

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.

Patent 9,723,662 B2

Declaration of Dr. R. Jacob Baker

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Claim Listing

Claim	Limitation No.	Limitation
1	1[p]	A power source module for an LED lamp, comprising:
	1[a]	a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, each of the first bi-pin terminal and the second bi-pin terminal configured to allow a current to flow from one pin to the other pin via the filament-simulating circuit during a pre-heat process executed by a ballast;
	1[b]	a current limiting circuit electrically connected to the filament-simulating circuit and configured to limit a current from the filament-simulating circuit;
	1[c]	a first rectifier electrically connected to the current limiting circuit and configured to rectify the current from the current limiting circuit; and
	1[d]	a filter electrically connected between the first rectifier and at least one LED of the LED lamp and configured to smooth the current from the first rectifier.
2	2[a]	The power source module of claim 1, wherein the filament-simulating circuit comprises: a first filament-simulating circuit comprising a first capacitor element electrically connected between two pins of the first bi-pin terminal; and
	2[b]	a second filament-simulating circuit comprising a second capacitor element electrically connected between two pins of the second bi-pin terminal.
5	5	The power source module of claim 2, wherein the first rectifier comprises two diodes electrically connected in series, and the first rectifier is electrically connected to the first filament-simulating circuit in series.

Claim	Limitation No.	Limitation
6	6[a]	The power source module of claim 2, wherein the first rectifier comprises two diodes electrically connected in series and a connection node connecting the two diodes is coupled to the current limiting circuit,
	6[b]	wherein a current flows from the at least one LED to one pin of the first bi-pin terminal through one of the two diodes and the current limiting circuit, or from one pin of the first bi-pin terminal to the at least one LED through the other of the two diodes and the current limiting circuit.
7	7	The power source module of claim 6, wherein the current limiting circuit comprises at least a capacitor.
9	9	The power source module of claim 1, wherein the power source module is configured inside a casing of the LED lamp.
10	10	The power source module of claim 1, further comprising a discharging circuit electrically connected to the filter in parallel for discharging the filter.
15	15	The power source module of claim 1, wherein the filter comprises a filtering capacitor electrically connected to the at least one LED.
16	16	The power source module of claim 1, further comprising a discharging circuit electrically connected to the filter in parallel for discharging the filter.
17	17[p]	A power source module for an LED lamp, comprising:
	17[a]	a rectifier electrically connected to terminals of the LED lamp and configured to receive a current;
	17[b]	a filter electrically connected between the rectifier and at least one LED of the LED lamp and configured to store energy from the rectifier and to smooth the current from the rectifier;

Claim	Limitation No.	Limitation
	17[c]	a discharging circuit electrically connected to the filter in parallel and configured to discharge the energy stored in the filter; and
	17[d]	a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, the filament-simulating circuit comprising at least one resistor connected in parallel to at least one capacitor and configured to simulate a filament of a fluorescent lamp during a pre-heat process executed by a ballast.
18	18	The power source module of claim 17, further comprising a current limiting circuit electrically connected to the first bi-pin terminal of the LED lamp, and configured to limit a current from the first bi-pin terminal.
21	21[p]	A power source module for an LED lamp, comprising:
	21[a]	a first circuit comprising a first capacitor element electrically connected between two pins of a first bi-pin terminal of the LED lamp, and a second circuit comprising a second capacitor element electrically connected between two pins of a second bi-pin terminal, wherein the first and second circuits are configured to simulate a filament of a fluorescent lamp during a pre-heat process executed by a ballast;
	21[b]	a current limiting circuit electrically connected to the first bi-pin terminal and configured to limit a current from the first bi-pin terminal;
	21[c]	a rectifier electrically connected between the current limiting circuit and the second circuit and configured to rectify the current from the current limiting circuit and a current from the second bi-pin terminal; and
	21[d]	a filter electrically connected between the rectifier and at least one LED of the LED lamp to

Claim	Limitation No.	Limitation
		store energy from the rectifier and configured to smooth the current from the rectifier.
23	23[p]	An LED lamp, comprising:
	23[a]	a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal;
	23[b]	a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit;
	23[c]	a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier; and
	23[d]	a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals having a current flowing from one pin to the other pin of the respective bi-pin terminal via the filament-simulating circuit during a pre-heat process executed by a ballast.
24	24[a]	The LED lamp of claim 23, wherein the filament-simulating circuit comprises: a first filament-simulating circuit comprising a first capacitor element electrically connected between two pins of the first bi-pin terminal; and
	24[b]	a second filament-simulating circuit comprising a second capacitor element electrically connected between two pins of the second bi-pin terminal.
29	29	The LED lamp of claim 23, further comprising a discharging circuit electrically connected to the filter in parallel for discharging the filter.
31	31	The power source module of claim 1, wherein the current limiting circuit comprises at least a capacitor.
32	32[a]	The power source module of claim 1, wherein: the filament-simulating circuit comprises a first

Claim	Limitation No.	Limitation
		filament-simulating circuit connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit connected between two pins of the second bi-pin terminal; and
	32[b]	the current limiting circuit comprises at least a capacitor connected to the first filament-simulating circuit, and at least a capacitor connected to the second filament-simulating circuit.
33	33[a]	The power source module of claim 1, wherein: the LED lamp comprises an LED module comprising the at least one LED;
	33[b]	the filament-simulating circuit comprises a first filament-simulating circuit comprising an impedance element electrically connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit comprising an impedance element electrically connected between two pins of the second bi-pin terminal; and
	33[c]	the power source module further comprises a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel.
34	34	The power source module of claim 17, further comprising a current limiting circuit electrically connected to the second bi-pin terminal of the LED lamp, and configured to limit a current from the second bi-pin terminal.
35	35	The power source module of claim 17, wherein the filament-simulating circuit comprises a first filament-simulating circuit connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit connected between two pins of the second bi-pin terminal.

Claim	Limitation No.	Limitation
36	36	The power source module of claim 21, further comprising another current limiting circuit electrically connected to the second bi-pin terminal of the LED lamp, configured to limit a current from the second bi-pin terminal.
37	37	The LED lamp of claim 23, further comprising another current limiting circuit electrically connected to a second terminal of the LED lamp, configured to limit a current from the second terminal.
38	38	The LED lamp of claim 23, wherein the current limiting circuit comprises at least a capacitor.
39	39	The LED lamp of claim 23, wherein the filament-simulating circuit comprises a first filament-simulating circuit connected between a first pin and a second pin pin [sic] of the first bi-pin terminal, and a second filament-simulating circuit connected between a first pin and a second pin of the second bi-pin terminal.
	40[a]	The LED lamp of claim 23, further comprising: an LED module comprising the at least one LED, wherein the filament-simulating circuit comprises a first filament-simulating circuit comprising an impedance element electrically connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit comprising an impedance element electrically connected between two pins of the second bi-pin terminal; and
	40[b]	a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel.
41	41[p]	An LED lamp, comprising:

Claim	Limitation No.	Limitation
	41[a]	a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal;
	41[b]	a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit;
	41[c]	a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier; and
	41[d]	a first filament-simulating circuit electrically connected to a first bi-pin terminal of the LED lamp and a second filament-simulating circuit electrically connected to a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals arranged to have a current flowing from one pin to the other pin of the respective bi-pin terminal via the respective first or second filament-simulating circuit during a pre-heat process executed by a ballast.
42	42[p]	An LED lamp, comprising:
	42[a]	a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal;
	42[b]	a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit;
	42[c]	a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier; and
	42[d]	a first filament-simulating circuit electrically connected to a first bi-pin terminal of the LED lamp, and a second filament-simulating circuit electrically connected to a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals arranged to have a current flowing from one pin to the other pin of the

Claim	Limitation No.	Limitation
		respective bi-pin terminal via the respective first or second filament-simulating circuit after the LED lamp is connected to a ballast and before a normal operation state of the LED lamp.
43	43[a]	The LED lamp of claim 42, further comprising: an LED module comprising the at least one LED, wherein the first filament-simulating circuit comprises an impedance element electrically connected between two pins of the first bi-pin terminal, and the second filament-simulating circuit comprises an impedance element electrically connected between two pins of the second bi-pin terminal; and
	43[b]	a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel.

I. BACKGROUND AND QUALIFICATIONS

1. I presently serve as a Professor of Electrical and Computer Engineering at the University of Nevada, Las Vegas (UNLV). All of my opinions stated in this declaration are based on my own personal knowledge and professional judgment. In forming my opinions, I have relied on my knowledge and experience in designing, developing, researching, and teaching regarding integrated circuit design, including the design and packaging of light emitting diodes (LEDs) and similar structures.

2. I am over 18 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein. I understand that a copy of my current curriculum vitae, which details my education and professional and academic experience, is being submitted by Current Lighting as Exhibit 1003. The following provides an overview of some of my experience that is relevant to the matters set forth in this declaration.

3. I have been teaching electrical engineering at UNLV since 2012. Prior to this position, I was a Professor of Electrical and Computer Engineering at Boise State University from 2000. Prior to my position at Boise State University, I was an Associate Professor of Electrical Engineering between 1998 and 2000 and Assistant Professor of Electrical Engineering between 1993 and 1998 at the University of Idaho. I have been teaching electrical engineering since 1991.

4. I received my Ph.D. in Electrical Engineering from the University of Nevada, Reno in 1993. I also received a MS and BS in Electrical Engineering from UNLV in 1988 and 1986, respectively.

5. As described in my CV, I am a licensed Professional Engineer and have more than 35 years of industry and academic experience, including extensive experience in the design of LEDs, the packaging of LEDs, and circuits that include LEDs. I was involved with Micron, in the early 2000s, evaluating the acquisition of companies developing LED lighting solutions. Further, I've also used LEDs in the design of sensing instrumentation and my funded research involving light sources for detection and ranging.

6. I have taught courses in integrated circuit design (analog, digital, mixed-signal, memory circuit design, etc.), linear circuits, microelectronics, communication systems, power electronics, and fiber optics. As a professor, I have been the main advisor to over 100 Master's and Doctoral students.

7. I am the author of several books covering the area of integrated circuit design including: DRAM Circuit Design: Fundamental and High-Speed Topics (two editions), CMOS Circuit Design, Layout, and Simulation (four editions), and CMOS Mixed-Signal Circuit Design (two editions). I have authored, and coauthored, more than 100 papers and presentations in the areas of solid-state circuit design, and I am the named inventor on over 150 granted U.S. patents.

8. I have received numerous awards for my work, including the Frederick Emmons Terman (the “Father of Silicon Valley”) Award. The Terman Award is bestowed annually upon an outstanding young electrical/computer engineering educator in recognition of the educator’s contributions to the profession.

9. I am a Fellow of the IEEE for contributions to memory circuit design. I have also received the IEEE Circuits and Systems Education Award (2011).

10. I have received the President’s Research and Scholarship Award (2005), Honored Faculty Member recognition (2003), and Outstanding Department of Electrical Engineering Faculty recognition (2001), all from Boise State University. I have also received the Tau Beta Pi Outstanding Electrical and Computer Engineering Professor award four of the years I have been at UNLV.

11. I am not an attorney and offer no legal opinions, but in the course of my work, I have had experience studying and analyzing patents and patent claims from the perspective of a person skilled in the art. Based on my experience and education, I consider myself to be an expert in the field of LED lighting design. As of October 17, 2014, I was at least a person of ordinary skill in the art of the ’662 Patent, and I had personal knowledge of the technologies involved in the ’662 Patent.

II. COMPENSATION

12. In consideration for my services, my work on this case is being billed to Current Lighting at an hourly rate of \$655 per hour, independent of the outcome of this proceeding. I am also being reimbursed for reasonable expenses I incur in relation to my services provided for this proceeding.

III. LEGAL CONSIDERATIONS

13. My understanding of the law is based on information provided by counsel for Current Lighting.

14. I understand that a reference anticipates a claim if it discloses each and every element recited in the claim, arranged as in the claim, so as to enable a person of ordinary skill in the art (POSITA) to make and use the claimed invention without the need for undue experimentation in light of the general knowledge available in the art. I understand that a U.S. Patent document is presumed to have sufficient description to include sufficient detail for a person of ordinary skill in the art to make and use the subject matter that document describes.

15. I understand that a claimed invention is obvious and, therefore, not patentable if the subject matter claimed would have been obvious to a POSITA at the time that the invention was made. I understand that a claim can be obvious in view of a single prior art reference (e.g., via modification of that prior art reference) or multiple prior art references (e.g., via a combination of two or more

prior art references), if such a modification or combination was within the skill of a POSITA. I understand that there must be some articulated reasoning with some rational underpinning to support a conclusion of obviousness. I further understand that exemplary rationales that may support a conclusion of obviousness include: (1) simply arranging old elements in a way in which each element performs the same function it was known to perform, and the arrangement yields expected results, (2) merely substituting one element for another known element in the field, if the substitution yields no more than a predictable result, (3) combining elements in a way that was “obvious to try” because of a design need or market pressure, where there was a finite number of identified, predictable solutions, (4) that design incentives or other market forces in a field would have prompted variations in a work that were predictable to a person of ordinary skill in the art, and (5) that there was some teaching, suggestion, or motivation in the prior art that would have led a POSITA to modify or combine prior art references to arrive at the claimed invention.

16. I understand that a prior art reference can anticipate a claimed range if that reference discloses a range that is different than, but overlaps, the claimed range. I further understand that a prior art range that nearly overlaps a claimed range can suggest obviousness if there would have been no unexpected differences between configurations in one range or the other. I understand that once a prior art

range is shown to nearly overlap a claimed range, the Patent Owner may counter that suggestion of obviousness with evidence that the claimed range is (a) critical to the operability of the claimed invention, and (b) leads to unexpected results over the prior art range.

17. I understand that a claim term is interpreted according to its ordinary and customary meaning as a POSITA would have understood the term in light of the surrounding claim language, other claims, the specification, and the patent's prosecution history, which are referred to as intrinsic evidence. I also understand that prior art references cited in the patent's prosecution history are considered intrinsic evidence. I further understand that evidence outside the patent and its prosecution history (e.g., dictionaries and technical articles), may inform the context in which a POSITA would have understood the claims of a patent. I understand this ordinary and customary meaning applies absent unique circumstances, such as where a patent clearly expresses an intent to set forth a special meaning for a term, or a claim term does not convey any particular structure to a POSITA (e.g., "means").

IV. TASK SUMMARY

18. I have been asked to review the challenged U.S. patent: the '662 Patent. I have been asked to provide my opinions from the perspective of a POSITA, having knowledge of the relevant art, as of October 17, 2014, and the

opinions stated in this declaration are from that perspective. The qualifications and abilities of such a person are described in Section VII below.

19. In preparing this declaration, I have considered this patent in its entirety and the general knowledge of those familiar with the field of LED lighting, as of October 17, 2014.

20. I have also reviewed the references in their entirety that form the basis for Current Lighting's challenge to the '662 Patent, including the publications listed in the following table:

Shorthand	Description
'662 Patent	U.S. Patent No. 9,723,662
Zhang	U.S. Patent No. 10,045,406
Tao	U.S. Patent App. Pub. No. 2016/0174307
Langovsky	U.S. Patent No. 8,330,381
	<i>MaxLite, Inc. v. Jiaxing Super Lighting Electric Appliance Co., Ltd.</i> , IPR2020-00181, Paper 1 (PTAB Nov. 25, 2019)
	<i>MaxLite, Inc. v. Jiaxing Super Lighting Electric Appliance Co., Ltd.</i> , IPR2020-00181, Paper 7 (PTAB May 26, 2020)
	Excerpts of the '662 Patent prosecution history
	U.S. Patent No. 9,338,853
	U.S. Patent No. 5,616,990
D'Andrade Report	Infringement Report of Dr. D'Andrade, <i>Jiaxing Super Lighting Electric Appliance Co., Ltd. v. MaxLite, Inc.</i> , Case No. 2:19-cv-04047 (C.D. Cal.)
	Draft Litigation Stipulation
	U.S. Patent No. 8,888,976
	Infringement Contentions, Cover Pleading and Claim Chart C
	U.S. Patent No. 8,441,824
	U.S. Patent No. 7,256,505
	U.S. Patent No. 7,557,521
	U.S. Patent No. 9,148,922
	U.S. Patent No. 6,703,795

Shorthand	Description
	U.S. Patent No. 8,841,897
	U.S. Patent No. 8,792,253
	U.S. Patent No. 8,134,297
	U.S. Patent No. 3,731,148
	U.S. Patent App. Pub. No. 2016/0345394
	U.S. Patent No. 7,966,075
	U.S. Patent App. Pub. No. 2012/0256551
	U.S. Patent App. Pub. No. 2012/0038289
	U.S. Patent App. Pub. No. 2013/0076255
	U.S. Patent No. 9,237,610
	U.S. Patent App. Pub. No. 2013/0234620
	U.S. Patent App. Pub. No. 2012/0206433
	U.S. Patent App. Pub. No. 2014/0009076
	U.S. Patent App. Pub. No. 2014/0084701
	U.S. Patent App. Pub. No. 2012/0300501
	U.S. Patent App. Pub. No. 2012/0147564
	U.S. Patent No. 9,066,403
	U.S. Patent App. Pub. No. 2010/0265732
	PCT App. No. WO 2014/1150100
	U.S. Patent No. 8,247,999

V. FIELD OF TECHNOLOGY

A. Fluorescent Lamps

21. “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. The glass tube is fitted into a fixture having sockets that receive electrode pins at an end of the glass tube.” U.S. Patent No. 9,338,853, 1:23-25. “Historically, fluorescent lamps use AC power, effectively meaning that the electrode that functions as the cathode switches back and forth.” U.S. Patent No. 9,338,853, 2:1-3.

22. “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.” U.S. Patent No. 9,338,853, 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.” U.S. Patent No. 9,338,853, 1:45-47. “The ballast is typically physically located in a box mounted near its lamp or lamps.” U.S. Patent No. 9,338,853, 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.” U.S. Patent No. 9,338,853, 2:18-22.

B. Pre-heat Process

23. “Fluorescent lamps often require that their filaments (electrodes) be preheated prior to lamp ignition.” U.S. Patent No. 5,616,990, 1:12-13. “In lamps that require preheating, it is difficult to start a lamp when the filaments have not been sufficiently preheated.” U.S. Patent No. 5,616,990, 1:38-40. “Preheating is often controlled by an automatic switch commonly referred to as a starter.” U.S. Patent No. 5,616,990, 1:13-15. During preheating, “current [] flows through the [starter’s] electrodes and lamp filaments heating the latter.” U.S. Patent No.

5,616,990, 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.” U.S. Patent No. 5,616,990, 1:15-17.

24. “[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.” U.S. Patent No. 9,338,853, 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.” U.S. Patent No. 9,338,853, 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.” U.S. Patent No. 9,338,853, 2:30-32.

VI. THE '662 PATENT

25. The '662 patent relates to “a power source module for an LED lamp for use in a fluorescent lamp base including a ballast.” '662 Patent, 2:12-14. In other words, the '662 patent discloses and claims certain aspects of an LED lamp replacement for fluorescent lamp fixtures.

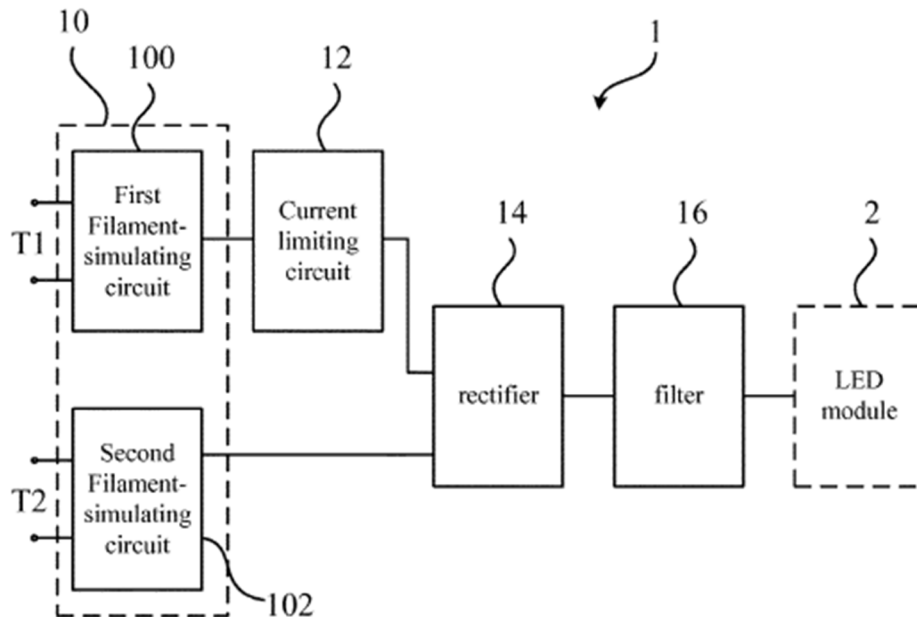
A. Issues With Replacing Fluorescent Lamps With LED Lamps

26. The '662 Patent explains that, in order “[t]o replace the traditional fluorescent lamp by the LED lamp, the original circuit included in the fluorescent lamp base might need to be modified to adapt the LED lamp.” ’662 Patent, 1:48-50. In particular, an “electrical ballast needs to be removed away by the user, and further the circuit in the fluorescent lamp base must be modified correspondingly for the LED lamp.” ’662 Patent, 1:64-67. This “modification ... is complicated to the user, even to the professional” and “requires manpower and material resources,” which “keeps the users from replacing the traditional fluorescent lamp with the LED lamp.” ’662 Patent, 2:1-6.

27. The '662 Patent explains that modification to the fluorescent lamp base is necessary because “[t]he starter and the electrical ballast generate a gaseous electric discharge in the fluorescent lamp by raising the voltage.” ’662 Patent, 1:56-58. This raised voltage “would cause the LED lamp to burn away.” ’662 Patent, 1:58-59. In addition, because an LED lamp lacks filaments, the ballast may “erroneously judg[e] that the filaments are open-circuited or short-circuited during the pre-heating process of the ballast.” ’662 Patent, 3:55-61.

B. Summary of Alleged Invention of the '662 Patent

28. The '662 Patent claims to solve the LED replacement problems described above by “provid[ing] a power source module for an LED lamp for use in a fluorescent lamp base including a ballast.” '662 Patent, 2:12-14.

