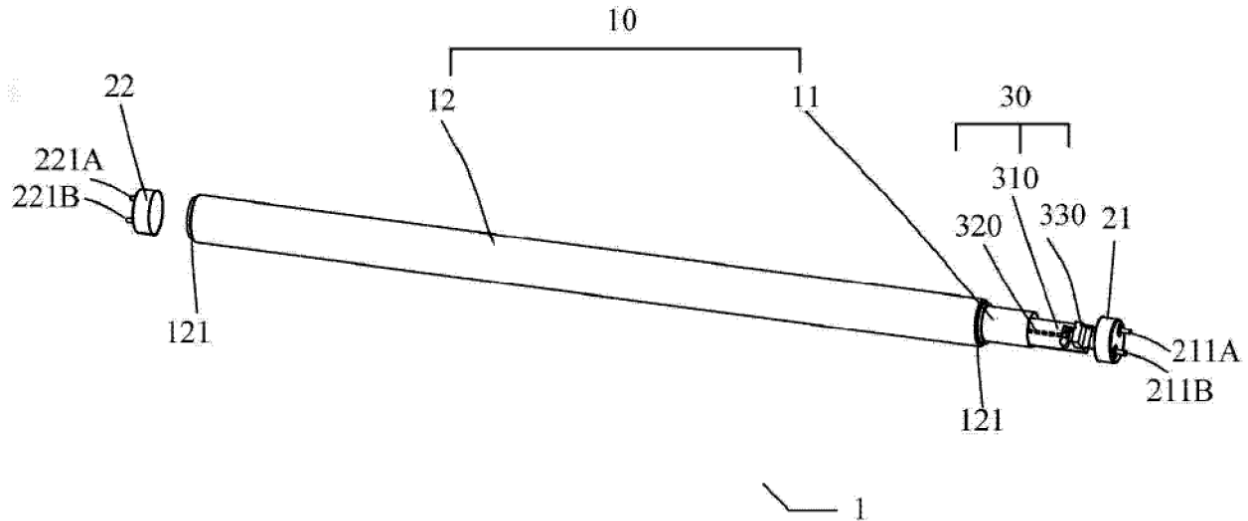


Fig. 1

EX1005, [0088]; FIG. 1; EX1003, ¶85.

(b) Limitation 1[a]

Li-Ono renders obvious a tube with two ends. EX1003, ¶86. The LED lamp tube body “comprises an [red] inner tube 11 and an [green] outer tube 12 sleeved outside the inner tube 11,” as shown in Figure 1, and both the inner and outer tubes have ends.

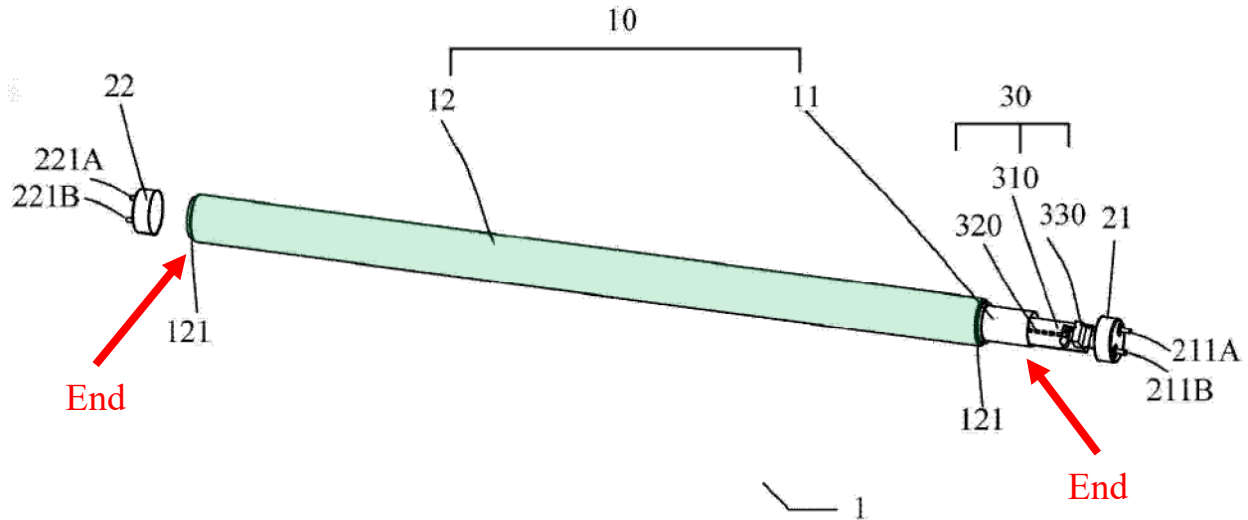


Fig. 1

EX1005, [0089], FIG. 1; EX1003, ¶86.

(c) *Limitation 1[b]*

Li-Ono renders obvious an LED light strip inside the tube. EX1003, ¶87. 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].

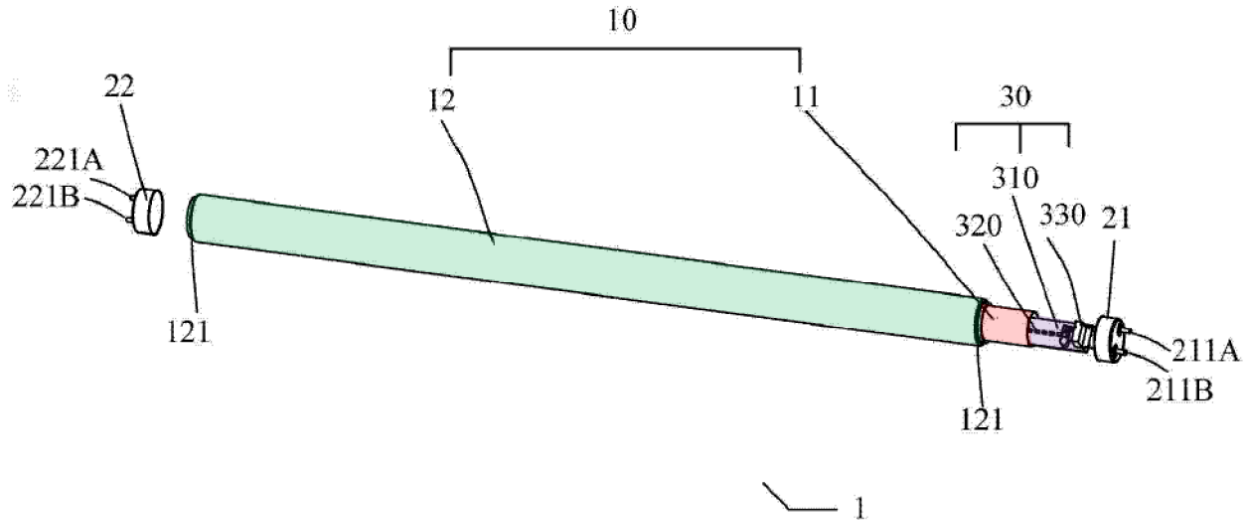
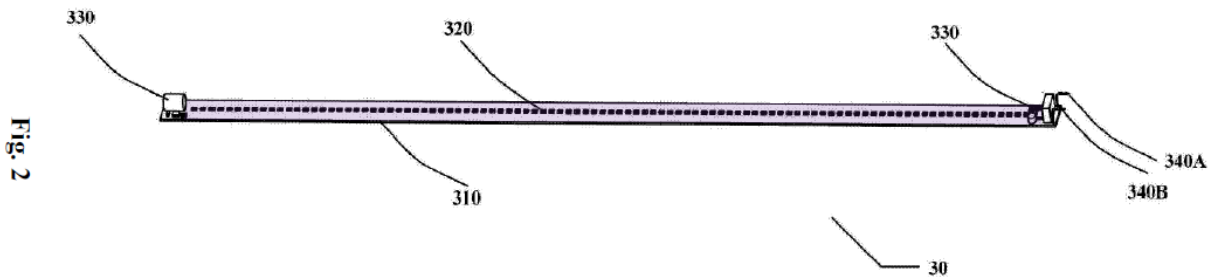


Fig. 1

Id., FIG. 1; EX1003, ¶87.

(d) Limitation 1[c]

Li-Ono renders obvious multiple LED light sources mounted on the LED light strip. EX1003, ¶88. Li's substrate includes "a plurality of LED units 320 [] arranged longitudinally along the [purple] substrate 310."



EX1005, [0098], FIG. 2; EX1003, ¶88.

(e) *Limitation 1[d]*

Li-Ono renders obvious a power supply connected and providing power to the LED light sources. EX1003, ¶¶89-90. Li's LED light 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.*

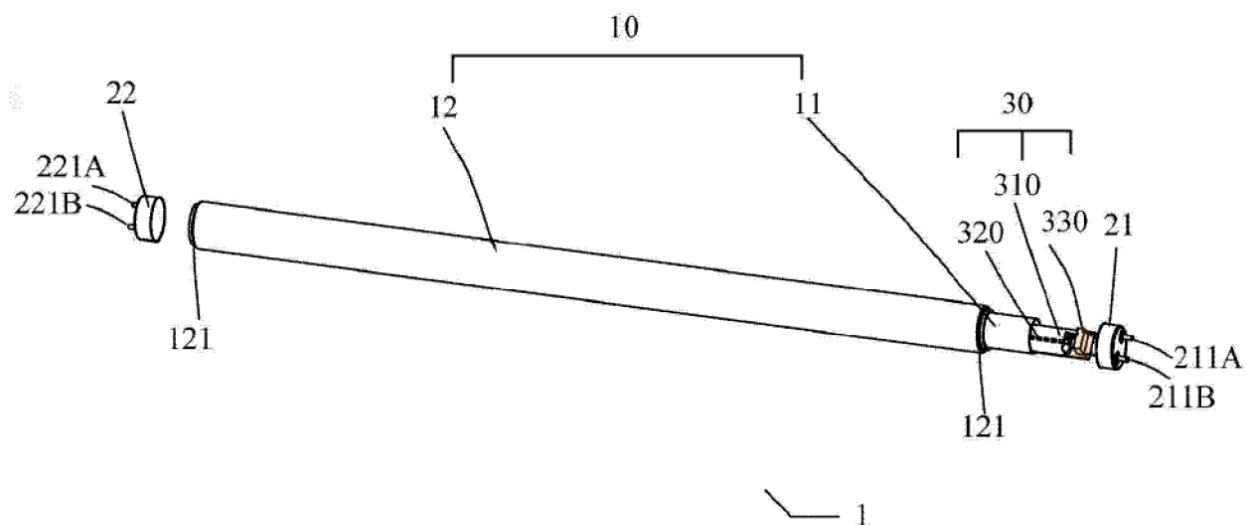


Fig. 1

Id., FIG. 1; EX1003, ¶89.

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.”

Id., [0082]; EX1003, ¶90.

(f) *Limitation 1[e]*

Li-Ono renders obvious end caps attached to each end of the tube, each having lateral and end walls. EX1003, ¶¶91-92. Li's LED light 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." EX1005, [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. *Id.*; EX1003, ¶91. The end wall is positioned away from the glass tube.

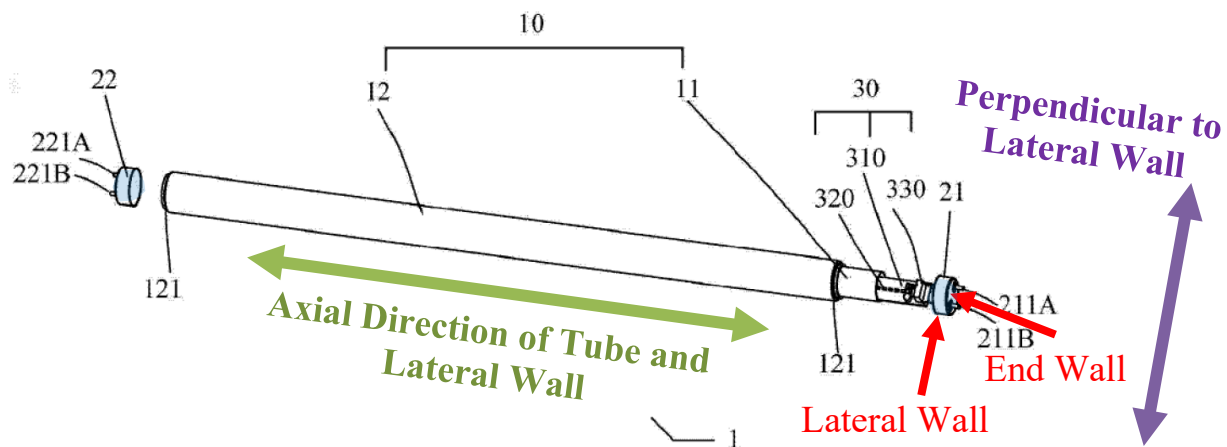
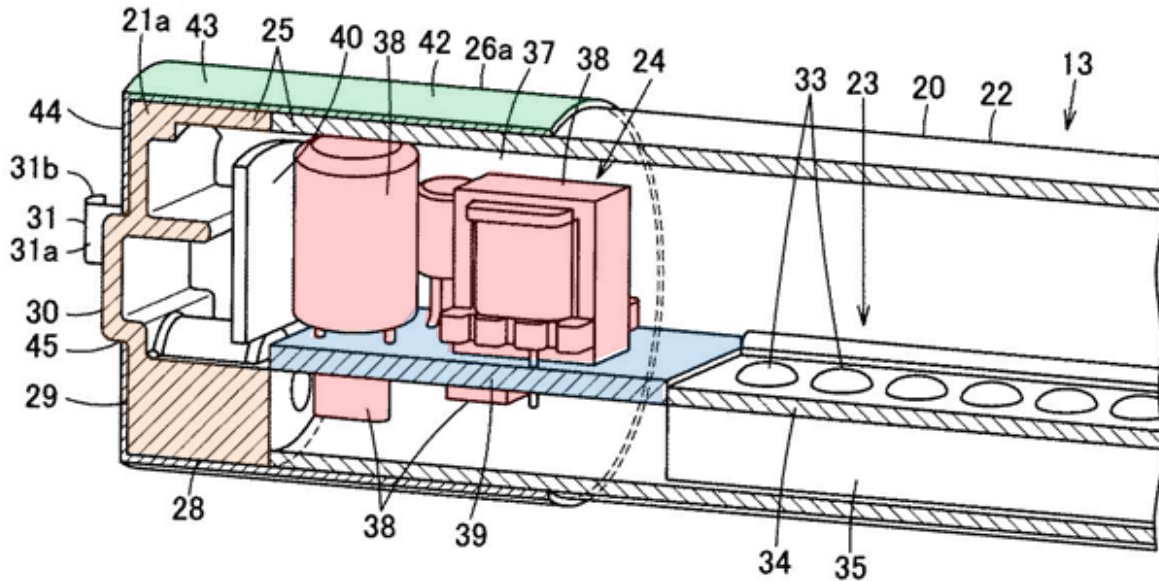


Fig. 1

EX1005, Abstract, FIGs. 1-2; EX1003, ¶91.

Ono similarly describes a cap 21a formed of a resin insulating material. EX1006, [0018], [0030]; *see also id.*, [0041]-[0044], FIGS. 1, 7; EX1003, ¶92. 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]



Id., FIG. 1; EX1003, ¶92.

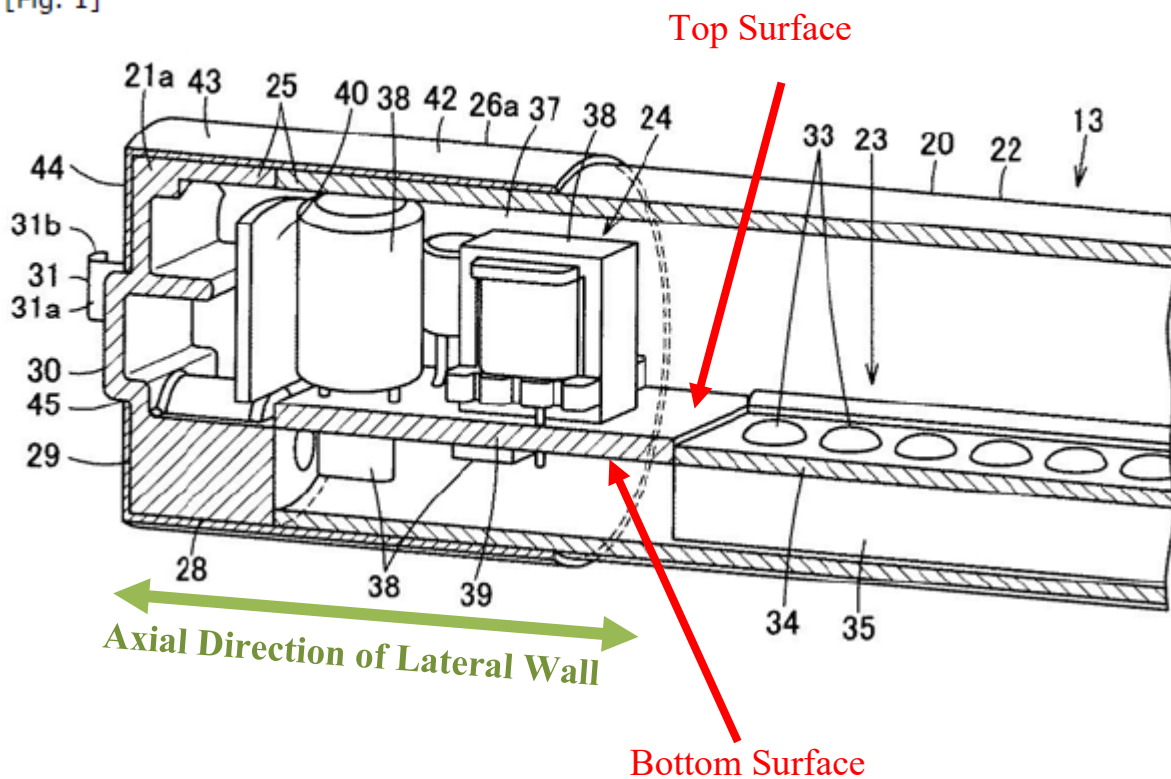
(g) *Limitation 1[f]*

Li-Ono 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, ¶¶93-95. Li discloses an LED drive circuit module 330, but does not describe the physical structure of the drive circuit. EX1003, ¶93. As explained above in Section IX.A.3, a POSITA would have been motivated to look to Ono to understand the physical implementation of the circuits described in Li. *Id.*, ¶94. 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 surfaces parallel to each other. EX1006, FIG. 1; EX1003, ¶95. The PCB is arranged substantially parallel with the axial direction of the lateral wall of the end cap.

[Fig. 1]



EX1006, FIG. 1; EX1003, ¶95.

(h) Limitation 1[g1]

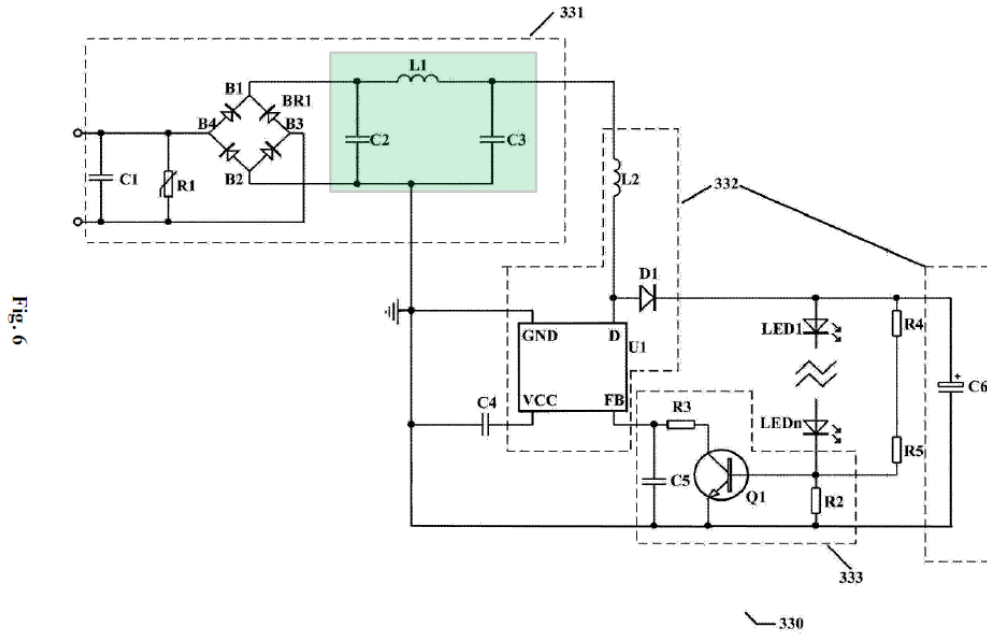
Li-Ono renders obvious a rectifying circuit with two input terminals.
EX1003, ¶96. Li describes that the drive circuit 330 includes “a [yellow] full-wave bridge rectifier BR1.”



EX1005, [0113], FIG. 6; EX1003, ¶¶96.

(i) *Limitation 1[g2]*

Li-Ono renders obvious a filtering circuit electrically connected to the rectifying circuit, under the proper construction of “electrically connected.” EX1003, ¶97; *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.

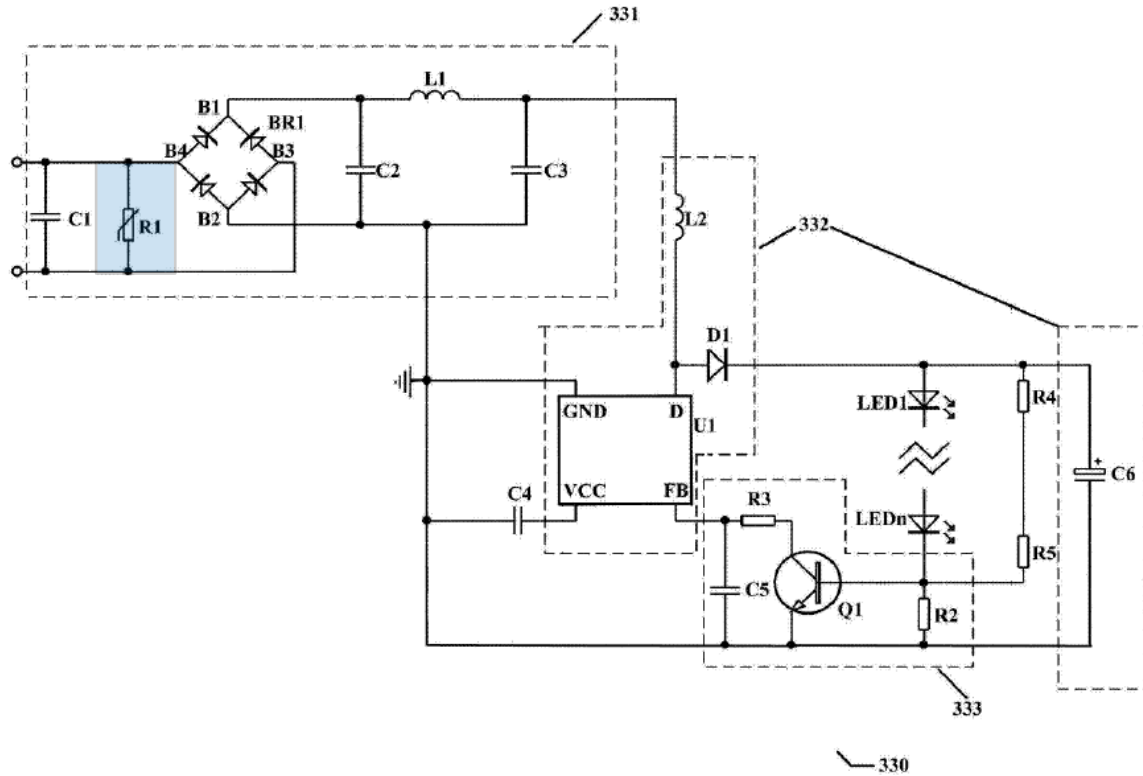


EX1005, [0113], FIG. 6; EX1003, ¶97.

(j) Limitation 1[h]

Li-Ono renders obvious a resistor located closest to the end wall of an end cap and connected to an input of the rectifying circuit. EX1003, ¶¶98-100. 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 light and thus varistor R1 is close to the end wall. EX1003, ¶98. 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, ¶98.

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, ¶99. 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, ¶99. 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. *Id.*

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. EX1003, ¶100.

(k) Limitation 1[i]

Li-Ono renders obvious an end wall made of an insulating material. EX1003, ¶101. Li is silent on the material that forms end caps 21 and 22. As explained in Section IX.A.4, 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 id.*, [0041]-[0044], FIGS. 1, 7; EX1003, ¶101.

(l) Limitation 2[a]

Li-Ono renders obvious a conductive pin connected to the first portion of an end wall. EX1003, ¶102. Li describes pins 211A and 211B on end cap 21.

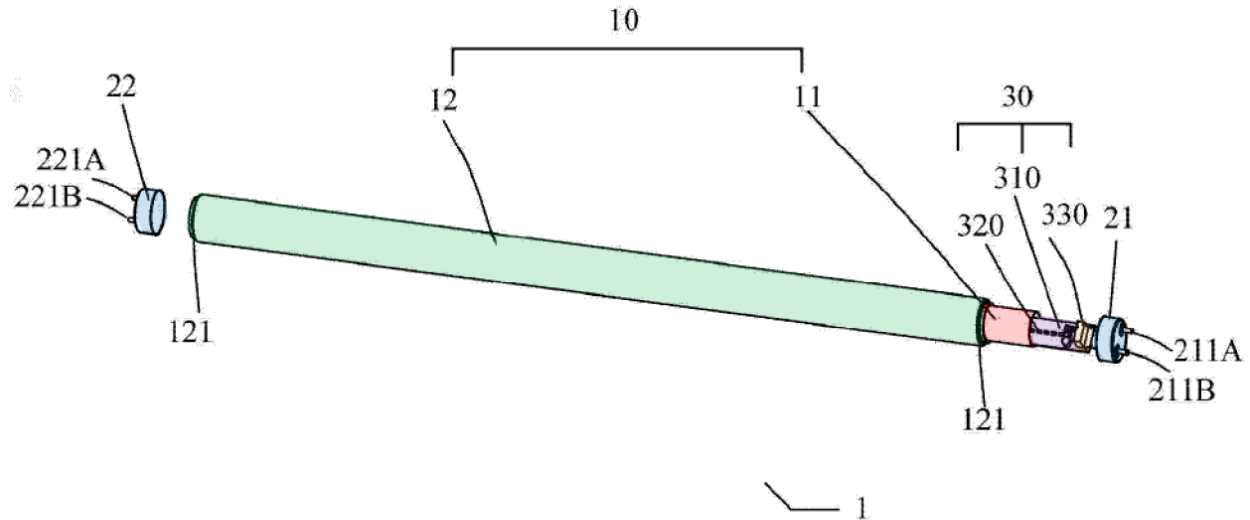
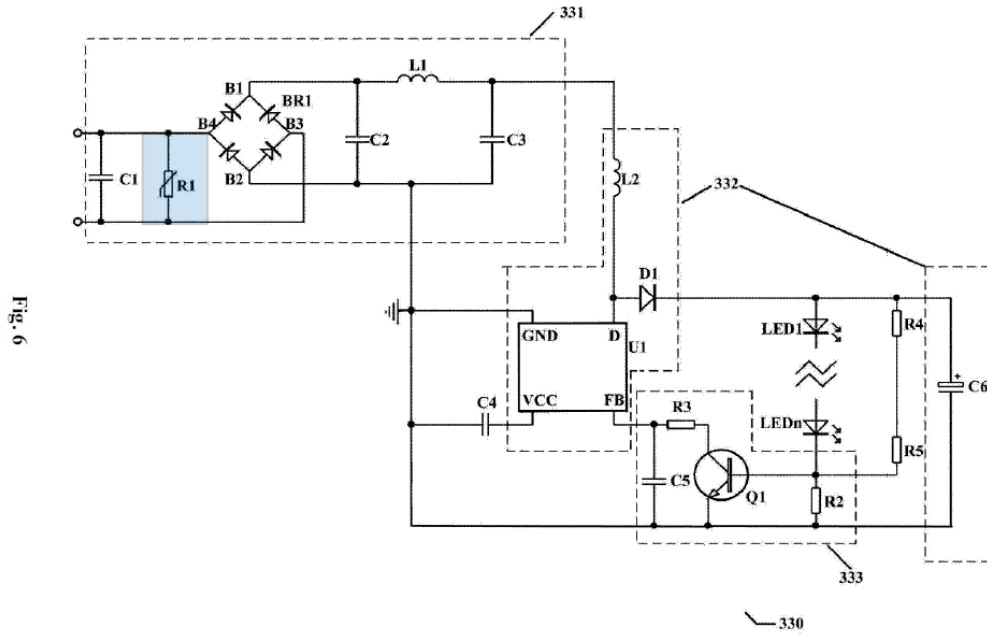


Fig. 1

EX1005, [0100], FIG. 1; EX1003, ¶102.