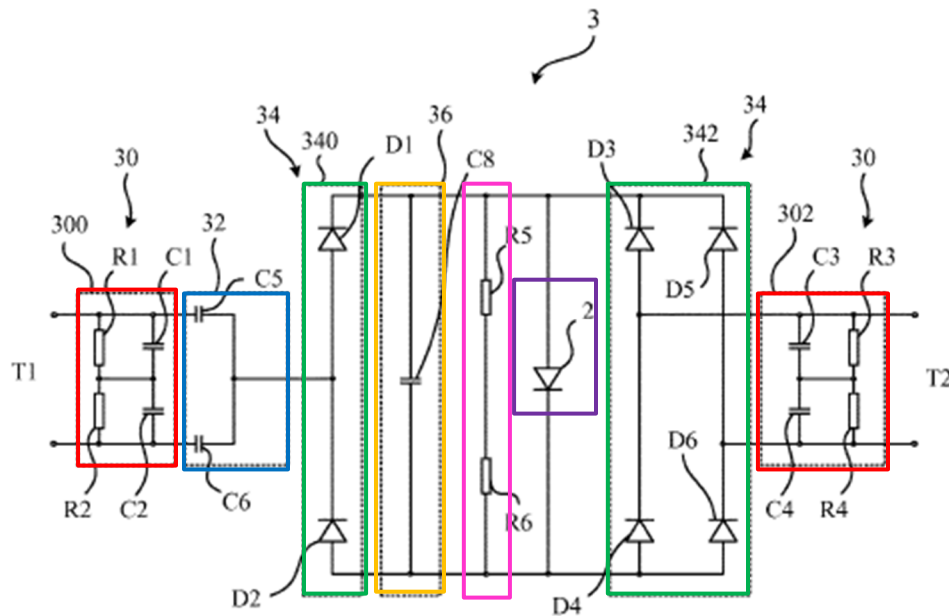


'662 Patent, FIG. 1. “As shown in FIG. 1, the power source module 1 includes a filament-simulating unit 10, a current limiting circuit 12, a rectifier 14, and a filter 16.” '662 Patent, 3:14-16. “The filament-simulating unit 10 can simulate a filament of the traditional fluorescent lamp, so as to prevent the ballast from erroneously judging that the filaments are open-circuited or short-circuited during the pre-heating process of the ballast.” '662 Patent, 3:57-61. “During a pre-heat process executed by the ballast of the fluorescent lamp base, a current flows from one pin to the other

pin of the first bi-pin terminal T1 via the first filament simulating circuit 100....”

’662 Patent, 3:35-41.

29. Figure 2 provides a circuit diagram of power source module 3:



’662 Patent, FIG. 2. The red rectangles illustrate first filament-simulating circuit 300 and second filament-simulating circuit 302. The blue rectangle illustrates current limiting circuit 32. The green rectangles illustrate first rectifier 340 and second rectifier 342. The orange rectangle illustrates filter 36. The purple rectangle illustrates LED module 2. And the pink rectangle illustrates the discharging circuit.

VII. A PERSON OF ORDINARY SKILL IN THE ART

30. I understand that the level of ordinary skill may be reflected by the prior art of record, and that a POSITA to which the claimed subject matter pertains

would have the capability of understanding the scientific and engineering principles applicable to the pertinent art.

31. I understand there are multiple factors relevant to determining the level of ordinary skill in the pertinent art, including (1) the levels of education and experience of persons working in the field at the time of the invention; (2) the sophistication of the technology; (3) the types of problems encountered in the field; (4) the prior art solutions to those problems; and (5) the rapidity with which innovations are made.

32. Based on my experience and understanding of the patent, the relevant art for the '662 Patent is LED lighting design.

33. It is my opinion that a POSITA as of October 17, 2014—the '662 Patent's earliest claimed priority date—would have had a Bachelor's degree in electrical engineering, or an equivalent field, as well as 1-2 years of academic or industry experience in lighting design, including knowledge of LEDs and related technology for driving LEDs. A POSITA with a higher level of education may have fewer years of academic or industry experience, or vice versa. A POSITA would have been familiar with the field of technology described in Section V above. The prior art and the '662 Patent also evidence this level of ordinary skill.

VIII. INTERPRETATION OF CERTAIN TERMS IN THE '662 PATENT

A. “electrically connected”

34. A POSITA in October 2014 would understand the term “electrically connected” to mean “connected through wires or other intervening electrical components.” “Electrically connected” is found in claims 1, 2, 5, 6, 10, 15-18, 21, 23, 24, 29, 34, 37, 41, and 42.

35. A POSITA would have recognized that “electrically connected” does not require a direct connection, having no intervening electrical components or modules. Claim 5 recites that “the first rectifier is electrically connected to the first filament-simulating circuit in series.” But independent claim 1 recites “a current limiting circuit electrically connected to the filament-simulating circuit” and “a first rectifier electrically connected to the current limiting circuit.” Further, each of the '662 Patent's figures consistently depicts the current limiting circuit between the first filament-simulating circuit and the first rectifier. Interpreting “electrically connected” to require a direct connection would thus exclude all disclosed embodiments.

36. I understand that in another case, Patent Owner served an expert report on infringement of the '662 Patent. For Limitation 23[a], which states “a current limiting circuit *electrically connected* to a first terminal of the LED lamp

for limiting a current from the first terminal,” Patent Owner’s expert, Dr.

D’Andrade, opined that the accused product met this limitation:

[T]he current-limiting circuit is electrically connected with circuit elements which are electrically connected to a first terminal. As a result, the current-limiting circuit is electrically connected to a first terminal of the LED lamp for limiting current from the first terminal.

Infringement Report at 41, 46. Dr. D’Andrade recognized that “the current-limiting circuit is electrically connected to a first terminal of the LED lamp,” even though intervening circuit elements were present between the current-limiting circuit and the first terminal.

37. Furthermore, the ’662 Patent itself confirms this construction. In particular, the ’662 Patent describes that “[t]he filter is *electrically connected* between the first rectifier *and at least one LED of the LED lamp* for smoothing the current from the first rectifier and then outputting the current to the LED.” ’662 Patent, 2:24-28. As illustrated in Section VI.B above, there are intervening components between filter 36 and the LED module 2. ’662 Patent, FIGS. 2, 3; 2:50-51 (explaining that “[t]he rectifier [is] *electrically connected* to the terminals of the LED lamp for receiving a current” despite intervening components including first filament-simulating circuit 300 and current limiting circuit 32).

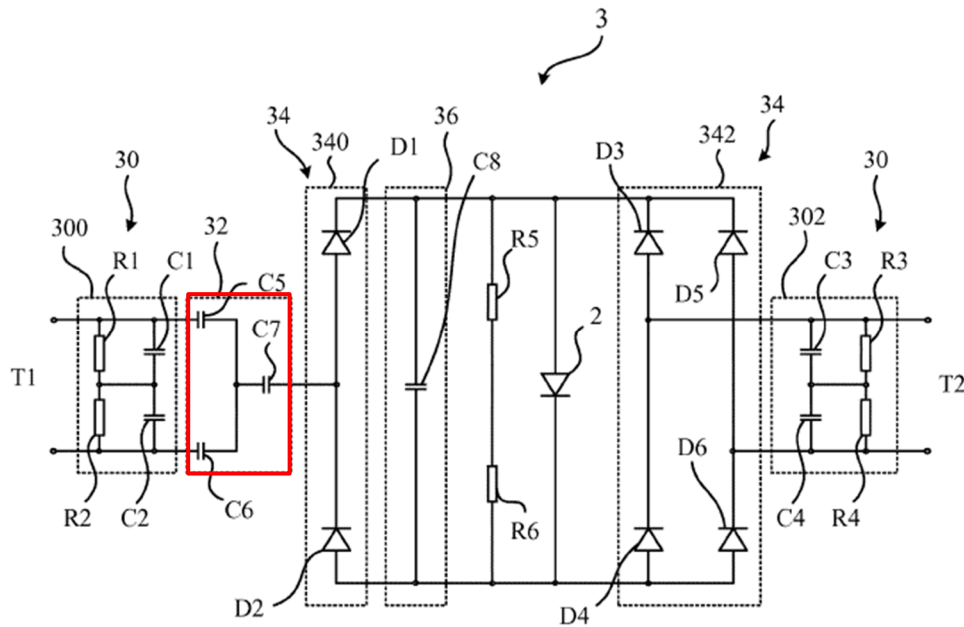
B. “current limiting circuit”

38. A POSITA in October 2014 would understand the term “current limiting circuit” is broad enough to encompass a circuit that provides an impedance. “Current limiting circuit” is found in claims 1, 6, 7, 18, 21, 23, 31, 32, 34, 36-38, 41, and 42. Independent claims 1, 21, 23, 41, and 42 state that a “current limiting circuit” is either “configured to limit a current” or “for limiting a current.” A POSITA would have recognized that an impedance limits a current. *See* U.S. Patent No. 8,888,976, 7:51-52 (“Impedance is a more general parameter that describes a circuit’s ability to resist the flow of electrical current.”).

39. Claim 7 also supports this broad interpretation of “current limiting circuit.” Claim 7 requires that “the current limiting circuit comprises at least a capacitor.” Because a current limiting circuit consisting of a single capacitor would meet claim 7, a POSITA would have understood that a current limiting circuit requires only an impedance element.

40. Patent Owner’s infringement contentions in the *Current* Case are consistent with a POSITA’s understanding of this term’s meaning. For Limitation 23[a], I understand that Patent Owner contends that “the current limiting circuit is comprised of one surface mount device (SMD) capacitor C5” and further asserts that “capacitor C5 is thus *configured to provide an impedance* that limits a current.” Infringement Contentions at 5-6.

41. The claims do not recite any impedance value provided by the current limiting circuit. The '662 Patent does provide the following embodiment of current limiting circuit 32, which “includes the third capacitance C7 connected between the capacitances C5 and C6,” where C7 is connected in series to the parallel combination of C5 and C6. '662 Patent, 5:5-11.



'662 Patent, FIG. 3. The '662 Patent states that “the values of the capacitances C5, C6, C7 are in the range of 0.47 nF to 12 nF.” '662 Patent, 5:11-15. In the scenario in which the pins of terminal T1 are shorted together, the total capacitance C_{T1} provided by capacitors C5, C6, and C7 in the figure above is $((C5 + C6) * C7)/(C5 + C6 + C7)$. Thus the disclosed total capacitance C_{T1} for that scenario varies from 0.31 nF to 8 nF. In another scenario in which all of the current flows through only one of the pins of terminal T1, the total capacitance C_{T2} provided by capacitors C5

and C7 in the figure above is $(C5 * C7)/(C5 + C7)$. Thus the disclosed total capacitance C_{T2} for that scenario varies from 0.24 nF to 6 nF. The formula for impedance provided by a capacitor is $1/(2\pi fC)$, where f is frequency. The '662 Patent discloses that the ballast “outputs an alternating current with a high frequency, e.g., 45 KHz, to the current limiting circuit 32.” '662 Patent, 4:46-49. Thus, for a 45 kHz frequency, the impedance for current limiting circuit 32 ranged from 442 Ω to 14,737 Ω .

IX. PRIOR ART OVERVIEW

A. Zhang

1. Zhang overview

42. Zhang's title is “Solid-State Lighting Apparatus for Use With Fluorescent Ballasts.” Zhang notes that “solid-state lighting devices may be attractive for retrofit replacement applications,” and states that “LED-based replacements for fluorescent lamps have [] been developed.” Zhang, 1:46-50, 1:54-59. Zhang discloses “a solid-state lighting circuit and first and second ballast connection ports configured to be coupled to a ballast,” as shown below. Zhang, 1:63-65.

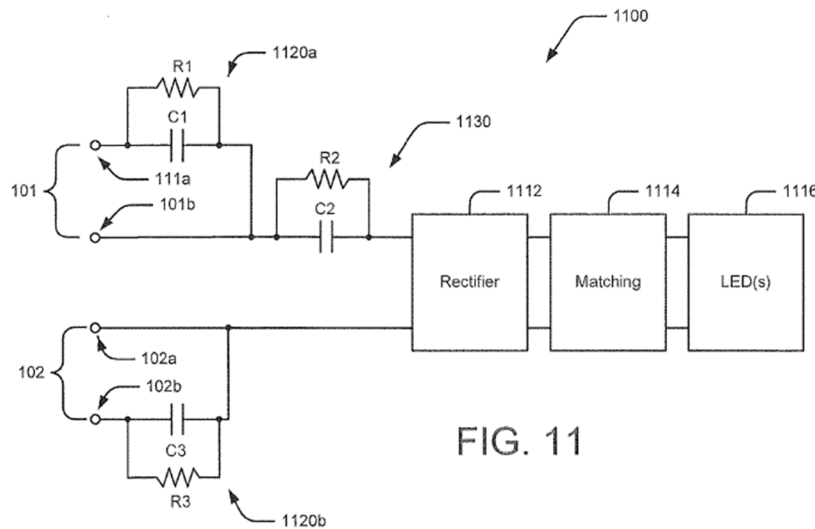


FIG. 11

Zhang, FIG. 11. “A first filament-imitating impedance is coupled to the first ballast connection port and a first low-frequency blocking impedance couples the first filament-imitating impedance to a first input terminal of the solid-state lighting circuit.” Zhang, 1:65 – 2:2. “A second filament-imitating impedance is coupled to the second ballast connection port and a second low-frequency blocking impedance couples the second filament-imitating impedance to a second input terminal of the solid - state lighting circuit.” Zhang, 2:2-6. “[T]he solid-state lighting circuit may include a rectifier circuit having an input port coupled to the first and second low-frequency blocking impedances and at least one light emitting diode (LED) coupled to an output port of the rectifier circuit.” Zhang, 2:34-38.

2. *Modification of Zhang*

43. One embodiment of Zhang teaches a lighting apparatus 1800 that includes “a rectifier circuit 1812, a matching circuit 1814, first and second filament-imitating impedances 1820a, 1820b, and first and second blocking impedances 1830a, 1830b.” Zhang, 9:4-8.

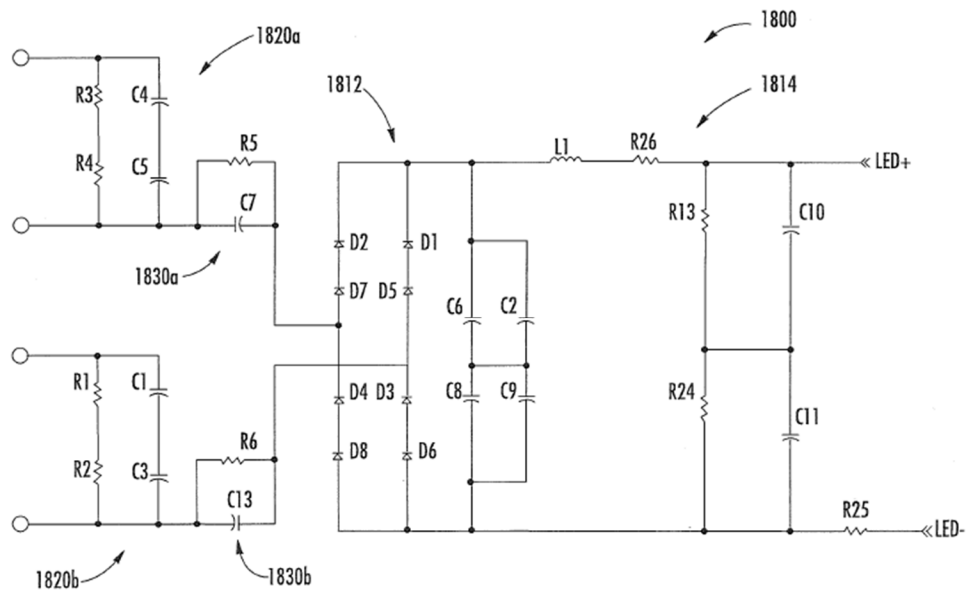
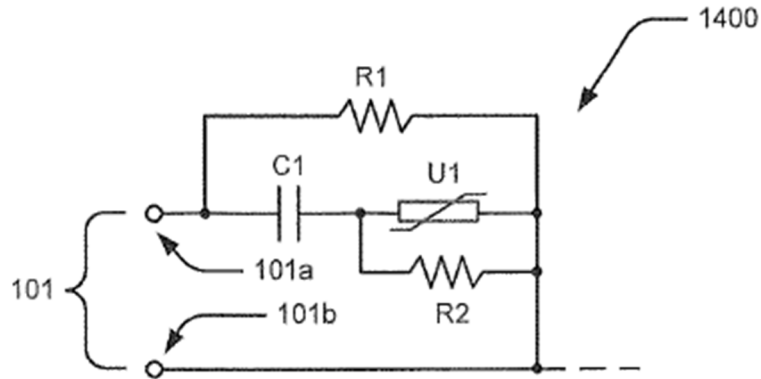


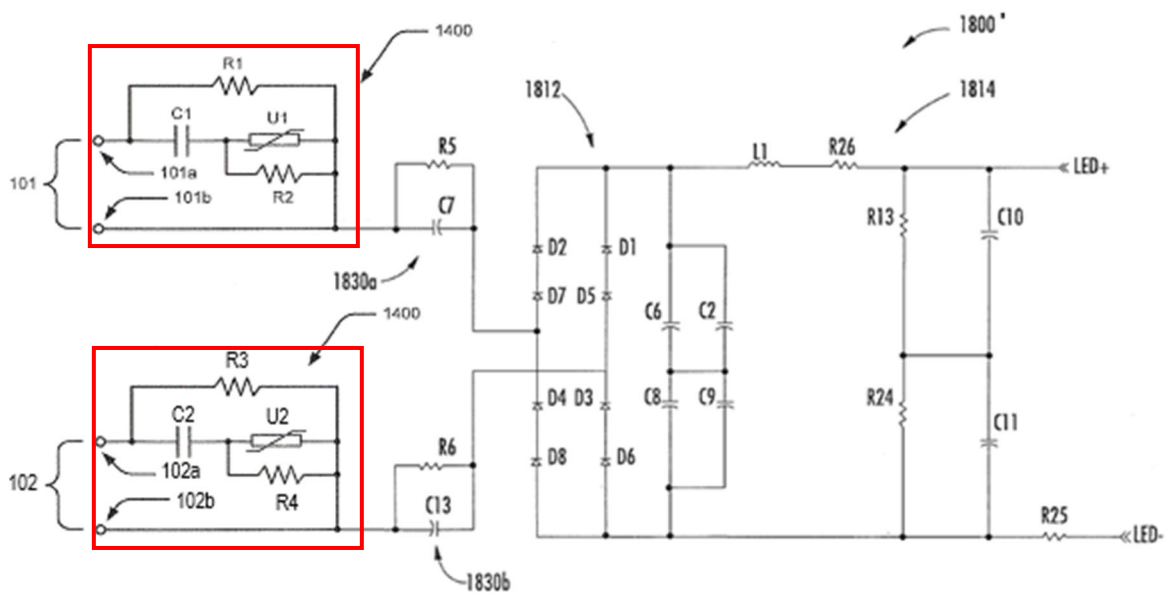
FIG. 18A

Zhang, FIG. 18A.

44. Another embodiment of Zhang teaches “a temperature-varying filament-imitating impedance” 1400 illustrated below. Zhang, 3:53-55.



Zhang, FIG. 14. In the modified apparatus 1800', temperature-varying filament-imitating impedance 1400 would replace first and second filament-imitating impedances 1820a and 1820b, as shown below:



Zhang, FIGS. 14 & 18A.

3. *Motivation to combine*

45. A POSITA would have been motivated to combine Zhang's temperature-varying filament-imitating impedance 1400 with the lighting apparatus 1800. Zhang supplies an explicit motivation to combine:

According to further embodiments, a filament-imitating impedance may be a temperature-varying impedance. Some ballasts perform filament tests in which a filament is tested by measuring a "cold" impedance of the filament before energizing, and then testing the filament impedance after the filament has been energized and heated up. If the change in impedance between the two temperatures fails to meet a predetermined criteria, the ballast may prevent operation. FIG. 14 illustrates a filament-imitating impedance 1400 including a capacitor C1 and resistor R1 along the lines described above, along with a parallel combination of an additional resistor R2 and a positive temperature coefficient (PTC) resistor U1 coupled in series with the capacitor C1. The PTC resistor U1 has a resistance that increases as current flows through the PTC resistor U1 and heats it up. Such an arrangement can be used to accommodate such a test and prevent shutdown due to failing the test.

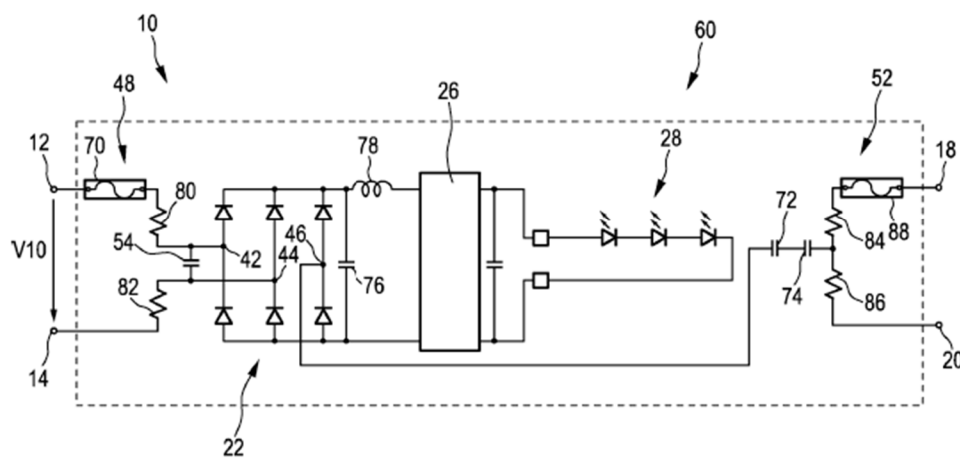
Zhang, 8:8-24. And another patent discloses an "electronic ballast" that has a "control circuit [] designed to determine the quotient of the present warm resistance and the initial cold resistance of one of the electrodes" of a connected discharge lamp." U.S. Patent No. 8,134,297, 7:4-7. A POSITA would have recognized that replacing elements 1820a and 1820b with element 1400 would result in a temperature-varying impedance that would prevent ballast shutdown due to test failure, which would increase the compatibility of modified apparatus 1800' with additional ballast types. By being compatible with additional ballast types, a

POSITA would have understood that modified apparatus 1800' reduced the need to remove the ballast from the fixture and make corresponding modifications to the fixture's circuit. For example, the '662 Patent's Background section explains that when "the electrical ballast needs to be removed away by the user," it is "complicated to the user, even to the professional," it requires "manpower and material resources," and "the circuit in the fluorescent lamp base must be modified correspondingly." '662 Patent, 1:64 – 2:4

B. Tao

1. *Tao overview*

46. Tao's title is "Connection Circuit for Connecting a Driver Device to an External Power Supply for Driving an LED Unit." Tao is directed to "a light apparatus" that includes "a plurality of LEDs, a driver device for driving the lighting elements and a connection circuit according to the present invention for connecting the driver device to an external power supply." Tao, [0013]

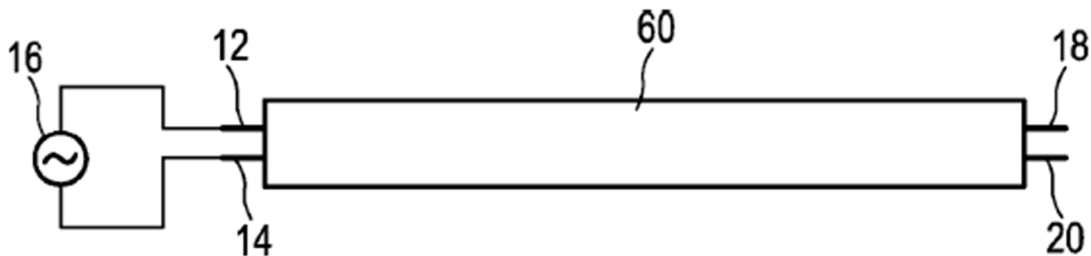


Id., FIG. 4. Tao discloses:

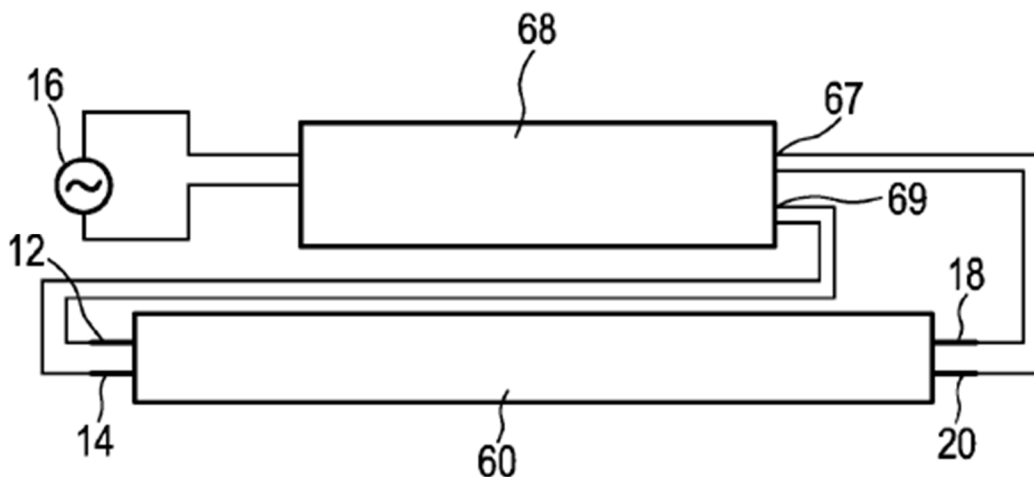
[A] lighting unit 28 comprising more prefer[ably] one or more LEDs so that the connection circuit 10, the driver stage 26 and the lighting unit 28 form a light apparatus 60. The light apparatus 60 can replace a fluorescent lamp as a retrofit lamp, wherein the input terminals 12, 14, 18, 20 can be flexibly connected to either mains 16 or a high frequency ballast so that a rewiring of the fluorescent lamp can be omitted.

Tao, [0041].

47. Tao depicts light apparatus 60 connected directly to a mains 16 (Figure 2a) and connected to a programmed start high frequency ballast 68 (Figure 2c). Tao, [0043], [0045].



Tao, FIG. 2a.



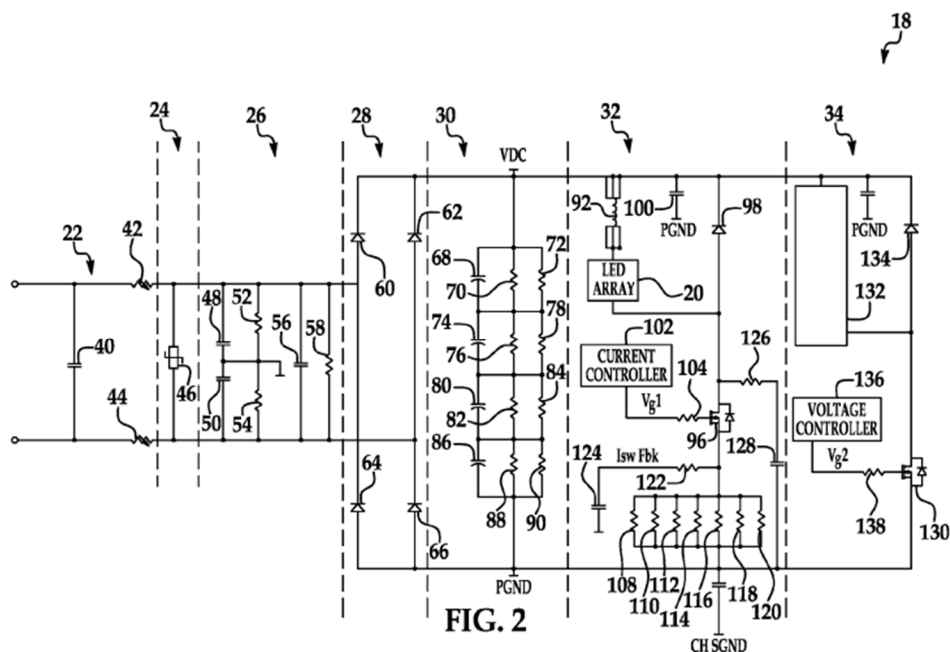
Tao, FIG. 2c.

C. Langovsky

1. Langovsky overview

48. Langovsky's title is "Electronic Circuit for DC Conversion of Fluorescent Lighting Ballast." Langovsky is directed to "an illumination device including LEDs for connection to an existing fluorescent lamp fixture including a conventional ballast, the ballast configured to provide a current signal."

Langovsky, 1:47-50. Langovsky discloses a "means for receiving a current signal from the conventional ballast and means for protecting the illumination device from the received current signal." Langovsky, 2:6-9.



Langovsky, FIG. 2. Inrush protection circuit 22 includes "protection circuitry configured to protect the illumination device from the ballast current signal."

Langovsky, Abstract. “Inrush protection circuit 22 can be realized by inrush current limiters 42 and 44.” Langovsky, 3:51-52. “High inrush currents may be moderated by placing inrush current limiters 42 and 44 in series with the current flow.” *Id.*, 3:65-67. Langovsky explains the following details about inrush current limiters 42 and 44:

Inrush current limiters 42 and 44 can be negative temperature coefficient (NTC) resistors. When signal source 14 is first connected, for example, NTC resistors can be cool and have a high resistance value thereby limiting inrush current. After a period of operation, NTC resistors can be warmed by current flowing therein, which in turn, can lower its resistance value.

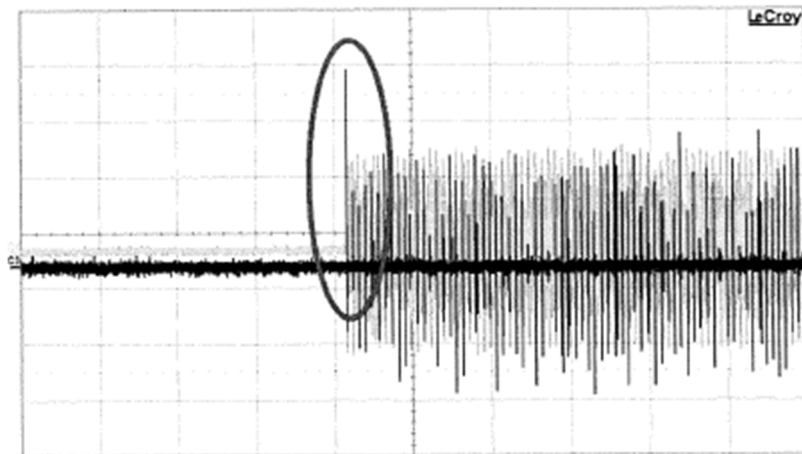
Langovsky, 3:67 – 4:6.

2. *Motivation to combine Tao and Langovsky*

49. A POSITA would have been motivated to include Langovsky’s inrush protection circuit 22 in Tao’s connection circuit 10. *See* Tao, [0037], [0038]; Langovsky, 3:49-50.

50. A POSITA would have recognized that an LED lamp power supply module may “include energy storage components that draw large currents,” “referred to as inrush currents,” “when power is first applied to them.” U.S. Patent No. 9,066,403, 5:30-33; *see* U.S. Patent App. Pub. No. 2013/0076255, [0061] (explaining that “the rectifier 40 may include the capacitor 420, such as an electrolytic capacitor, and...an inrush current may be generated by an initial charge current of the electrolytic capacitor”); U.S. Patent App. Pub. No. 2012/0206433

[0114] (stating that when “a capacitor [] [is] charged by the high voltage at the time of opening state, the excessive current (inrush current) flows toward the LED module”). Tao’s filter capacitors 72, 74, capacitor 76, input capacitor 90, output capacitor 96, (*see* Tao, [0055]), and filter capacitor 56 would generate an inrush current when power is first applied and the capacitors are charged. This inrush current may damage, among other things, Tao’s rectifier diodes or the connected ballast. The following figure shows an example of an inrush current in an LED lamp.



U.S. Patent App. Pub. No. 2012/0038289, FIG. 6A.

51. A POSITA would have understood the damage that surge and inrush currents could cause to LED lighting. *See* U.S. Patent App. Pub. No. 2012/0256551, [0033] (stating that “LED devices used for illumination [] are extremely sensitive to the surge current”); U.S. Patent App. Pub. No. 2012/0038289, [0027] (“Due to inrush current,” the LED lamp’s “internal elements

may be damaged.”); U.S. Patent No. 9,237,610, 5:33-35 (“Inrush currents may be of a magnitude that exceed safe operating limits of various components and thus may reduce the lifespan of a lamp unit [.]”); U.S. Patent App. Pub. No. 2013/0076255, [0061] (“[A]n inrush current may damage the ballast 20...of the LED lighting apparatus 1.”).

52. A POSITA would have recognized that the ballast and Tao’s light apparatus 60 could likewise be damaged by an inrush current. Tao includes filter capacitor(s) to reduce “leakage current from mains and the risk of electrical shocks at the second input terminals,” (Tao, [0037]), but Tao does not include protection against current spikes due to inrush currents.

53. The teaching of Langovsky and several other references, would have motivated a POSITA to include an inrush current protection module, such as Langovsky’s inrush protection circuit 22, in Tao’s connection circuit 10. Langovsky teaches that the “protection circuitry [is] configured to protect the illumination device from the ballast current signal,” and “the resistance of the inrush current limiter can be of a value such that components of rectifier circuit [] are not stressed.” Langovsky, 1:50-58, 4:23-25; *see* U.S. Patent App. Pub. No. 2014/0009076, Abstract (disclosing “a current limiting resistor to prevent the first and second rectifiers from being damaged”); U.S. Patent App. Pub. No. 2012/0038289, [0029] (“The thermistor 10 prevents an instantaneous overcurrent

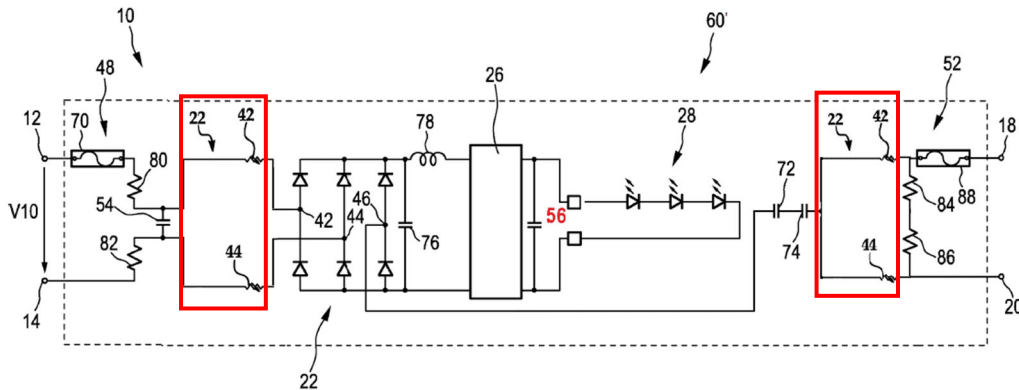
by limiting an inrush current when an initial voltage is applied. Thus, the circuit elements can be protected"); U.S. Patent No. 9,237,610, 5:26-30 ("[A]n inrush limiter 310 [] is designed to protect internal components of the lamp unit 306 from damage by controlling and limiting the amount of current flowing into the power supply 308."); U.S. Patent App. Pub. No. 2013/0234620, [0035] ("A signal conditioning circuit 30 may include one or more input resistors that limit inrush current through the circuit."). The purpose of Tao's filter capacitors 72 and 74 is to protect against electric shock from mains during installation, (Tao, [0037,] [0048]), while the purpose of Langovsky's inrush protection circuit 22 is to limit high inrush current when power is initially applied to the lamp (Langovsky, 3:63-67).

3. Modification of Tao in view of Langovsky

54. As discussed in the section above, a POSITA would have been motivated to combine Tao's connection circuit 10 with Langovsky's inrush protection circuit 22. See Tao, [0037], [0038]; Langovsky, 3:49-50. Langovsky explains that "[i]nrush protection circuit 22 can be realized by inrush current limiters 42 and 44." Langovsky, 3:51-52.

55. In the combined Tao-Langovsky lighting apparatus, Langovsky's inrush protection circuit 22 would have been inserted between Tao's input capacitor 54 and nodes 42 and 44 to protect components, including rectifier unit

22, from current pulses. Langovsky's inrush protection circuit 22 would also have been inserted between Tao's resistors 84, 86 and filter capacitor 74. As shown below, the combination of Langovsky's inrush protection circuit 22 with Tao's connection circuit 10 forms modified light apparatus 60'.



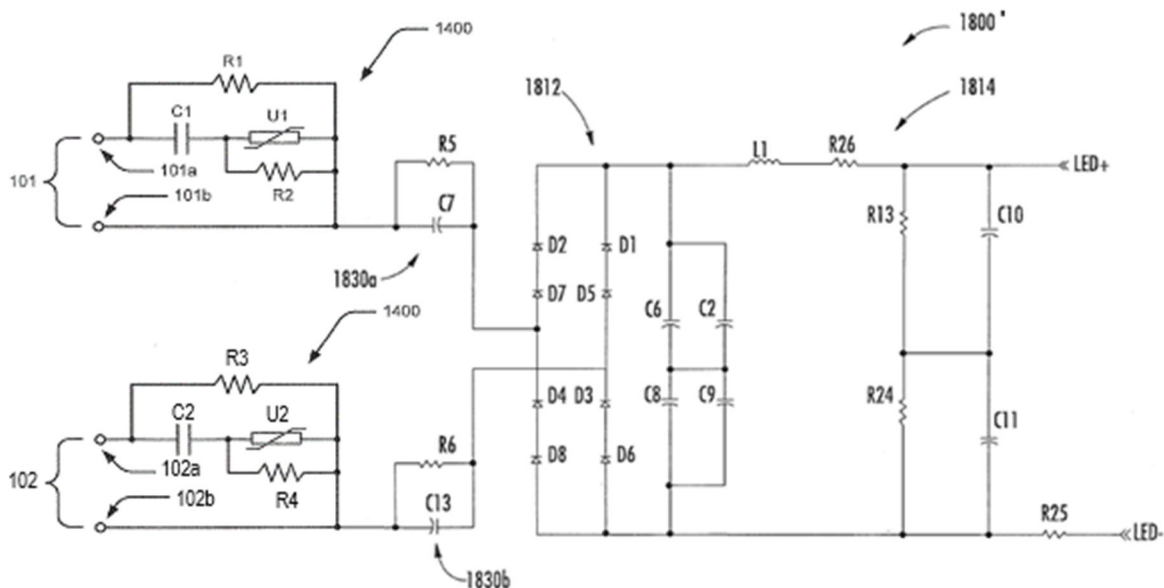
Tao, FIG. 4; Langovsky, FIG. 2.

X. COMPARISON OF PRIOR ART TO CHALLENGED CLAIMS

A. Ground 1 – Zhang Renders Obvious Claims 1, 2, 5-7, 9, 10, 15-18, 21, 23, 24, 29, 31, 32, 34-39, 41, and 42

(a) *Limitation 1[p] – A power source module for an LED lamp, comprising:*

56. To the extent it is limiting, Zhang renders the preamble obvious. A POSITA would have understood that modified apparatus 1800' includes a power source module having a filament-simulating circuit, a current limiting circuit, a first rectifier, and a filter.



Zhang, FIGS. 14 & 18A.

57. The modified apparatus 1800' receives electrical power from a ballast through the ballast connection ports 101 and 102. *See* Zhang, 5:1-5 (“The terminals 101a, 101b may comprise, for example, pins that are configured to be connected to a fluorescent lamp connector (e.g., a tombstone connector) that provides electrical coupling to a fluorescent lighting ballast.”). The power source module of the modified apparatus 1800' provides “output [] to the LED segments 1816a, 1816b” via the ports labeled LED+ and LED-. Zhang, 9:64-67.

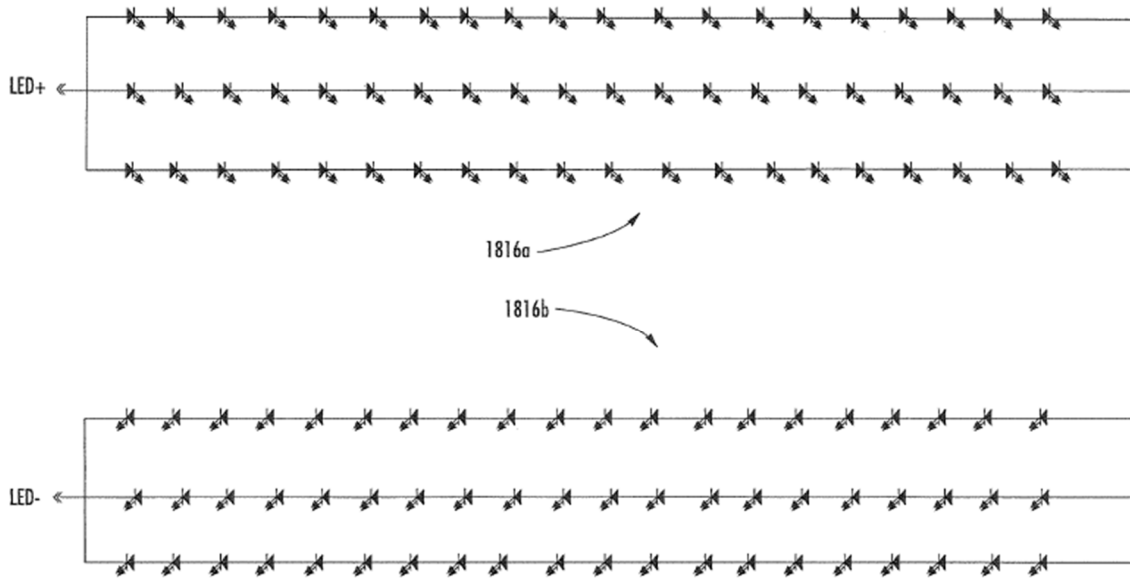


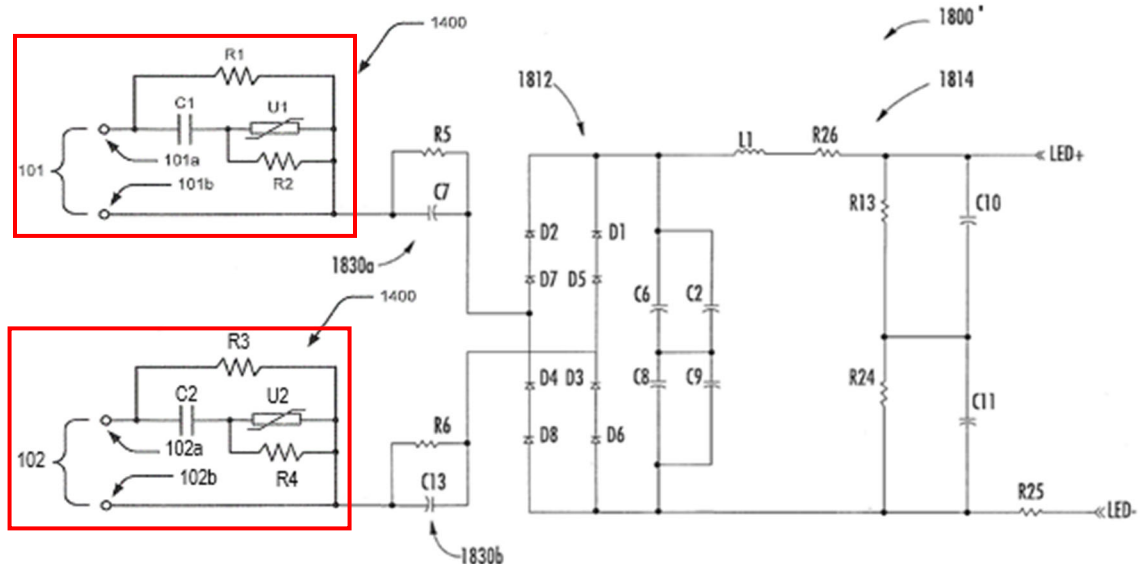
FIG. 18B

Zhang, FIG. 18B.

58. The power source module of apparatus 1800' (FIGS. 14, 18A & 18B) is also for an LED lamp, because it is located within the LED lamp. *See* Zhang, 10:19-20 (“The apparatus 1800 may be included in a fluorescent tube replacement lamp....”).

(b) *Limitation 1[a] – a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, each of the first bi-pin terminal and the second bi-pin terminal configured to allow a current to flow from one pin to the other pin via the filament simulating circuit during a pre-heat process executed by a ballast*

59. The power source module of Zhang’s modified apparatus 1800’ satisfies this limitation. As illustrated below in the red rectangles, both filament-imitating impedances 1400 are a filament-simulating circuit.



Zhang, FIGS. 14 & 18A. Top filament-imitating impedance 1400 includes “a capacitor C1 and resistor R1 ... , along with a parallel combination of an additional resistor R2 and a positive temperature coefficient (PTC) resistor U1 coupled in series with the capacitor C1.” Zhang, 8:16-20. Similarly, bottom filament-imitating impedance 1400 comprises a capacitor C2 and resistor R3 ... , along with a parallel combination of an additional resistor R4 and a positive temperature coefficient (PTC) resistor U2 coupled in series with the capacitor C2. Zhang, 8:16-20. As shown above, top filament-imitating impedance 1400 is electrically connected to first ballast connection port 101, and bottom filament-imitating impedance 1400 is electrically connected to second ballast connection port 101.

60. Zhang teaches that first ballast connection port 101 has a bi-pin terminal having pins 101a and 101b. Referring to FIG. 1, Zhang explains that

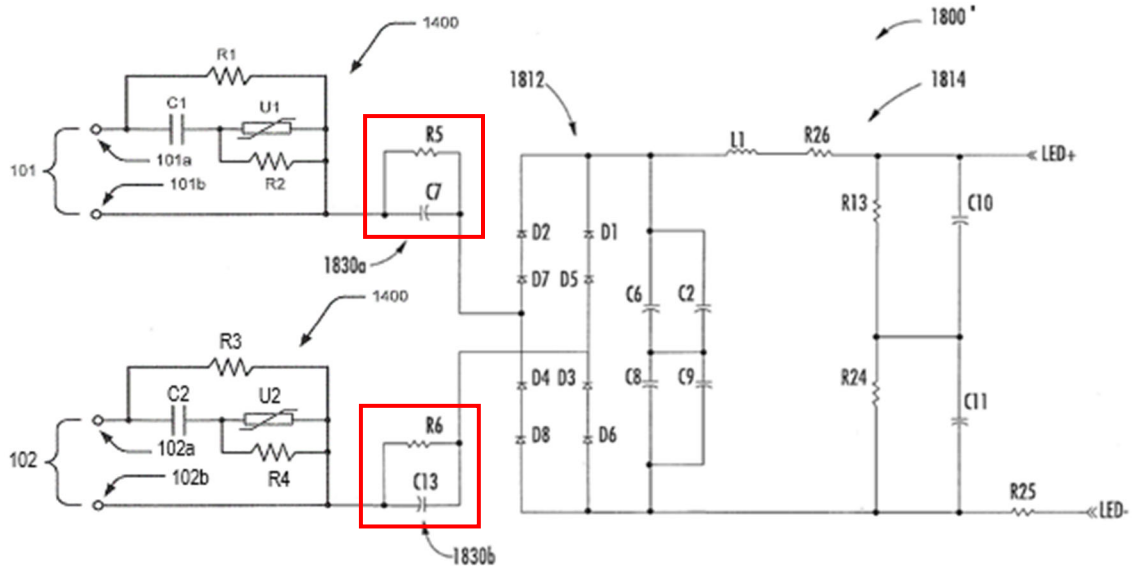
“[t]he terminals 101a , 101b may comprise, for example, pins that are configured to be connected to a fluorescent lamp connector.” Zhang, 5:1-5. Zhang similarly teaches that second ballast connection port 102 has a bi-pin terminal having pins 102a and 102b. Referring again to FIG. 1, Zhang explains that “[t]he apparatus 100 may also include a second port 102 with similar terminals 102a, 102b for use in, for example, bi-pin fluorescent tube replacement applications.” Zhang, 5:5-7.