(m) Limitation 2[b]

Li-Ono renders obvious a resistor connected between the conductive pin and an input terminal of the rectifying circuit. EX1003, ¶103. Li describes a varistor R1 located between the AC inputs of the drive circuit 330. 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 light and thus varistor R1 is electrically connected to the conductive pin. *Id.* The varistor R1 is also electrically connected to an input of the rectifying circuit, specifically to input terminals B3 and B4.



EX1005, [0115], FIG. 6; EX1003, ¶103.

(n) Claim 4

Li-Ono renders obvious two conductive pins connected to a first portion of the end cap and a resistor connected between the two pins. EX1003, ¶¶104-105. Li describes [blue] pins 211A and 211B on end cap 21.

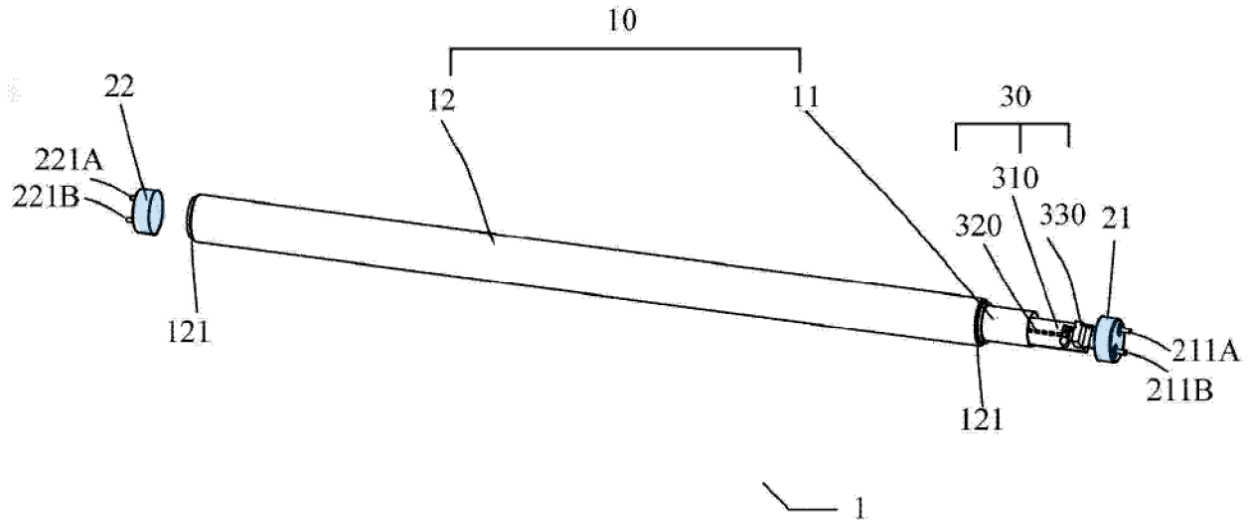
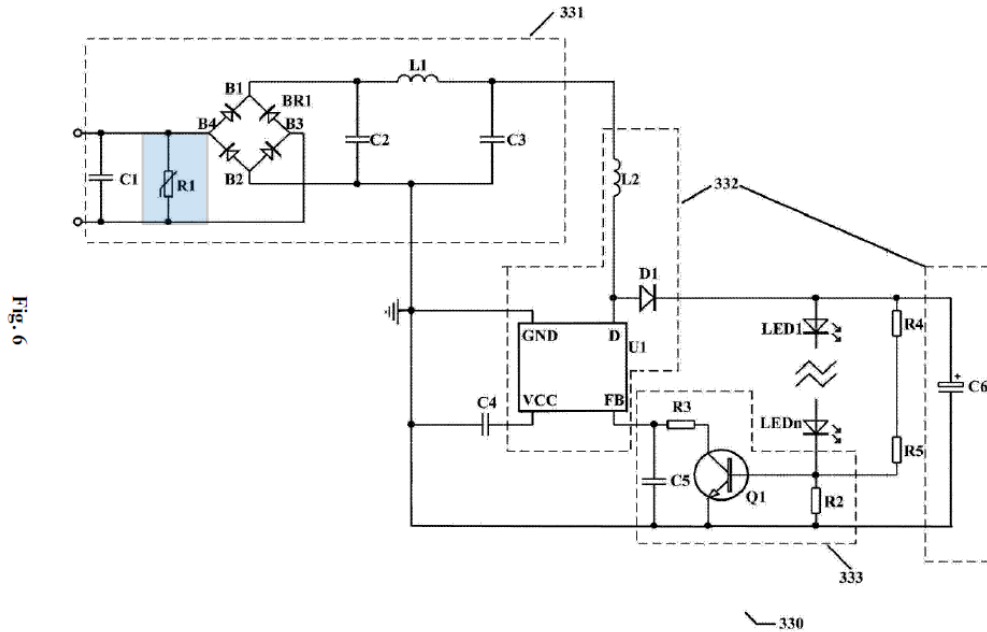


Fig. 1

EX1005, [0100], FIG. 1; EX1003, ¶104.

Li describes a varistor R1 located between the AC inputs of the drive circuit 330. 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 light 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 across input terminals B3 and B4.

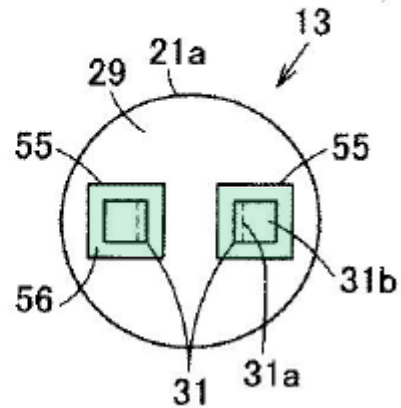


EX1005, [0115], FIG. 6; EX1003, ¶105.

(o) *Claim 5*

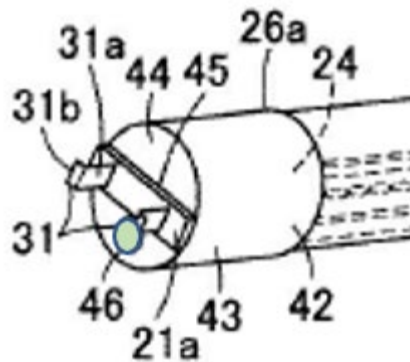
Li-Ono renders obvious an opening in the end wall. EX1003, ¶¶106-107. Li is silent on the design of end caps 21 and 22. As explained in Section IX.A.4, a POSITA would have been motivated to look to other LED lighting references, such as Ono, to determine potential designs for end caps. EX1003, ¶106. Ono describes that end cap 21a has “a pair of [green] openings 55.”

[Fig. 8]



EX1006, [0040], FIG. 8; EX1003, ¶106. Ono additionally describes that each cap end surface covering portion 44 has openings at “mounting holes 46 [green] for screwing a non-combustible cover 26a, 26b into a cap 21a, 21b” shown in excerpted FIG. 2 below.

[Fig. 2]



EX1006, [0019], FIG. 2; EX1003, ¶107.

(p) *Claim 6*

Li-Ono renders obvious a resistor positioned closest to the opening in the end wall. EX1003, ¶¶108-110. 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. EX1003, ¶108. Ono teaches that conductive pins extend through openings 55. EX1006, [0040].

While Li shows the capacitor C1 located closer to the input pins than varistor R1, a POSITA would have understood that because the capacitor and resistor are connected in parallel (EX1005, [0115], FIG. 6), the physical location of the capacitor and resistor could be swapped without any impact on the function of the described

circuit. EX1003, ¶108. Therefore, a POSITA would have understood Li as teaching that either the resistor or the capacitor could be the electronic component mounted closest to the opening in the end wall. *Id.*

Additionally, 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, ¶109. 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, ¶109. 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 and thus closest to the opening in that end wall. EX1003, ¶109.

Finally, a POSITA would have understood that it would be advantageous to place the resistor, a heat-generating element, near the opening in 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. EX1003, ¶110.

(q) *Limitation 30[p]*

Li-Ono describes an LED tube lamp. EX1003, ¶111; *see* Limitation 1[p], Section IX.A.5(a).

(r) *Limitation 30[a]*

Li-Ono describes a tube with two ends. EX1003, ¶112; *see* Limitation 1[a], Section IX.A.5(b).

(s) *Limitation 30[b]*

Li-Ono describes an LED light strip inside the tube. EX1003, ¶113; *see* Limitation 1[b], Section IX.A.5(c).

(t) *Limitation 30[c]*

Li-Ono describes multiple LED light sources mounted on the LED light strip. EX1003, ¶114; *see* Limitation 1[c], Section IX.A.5(d).

(u) *Limitation 30[d]*

Li-Ono describes a power supply connected and providing power to the LED light sources. EX1003, ¶115; *see* Limitation 1[d], Section IX.A.5(e).

(v) *Limitation 30[e]*

Li-Ono describes end caps attached to each end of the tube, each having lateral and end walls. EX1003, ¶116; *see* Limitation 1[e], Section IX.A.5(f).

(w) *Limitation 30[f]*

Li-Ono describes 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, ¶117; *see* Limitation 1[f], Section IX.A.5(g).

(x) *Limitation 30[g1]*

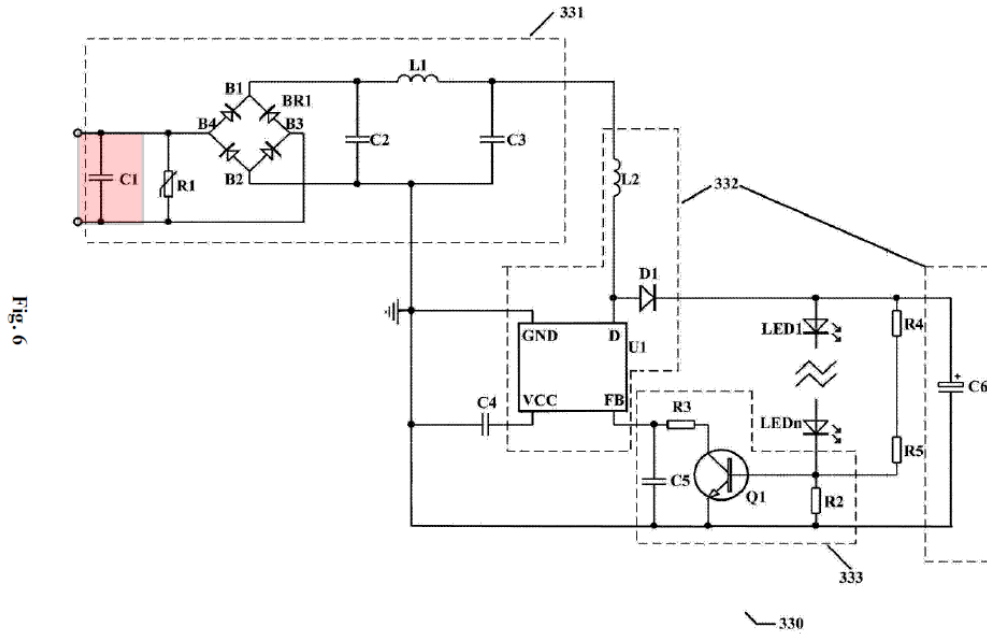
Li-Ono describes a rectifying circuit with two input terminals. EX1003, ¶118; *see* Limitation 1[g1], Section IX.A.5(h).

(y) *Limitation 30[g2]*

Li-Ono describes a filtering circuit electrically connected to the rectifying circuit. EX1003, ¶119; *see* Limitation 1[g2], Section IX.A.5(i).

(z) *Limitation 30[h]*

Li-Ono renders obvious a capacitor located closest to the end wall of an end cap. EX1003, ¶¶120-122. Li describes a [red] capacitor C1 located between the AC inputs of the drive circuit 330. EX1005, [0115], FIG. 6. 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 light and thus capacitor C1 is closest to the end wall. EX1003, ¶120.



EX1005, [0115], FIG. 6; EX1003, ¶120.

The location of the capacitor C1 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, ¶121. 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, ¶121. 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, ¶121.

Finally, a POSITA would have understood that it would be advantageous to place the capacitor, a heat-sensitive element, near the opening in the end cap to dissipate heat created by the other components on the PCB to mitigate the impact the heat causes on the capacitor. EX1003, ¶122.