61. The first ballast connection port 101 and 102 permits a flow of current from one pin 101a to the other pin 101b via the top filament-imitating impedance 1400 during a pre-heat process executed by a ballast. Similarly, the second ballast connection port 102 permits a flow of current from one pin 102a to the other pin 102b via the bottom filament-imitating impedance 1400 during the ballast’s pre-heat process. The connected ballast “perform[s] filament tests in which a filament is tested by measuring a ‘cold’ impedance of the filament before energizing, and then testing the filament impedance after the filament has been energized and heated up.” Zhang, 8:9-13. A POSITA would have understood that the described filament tests disclose a pre-heat process executed by a ballast, because they involve “testing the filament impedance after the filament has been energized and heated up.” Zhang, 8:9-13. Further, a POSITA would have recognized that measuring impedances and energizing and heating up a filament (or a “filament-imitating impedance” (Zhang, 8:8-9) necessarily requires a current to flow from

one pin 101a to the other pin 101b and likewise from one pin 102a to the other pin 102b. *See* WO 2014/115010, 5:29-34 (“During the preheat phase the fluorescent tube lighting fixture is arranged to, at each of the two ends of a fluorescent tube, apply a current between a first pair of contact pins at a first end of the fluorescent tube and between a second pair of contact pins at a second end of the fluorescent tube. The current is applied in order to heat a corresponding filament connected between said first and second pair of contact pins, respectively, so that electrons are emitted.”). And a POSITA would have further understood that the sole path from one pin 101a to the other pin 101b in modified apparatus 1800’ is through the top filament-imitating impedance 1400. The same is true for bottom filament-imitating impedance 1400 coupled to port 102, with pins 102a and 102b.

(c) *Limitation 1[b] - a current limiting circuit electrically connected to the filament-simulating circuit and configured to limit a current from the filament-simulating circuit*

62. The power source module of Zhang’s modified apparatus 1800’ satisfies this limitation. As illustrated below in the red rectangle, first blocking impedance 1830a and second blocking impedance 1830b are each a current limiting circuit:



Zhang, FIGS. 14 & 18A. First blocking impedance 1830a is electrically connected to the filament-imitating impedance: “[t]he first filament-imitating impedance [1400] is coupled to a first terminal of an input port of the rectifier circuit 1812 by the first blocking impedance 1830a.” Zhang, 9:25-28. The second blocking impedance is likewise electrically connected to the filament-imitating impedance: “[t]he second filament-imitating impedance 1820b ... is coupled to a second terminal of the input port of the rectifier circuit 1812 by the second blocking impedance 1830b.” Zhang, 9:28-33.

63. First blocking impedance 1830a is a circuit designed to provide an impedance that limits a current from the first filament-imitating impedance. First blocking impedance 1830a includes “a capacitor C7 and a resistor R5” connected in parallel (Zhang, 9:25-28), which forms a high pass RC filter. U.S. Patent No.

3,731,148, 2:40-42 (disclosing “a high-pass filter formed by a resistance 18 and a capacitance 17 connected in parallel”). A POSITA would have understood that the

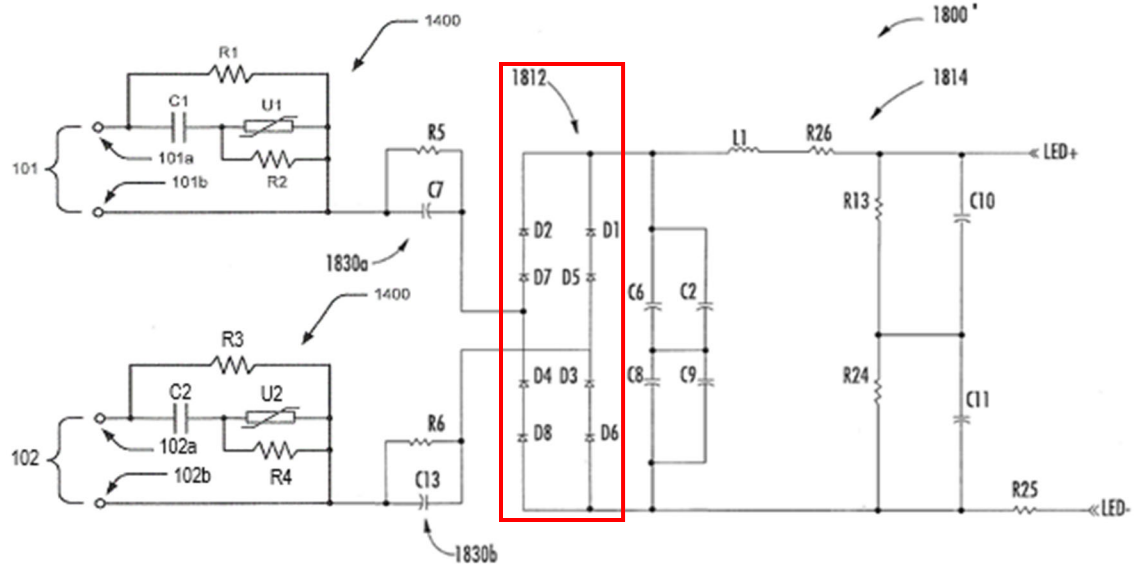
impedance provided by first blocking impedance 1830a is $Z = \frac{1}{\sqrt{(1/R5)^2 + (2\pi f C7)^2}}$.

“[T]he first and second blocking impedances 1830a, 1830b may be configured to block a lower frequency component that may be provided by the ballast, such as a DC offset produced by the ballast.” Zhang, 9:37-41. A POSITA would have recognized that first blocking impedance 1830a, which is an RC filter, limits the current from the filament-imitating impedance by blocking a lower frequency component generated by the ballast through the filament-imitating impedance.

U.S. Patent App. Pub. No. 2016/0345394, [0104] (explaining that “the resistor and capacitor of RC filter are sized appropriately to limit current drawn from converter”). The same is true for second blocking impedance 1830b.

(d) *Limitation 1[c] - a first rectifier electrically connected to the current limiting circuit and configured to rectify the current from the current limiting circuit*

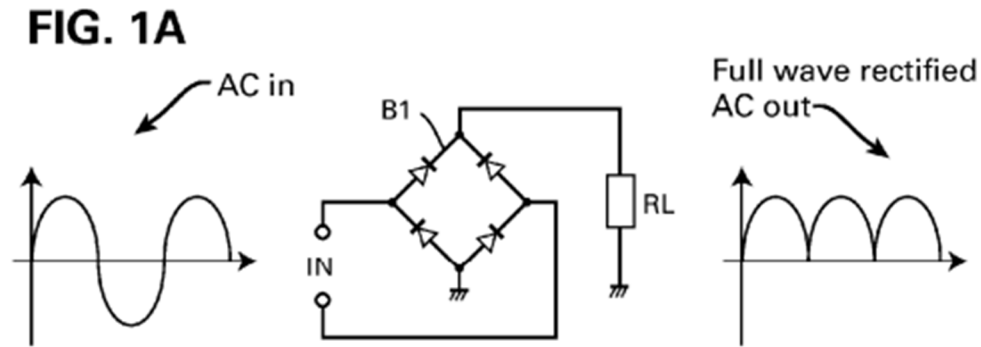
64. The power source module of Zhang’s modified apparatus 1800’ satisfies this limitation. As illustrated below in the red rectangle, rectifier circuit 1812 is a first rectifier.



Zhang, FIGS. 14 & 18A. Rectifier circuit 1812 is electrically connected to the first blocking impedance 1830a: “[t]he first filament-imitating impedance [1400] is coupled to a first terminal of an input port of the rectifier circuit 1812 by the first blocking impedance 1830a.” Zhang, 9:25-28. Rectifier circuit 1812 is similarly electrically connected to second blocking impedance 1830b: “[t]he second filament-imitating impedance 1820b...is coupled to a second terminal of the input port of the rectifier circuit 1812 by the second blocking impedance 1830b.” Zhang, 9:28-33.

65. Rectifier circuit 1812 rectifies the current flowing from the blocking impedances 1830a and 1830b. “The rectifier circuit 1812 is a diode bridge including diodes D1-D8. The diode bridge is configured to provide redundancy by including respective serially-connected diode pairs D1/D5, D2/D7, D4/D8, D3/D6 in each branch of the diode bridge.” Zhang, 9:8-13. A POSITA would have

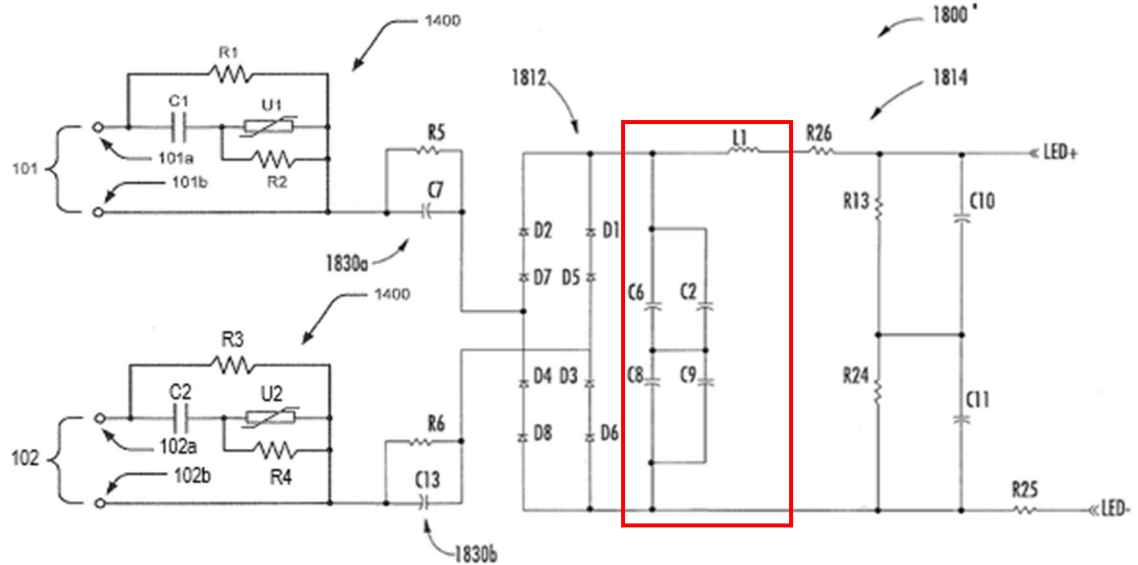
understood that rectifier circuit 1812, as a diode bridge, performs full wave rectification of an alternating current flowing from the first and second blocking impedances 1830a and 1830b.



See U.S. Patent No. 8,441,824, FIG. 1A. Although the figure above shows the voltage across the load, a POSITA would have understood that the rectified current flowing through the load is related to the rectified voltage by Ohm's law, $I=V/R$. See U.S. Patent No. 8,841,897, 7:25-30.

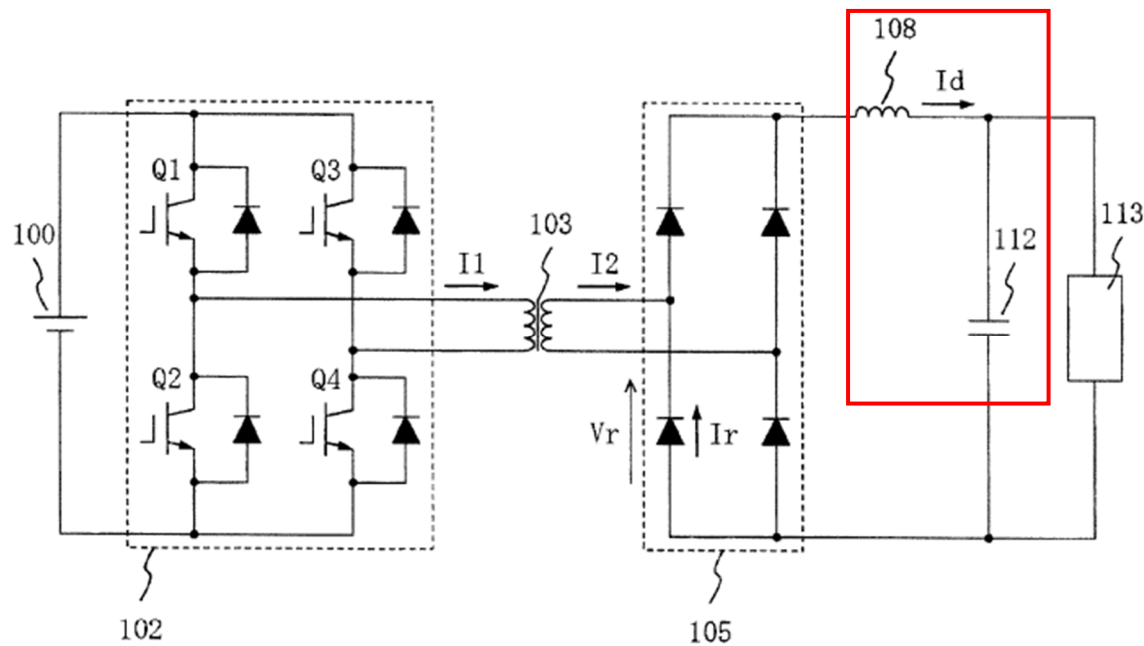
(e) ***Limitation 1[d] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp and configured to smooth the current from the first rectifier***

66. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. As illustrated below in the red rectangle, matching circuit 1814 is a filter.



Zhang, FIGS. 14 & 18A. Zhang explains that “matching circuit 1814 includes capacitors C2, C6, C8, C[9] and inductor L1, and is configured to be coupled to at least one LED, here an LED string including first and second serially-connected segments 1816a, 1816b.” Zhang, 9:49-52. The figure below illustrates a “a filter reactor 108 and filter capacitor 112 for smoothing the DC power outputted from

the rectifier circuit 105.” U.S. Patent App. Pub. No. 2012/0300501, [0006].



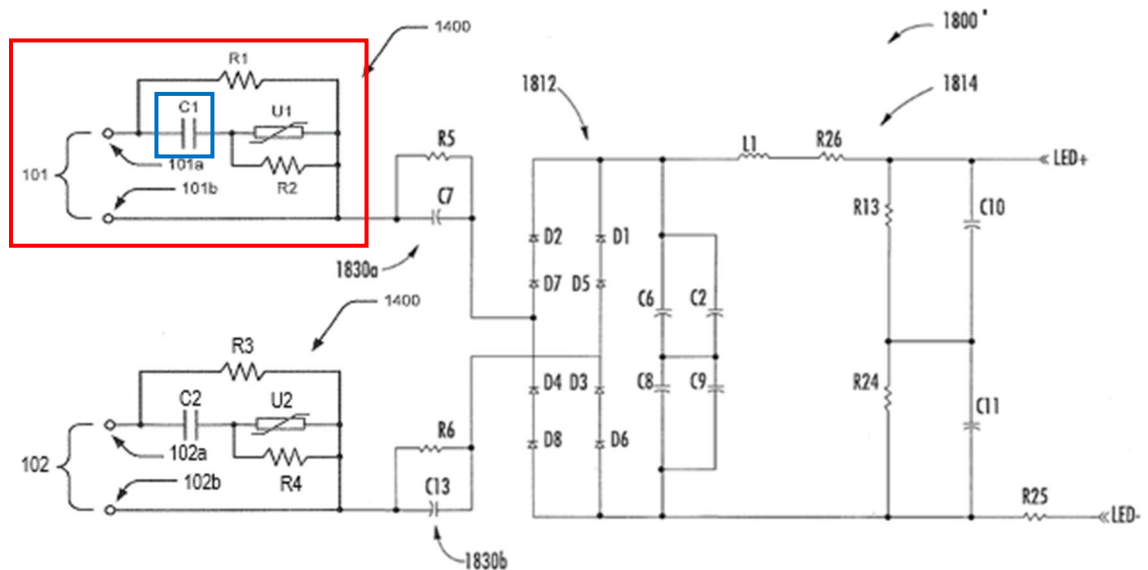
U.S. Patent App. Pub. No. 2012/0300501, FIG. 8. Like filter reactor [inductor] 108 and filter capacitor 112 illustrated above, a POSITA would have recognized that the illustrated circuit structure of capacitors C2, C6, C8, C9 in parallel with the rectifier 1812 and the inductor L1 in series with the output of the rectifier 1812 filters and smooths the output of rectifier circuit 1812.

67. Zhang also discloses that “[c]apacitors C10, C11 may be connected across the output of the matching circuit 1814, and may provide **additional smoothing** of the output provided to the LED segments 1816a, 1816b.” Zhang, 9:64-67. The mention of “additional smoothing” indicates that matching circuit 1814 itself performs smoothing.

68. Further, as shown in the figure above, matching circuit 1814 is electrically connected between rectifier circuit 1812 and LED segments 1816a and 1816b. Zhang discloses that “[t]he matching circuit 1814...is configured to be coupled to at least one LED, here an LED string including first and second serially-connected segments 1816a, 1816b.” Zhang, 9:49-52.

(f) ***Limitation 2[a] – [The power source module of claim 1,] wherein the filament-simulating circuit comprises: a first filament-simulating circuit comprising a first capacitor element electrically connected between two pins of the first bi-pin terminal***

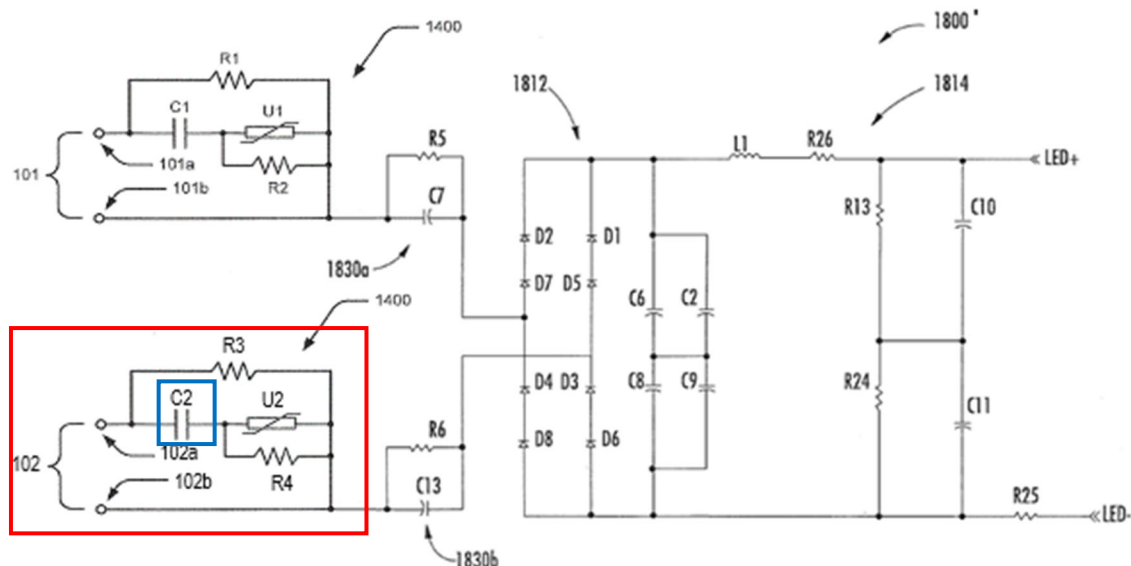
69. The power source module of Zhang’s modified apparatus 1800’ satisfies this limitation. The top filament-imitating impedance 1400 is a first filament-simulating circuit. As illustrated below in the red and blue rectangles, the top filament-imitating impedance 1400 includes a capacitor C1.



Zhang, FIGS. 14 & 18A. “FIG. 14 illustrates a filament-imitating impedance 1400 including a capacitor C1....” Zhang, 8:16-20. Zhang also discloses that capacitor C1 is electrically connected between pins 101a and 101b of the first port 101. As illustrated in the figure above, capacitor C1 is directly connected to one pin 101a and is connected to the other pin 101b through “a parallel combination of an additional resistor R2 and a positive temperature coefficient (PTC) resistor U1.” Zhang, 8:16-20.

(g) *Limitation 2[b] - a second filament-simulating circuit comprising a second capacitor element electrically connected between two pins of the second bi-pin terminal*

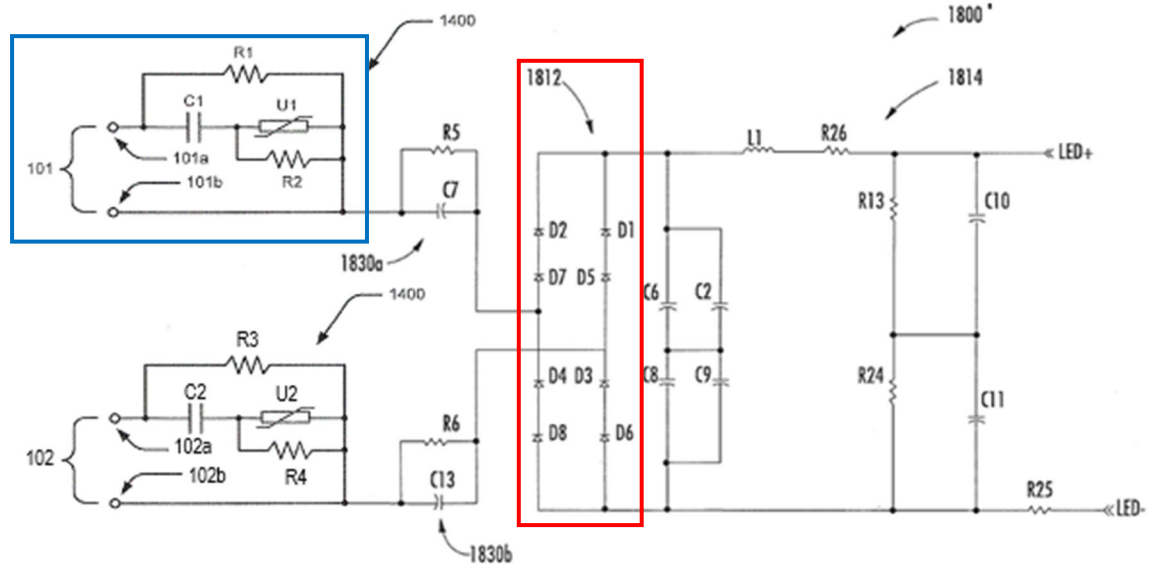
70. The power source module of Zhang’s modified apparatus 1800’ satisfies this limitation. The bottom filament-imitating impedance 1400 is a second filament-simulating circuit. As illustrated below in the red and blue rectangles, the second filament-imitating impedance 1400 includes a capacitor C2.



Zhang, FIGS. 14 & 18A. Capacitor C2 is electrically connected between pins 102a and 102b of port 102 for the same reasons as capacitor C1 is electrically connected between pins 101a and 101b. See Limitation 2[a].

- (h) ***Claim 5 – [The power source module of claim 2,] wherein the first rectifier comprises two diodes electrically connected in series, and the first rectifier is electrically connected to the first filament-simulating circuit in series***

71. The power source module of Zhang's modified apparatus 1800' satisfies this claim. As shown below in the red rectangle, rectifier circuit 1812 includes two diodes electrically connected in series.

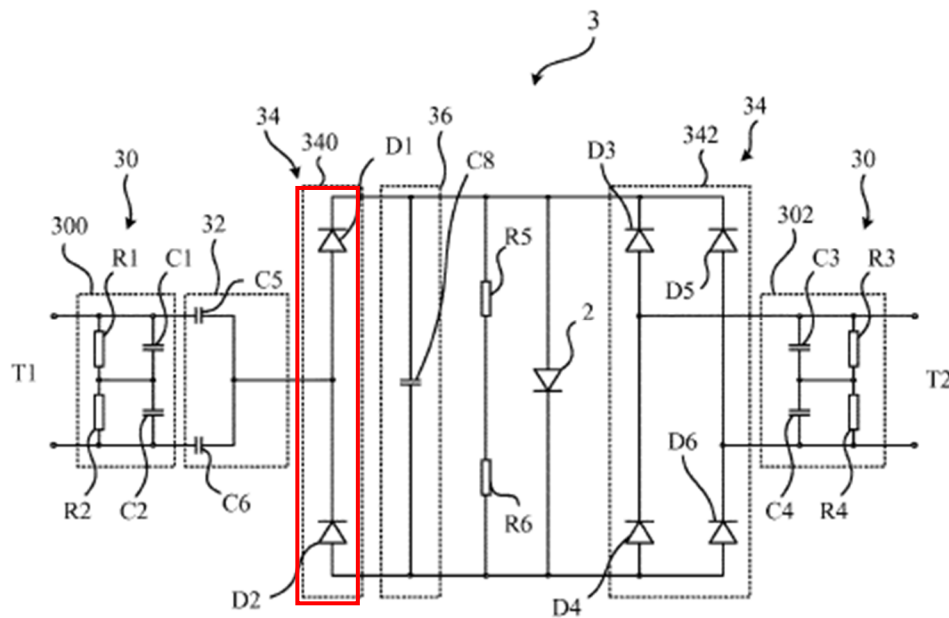


Zhang, FIGS. 14 & 18A. Zhang explains that “[t]he diode bridge is configured to provide redundancy by including respective serially-connected diode pairs D1/D5, D2/D7, D4/D8, D3/D6 in each branch of the diode bridge.” Zhang, 9:10-13. A POSITA would have understood that each of the “serially-connected diode pairs” comprises two diodes electrically connected in series.

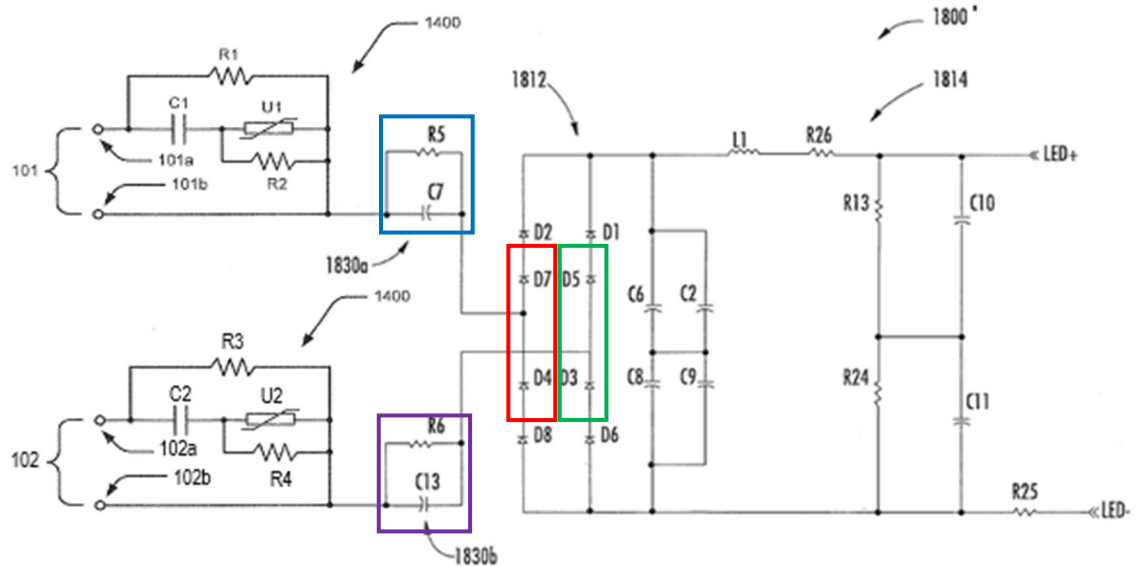
72. And as illustrated above in the red and blue rectangles, Zhang also discloses that rectifier circuit 1812 is electrically connected to top filament-imitating impedance 1400 in series. Rectifier circuit 1812 is connected to top filament-imitating impedance 1400 through a single conductor (i.e., in series) through first blocking impedance 1830a.

- (i) ***Limitation 6[a] – [The power source module of claim 2,] wherein the first rectifier comprises two diodes electrically connected in series and a connection node connecting the two diodes is coupled to the current limiting circuit***

73. The power source module of Zhang’s modified apparatus 1800’ satisfies this limitation. As an initial matter, the ’662 Patent states that that “the first rectifier 340 includes diodes D1, D2 electrically connected in series.” ’622 Patent, 5:22-26.



’622 Patent, FIG. 3. To the extent that diodes D1 and D2 of the ’662 Patent are electrically connected in series, Zhang’s rectifier circuit 1812 also has two diodes, D7 and D7 (red rectangle), electrically connected in series and two additional diodes, D5 and D3 (green rectangle), also electrically connected in series.

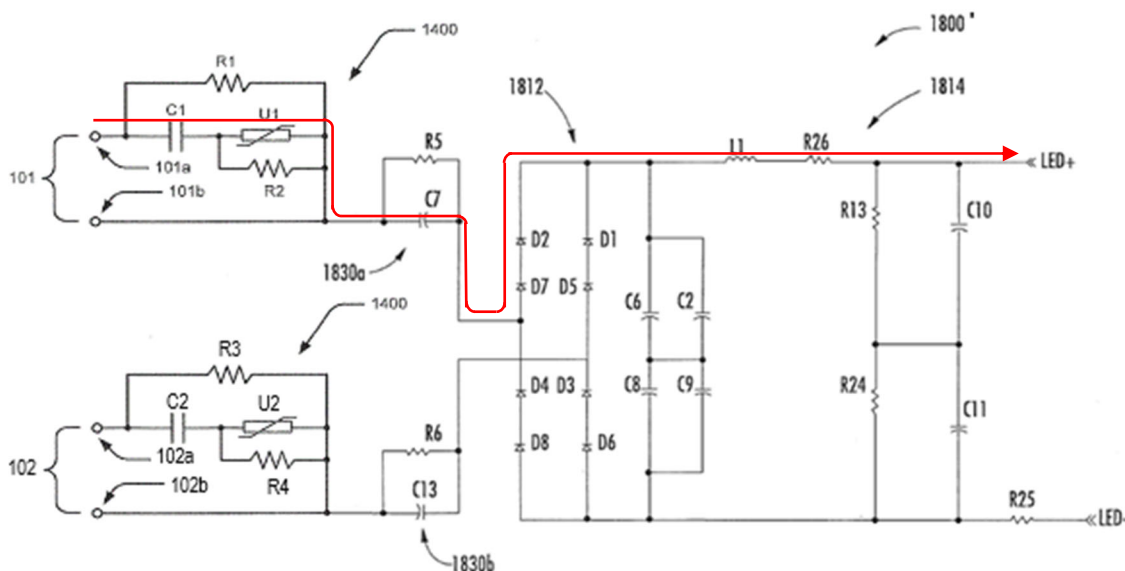


Zhang, FIGS. 14 & 18A. The connection node connecting diodes D4 and D7 is coupled to the first blocking impedance 1830a (blue rectangle), and the connection node connecting diodes D3 and D5 is coupled to the second blocking impedance 1830b (purple rectangle). The first blocking impedance 1830a and the second blocking impedance 1830b are the “current limiting circuit.”

- (j) ***Limitation 6[b] - wherein a current flows from the at least one LED to one pin of the first bi-pin terminal through one of the two diodes and the current limiting circuit, or from one pin of the first bi-pin terminal to the at least one LED through the other of the two diodes and the current limiting circuit***

74. The power source module of Zhang’s modified apparatus 1800’ satisfies this limitation. In particular, Zhang teaches a current flowing “from one pin of the first bi-pin terminal to the at least one LED through the other of the two

diodes and the current limiting circuit.” The red arrow below illustrates the flow of current.



Zhang, FIGS. 14 & 18A. A POSITA would have understood that current would flow from pin 101a of first port 101 through top filament-imitating impedance 1400 and through first blocking impedance 1830a. The current then flows into the connection node through diode D7 and D2 from anode to cathode, but the current is blocked from flowing through diodes D4 and D8 from cathode to anode. The current then flows through L1 and R26 into the LED string 1816a and 1816b via the LED+ terminal.

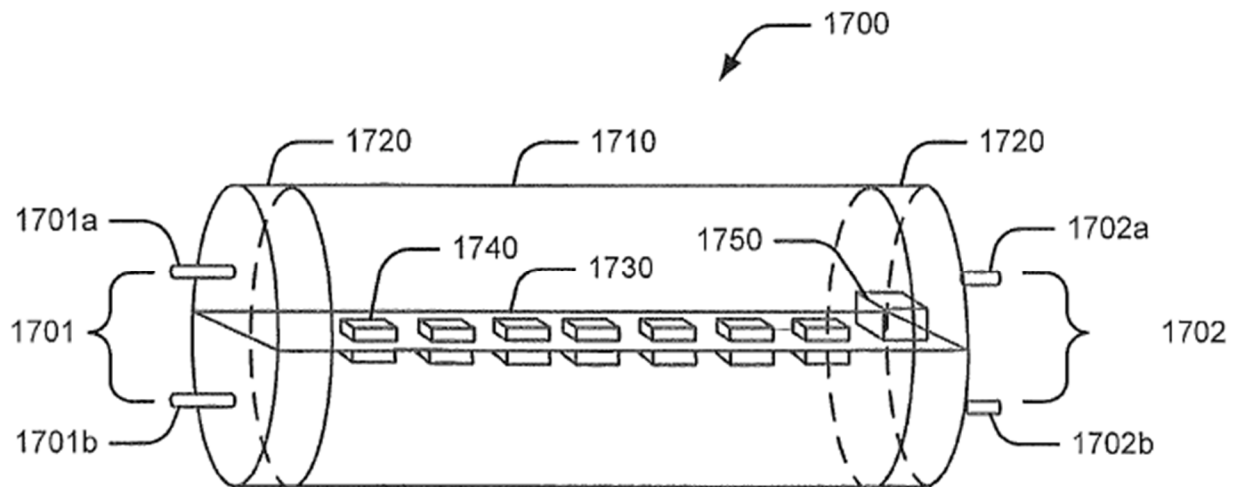
(k) **Claim 7**–[The power source module of claim 6,] wherein the current limiting circuit comprises at least a capacitor

75. The power source module of Zhang’s modified apparatus 1800’ satisfies this claim. First blocking impedance 1830a includes capacitor C7: “first

blocking impedance 1830a [] includes a capacitor C7.” Zhang, 9:25-28. Similarly, “the second blocking impedance 1830b [] includes a capacitor C13.” Zhang, 9:28-33.

(l) Claim 9 – [The power source module of claim 1,] wherein the power source module is configured inside a casing of the LED lamp

76. The power source module of Zhang’s modified apparatus 1800’ satisfies this claim. Zhang states that “[t]he apparatus 1800 may be included in a fluorescent tube replacement lamp along the lines illustrated in FIG. 17.” Zhang, 10:19-20.

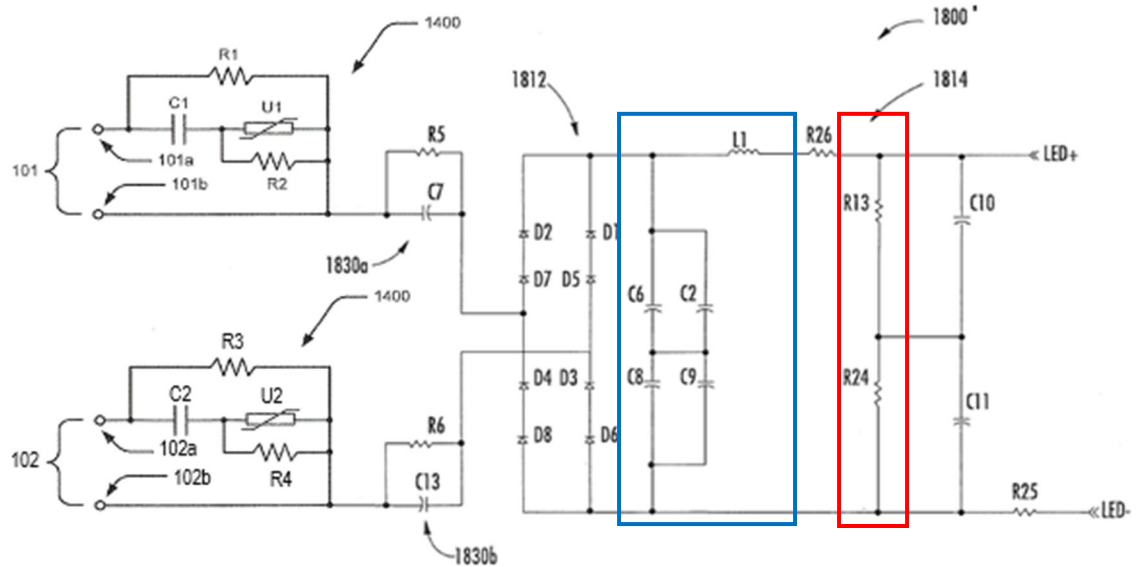


Zhang, FIG. 17. In addition, apparatus 1800 comprises “three parallel connected strings of LEDs.” Zhang, 10:12-15. As such, a POSITA would have understood that fluorescent tube replacement lamp 1700 is an LED lamp, because Zhang discloses that “[t]he lamp 1700 includes a tubular housing 1710” and “LEDs 1740

of an LED string may be mounted on a substrate 1730 positioned within the housing 1710.” Zhang, 8:50-58. Zhang further states that “[t]he lamp 1700 includes a tubular housing 1710,” (Zhang, 8:50-52), which is a casing, and the modified apparatus 1800’ would be disposed within that casing; *see* U.S. Patent App. Pub. No. 2010/0265732, Abstract (“A light tube with an LED light source includes a casing” and “an LED circuit board inside the casing”). In any event, it would have been obvious for a POSITA to place Zhang’s power source module inside of Zhang’s tubular housing 1710. Tao’s tubular housing 1710 would help protect the power source module from damage and the environment and prevent accidental contact of the power source module by a human installer.

(m) *Claim 10 – [The power source module of claim 1, further comprising] a discharging circuit electrically connected to the filter in parallel for discharging the filter*

77. The power source module of Zhang’s modified apparatus 1800’ satisfies this claim. As illustrated below in the red rectangle, resistors R13 and R24 are a discharging circuit that is connected to matching circuit 1814 (blue rectangle), i.e., the filter (*see* Limitation 1[d] above), in parallel for discharging the matching circuit. Resistors R13 and R24 are electrically connected to matching circuit 1814 in parallel.

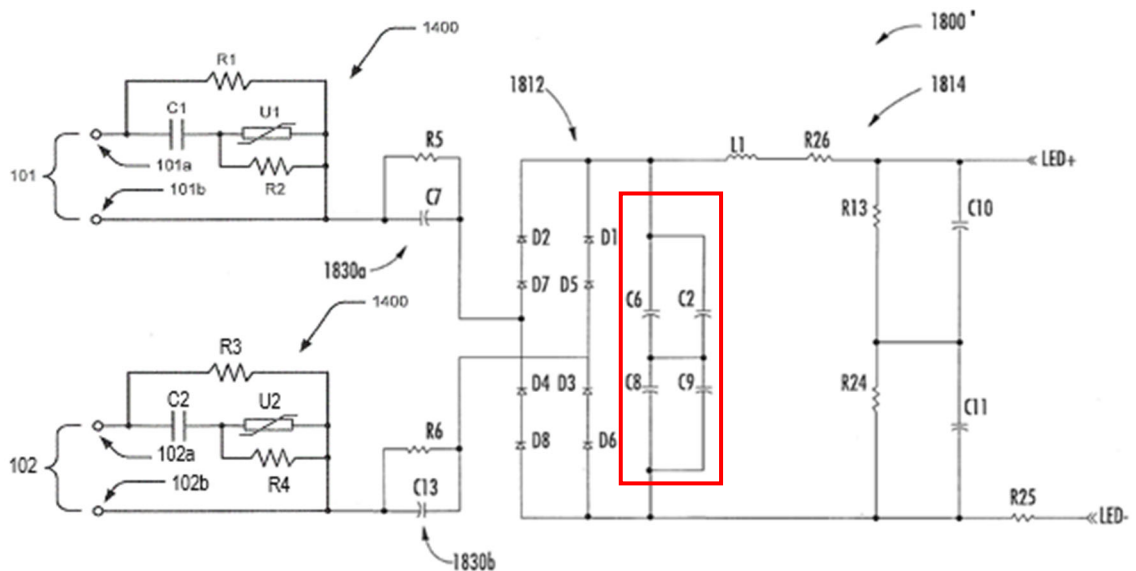


Zhang, FIGS. 14 & 18A.

78. Zhang teaches that resistors R13 and R24 form a discharging circuit: “Resistors R13, R24 ... may be used to **discharge** the capacitors C10, C11 when power to the apparatus 1800 is removed, thus enabling a crisper turnoff of the LED segments 1816 a, 1816 b.” Zhang, 9:67 – 10:4. Although Zhang explicitly teaches discharging C10 and C11, a POSITA would have recognized that resistors R13 and R24 additionally discharge capacitors C2, C6, C8, C9 and inductor L1 of matching circuit 1814. When external power to modified apparatus 1800’ shuts off, resistors R13 and R24 provide a path for the stored energy in capacitors C2, C6, C8, C9 and inductor L1 to discharge. See U.S. Patent No. 7,256,505, 8:12-13 (“DC output of rectifier 40 charges storage capacitor 42.”); U.S. Patent No. 7,557,521, 27:47-52 (“energy is stored in the inductor’s magnetic field.”).

(n) **Claim 15 – [The power source module of claim 1,] wherein the filter comprises a filtering capacitor electrically connected to the at least one LED**

79. The power source module of Zhang’s modified apparatus 1800’ satisfies this claim. As illustrated below in the red rectangle, matching circuit 1814 includes a filtering capacitor, e.g., C2, C6, C8, C9 .



Zhang, FIGS. 14 & 18A. A POSITA would have understood capacitors C2, C6, C8, C9 are filtering capacitors because they provide a low impedance to the high frequency signals and thus shunt those signals away from the LED segments attached to LED+ and LED-. See U.S. Patent No. 7,966,075, 28:62-63 (“The capacitive reactance is a very low impedance at high frequency”). Capacitors C2, C6, C8, C9 are electrically connected to the at least one LED. One terminal of the capacitors is electrically connected with the LED+ terminal through inductor L1 and

resistor R26, and the other terminal of the capacitors is connected with the LED-terminal through resistor R25.

(o) Claim 16 – [The power source module of claim 1, further comprising] a discharging circuit electrically connected to the filter in parallel for discharging the filter

80. The power source module of Zhang’s combined lighting apparatus satisfies this claim. *See* Claim 10 above.

(p) Limitation 17[p] - A power source module for an LED lamp, comprising

81. To the extent it is limiting, the power source module of Zhang’s combined lighting apparatus satisfies the preamble. A POSITA would have understood that modified apparatus 1800’ includes a power source module having a rectifier, a filter, a discharging circuit, and a filament simulating circuit. *See* Limitation 1[p] above.

(q) Limitation 17[a] - a rectifier electrically connected to terminals of the LED lamp and configured to receive a current

82. The power source module of Zhang’s modified apparatus 1800’ satisfies this limitation. Rectifier circuit 1812 is connected to first port 101 through top filament-imitating impedance 1400 and first blocking impedance 1830a. “The first filament-imitating impedance 1820a is coupled to a first terminal of an input port of the rectifier circuit 1812...” Zhang, 9:25-28, FIG. 14 (illustrating that filament-imitating impedance 1400 is connected to first port 101).

Rectifier circuit 1812 is similarly connected to port 102 through bottom filament-imitating impedance 1400 and second blocking impedance 1830b. And a POSITA would have understood that rectifier circuit 1812 is configured to receive a current from first ballast port 101 and second ballast port 102 based upon being electrically connected to those two ballast ports.

(r) *Limitation 17[b] - a filter electrically connected between the rectifier and at least one LED of the LED lamp and configured to store energy from the rectifier and to smooth the current from the rectifier*

83. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. *See* Limitation 1[d] above. A POSITA would have recognized that matching circuit 1814 stores energy from rectifier circuit 1812. Rectifier circuit 1812 produces a DC voltage, which charges capacitors C2, C6, C8, C9. *See* Claim 10 above.

(s) *Limitation 17[c] - a discharging circuit electrically connected to the filter in parallel and configured to discharge the energy stored in the filter*

84. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. *See* Claim 10 above.

- (t) ***Limitation 17[d] - a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, the filament-simulating circuit comprising at least one resistor connected in parallel to at least one capacitor and configured to simulate a filament of a fluorescent lamp during a pre-heat process executed by a ballast***

85. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. *See* Limitation 1[a] above. Top filament-imitating impedance 1400 includes resistor R1 connected in parallel with capacitor C1. And bottom filament-imitating impedance 1400 includes resistor R3 connected in parallel with capacitor C3.

- (u) ***Claim 18 – [The power source module of claim 17,] further comprising a current limiting circuit electrically connected to the first bi-pin terminal of the LED lamp, and configured to limit a current from the first bi-pin terminal***

86. The power source module of Zhang's modified apparatus 1800' satisfies this claim. *See* Limitation 1[b] above. First blocking impedance 1830a is electrically connected to first port 101 through top filament-imitating impedance 1400.