(aa) Limitation 30[i]

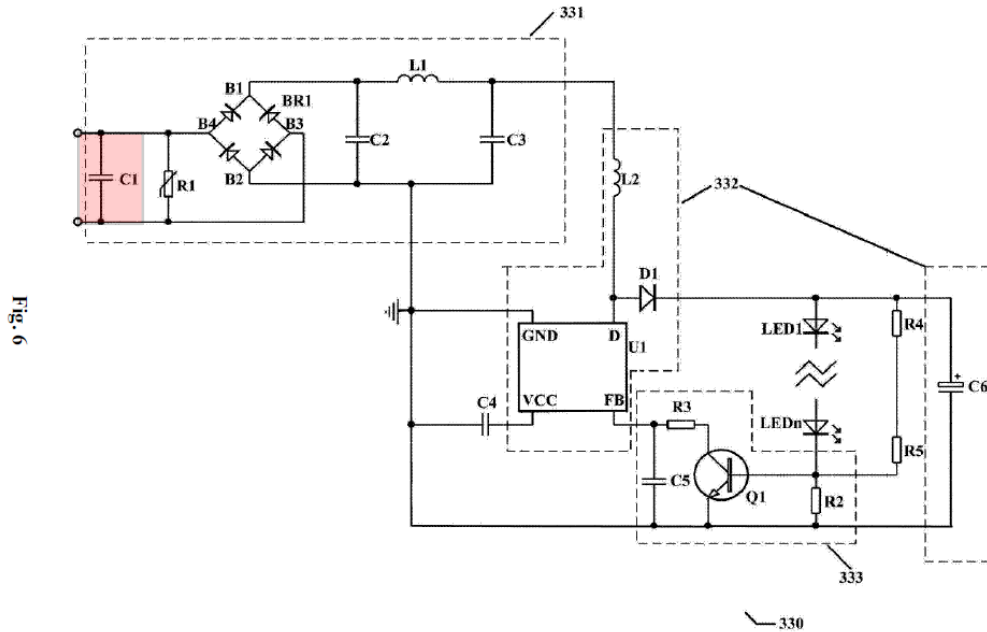
Li-Ono describes an end wall made of an insulating material. EX1003, ¶123; *see* Limitation 1[i], Section IX.A.5(k).

(bb) Claim 31

Li-Ono describes an end wall comprising at least one opening. EX1003, ¶124; *see* Claim 5, Section IX.A.5(o).

(cc) Claim 37

Li-Ono renders obvious that a capacitor connects between the input terminals of the rectifying circuit. EX1003, ¶125. Li describes a capacitor C1 that connects to the circuitry that forms the input of the rectifying circuit, specifically to input terminals B3 and B4.



EX1005, [0115], FIG. 6; EX1003, ¶125.

(dd) Claim 88

Li-Ono renders obvious a tube of an LED light made of glass. EX1003, ¶126. Li describes that both inner tube 11 and outer tube 12 “may be made of a glass material.” EX1005, [0089]; EX1003, ¶126.

(ee) Claim 90

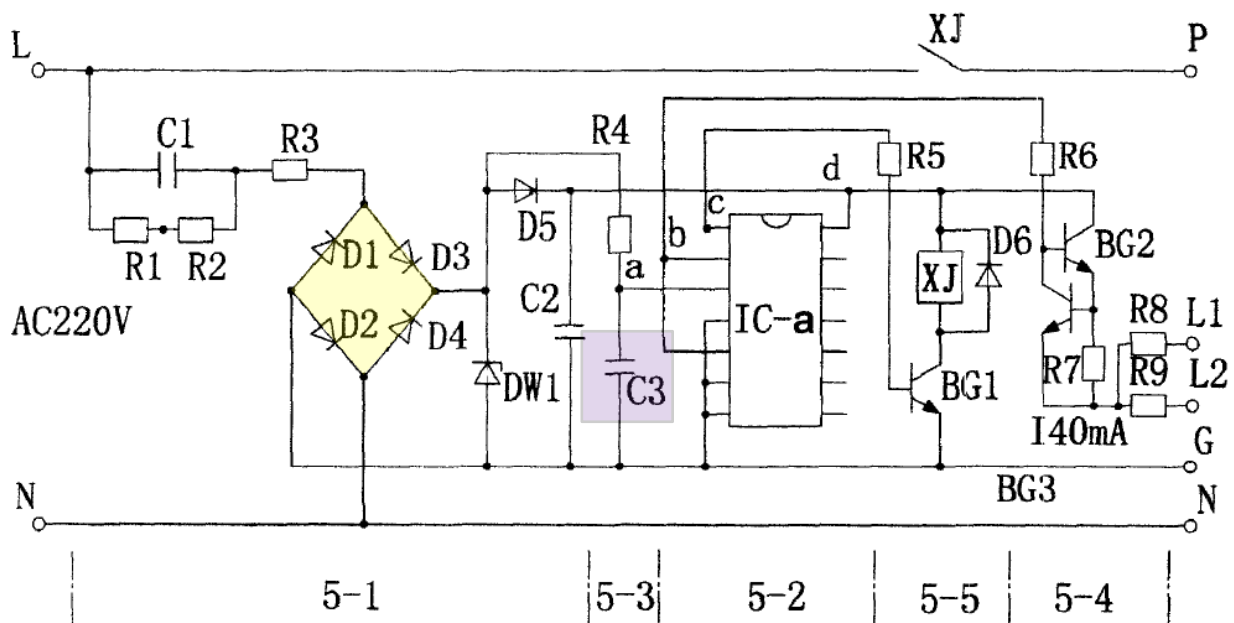
Li-Ono describes a tube of an LED light made of glass. EX1003, ¶127; *see* Claim 88, Section IX.A.5(dd).

B. Ground 2 - Claims 12-14 are Obvious over Li in view of Ono, and Xu

1. Xu

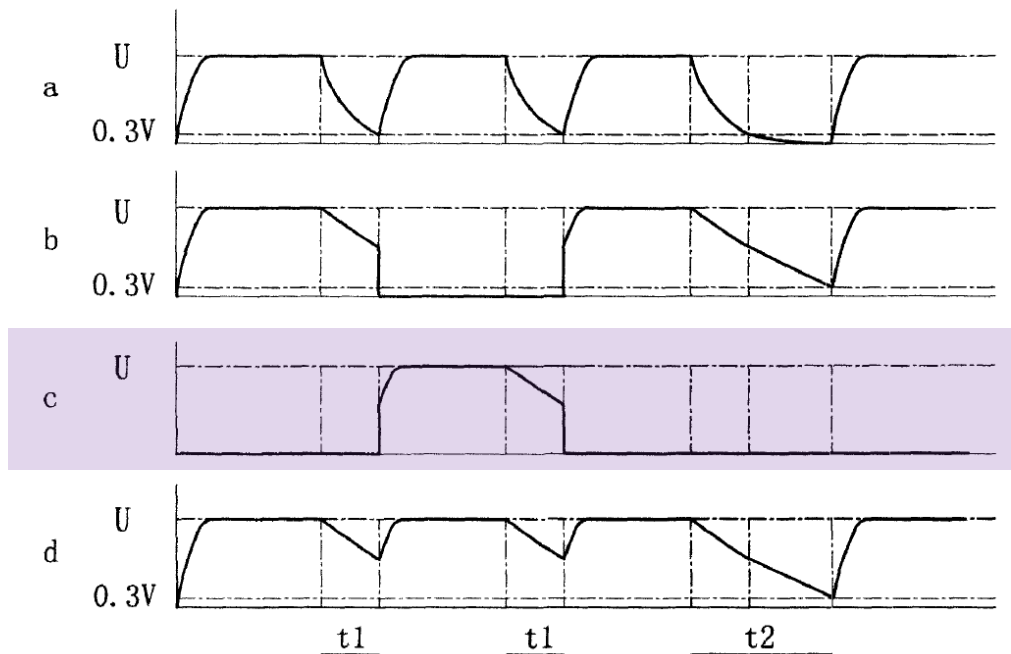
Xu is titled “Multiple Light Source Lighting Device.” Xu discloses a switching circuit connected to a power supply for an LED lamp. EX1009, 5/36. The

power supply includes a rectifying circuit formed of a [yellow] bridge rectifier circuit D1-D4. EX1009, 5/36. After the bridge rectifier is a [purple] capacitor C3. EX1009, 5-6/36. The capacitor C3 in combination with resistor R4 form triggering signal circuit 5-3, which is also a delay circuit, a simple RC circuit to introduce a delay interval between 0.5-2 seconds with the delay being selected by adjusting the capacitance of the capacitor C3. *Id.* “The signal from the control triggering signal circuit 5-3 is output through two circuits (one positive and one negative) of the bistable controller 5-2 to control the LED light source assembly driver 5-4.” *Id.*, 6/36. Additionally, capacitor C2 serves as both a filter capacitor and as an additional delay element.



EX1009, 5/36, FIG. 5; EX1003, ¶38.

Xu describes various timing adjustments, as shown in Figure 6. The example in [purple] Fig. 6c is an example of a delay, where the LED lamp does not turn on until after the time period t_1 which is controlled by the capacitance value of capacitor C3, the resistance of resistor R4, or both. EX1009, 6/36, FIG. 6; EX1003, ¶39. The delay interval t_1 is between “0.5-2 seconds.” EX1009, 5/36.



EX1009, FIG. 6.

2. *Motivation to Combine*

As explained in Sections IX.A.3-IX.A.5 for Ground 1, Li-Ono renders obvious claim 1. A POSITA would have also been motivated to further modify Li-Ono in view of Xu for each of several reasons. EX1003, ¶¶128-132.

Li describes that its LED lamp solves the drawbacks of incompatible of LED lamps with existing fluorescent lamp fixtures. EX1005, [0004-0005]. A POSITA

would have understood that one way to increase the compatibility of LED lamps with fixtures for conventional fluorescent lamps is to ensure that the LED lamp can work with different ballasts included in these fixtures. EX1008, 2:55-58. Because many ballasts utilize different turn-on protocols, such as filament pre-heating, instant start, and rapid start (EX1007, 2:30-58), a POSITA would have recognized the benefit of adding a delay to provide time for the electrical signal provided to an LED lamp to reach the desired voltage. EX1008, 5:1-35, EX1003, ¶129. This would serve to maximize efficiency and minimize the potential for damage to the LED tube lamp due, for example, to a high voltage pulse as is normally generated in the instant start turn-on protocol. EX1003, ¶129.

Xu describes various delays and current dumps that impact the timing of illumination of an LED lamp. EX1009, 3/36, FIG. 6. These features “bring[] convenience to users.” EX1009, 3/36. The features also introduce the capability for the LED lamp to be used with a dimmer switch. EX1009, 3/36. 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 and Ono. EX1003, ¶131.

Specifically, Xu describes a triggering signal circuit 5-3 that is composed of resistor R3 and capacitor C3. EX1009, 5-6/36. Xu teaches that triggering signal circuit 5-3 “control[s] the LED light assembly driver 5-4” (*id.*, 6/36, 3/36) and

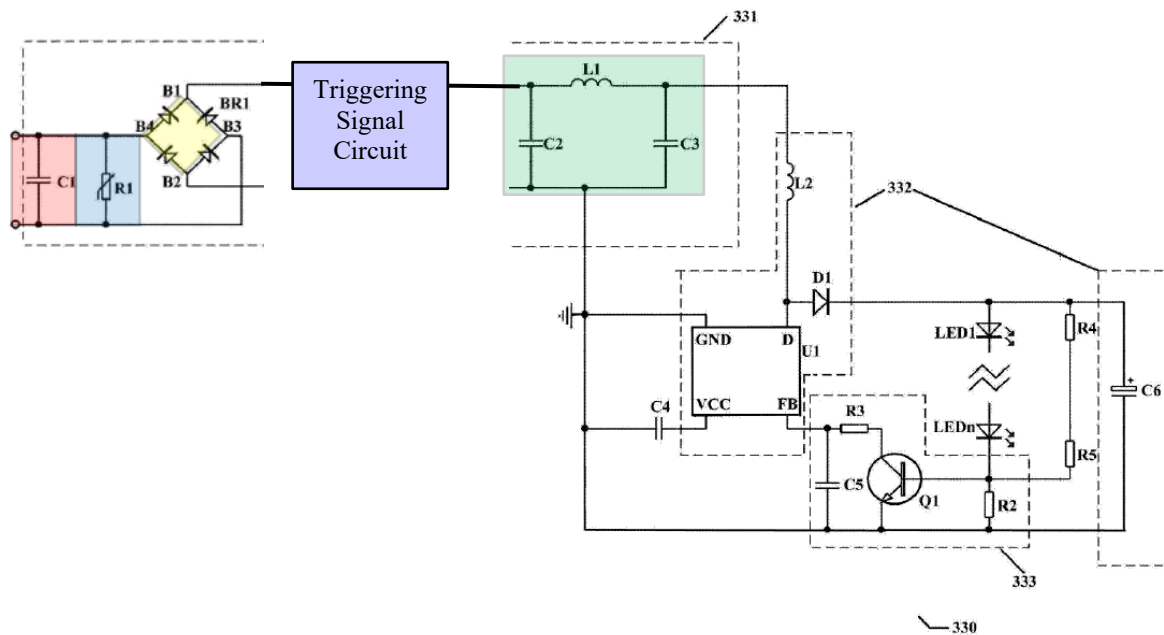
“energize[s] the [LED] light bulb” (*id.*, claims 2, 6). Xu teaches using capacitor C3 to introduce a delay. EX1009, 6/36. Using a properly positioned capacitor would have predictably achieved the benefits Xu describes with the Li-Ono LED lamp. EX1003, ¶130.

Incorporating Xu’s delay capability in Li-Ono would have been a known use of existing technology to provide capability in LED lamps. EX1003, ¶132. A POSITA would have been familiar with the use of capacitors to delay the transmission of current to downstream components until the capacitor was charged to a specific threshold voltage and triggered a controller. EX1009, 5-6/36; EX1003, ¶132. Xu describes its capacitive delay as a “control triggering signal circuit.” EX1009, 5-6/36. A POSITA would have also been familiar with the use of capacitors in conjunction with filtering circuits to further smooth the electricity provided to downstream components. EX1003, ¶132. Thus, when a POSITA selected a capacitor to provide an amount of delay of the LED lamp, the POSITA would have had a reasonable expectation that such an implementation would be successful to cause a delay before the LED lamp lights up. *Id.*

Finally, a POSITA would have reasonably expected to successfully incorporate a delay circuit into Li-Ono’s LED lamp, at least because such delay circuits were known in the art, and because Xu successfully uses them in the same field—i.e., delay circuits for LED lamps. EX1009, 1/36, 5-6/36; EX1003, ¶132.

3. *Modification of Li-Ono in view of Xu*

Modification of Li-Ono to implement the Xu's triggering signal circuit 5-3 using a capacitor for a delay before the Li-Ono LED tube lamp energizes would leave Li-Ono essentially unchanged, but implement Xu's capacitive delay. EX1003, ¶133. The triggering signal circuit 5-3 would be implemented between the output of bridge rectifier BR1 and the filtering circuit formed of C2, C3, and L1 of Li-Ono's drive circuit. *See, e.g.*, EX1008, 12:44-49; EX1003, ¶¶133-134.



Li FIG. 6
(Modified per Li-Ono-Xu)

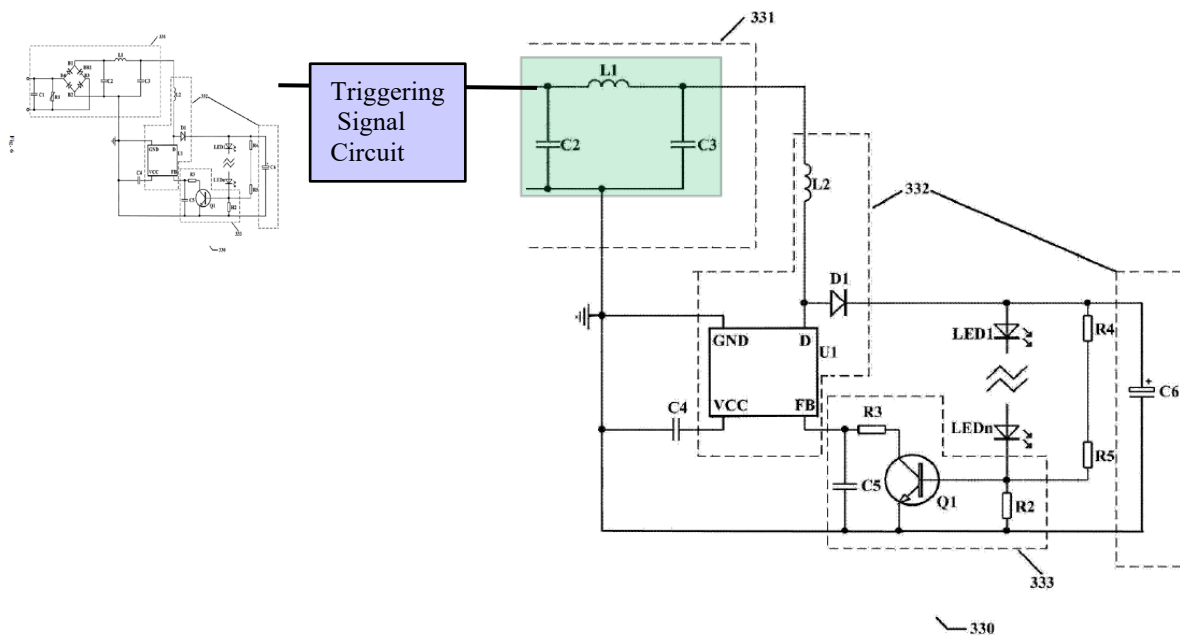
4. *Element-by-Element Analysis*

(a) *Claim 12*

Li-Ono-Xu renders obvious a circuit between the rectifying and filtering circuits that causes a delay before the LED lamp lights up. EX1003, ¶¶135-137. As

described above in Section IX.B.2, a POSITA would have been motivated to include the triggering signal circuit 5-3 described in Xu in the Li-Ono LED lamp to cause a delay before energizing the LED lamp. EX1003, ¶135.

Xu teaches that “triggering signal circuit 5-3” “control[s] the LED light assembly driver 5-4” (*id.*, 6/36, 3/36) and “energize[s] the [LED] light bulb” (*id.*, claims 2, 6). Specifically, resistor R3 and/or capacitor C3 introduces a delay. EX1009, 6/36. Further, as described above in Section IX.B.3, a POSITA would have implemented the triggering signal circuit 5-3 between the output of bridge rectifier BR1 and the filtering circuit formed of C2, C3, and L1 in the Li-Ono LED tube lamp.



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

Xu's delay circuit causes a delay before the LED lamp lights up because it does not output a voltage until after "the power-off delay interval t_1 ," which is "adjusted by adjusting the resistance value of R4 and the capacity value of C3." EX1009, 6/36, FIG. 6; EX1003, ¶137. A POSITA would have understood that the capacitor C3 described in Xu would be implemented by selecting the capacitance of the capacitor C3 to create the desired start-up delay. EX1003, ¶137; *see also* Section IX.B.3.

(b) Claim 13

Li-Ono-Xu renders obvious a circuit including a capacitor that is charged to a threshold voltage by the AC driving signal and that conducts when the capacitor's voltage exceeds the threshold trigger voltage. EX1003, ¶¶138-139. As described above in Section IX.B.2, a POSITA would have been motivated to include the triggering signal circuit 5-3 described in Xu in the Li-Ono LED lamp to implement a delay before energizing the LED lamp. EX1003, ¶138.

As explained above in Claim 12, Xu's capacitor C3 creates a delay before the LED lamp lights up. EX1009, 5-6/36; Section IX.B.4(a); EX1003, ¶139. A capacitor works by charging until it reaches a specified voltage, i.e., a threshold trigger voltage, at which point the current is allowed to flow through the circuit to the LEDs in the LED lamp. EX1003, ¶139. Therefore the capacitor serves to control the threshold trigger voltage. *Id.* In the Li-Ono-Xu implementation, the capacitor

C3 outputs a predetermined voltage after a lapse of a predetermined period of time based on the capacitance of the capacitor C3, after which the LED lamp will light up. *Id.*

(c) Claim 14

Li-Ono-Xu renders obvious a start-up delay of between 0.1-3 seconds. EX1003, ¶¶140-141. As described above in Section IX.B.2, a POSITA would have been motivated to include a triggering signal circuit like what is described in Xu to implement a turn-on delay in the LED lamp. EX1003, ¶140.

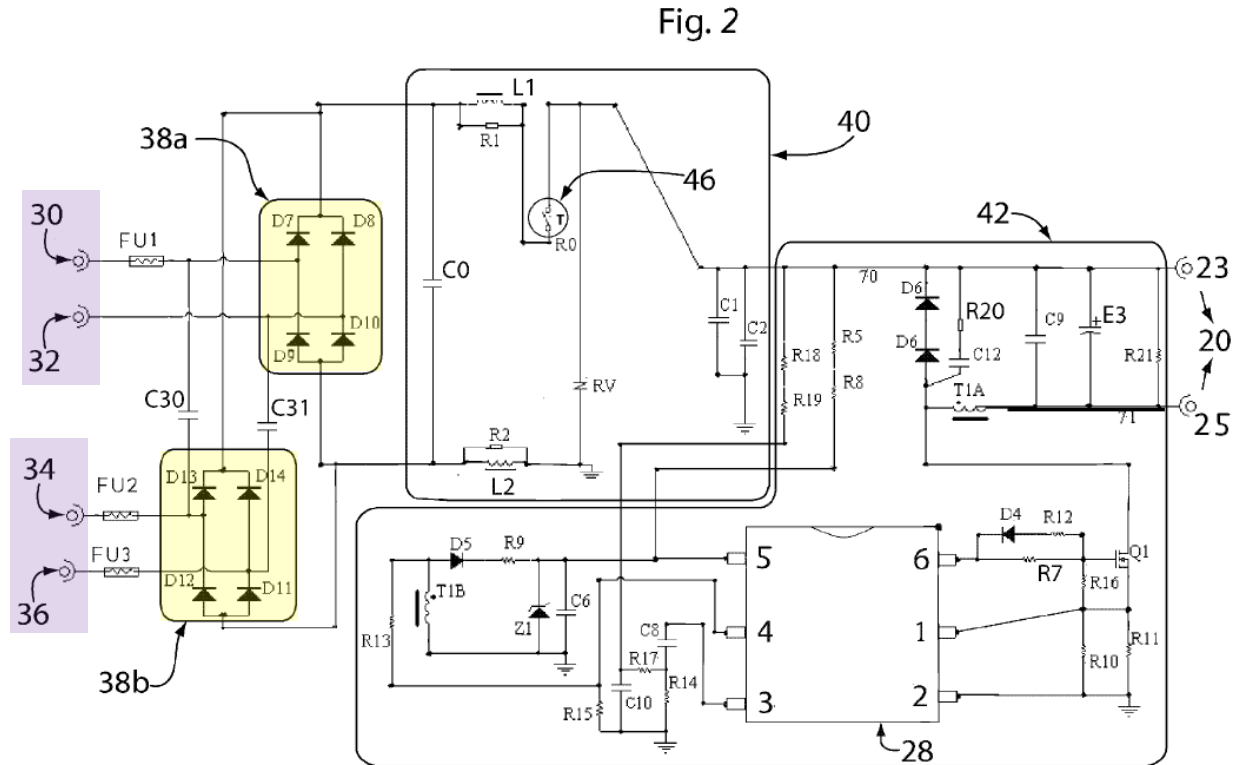
As explained above in Claim 12, Xu discloses a capacitor C3 that creates a delay before the LED lamp lights up. EX1009, 5-6/36; Section IX.B.4(a); EX1003, ¶141. The delay interval t_1 is between 0.5-2 seconds. EX1009, 5/36; EX1003, ¶141.

C. Ground 3 - Claim 47 and 77 are Obvious over Li in view of Ono 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. EX1007, 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.” EX1007, 9:28-30.



EX1007, FIG. 2; EX1003, ¶41.

2. Motivation to Combine

As explained in Sections IX.A.3-IX.A.5 for Ground 1, Li-Ono renders obvious claims 4 and 30.

A POSITA would have also been motivated to further modify Li-Ono with Guang for each of several independent reasons. EX1003, ¶¶142-146.

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 a

second pair of pins 350A and 350B on the opposite end of the tube lamp. EX1005, [0101]. Li further describes a drive circuit module on each end of the tube lamp connected to the pins 340A/340B and 350A/350B, respectively. EX1005, [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. EX1005, [0105]. A POSITA would have been motivated to include two full-wave bridge rectifying circuit, like what is 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, ¶¶143-144.

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, ¶144. By incorporating aspects of Guang’s power management circuitry into Li-Ono, a POSITA could have recognized the benefits provided by Guang. EX1003, ¶145. 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 by placing a full-wave bridge rectifier circuit at each set of conductive pins, the compatibility of the LED lamp with conventional lamp holders would have been increased. EX1003, ¶145.

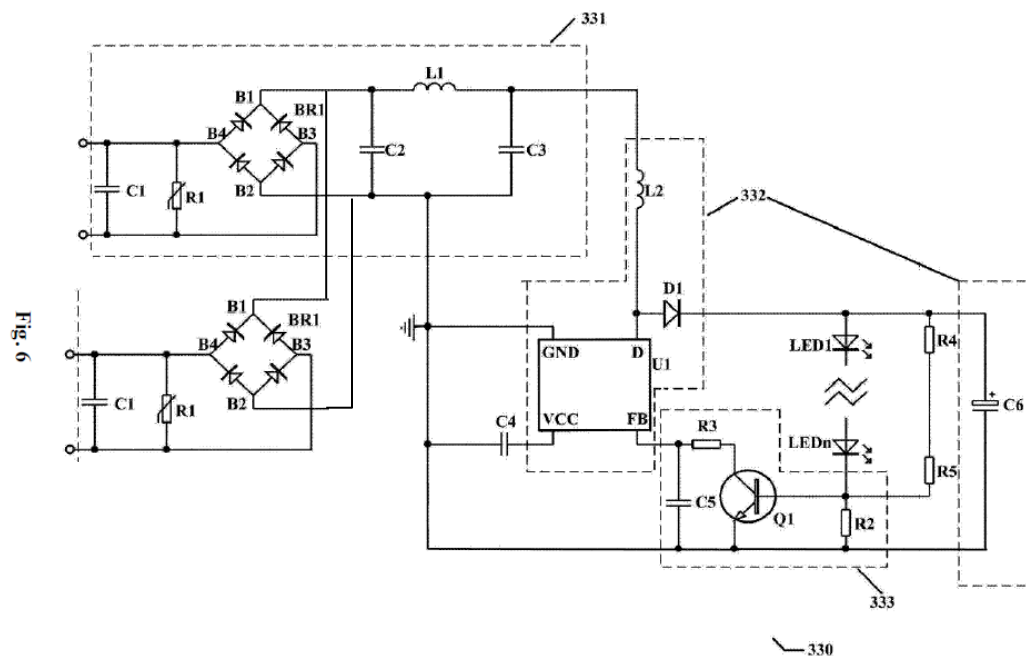
Li already discloses a full-wave bridge rectifier circuit, BR1, in the drive power module. EX1005, [0115]. A POSITA would have expected that including a second full-wave bridge rectifier circuit at a second set of pins would be successful because to do so was an implementation of known components already existing in the drive power module in exactly the same way, just at another, second location. EX1003, ¶146. No other changes to the circuit would be required as both full-wave 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 full-wave bridge rectifying circuit into Li-Ono’s LED lamp, at least because full-wave 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, ¶146.