- (v) ***Limitation 21[p] - A power source module for an LED lamp, comprising:***

87. To the extent it is limiting, the power source module of Zhang's modified apparatus 1800' satisfies this preamble. *See* Limitation 1[p] above.

- (w) ***Limitation 21[a] - a first circuit comprising a first capacitor element electrically connected between two pins of a first bi-pin terminal of the LED lamp, and a second circuit comprising a second capacitor element electrically connected between two pins of a second bi-pin terminal, wherein the first and second circuits are configured to simulate a filament of a fluorescent lamp during a pre-heat process executed by a ballast***

88. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. See Limitations 1[a], 2[a], and 2[b] above. The first circuit is the first filament-simulating circuit, and the second is the second filament-simulating circuit.

- (x) ***Limitation 21[b] - a current limiting circuit electrically connected to the first bi-pin terminal and configured to limit a current from the first bi-pin terminal***

89. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[b] and Claim 18 above.

- (y) ***Limitation 21[c] - a rectifier electrically connected between the current limiting circuit and the second circuit and configured to rectify the current from the current limiting circuit and a current from the second bi-pin terminal***

90. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[c]. Rectifier circuit 1812 is electrically connected between first blocking impedance 1830a and second filament-imitating impedance 1400. When the alternating current has a positive voltage, a POSITA would have recognized that current flows from first blocking impedance 1830a and

from the anode to the cathode of diodes D7 and D2. When the alternating current has a negative voltage, a POSITA would have recognized that current flows from third and fourth terminals 102a and 102b and from the anode to the cathode of diodes D5 and D1.

(z) *Limitation 21[d] - a filter electrically connected between the rectifier and at least one LED of the LED lamp to store energy from the rectifier and configured to smooth the current from the rectifier*

91. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. *See* Limitations 1[d] and 17[b] above.

(aa) *Limitation 23[p] - An LED lamp, comprising*

92. To the extent it is limiting, Zhang renders the preamble obvious. A POSITA would have understood that modified apparatus 1800' is located within fluorescent tube replacement lamp 1700, which is an LED lamp. Zhang explains that "[t]he lamp 1700 includes a tubular housing 1710" and "LEDs 1740 of an LED string may be mounted on a substrate 1730 positioned within the housing 1710." Zhang, 8:50-58. A POSITA would have understood that modified apparatus 1800' includes a current limiting circuit, a first rectifier, a filter, a first filament-simulating circuit, and a second filament-simulating circuit. *See* Limitation 1[p] and Claim 9 above.

(bb) Limitation 23[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal

93. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[b] and Claim 18 above.

(cc) Limitation 23[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit

94. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[c] above.

(dd) Limitation 23[c] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier

95. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[d] above.

(ee) Limitation 23[d] - a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals having a current flowing from one pin to the other pin of the respective bi-pin terminal via the filament-simulating circuit during a pre-heat process executed by a ballast

96. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[a] above.

(ff) Limitation 24[a] – [The LED lamp of claim 23,] wherein the filament simulating circuit comprises: a first filament-simulating circuit comprising a first capacitor element electrically connected between two pins of the first bi-pin terminal

97. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. *See* Limitation 2[a] above.

(gg) Limitation 24[b] - a second filament-simulating circuit comprising a second capacitor element electrically connected between two pins of the second bi-pin terminal

98. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. *See* Limitation 2[b] above.

(hh) Claim 29 – [The LED lamp of claim 23,] further comprising a discharging circuit electrically connected to the filter in parallel for discharging the filter

99. The LED lamp of Zhang's modified apparatus 1800' satisfies this claim. *See* Claim 10 above.

(ii) Claim 31 – [The power source module of claim 1,] wherein the current limiting circuit comprises at least a capacitor

100. The power source module of Zhang's modified apparatus 1800' satisfies this claim. *See* Claim 7 above.

- (jj) ***Limitation 32[a] – [The power source module of claim 1, wherein:] the filament-simulating circuit comprises a first filament simulating circuit connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit connected between two pins of the second bi-pin terminal***

101. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. See Limitations 2[a] and 2[b] above.

- (kk) ***Limitation 32[b] - the current limiting circuit comprises at least a capacitor connected to the first filament-simulating circuit, and at least a capacitor connected to the second filament simulating circuit***

102. The power source module of Zhang's modified apparatus 1800' satisfies this limitation. First and second blocking impedances 1830a and 1830b include capacitors C7 and C13. Capacitor C7 is connected to first filament-imitating impedance 1400, and capacitor C13 is connected to second filament-imitating impedance 1400.

- (ll) ***Claim 34 – [The power source module of claim 17, further comprising] a current limiting circuit electrically connected to the second bi-pin terminal of the LED lamp, and configured to limit a current from the second bi-pin terminal***

103. The power source module of Zhang's modified apparatus 1800' satisfies this claim. See Limitation 1[b] above. Second blocking impedance 1830b is a current limiting circuit electrically connected to second port 102 through the bottom filament-imitating impedance 1400 and limits a current from the second port 102.

(mm) Claim 35 – [The power source module of claim 17,] wherein the filament-simulating circuit comprises a first filament-simulating circuit connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit connected between two pins of the second bi-pin terminal.

104. The power source module of Zhang's modified apparatus 1800' satisfies this claim. See Limitations 2[a] and 2[b] above.

(nn) Claim 36 – [The power source module of claim 21,] further comprising another current limiting circuit electrically connected to the second bi-pin terminal of the LED lamp, configured to limit a current from the second bi-pin terminal

105. The power source module of Zhang's modified apparatus 1800' satisfies this claim. See Claim 34 above.

(oo) Claim 37 – [The LED lamp of claim 23,] further comprising another current limiting circuit electrically connected to a second terminal of the LED lamp, configured to limit a current from the second terminal

106. The LED lamp of Zhang's modified apparatus 1800' satisfies this claim. See Claim 34 above.

(pp) Claim 38 – [The LED lamp of claim 23,] wherein the current limiting circuit comprises at least a capacitor

107. The LED lamp of Zhang's modified apparatus 1800' satisfies this claim. See Claim 7 above.

(qq) Claim 39 – [The LED lamp of claim 23,] wherein the filament simulating circuit comprises a first filament-simulating circuit connected between a first pin and a second pin [sic] of the first bi-pin terminal, and a second filament-simulating circuit connected between a first pin and a second pin of the second bi-pin terminal

108. The LED lamp of Zhang's modified apparatus 1800' satisfies this claim. See Limitations 2[a] and 2[b] above.

(rr) Limitation 41[p] - An LED lamp, comprising

109. To the extent the preamble is limiting, the LED lamp of Zhang's modified apparatus 1800' satisfies this preamble. See Limitation 23[p] above.

(ss) Limitation 41[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal

110. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[b] and Claim 18 above.

(tt) Limitation 41[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit

111. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[c] above.

(uu) Limitation 41[c] – a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier

112. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[d] above.

(vv) *Limitation 41[d] – a first filament-simulating circuit electrically connected to a first bi-pin terminal of the LED lamp and a second filament-simulating circuit electrically connected to a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals arranged to have a current flowing from one pin to the other pin of the respective bi-pin terminal via the respective first or second filament-simulating circuit during a pre-heat process executed by a ballast*

113. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitations 1[a], 2[a], and 2[b] above.

(ww) *Limitation 42[p] - An LED lamp, comprising*

114. To the extent the preamble is limiting, the LED lamp of Zhang's modified apparatus 1800' satisfies this preamble. See Limitation 23[p] above.

(xx) *Limitation 42[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal*

115. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[b] and Claim 18 above.

(yy) *Limitation 42[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit*

116. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[c] above.

(zz) Limitation 42[c] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier

117. The LED lamp of Zhang's modified apparatus 1800' satisfies this limitation. See Limitation 1[d] above.

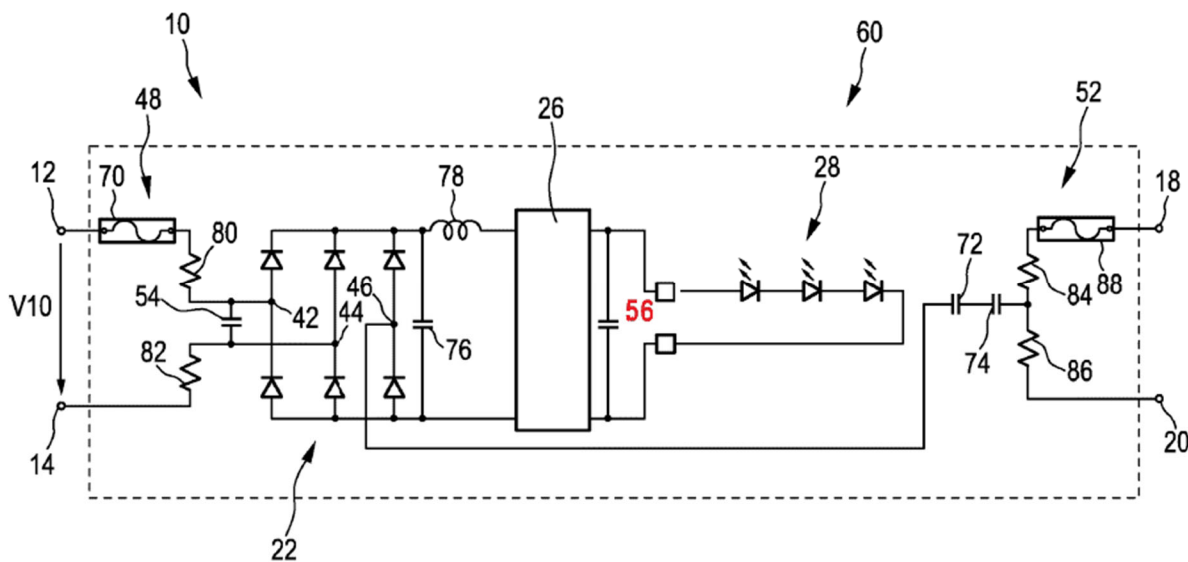
(aaa) Limitation 42[d] - a first filament-simulating circuit electrically connected to a first bi-pin terminal of the LED lamp, and a second filament-simulating circuit electrically connected to a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals arranged to have a current flowing from one pin to the other pin of the respective bi-pin terminal via the respective first or second filament-simulating circuit after the LED lamp is connected to a ballast and before a normal operation state of the LED lamp

118. The LED lamp of Zhang's combined lighting apparatus satisfies this limitation. See Limitations 1[a], 2[a], and 2[b] above. The connected ballast "perform[s] filament tests in which a filament is tested by measuring a 'cold' impedance of the filament before energizing, and then testing the filament impedance after the filament has been energized and heated up." Zhang, 8:9-13. A POSITA would have understood that the described filament tests take place after the LED lamp is connected to a ballast and prior to a normal operation state of the LED lamp.

B. Ground 2 – Tao Renders Obvious Claims 1, 9, 15, 23, 31-33, and 38-43

(a) Limitation 1[p] - A power source module for an LED lamp, comprising

119. To the extent it is limiting, Tao discloses the preamble. A POSITA would have understood that light apparatus 60 includes input circuitry 48 and 52, input capacitor 54, filter capacitors 72 and 74, rectifier unit 22, capacitor 76, inductance 78, driver stage 26, and filter capacitor 56, which together implement a power source module. Tao, [0035], [0037]-[0040], [0048], [0049]; FIG. 4 (reproduced below); *see* '662 Patent, 3:29-31 (“The power source module 1 may also be described as a power source circuit, or a power supply circuit.”).



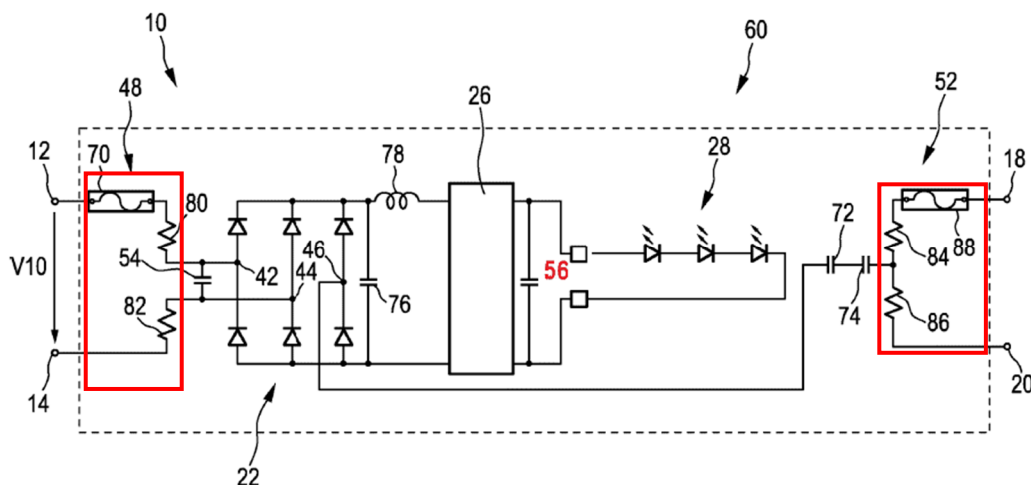
This is because these components form a circuit in light apparatus 60 that connects lighting unit 28 to an external power supply and provides power from that external power supply to the lighting unit. *See* Tao, [0009] (disclosing “a connection circuit

... for connecting a driver device to an external power supply for driving ... an LED unit comprising one or more LEDs”)

120. “Light apparatus 60” is also an LED lamp because it includes “lighting unit 28” having “one or more LEDs.” See Tao, (“Various LEDs [sic] tubes (TLED) are used to replace fluorescent (TL) lamps as a retrofit lamp.”). Because the power source module is part of that LED lamp, the power source module is “for an LED lamp.”

(b) *Limitation 1[a] - a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, each of the first bi-pin terminal and the second bi-pin terminal configured to allow a current to flow from one pin to the other pin via the filament-simulating circuit during a pre-heat process executed by a ballast*

121. The power source module of Tao’s light apparatus 60 satisfies this limitation. As illustrated below in the red rectangles, input circuitry 48 and 52 together are a filament-simulating circuit.



Tao, FIG. 4. “The input circuitry 48 comprises the fuse 70 and two resistors 80, 82.” Tao, [0052]. And “[t]he input circuitry 52 comprises two resistors 84, 86 and a fuse 88....” Tao, [0053]. Tao discloses that “the input circuitry comprises a plurality of resistors,” and “[b]y means of the resistors, the filament resistance of the lamp to be replaced by the connection circuit can be emulated.” Tao, [0020]; *see also* Tao, [0052] (“The resistors 80, 82 of the input circuitry 48 have a resistance value similar to the filament resistance of the fluorescent lamp....”), [0053] (“The resistance values of the resistors 84, 86 are similar to the filament resistance of the fluorescent lamp....”).

122. Tao disclose that input circuitry 48 and 52 are electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, respectively. A POSITA would have recognized that first input terminals 12 and 14 are a first bi-pin terminal and second input terminals 18 and 20 are a second bi-pin terminal. Tao teaches that “[t]he light apparatus 60 can replace a fluorescent lamp as a retrofit lamp, wherein the input terminals 12, 14, 18, 20 can be flexibly connected to either mains 16 or a high frequency ballast so that a rewiring of the fluorescent lamp can be omitted.” Tao, [0041]. A POSITA would have understood that fluorescent lamps comprise bi-pin terminals, *see* Section VI.A above, and Tao’s retrofit light apparatus 60 likewise includes bi-pin terminals. A POSITA would have therefore further recognized that Tao’s input terminals 12, 14,

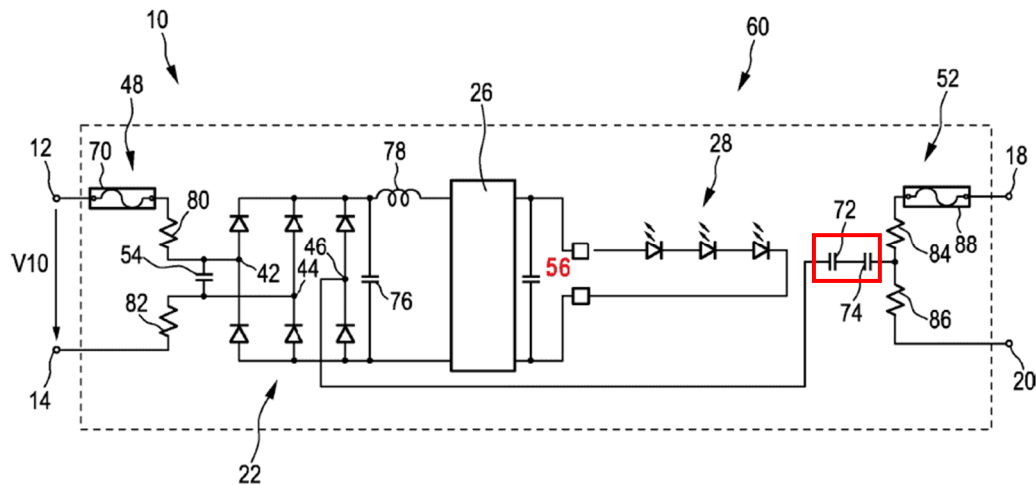
18, and 20 are pins. *See* Tao, [0017] (explaining that “the low mains frequency can be blocked for *pin safety*”). And as illustrated above, the input circuitry 48 is electrically connected to input terminals 12 and 14, and input circuitry 52 is electrically connected to input terminals 18 and 20. *See* Tao, [0037] (“The first input terminals 12, 14 are connected via an input circuitry 48 to the rectifier unit 22....”), [0038] (“The second input terminals 18, 20 are connected via an input circuitry 52 to the filter capacitor 50....”).

123. A POSITA would have recognized that current flows between input terminals 12 and 14 and between input terminals 18 and 20 via input circuitry 48 and 52 during a pre-heat process executed by a ballast. Tao teaches that “program start ballasts preheat the filament before ignit[ing] the lamp” by “provid[ing] a heating current.” Tao, [0002], [0045]; *see* WO 2014/115010, 5:29-34 (“During the preheat phase the fluorescent tube lighting fixture is arranged to, at each of the two ends of a fluorescent tube, apply a current between a first pair of contact pins at a first end of the fluorescent tube and between a second pair of contact pins at a second end of the fluorescent tube. The current is applied in order to heat a corresponding filament connected between said first and second pair of contact pins, respectively, so that electrons are emitted.”). And a POSITA would have further understood that the sole path from input terminal 12 to input terminal 14 in

light apparatus 60 is through input circuitry 48. The same is true for input circuitry 52 coupled to input terminals 18 and 20.

(c) ***Limitation 1[b] - a current limiting circuit electrically connected to the filament-simulating circuit and configured to limit a current from the filament-simulating circuit***

124. The power source module of Tao's light apparatus 60 satisfies this limitation. As illustrated below in the red rectangle, filter capacitors 72 and 74 are a current limiting circuit.



Tao, FIG. 4.

125. As illustrated in the figure above, filter capacitors 72 and 74 are directly connected to input circuitry 52, and thus to the filament-simulating circuit. See Tao, [0053] (“The input circuitry 52 comprises two resistors 84, 86 and a fuse 88 for connecting the second input terminals 18, 20 to each other and to the filter capacitors 72, 74.”), FIG. 4. And as illustrated above, filter capacitors 72 and 74 are electrically connected to input circuitry 48, and thus to the filament-simulating

circuit, though input capacitor 54, rectifier unit 22, capacitor 76, inductance 78, driver stage 26, and filter capacitor 56. *See* Tao, FIG. 4.

126. Patent Owner’s infringement contentions appear to apply a broad read of “electrically connected” for this claim limitation. For Limitation 1[a], Patent Owner points to two separate circuits as “a filament simulating circuit electrically connected to a first and second bi-pin terminal”:

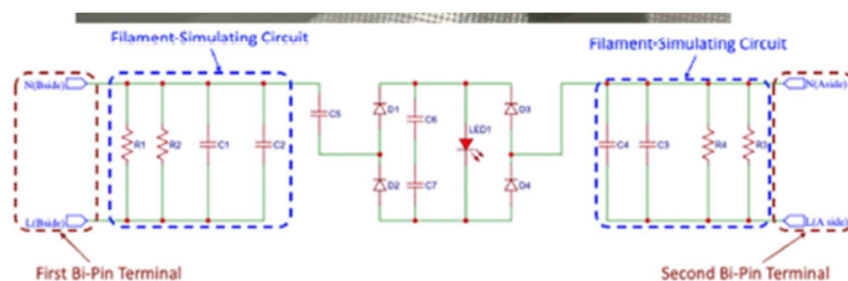


Figure 4. Photo (Top) and circuit schematic (Bottom) for the GE LED14ET8/G/4/840 showing a filament simulating circuit electrically connected to a first and second bi-pin terminal.

Infringement Contentions, 5. And Patent Owner alleges that C5 is the “current limiting circuit”:

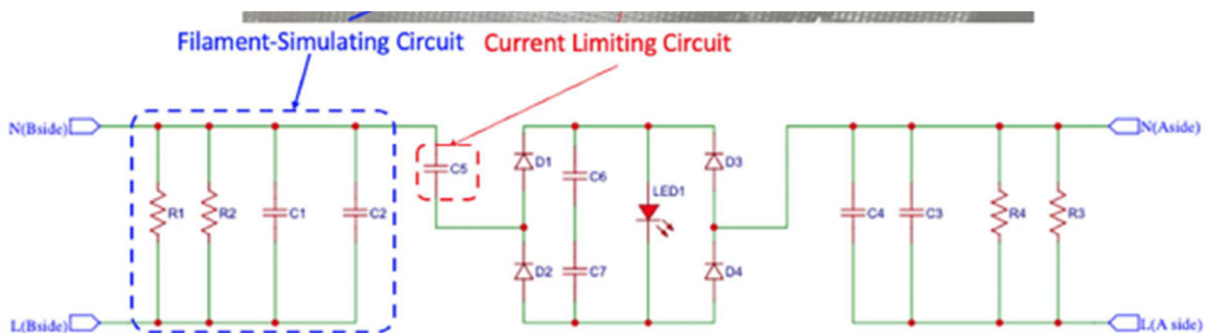


Figure 8. Photo (Top) and circuit schematic (Bottom) for GE LED14ET8/G/4/840 showing a current limiting circuit.

Infringement Contentions, 9. In order for capacitor C5 to be “electrically connected” to the second half of the alleged filament-simulating circuit (C3, C4,

R3, and R4), Patent Owner must contend that a connection through intervening diodes D1-D4, capacitors C6 and C7, and LED1 is “electrically connected.” To the extent that PO’s contention is correct, Tao similarly teaches that filter capacitors 72 and 74 are electrically connected to input circuitry 48.

127. Filter capacitors 72 and 74 are a current limiting circuit for limiting a current from input circuitry 52 generated by connected ballast 62 or 68. *See* Tao, FIGS. 2b and 2c. Tao explains that filter capacitor 50, shown in the embodiment below, “has a capacity of 0.5 n[F] -10 nF and serves as a high pass filter. The filter capacitor 50 has a low impedance for high frequency voltages typically >25 kHz provided by the second external power supply 21....” Tao, [0037].