3. *Modification of Li-Ono in view of Guang*

Modification of Li-Ono to include the two full-wave bridge rectifying circuits, as described by Guang, would supplement the single full-wave bridge rectifying circuit of Li. EX1003, ¶147. This modification would allow a full-wave bridge rectifying circuit to be electrically connected to each set of conductive pins located on opposite sides of the LED tube lamp. *Id.*



Li FIG. 6
(Modified per Li-Ono-Guang)

EX1005, FIG. 6; EX1007, FIG. 2; EX1003, ¶147.

4. *Element-by-Element Analysis*

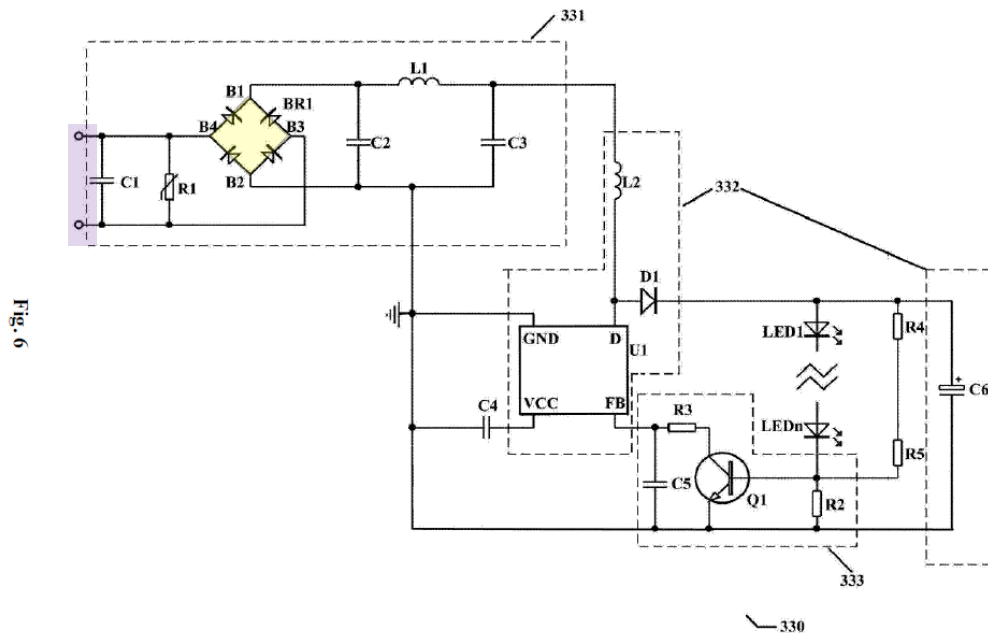
(a) *Limitation 47[a]*

38a connected to a [purple] set of conductive pins 30, 32.



EX1007, 9:2-8, FIG. 2; EX1003, ¶148. 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.

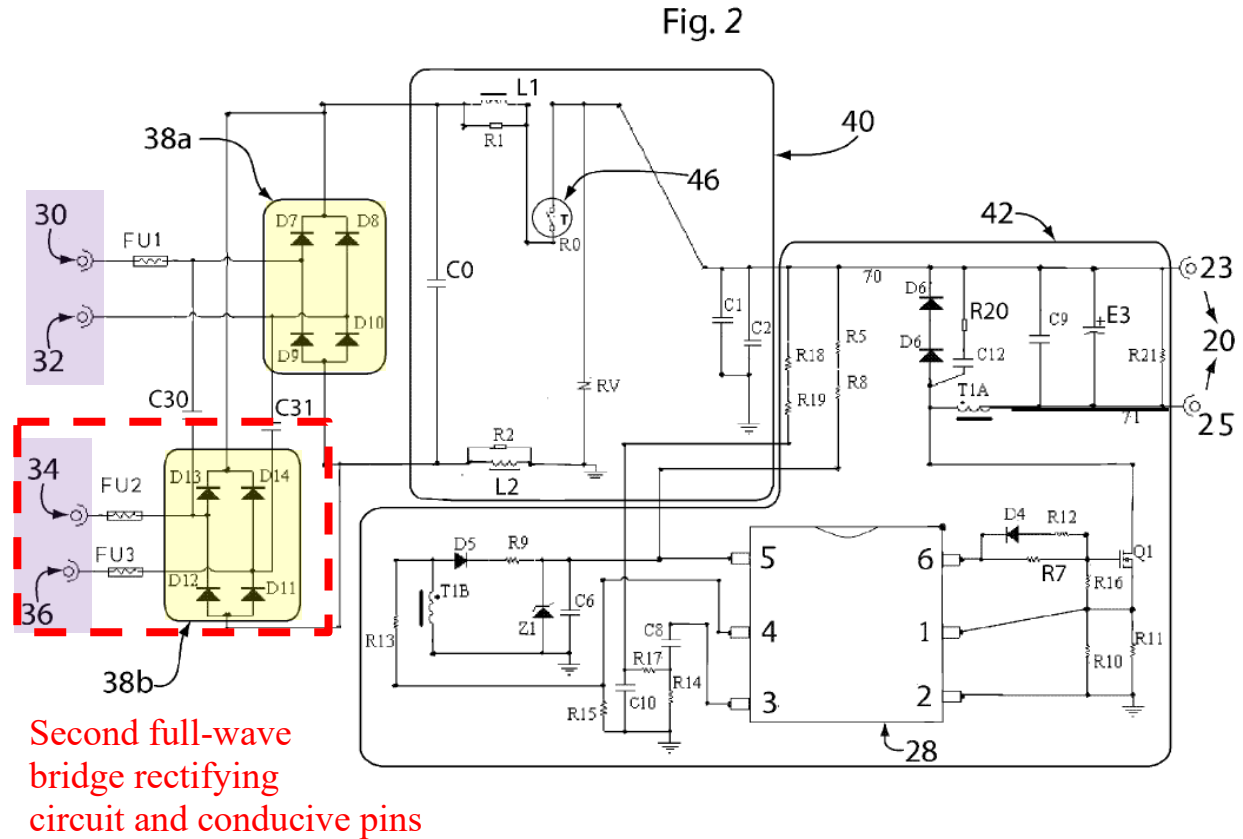


EX1005, [0113], FIG. 6; EX1003, ¶149.

(b) *Limitation 47[b]*

Li-Ono-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, ¶150. 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.C.2; EX1003, ¶150. Specifically, Guang describes a [yellow]

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

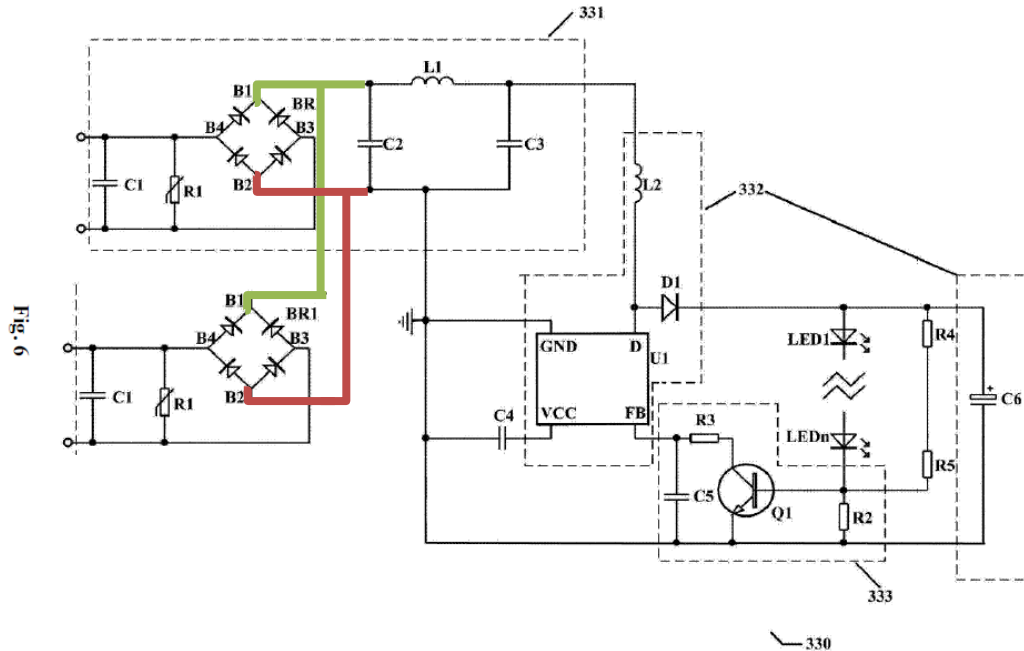


EX1007, 9:2-8, 9:28-30, 9:39-50, FIG. 2; EX1003, ¶150.

(c) *Limitation 47[c]*

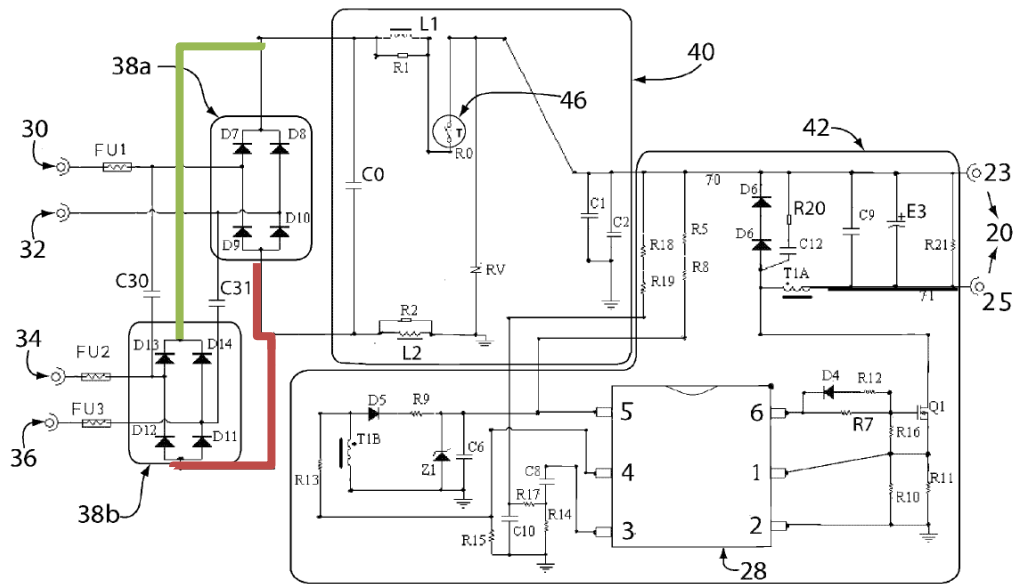
Li-Ono-Guang renders obvious a circuit where the positive output terminals of the two full-wave bridge rectifying circuits are electrically connected and the negative output terminals of the two full-wave bridge rectifying circuits are electrically connected. EX1003, ¶¶151-152. In the Li-Ono-Guang system, 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. EX1003, ¶151. 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, ¶151. 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



EX1007, FIG. 2; EX1003, ¶152.

(d) Limitation 77[a]

Li-Ono-Guang describes a first full-wave bridge rectifying circuit, with positive and negative output terminals, connected to one set of conductive pins.

EX1003, ¶153; see Limitation 47[a], Section IX.C.4(a).

(e) Limitation 77[b]

Li-Ono-Guang describes a second full-wave bridge rectifying circuit, with positive and negative output terminals, connected to the other set of conductive pins.

EX1003, ¶154; see Limitation 47[b], Section IX.C.4(b).

(f) Limitation 77[c]

Li-Ono-Guang describes 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, ¶155; *see* Limitation 47[c], Section IX.C.4(c).

D. Ground 4 - Claims 84-86 are Obvious over Li in view of Ono and Zhang

1. Zhang

Zhang is titled “Solid-State Lighting Apparatus With Filament Imitation for Use With Fluorescent Ballasts.” EX1014, Cover. Zhang explains that “[s]olid-state lighting devices may be attractive for retrofit replacement applications” and notes that “LED-based replacements for fluorescent lamps have [] been developed.” EX1014, 1:24-25, 1:33-34. Zhang discloses various filament-imitating circuits. EX1003, ¶43. One such circuit is shown in Figure 4 and includes “a capacitor C1 coupled to the first and second terminals 101a, 101b of the first ballast port 101 and to a LED lighting circuit 110,” as shown below. EX1014, 4:59-62.

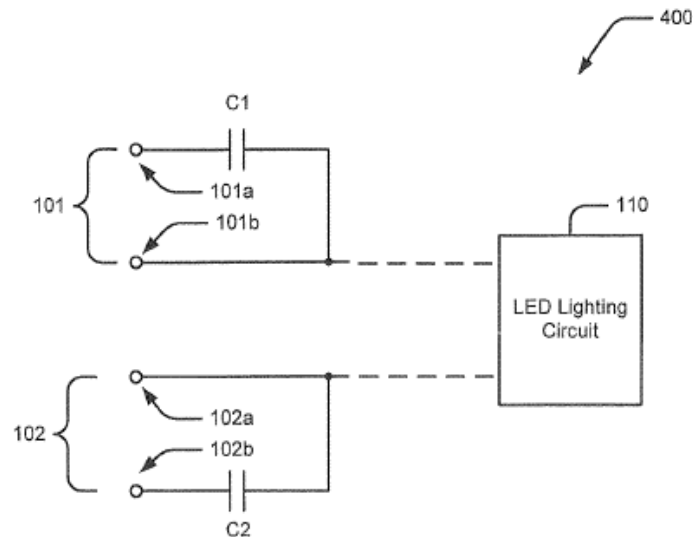


FIG. 4

Id., FIG. 4; EX1003, ¶43. The capacitor C1 presents an impedance in the circuit to imitate the filament impedance of a fluorescent lamp. *Id.*, 4:62-5:3; EX1003, ¶43.

2. Motivation to Combine

As explained in Sections IX.A.3-IX.A.5 for Ground 1, Li-Ono renders obvious claim 30.

A POSITA would have also been motivated to combine Zhang with Li-Ono with a reasonable expectation of success for several reasons. EX1003, ¶¶156-160.

Li describes that its LED lamp solves the drawbacks of incompatible of LED lamps with existing fluorescent lamp fixtures. EX1005, [0004-0005]. A POSITA would have understood that one way to increase the compatibility of LED lamps with fixtures for conventional fluorescent lamps is to ensure that the LED lamp can work with ballasts included in these fixtures. A POSITA would have known that light fixtures often include ballasts used for preheating before the lamp is started. EX1007, 2:41-45; EX1003, ¶157. When replacing a traditional fluorescent lamp, if the light fixture is not modified, the lack of filament in the LED lamp may cause the ballast in the light fixture to erroneously determine that filaments are open-circuited or short-circuited during the pre-heating process. EX1003, ¶157. Because Li-Ono has the goal of increasing the compatibility of LED lamps with conventional light fixtures, a POSITA would have been motivated to solve the problem created by the absence of a filament in the LED lamp. *Id.* Thus, a POSITA would have been

motivated to combine Li-Ono with Zhang to ensure that the Li-Ono LED lamp is compatible with conventional light fixtures by simulating the load that would typically be generated by a conventional light bulb. *Id.*

Specifically, Zhang describes that “some fluorescent lighting ballasts may be configured to detect the state of an attached lamp by monitoring the AC and/or DC impedance between terminals of pins connected to the ends of the filament, and may shut down the ballast if the impedance indicates a failed/failing lamp.” EX1014, 4:46-51; EX1003, ¶158. Therefore, Zhang teaches that “[t]he filament-imitating impedance may mimic the impedance of a healthy filament under such monitoring and, therefore, may prevent unwanted shutdown.” *Id.*, 4:51-54. Thus, Li and Zhang are directed to solving the same problem of using an LED tube lamp in an existing ballast and a POSITA would have readily looked to both when searching for a solution. EX1003, ¶159. Li does not explicitly describe the structure of a filament-simulating circuit that could be implemented on the power supply PCB. *Id.* A POSITA would have been motivated to look for examples of filament-simulating circuits for LED tube lamps to see how others had approached the design of said circuits in the past. *Id.* Zhang describes one such approach. EX1014, 5:11-20, FIG. 4.

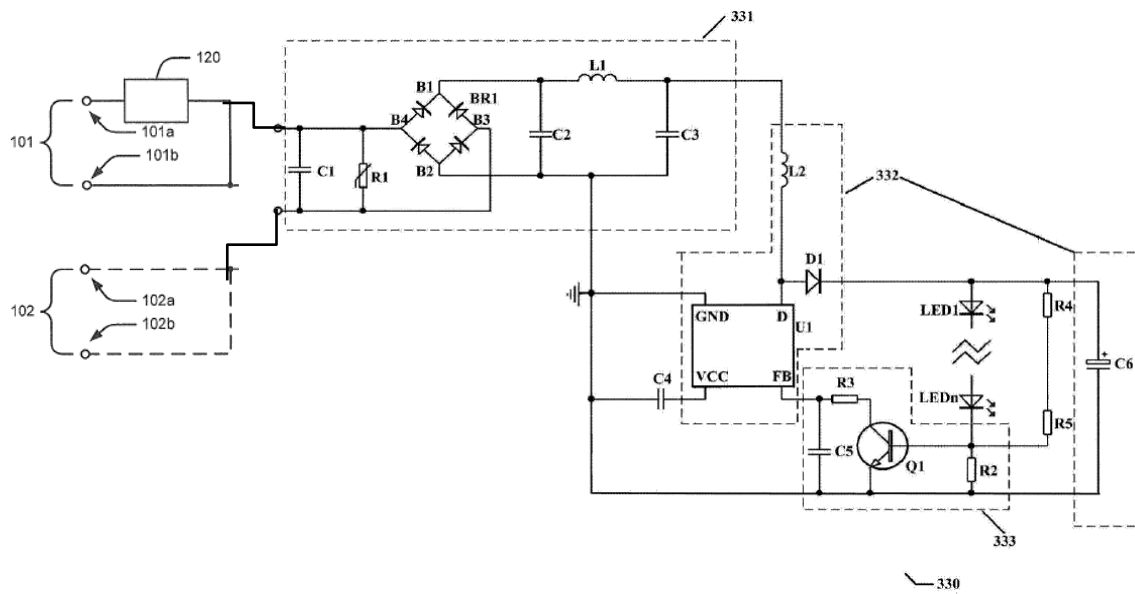
Zhang discloses a capacitor connected to each input pin pair. EX1014, 5:18-20, FIG. 4. The capacitor acts to simulate the presence of a filament in the LED

lamp. EX1014, 4:59-5:3; EX1003, ¶160. A POSITA would have been motivated to include this capacitor in Li-Ono. EX1003, ¶160. A POSITA would have had a reasonable expectation of success because the modification would have been the implementation of known components, resistors and capacitors, in a conventional way to achieve conventional results. *Id.* Filament-simulating circuits were well known, as described by Zhang, and a POSITA would have been readily able to add such a circuit to the existing drive circuit of Li-Ono. *Id.*

Finally, a POSITA would have reasonably expected to successfully incorporate a filament-simulating circuit into Li-Ono's LED lamp, at least because filament-simulating circuits were known in the art, and because Zhang successfully uses them in the same field—i.e., filament-simulating circuits for LED lamps. EX1014, Abstract, 2:23-33; EX1003, ¶160.

3. Modification of Li-Ono in view of Zhang

Modification of Li-Ono to include a filament-simulating circuit, as described by Zhang, would add filament-simulating capability to Li-Ono's circuitry between the input of the drive circuit and the pins in the end caps of the LED lamp. EX1003, ¶161. This modification would prevent compatibility problems when the LED lamp is used in a conventional light fixture.. *Id.*



Li FIG. 6
(Modified per Li-Ono-Zhang)

4. *Element-by-Element Analysis*

(a) *Claim 84*

Li-Ono-Zhang renders obvious a filament-simulating circuit configured to conduct current during a preheat process when the LED lamp is powered by a ballast. EX1003, ¶¶162-166. As described above in Section IX.D.2, a POSITA would have been motivated to include the filament-simulating circuit described in Zhang in the Li-Ono LED lamp to improve the compatibility of the LED lamp with conventional light fixtures. EX1003, ¶162.

Zhang describes a filament-imitating circuit 120 connected to the input terminals 101 of the LED lamp. EX1014, 4:27-28.

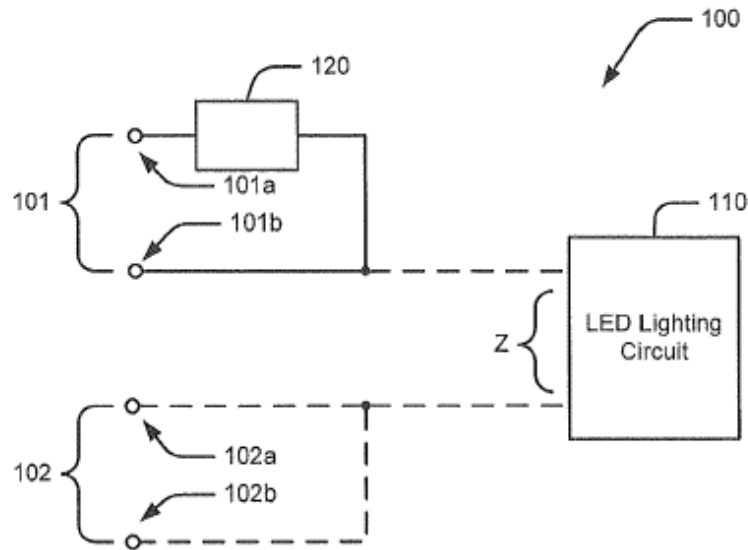


FIG. 1

Id., 4:27-28, FIG. 1; EX1003, ¶163.

Zhang explains that terminals 101a and 101b are “pins that are configured to be connected to a fluorescent lamp connector ... that provides electrical coupling to a fluorescent lighting ballast.” EX1014, 4:20-24. A POSITA would have understood that these terminals coincide with the end terminals of an LED replacement tube lamp designed to fit into a fluorescent light fixture which commonly utilize tombstone connectors at each end. EX1003, ¶164. Zhang further describes this usage by disclosing that the apparatus “may also include a second port 102 with similar terminals 102a, 102b for use in, for example, bi-pin fluorescent tube replacement applications. EX1014, 4:24-26. Thus a POSITA would further understand that terminals 101a and 101b would correspond to the pin terminals at one end of a replacement LED tube lamp, and that terminals 102a and 102b would

correspond to the pin terminals at the other end of a fluorescent replacement LED tube lamp. EX1003, ¶164.

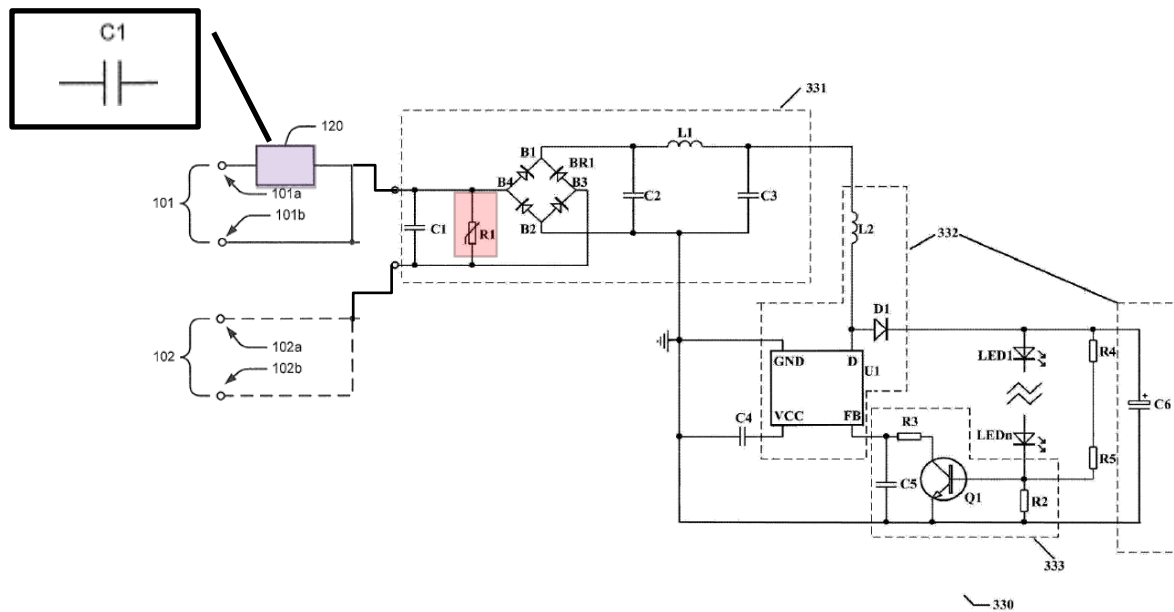
Zhang describes that the filament-imitating impedance 120 “is configured to provide an impedance mimics behavior of the filament of a fluorescent lamp.” EX1014, 4:36-38. Zhang further describes that the filament-imitating impedance 120 may be the capacitor C1 which “may be sized” to “provid[e] an impedance sufficient to imitate the filament impedance of a fluorescent lamp and, thus, prevent shutdown due to failure of a filament test by the ballast.” *Id.*, 4:62-5:1. A POSITA would have understood that the ballast performs a filament test at start-up as part of its process to provide current and preheat the lamp. EX1003, ¶165.

Therefore, the filament-imitating impedance 120 forms a filament-simulating circuit that conducts current during a preheat process while the LED lamp is powered by different types of ballast. EX1003, ¶166.

(b) Claim 85

Li-Ono-Zhang renders obvious that the filament simulating circuit includes a second capacitor coupled between the two conductive pins of one end cap. EX1003, ¶¶167-168. As described above in Section IX.D.2, a POSITA would have been motivated to include the filament-simulating circuit described in Zhang in the Li-Ono LED lamp to improve the compatibility of the LED lamp with conventional light fixtures. EX1003, ¶167.

In Li-Ono-Zhang, the [red] capacitor C1 corresponds to the capacitor recited in Limitation 30[h]. The input also includes a [purple] filament-imitating impedance 120. “[A] filament-imitating impedance may take the form of a [second] capacitor C1 coupled to the first and second terminals 101a, 101b.” EX1014, 4:59-62, FIG. 2.



EX1005, FIG. 6; EX1014, FIG. 1, 2; EX1003, ¶168.