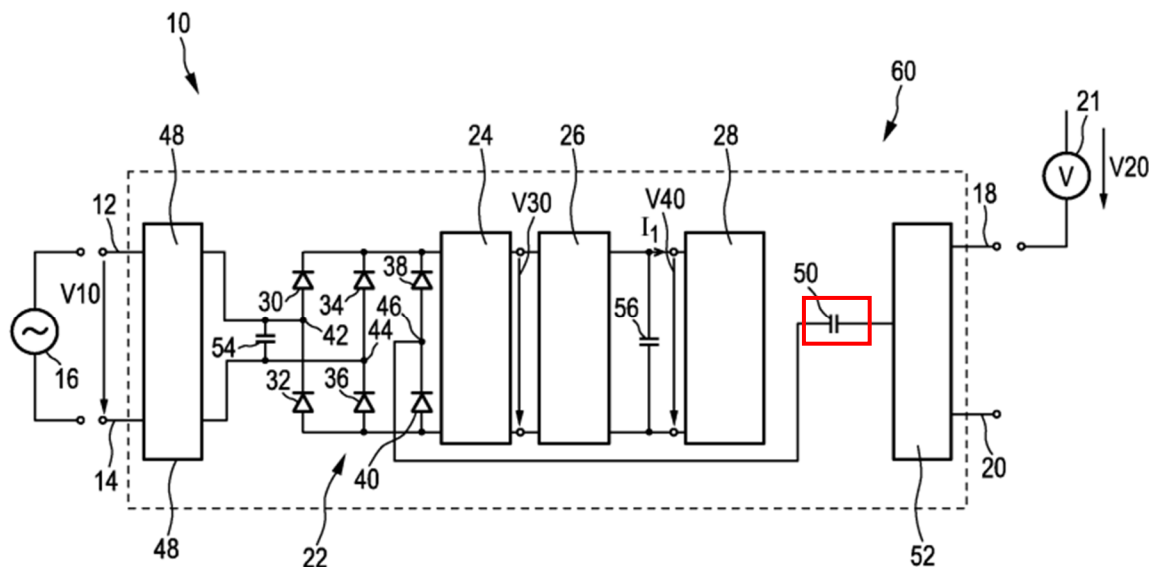


FIG. 1

Tao, FIG. 1.

128. A POSITA would have recognized that the filter capacitors 72 and 74 provide the same function as filter capacitor 50 in Figure 1. *See* Tao, [0048] (explaining that filter capacitors 72, 74 “protect the second input terminal from mains voltage V10 as mentioned above” and “are connected in series to each other in order to provide an improved safety if one of the two filter capacitors 72, 74 fails.”). Tao does not disclose the capacitance values of filter capacitors 72 and 74. A POSITA would have been motivated by the disclosure of filter capacitor 50 to select the same total capacitance of filter capacitors 72 and 74: 0.5 nF -10 nF. *See* Tao, [0037].

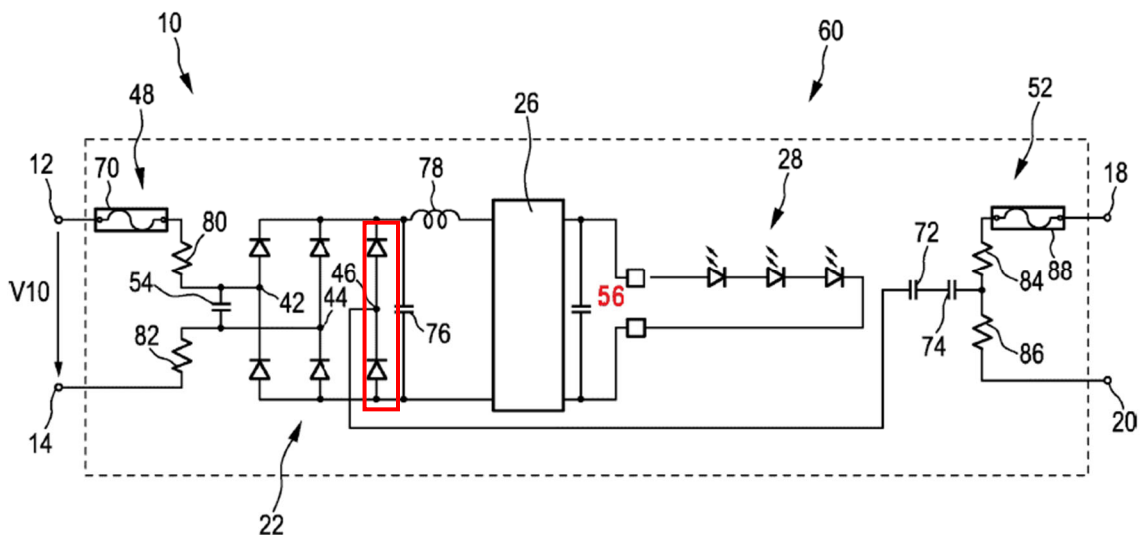
129. A POSITA would have understood that the formula for a capacitor’s impedance is $Z = 1/(2\pi fC)$, where Z is the impedance, f is frequency, and C is the capacitance. U.S. Patent Pub. No. 2014/0084701, [0242]. Assuming a high frequency ballast input signal of 45 kHz, Tao’s filter capacitors 72 and 74 provide an impedance in the range of 354 Ω to 7,074 Ω , which overlaps the calculated 442 Ω to 14,737 Ω range of the ’662 Patent’s current limiting circuit 32. *See* Section VIII.B above. A POSITA would have recognized that filter capacitors 72’s and 74’s impedance would limit the current from input circuitry 52 generated by a connected ballast.

130. Second, filter capacitors 72 and 74 are a current limiting circuit for limiting a current from input circuitry 48 generated by connected mains 16, as

described above. *See* Tao, [0017] (disclosing that “the low mains frequency can be blocked for pin safety”), [0037] (describing the filter capacitor’s purpose is “so that the leakage current from mains and the risk of electrical shocks at the second input terminals is reduced”).

(d) *Limitation 1[c] - a first rectifier electrically connected to the current limiting circuit and configured to rectify the current from the current limiting circuit*

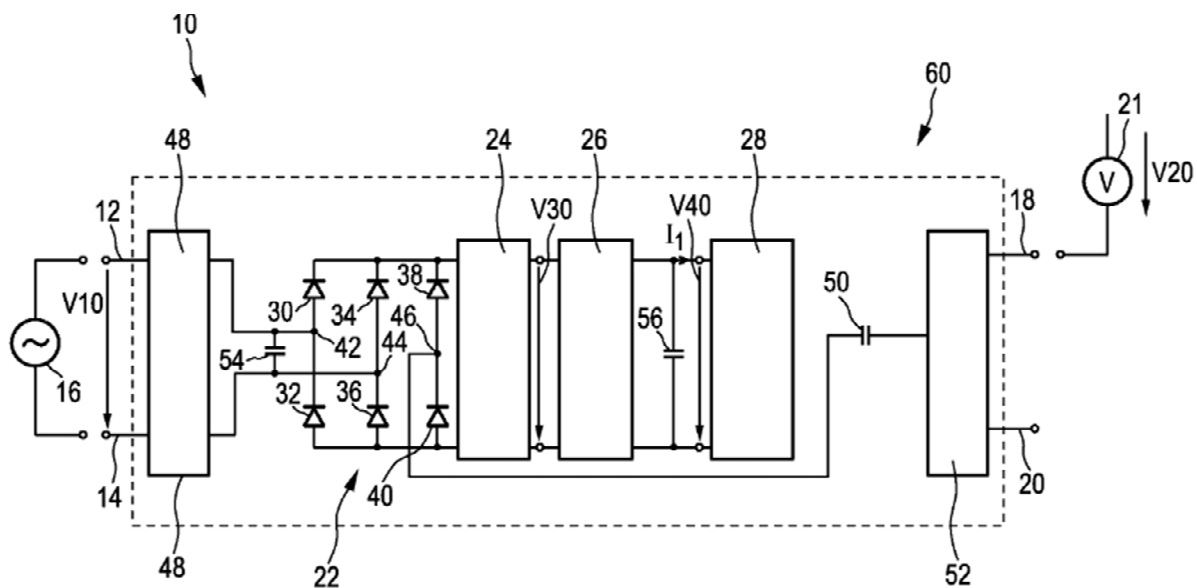
131. The power source module of Tao’s light apparatus 60 satisfies this limitation. As illustrated below in the red rectangle, the power source module includes what Tao calls a third rectifier path (diodes 38 and 40), which a POSITA would have recognized is a rectifier, i.e., the “first rectifier.”



Tao, FIG. 4. As illustrated, this first rectifier is electrically connected to filter capacitors 72 and 74, i.e., the “current limiting circuit” (*see* Limitation 1[b] above)). and is thus configured to rectify current from that current limiting circuit. Tao,

[0053] (“The second input terminals 18, 20 are connected via the input circuitry 52 and via the filter capacitors 72, 74 to the node 46.”).

132. Tao explains the third rectifier path in more detail with respect to Figure 1’s circuit, shown below, and that description is applicable to Figure 4’s circuit, because Figure 4’s circuit is merely an implementation of Figure 1’s circuit. See Tao, [0033] (“FIG. 4 shows a further embodiment *of the connection circuitry shown in FIG. 1*” (emphasis added)). Tao states that the circuits of Figures 1 and 4 are the same regarding rectifying circuit 22. Tao, [0051]-[0054] (describing only “differences” between the circuits of Figures 1 and 4, none of which relate to rectifying circuit 22).

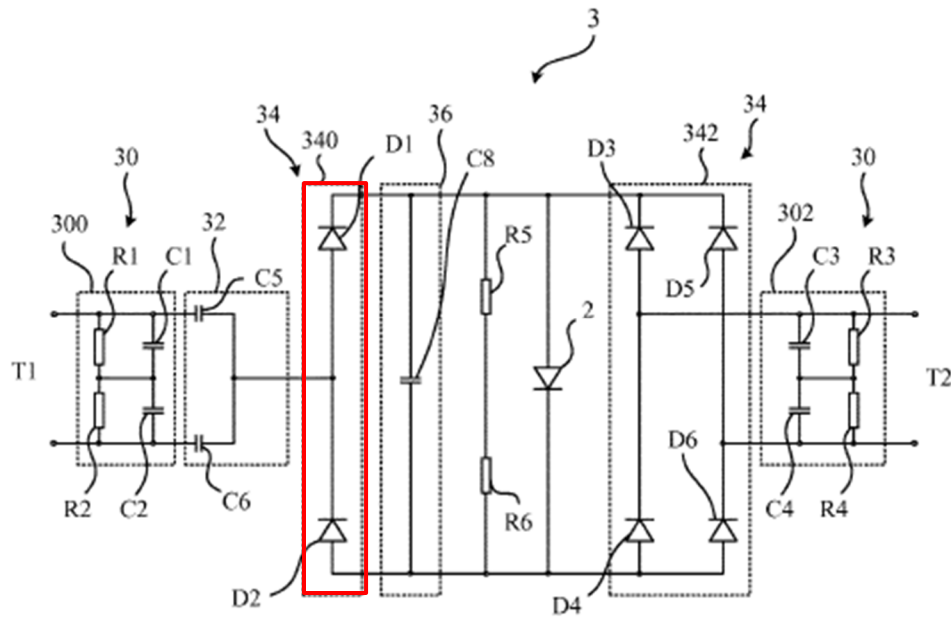


133. Tao explains that “[t]he rectifier unit 22 is a complex rectifier comprising three parallel rectifying paths,” and “the second input terminals 18, 20

are connected to a third of the rectifying path.” Tao discloses that “two of the rectifying paths *each* form a rectifier depending on which of the input terminals ... are connected to an external power supply” (Tao, [0036] (emphasis added)), which means that each of the rectifying paths serves as a rectifier.

134. This is also consistent with a POSITA’s understanding. In the usage cases seen in FIGS. 2b and 2c of Tao, for example, first input terminals 12 and 14 and second terminals 18 and 20 are connected to the outputs of ballast 62 (FIG. 2b) or ballast 68 (FIG. 2c). When powered by a ballast 62 or 68, when input terminals 18 and 20 were at a higher potential than input terminals 12 and 14, diode 38 and diodes 32 and 36 would turn on to *rectify* the AC signal output by the ballast. In the converse situation, that is when input terminals 18 and 20 were at a lower voltage than input terminals 12 and 14, the diode 40 and diodes 30 and 34 would turn on to rectify the AC signal output by the ballast. This third rectifying path consisting of diodes 38 and 40 is therefore a rectifier when a ballast is connected (usage cases in FIGs. 2b and 2c) and there is a connection to input terminals 18 and 20, e.g., embodiments in FIGS. 2b and 2c.

135. The ’662 Patent refers to element 340, which has the same components and structure as Tao’s third rectifying path, as a “first rectifier.” ’662 Patent, 5:16-20.



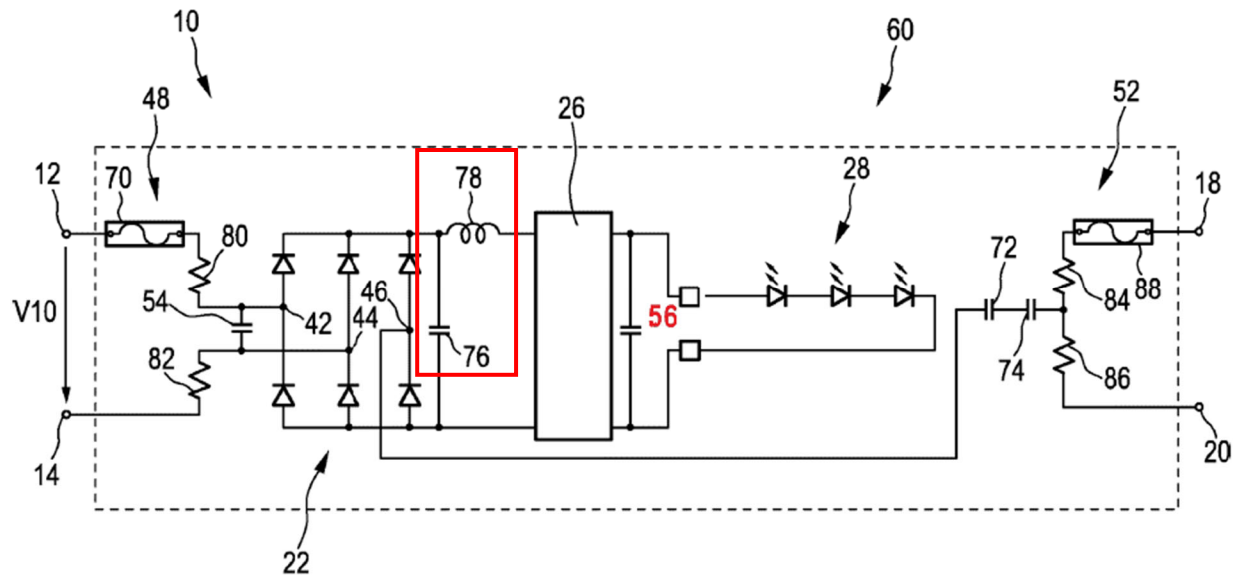
'662 Patent, FIG. 2.

- (e) *Limitation 1[d] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp and configured to smooth the current from the first rectifier*

136. The power source module of Tao's light apparatus 60 satisfies this limitation.

First Alternative

137. As illustrated below in the red rectangle, capacitor 76 and inductance 78 are a filter.

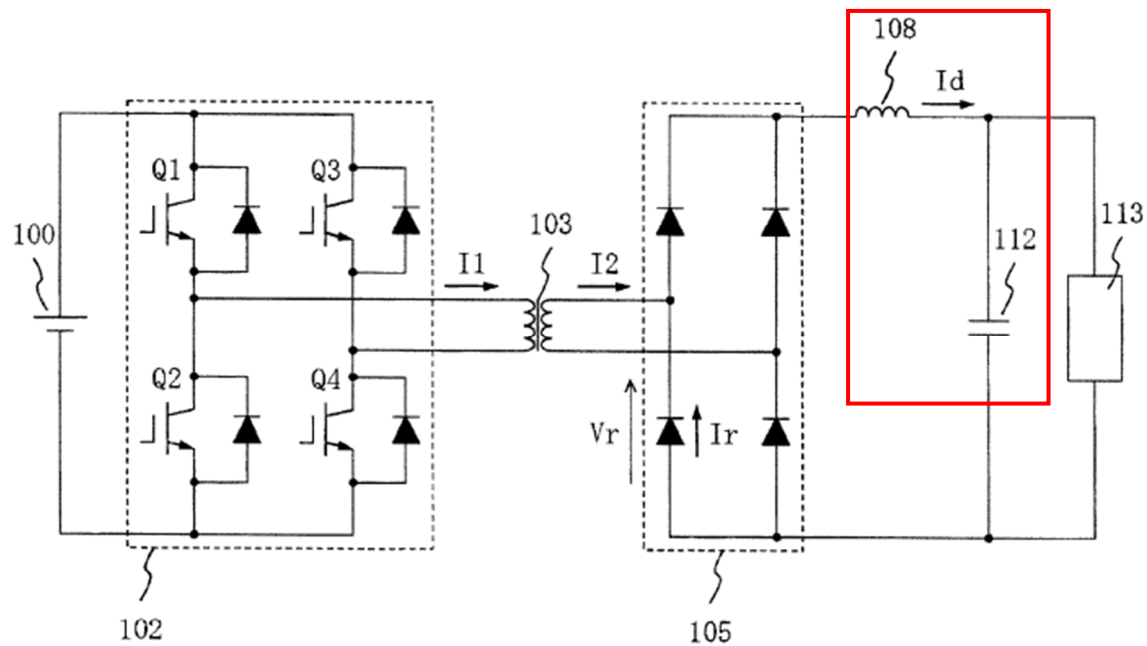


Tao, FIG. 4.

138. Tao discloses that capacitor 76 and inductance 78 are electrically connected between the third rectifier path, i.e., the “first rectifier” (*see* Limitation 1[c] above), and lighting unit 28, which includes at least one LED (*See* Tao, [0041] (disclosing “a lighting unit 28 comprising more preferred [sic] one or more LEDs.”)). In particular, as illustrated above, capacitor 76 and inductance 78 are directly connected to the third rectifying path. And capacitor 76 and inductance 78 are electrically connected to lighting unit 28 through driver stage 26 and filter capacitor 56. *See* Tao, FIG. 4.

139. A POSITA would have recognized that capacitor 76 and inductance 78 are a filter that smooths the current from the third rectifier path. The figure below illustrates a “a filter reactor 108 and filter capacitor 112 for smoothing the DC power outputted from the rectifier circuit 105.” U.S. Patent App. Pub. No.

2012/0300501, [0006].



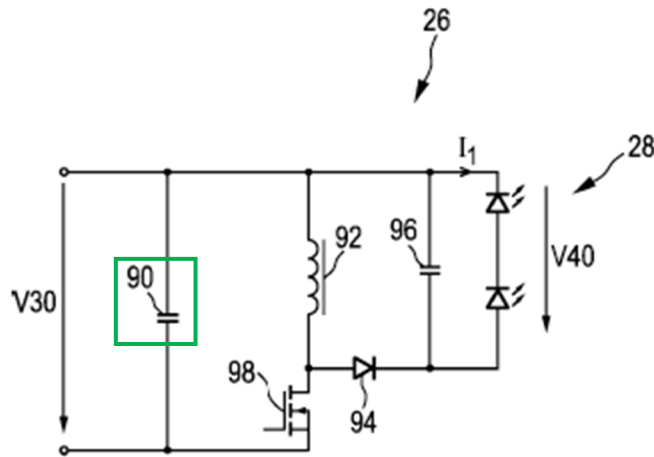
U.S. Patent App. Pub. No. 2012/0300501, FIG. 8. Like filter reactor [inductor] 108 and filter capacitor 112 illustrated above, Tao's capacitor 76 is connected in parallel to the output of a rectifier, and Tao's inductance 78 is connected in series to the output of a rectifier; as such, capacitor 76 and inductance 78 filter and smooth the third rectifier's output.

140. In any event, it would have been obvious to a POSITA to configure capacitor 76 and inductance 78 as a filter to smooth the current from the third rectifier path. That is because doing so would have addressed the known need to filter and smooth the current supplied to a DC-DC converter, such as driver stage 26. A POSITA would have understood that a buck-boost DC-DC converter converts a DC input signal at some voltage (V_s) into a DC output signal (V_o) at

some different voltage according to the following formula: $V_o = -D * V_s / (1 - D)$, (U.S. Patent No. 8,247,999, 6:8-27), where D is the duty cycle of the driver stage 26's controllable switch 98. Tao, [0055]. A POSITA would have understood, based on the formula, that variations in V_s would have necessarily resulted in variations in V_o , which would vary the voltage applied to the LEDs and would generate unwanted flicker. The capacitor 76 and inductance 78 are used to filter out variations in the output of the rectifier to provide a DC (ideally constant) input signal to the DC-DC converter. See U.S. Patent App. Pub. No. 2012/0147564, [0044] ("Between the DC source and the DC/DC converter 62 is a capacitor 64, used to filter the input current switching ripple of the DC/DC converter 62.").

Second Alternative

141. As illustrated below in the green rectangle, input capacitor 90 is a filter.



Tao, FIG. 5. “FIG. 5 shows a preferred embodiment of the driver stage 26,” which is depicted in FIG. 4. Tao, [0055]. “The driver stage 26 comprises an input capacitor 90,” (Tao, [0055]), which is not a component of the buck-boost converter, comprising “an inductance 92, a diode 94, an output capacitor 96 and a controllable switch 98,” (Tao, [0055]).

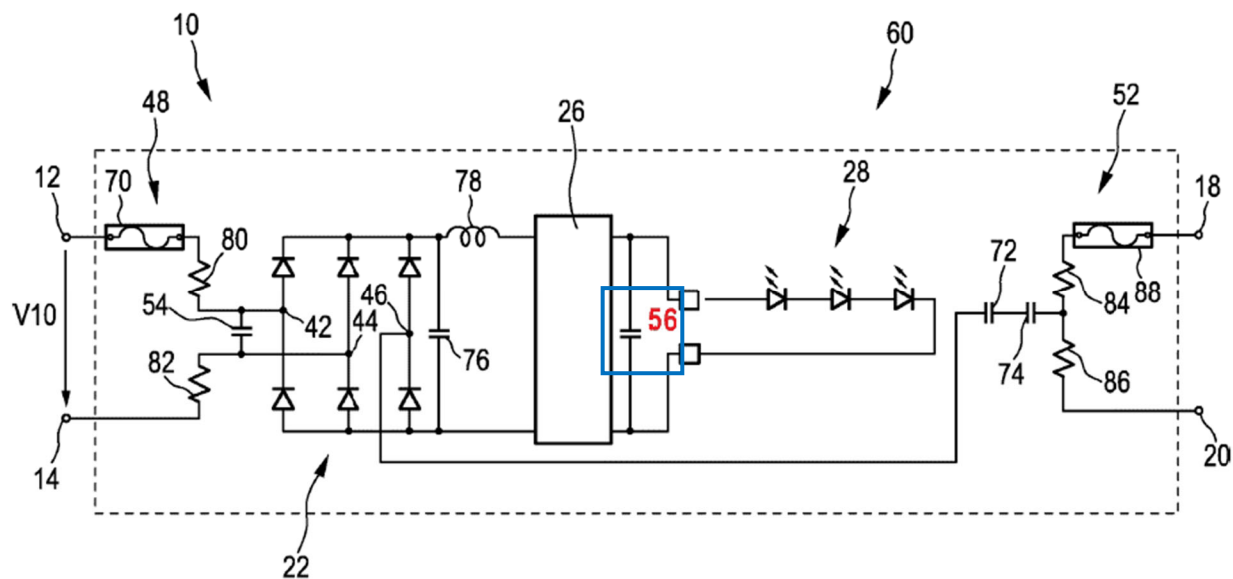
142. Tao explains that input capacitor 90 is electrically connected between the third rectifier path, i.e., the “first rectifier” (*see* Limitation 1[c])—and lighting unit 28, which includes at least one LED (*see* Tao, [0041]). In particular, input capacitor 90 is electrically connected to the third rectifying path through capacitor 76 and inductance 78. Tao, FIGS. 4 & 5. And input capacitor 90 is electrically connected to lighting unit 28 through an inductance 92, a diode 94, an output capacitor 96, a controllable switch 98, and filter capacitor 56. Tao, FIGS. 4 & 5. .