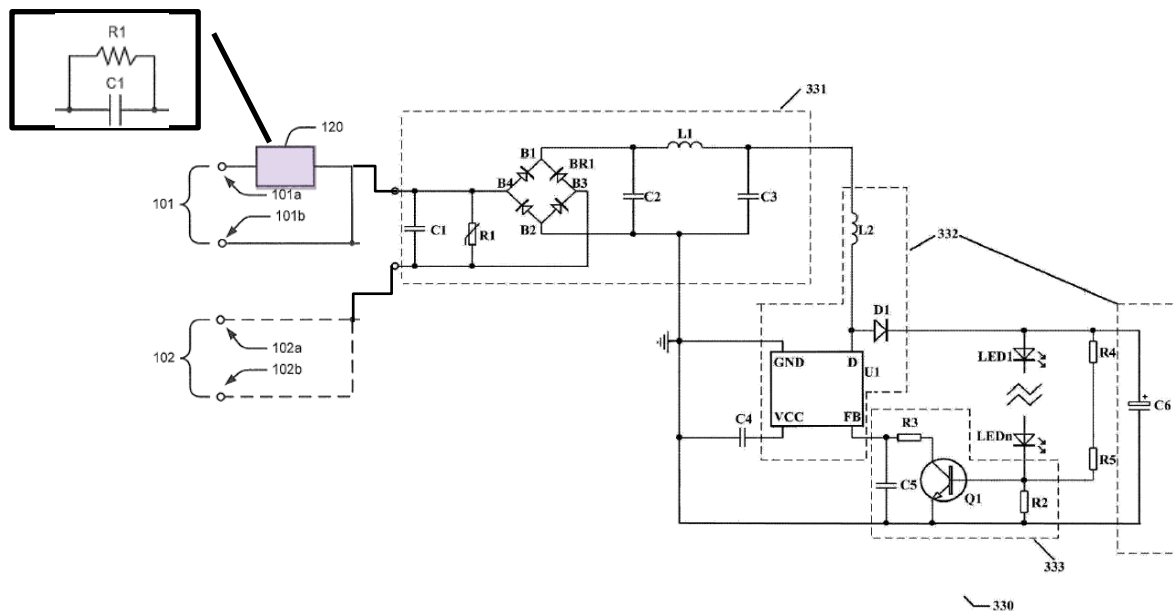
(c) **Claim 86**

Li-Ono-Zhang renders obvious a filament-simulating circuit including a resistor coupled to the second capacitor in parallel. EX1003, ¶¶169-170. As described above in Section IX.D.2, a POSITA would have been motivated to include the filament-simulating circuit described in Zhang in the Li-Ono LED lamp to

improve the compatibility of the LED lamp with conventional light fixtures.

EX1003, ¶169.

In Li-Ono-Zhang, the input includes a [purple] filament-imitating impedance 120. A filament-imitating impedance may “include[] a capacitor C1 and a resistor R1 connected in parallel with the capacitor C1” and coupled to the first and second terminals 101a and 101b. EX1014, 5:35-38, FIG. 7; EX1003, ¶170.



EX1005, FIG. 6; EX1014, FIG. 1, 7; EX1003, ¶170.

E. Ground 5 - Claims 5, 6, and 31 are Obvious over Li in view of Ono and Halliwell

1. Halliwell

Halliwell is titled “Linear LED Lamp Tube With Internal Driver and Interconnect to Line Voltage and Methods of Installing the Same.” Halliwell describes an LED lamp tube. EX1015, Abstract. The LED lamp tube includes “at

least one end cap 11 [that] may comprise a small hole 111 on the end of the end cap 11.” EX1015, 8:61-63. “[T]he hole 111 acts to allow the pressure within the tube to maintain a pressure substantially similar to the ambient air pressure.” *Id.*, 8:66-9:1.

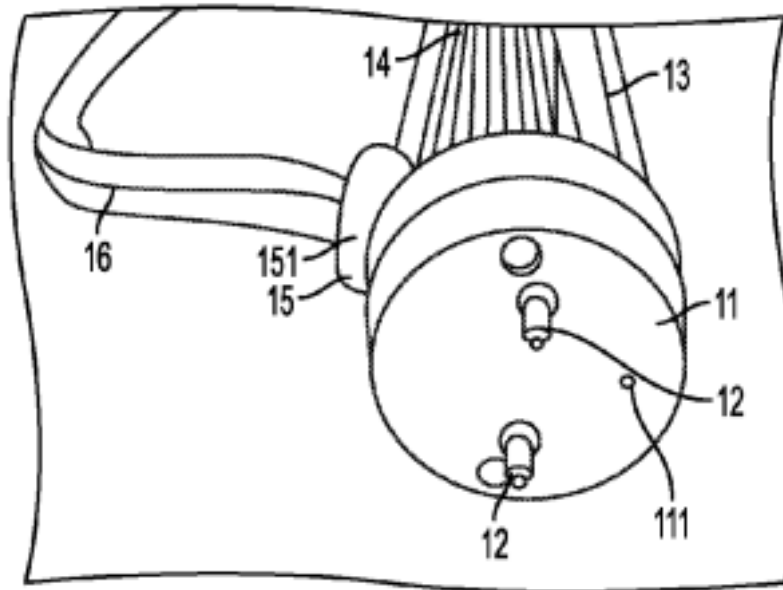


FIG. 18

EX1015, FIG. 18; EX1003, ¶45.

2. *Motivation to Combine*

As explained in Sections IX.A.3-IX.A.5 for Ground 1, Li-Ono renders obvious claims 4 and 30.

A POSITA would have also been motivated further modify Li-Ono in view of Halliwell, with a reasonable expectation of success, for several reasons. EX1003, ¶¶171-176.

Li describes that “[a]nother objective of the present invention is to provide an installation method of the foregoing LED fluorescent lamp which has an advantage of simple installation.” EX1005, [0032]. Li further describes components, such as the drive circuit located in the end caps and that, during assembly, the end caps are bonded to the tube body of the LED lamp. EX1005, [0092], [0100].

A POSITA would have understood that if the end caps on the LED tube lamp have features that extend into the tube, this will reduce the interior volume of the tube as, during assembly, the end caps are attached to the end of the tube. EX1003, ¶¶172-173. Thus, it is necessary to allow air within the tube to escape so as not to compress the interior air to a higher pressure during assembly, potentially reducing the reliability of the tube lamp. EX1003, ¶173. A POSITA would therefore have been motivated to look to other solutions for preventing the Li-Ono LED lamp from suffering from a build-up of pressure inside the tube lamp. *Id.*

In addition, a POSITA would have understood the importance of equalizing the pressure within the long tube of the LED lamp so that the internal pressure equals the external pressure to prevent damage to the lamp. EX1003, ¶174. Pressure builds up inside an LED lamp as the LEDs within the lamp generate heat. EX1010, 167/367; EX1003, ¶174. This increase can, if not compensated for, result in a pressure imbalance between the interior of the tube and the ambient pressure outside the tube. EX1003, ¶174. If the pressure is allowed to continue to build, the pressure

imbalance can damage the lamp, for example, shattering the lamp tube, or popping off one or both end caps. *Id.*

For example, a POSITA would have been motivated to look to Halliwell which discloses small hole 111 in the end of end cap 11, such that “hole 111 acts to allow the pressure within the tube to maintain a pressure substantially equal to the ambient air pressure.” EX1015, 8:66-9:1; FIG. 18; EX1003, ¶175. A POSITA would additionally have understood that the use of a larger single hole or multiple small holes would have the same beneficial effect in balancing the air pressure inside and outside the tube lamp. EX1003, ¶175.

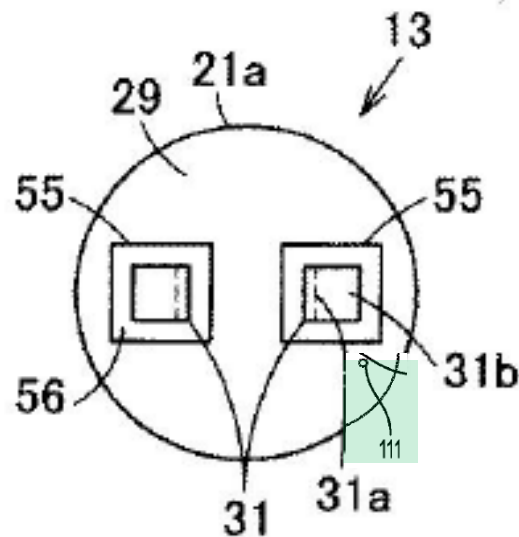
A POSITA would have been familiar with the use of vents to provide air flow through an LED lamp to equalize the pressure between the inside of the lamp and the outside of the lamp. EX1003, ¶176; *see also* EX1012, ¶[0037], FIGS. 1 and 3. Halliwell describes a hole 111 in each end cap. EX1015, 8:61-63, FIG. 18; EX1003, ¶176. A POSITA would have recognized that Halliwell’s hole 111 would have provide air flow through the LED lamp and would have been motivated to improve Li-Ono with at least one hole, in addition to Ono’s openings 55 to improve air flow in the LED lamp. EX1003, ¶176. A POSITA would have been motivated to modify the Li-Ono’s LED lamp to include a small hole in the end cap, as described by Halliwell, because venting for improved pressure equalization was well known and such a modification would have been a straight-forward implementation of known

technology. *Id.* A POSITA would have expected this implementation to be successful based on the stability of the technology and Halliwell's implementation of the solution. *Id.*

3. *Modification of Li with Ono and Halliwell*

The Li-Ono-Halliwell LED lamp includes Ono's end cap as modified with the addition of Halliwell's [green] hole 111. EX1003, ¶177.

[Fig. 8]



Ono FIG. 8
(Modified per Li-Ono-Halliwell)

EX1006, FIG. 8; EX1015, FIG. 18; EX1003, ¶177.

4. *Element-by-Element Analysis*

(a) *Claim 5*

Li-Ono-Halliwell renders obvious an opening in the end wall. EX1003, ¶¶178-179. As described above in Ground 1, Li-Ono discloses all limitations of Claim 1. *See* Sections IX.A.5(a)-IX.A.5(k). Further, as explained in Section IX.A.5(o), Li-Ono teaches an opening in the end wall.

To the extent PO argues that Li-Ono does not disclose an opening in the end wall, Halliwell teaches this element. As explained in Section IX.E.2, a POSITA would have been motivated to look to other LED lighting references, such as Halliwell, to determine potential designs for increasing air flow through the LED lamp. EX1003, ¶178. Halliwell describes an LED lamp tube that includes “at least one end cap 11 [that] may comprise a small hole 111 on the end of the end cap 11.”

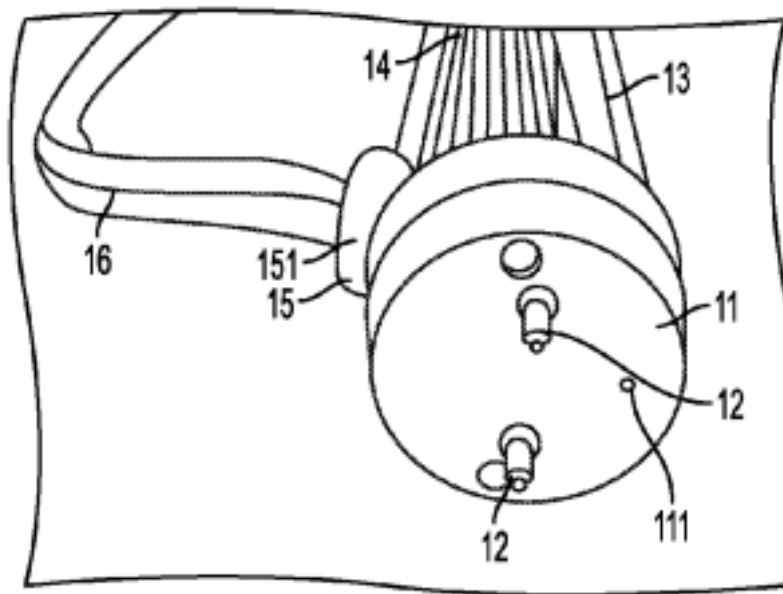


FIG. 18

EX1015, 8:61-9:1, FIG. 18; EX1003, ¶179. As explained above in Section IX.E.3, Halliwell's hole 111 is incorporated into the Li-Ono-Halliwell end cap.

(b) Claim 6

Li-Ono-Halliwell renders obvious a resistor positioned closest to the opening in the end wall. EX1003, ¶¶180-184. As explained above in Ground 1, Li describes a varistor R1 located between the AC inputs of the drive circuit 330. EX1005, [0115]; Section IX.A.5(p). A POSITA would have understood the AC input of the drive circuit to be the conductive pins in the end wall. EX1003, ¶181. Therefore, components closest to the conductive pins are also closest to the openings because both the conductive pins and the hole are in the end wall.

While Li shows the capacitor C1 located closer to the input pins than varistor R1, a POSITA would have understood that because the capacitor and resistor are connected in parallel (EX1005, [0115], FIG. 6), the physical location of the capacitor and resistor could be swapped without any impact on the function of the described circuit. EX1003, ¶182. Therefore, a POSITA would have understood Li as teaching that either the resistor or the capacitor could be the electronic component mounted closest to the opening in the end wall. *Id.*

Additionally, 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, ¶183. 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, ¶183. 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 and thus closest to the opening in that end wall. EX1003, ¶183.

Finally, a POSITA would have understood that it would be advantageous to place the resistor, a heat-generating element, near the opening in 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. EX1003, ¶184.

(c) Claim 31

Li-Ono describes an end wall comprising at least one opening. EX1003, ¶185; *see* Claim 5, Section IX.E.4(a). And as described above in Ground 1, Li-Ono discloses all limitations of Claim 1. *See* Sections IX.A.5(a)-IX.A.5(aa).

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,⁵ meaning trial likely will not occur until at least October 2024—about 4 months *after* a decision here.

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

⁵ <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. EX1017.

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.⁶

XI. CONCLUSION

For the above reasons, Claims 1, 2, 4-6, 12-14, 30, 31, 37, 47, 77, 84-86, 88, and 90 are invalid under §103(a).

Dated: December 14, 2022

Respectfully submitted,

/Eagle H. Robinson/
Eagle H. Robinson

Lead Counsel for Petitioner

⁶ 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 12,688 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 December 14, 2022, a complete copy of this Petition for *Inter Partes* Review, Petitioner's power of attorney, and all exhibits were served on Patent Owner at the correspondence addresses of record listed below by FedEx®:

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