143. A POSITA would have recognized that input capacitor 90 is a filter that is configured to smooth the current from the third rectifier path. See U.S. Patent No. 6,703,795, 4:66-5:2 (claiming “a *filter* capacitor connected in parallel with the diode bridge and configured to *remove ripple voltages* from the unfiltered direct current voltage to produce a steady direct current voltage”). Tao’s input capacitor 90 is connected in parallel to the output of a rectifier and is thus configured to filter and smooth the rectifier’s output.

144. And in any event, it would have been obvious to configure input capacitor 90 as a filter for smoothing the current from the third rectifier path. See First Alternative above.

Third Alternative

145. As illustrated below in the blue rectangle, filter capacitor 56 is a filter.



Tao, FIG. 4.

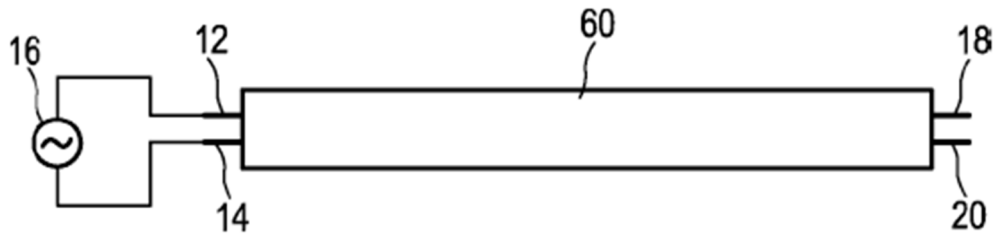
146. Tao discloses that filter capacitor 56 is electrically connected between the third rectifier path, i.e., the “first rectifier” (see Limitation 1[c] above), and lighting unit 28, which includes at least one LED (See Tao, [0041] (disclosing “a lighting unit 28 comprising more preferred [sic] one or more LEDs.”). In particular, as illustrated above, filter capacitor 56 is electrically connected to the third rectifying path through capacitor 76, inductance 78, and driver stage 26. And filter capacitor 56 is directly connected to lighting unit 28 . See Tao, FIG. 4.

147. A POSITA would have recognized that capacitor 56 is a filter that smooths the current from the third rectifier path. Tao explains that filter capacitor 56 “filter[s] the output voltage V40 and [] reduce[s] a ripple of the load current I_1 .” Tao, [0040]. A POSITA would have recognized that load current I_1 comes from the first rectifier, i.e., the third rectifier path.

(f) Claim 9 - [The power source module of claim 1,] wherein the power source module is configured inside a casing of the LED lamp

148. The power source module of Tao’s light apparatus 60 satisfies this limitation. See Limitation 1[p] above.

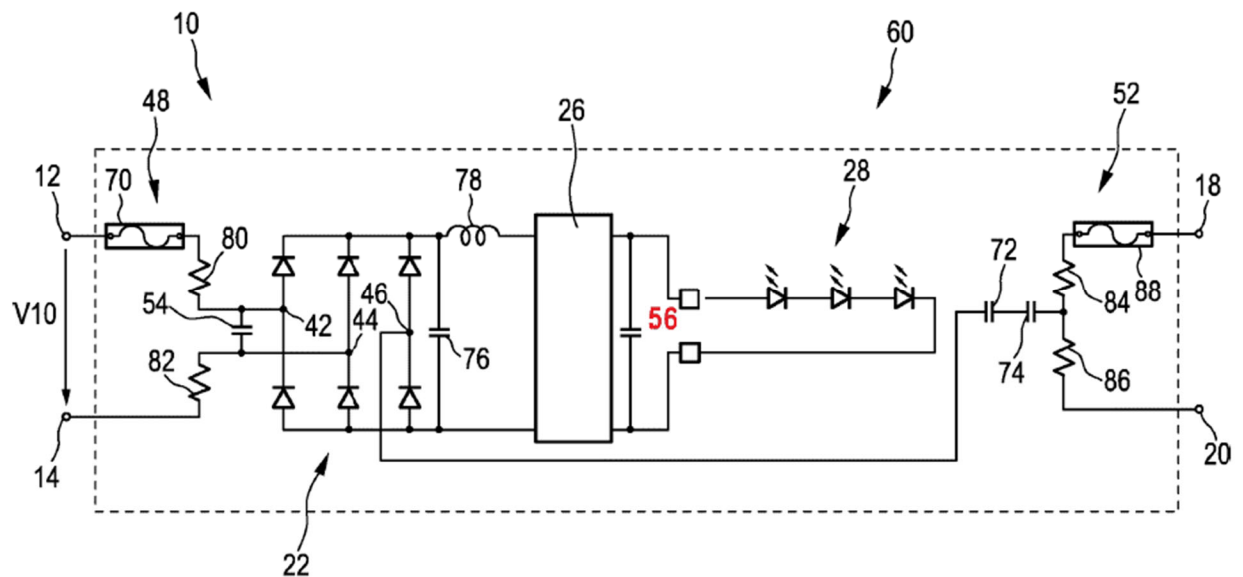
149. Light apparatus 60 is an LED tube lamp. See Tao, (“Various LEDs [sic] tubes (TLED) are used to replace fluorescent (TL) lamps as a retrofit lamp.”).



Tao, FIG. 2a. A POSITA would have recognized that an LED tube is a casing.

See U.S. Patent App. Pub. No. 2010/0265732, Abstract (“A light tube with an LED light source includes a casing” and “an LED circuit board inside the casing”).

Tao’s input circuitry 48 and 52, input capacitor 54, filter capacitors 72 and 74, rectifier unit 22, capacitor 76, inductance 78, driver stage 26, and filter capacitor 56, which together comprise the power source module, are included within light apparatus 60, and thus inside its tube, as shown below. Tao, [0035], [0037]-[0040], [0048], [0049].



Tao, FIG. 4.

150. In any event, it would have been obvious for a POSITA to place Tao's power source module inside of Tao's tube. Tao's tube would help protect the power source module from damage and the environment and prevent accidental contact of the power source module by a human installer.

**(g) Claim 15 - [The power source module of claim 1,]
wherein the filter comprises a filtering capacitor
electrically connected to the at least one LED**

First Alternative

151. Tao's power source module includes capacitor 76, which is electrically connected to at least one of Tao's LEDs and is or obviously would have been configured as a filtering capacitor. *See* Limitation 1[d] above.

Second Alternative

152. Tao's power source module includes input capacitor 90, which is electrically connected to at least one of Tao's LEDs and is or obviously would have been configured as a filtering capacitor. *See* Limitation 1[d] above.

Third Alternative

153. Tao's power source module includes filter capacitor 56, which is electrically connected to at least one of Tao's LEDs and is a filtering capacitor. *See* Limitation 1[d] above.

(h) *Limitation 23[p] - An LED lamp, comprising:*

154. To the extent it is limiting, Tao discloses the preamble. A POSITA would have understood that light apparatus 60 is an LED lamp. *See* Tao, [0041] (describing light apparatus 60 as “a retrofit lamp” that includes a “lighting unit” comprising “one or more LEDs”). A POSITA would have also understood that light apparatus 60 includes input circuitry 48 and 52, input capacitor 54, filter capacitors 72 and 74, rectifier unit 22, capacitor 76, inductance 78, driver stage 26, and filter capacitor 56. *See* Limitation 1[p] and Claim 9 above.

(i) *Limitation 23[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal*

155. The LED lamp of Tao’s light apparatus 60 satisfies this limitation.
See Limitation 1[b] above.

(j) *Limitation 23[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit*

156. The LED lamp of Tao’s light apparatus 60 satisfies this limitation.
See Limitation 1[c] above.

(k) *Limitation 23[c] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier*

157. The LED lamp of Tao’s light apparatus 60 satisfies this limitation.
See Limitation 1[d] above.

- (l) *Limitation 23[d] - a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals having a current flowing from one pin to the other pin of the respective bi-pin terminal via the filament-simulating circuit during a pre-heat process executed by a ballast*

158. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

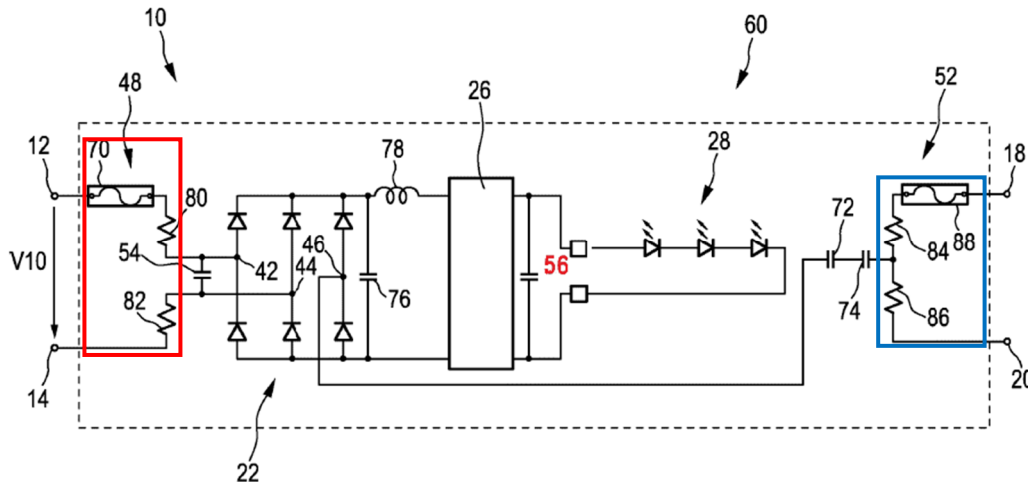
See Limitation 1[a] above.

- (m) *Claim 31 - [The power source module of claim 1, wherein the current limiting circuit comprises at least a capacitor*

159. The power source module of Tao's light apparatus 60 satisfies this limitation. The power source module's current limiting circuit, i.e., filter capacitors 72 and 74, are capacitors. See Limitation 1[b] above.

- (n) *Limitation 32[a] - [The power source module of claim 1, wherein:] wherein the filament-simulating circuit comprises a first filament-simulating circuit connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit connected between two pins of the second bi-pin terminal*

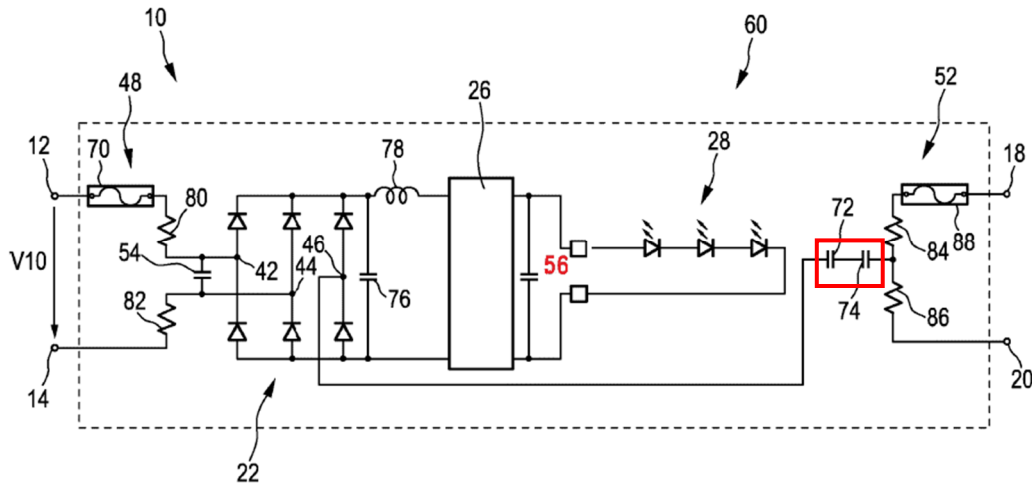
160. The power source module of Tao's light apparatus 60 satisfies this limitation. As illustrated below in the blue rectangle, input circuitry 52 is a first filament-simulating circuit electrically connected between input terminals 18 and 20. And as illustrated below in the red rectangle, input circuitry 48 is a second filament-simulating circuit electrically connected between input terminals 12 and 14.



Tao, FIG. 4; *see* Limitation 1[a] above (explaining that Tao's input terminals 12 and 14 and input terminals 18 and 20 are each a bi-pin terminal)..

- (o) ***Limitation 32[b] - the current limiting circuit comprises at least a capacitor connected to the first filament-simulating circuit, and at least a capacitor connected to the second filament-simulating circuit***

161. The power source module of Tao's light apparatus 60 satisfies this limitation. Filter capacitors 72 and 74, i.e., the current limiting circuit, are capacitors. *See* Claim 31 above. As illustrated below, capacitor 74 is directly connected to input circuit 52, i.e., the first filament-simulating circuit (*see* Limitation 32[a] above), and capacitor 72 is electrically connected to input circuit 48, i.e., the second filament-simulating circuit, through rectifier unit 22.



Tao, FIG. 4.

- (p) *Limitation 33[a] – [The power source module of claim 1, wherein:] the LED lamp comprises an LED module comprising the at least one LED*

162. Tao’s light apparatus 60 satisfies this limitation. See Limitation 1[p] above. Tao teaches that light apparatus 60 includes a “lighting unit 28,” which is a lighting module and comprises “one or more LEDs.” Tao, [0041].

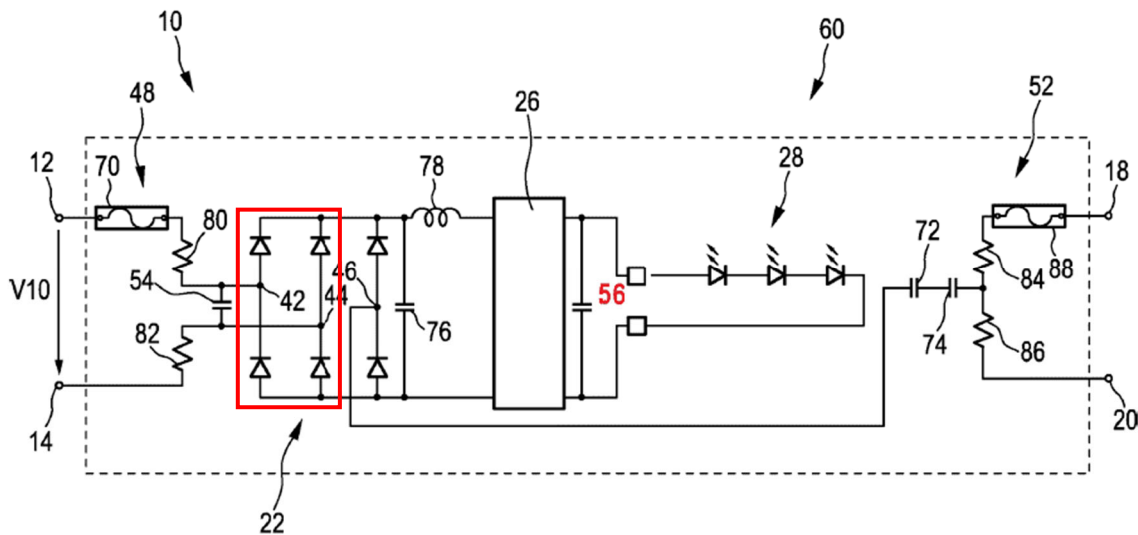
- (q) *Limitation 33[b] - the filament-simulating circuit comprises a first filament-simulating circuit comprising an impedance element electrically connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit comprising an impedance element electrically connected between two pins of the second bi-pin terminal*

163. The power source module of Tao’s light apparatus 60 satisfies this limitation. See Limitation 32[a] above. Each portion of Tao’s filament-simulating circuit includes two resistors connected between the pins of their respective bi-pin terminals: resistors 80 and 82 for the second filament-simulating circuit, and

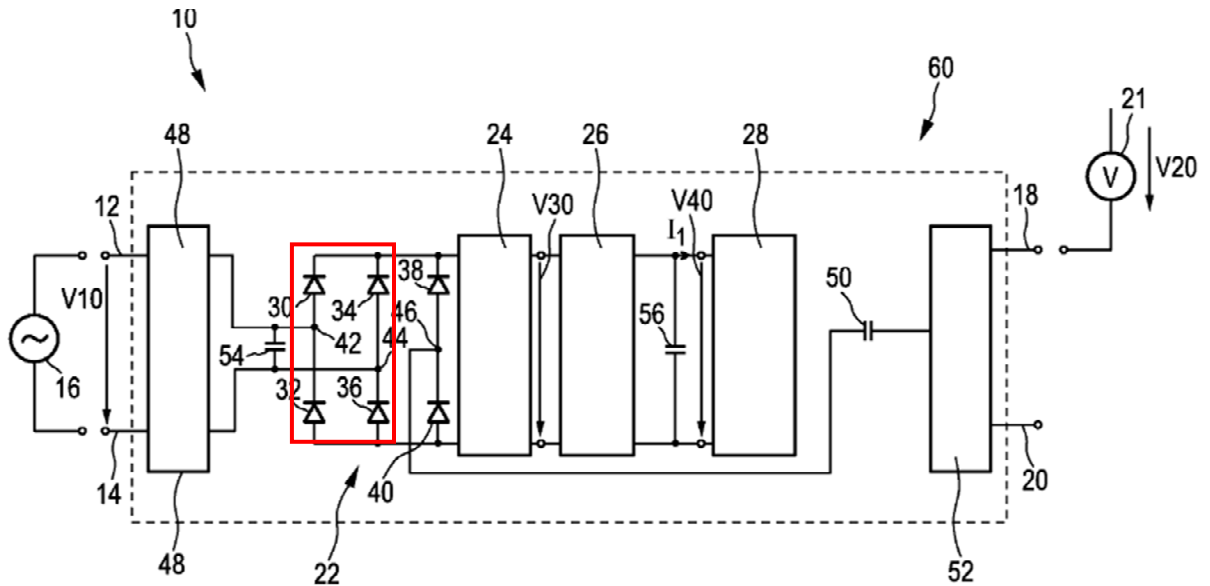
resistors 84 and 86 for the first filament-simulating circuit. A POSITA would have recognized that each of resistors 80, 82, 84, and 86 is an impedance element. See U.S. Patent No. 9,148,922, 15:40-42 (referring to “resistive impedance (resistor 202)”).

- (r) *Limitation 33[c] - the power source module further comprises a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel*

164. The power source module of Tao’s light apparatus 60 satisfies this limitation. As illustrated below in the red rectangle, the first and second rectifying paths (diodes 30, 32, 34, and 36 (Tao, FIG. 1)) are a second rectifier.



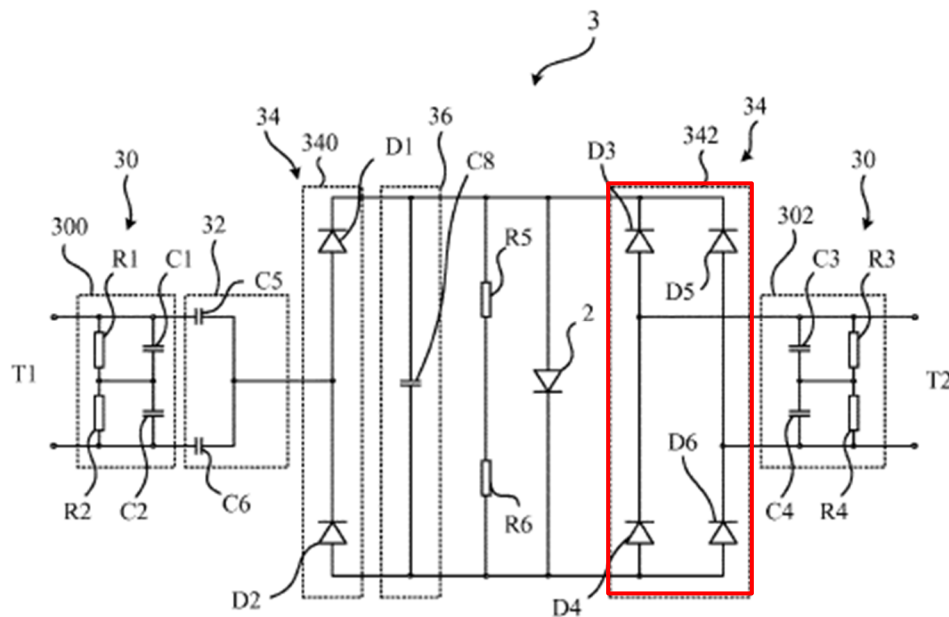
Tao, FIG. 4.



Tao, FIG. 1.

165. A POSITA would have recognized that the first and second rectifying paths are a full-bridge rectifier. When powered by a ballast 62 or 68, in the situation when input terminals 18 and 20 are at a higher potential than input terminals 12 and 14, diode 38 and diodes 32 and 36 turn on to rectify the AC signal output by the ballast. In the converse situation, that is when input terminals 18 and 20 are at a lower voltage than input terminals 12 and 14, the diode 40 and diodes 39 and 34 turn on, again, rectifying the AC signal output by the ballast. These first and second rectifying paths consisting of diodes 30, 32, 34, and 36 are used when a ballast is used and there is a connection to input terminals 18 and 20, e.g., usages in FIGS. 2b and 2c. In addition, when powered by directly by mains voltage 16, in the situation when input terminal 12 is at a higher potential than input terminal 14,

diodes 30 and 36 turn on to rectify the mains AC signal. In the converse situation, that is when input terminal 12 is at a lower voltage than input terminals 14, the diodes 32 and 34 turn on, again, rectifying the mains AC signal.



167. First and second rectifying paths are coupled between input circuitry 48, i.e., the “second filament simulating circuit (see Limitation 32[a]) and lighting unit 28, i.e., the “LED module,” as illustrated above in Tao’s Figure 4. And each of those couplings is a parallel electrical connection. As to the second filament simulating circuit, in the first rectifying path, the anode of diode 30, the cathode of

diode 32, and input terminal 12 are each electrically connected to node 42, and in the second rectifying path, the anode of diode 34, the cathode of diode 36, and input terminal 14 are each electrically connected to node 44. And as to the LED module, the cathodes of diodes 30 and 34 are electrically connected to the lighting unit 28 through inductance 78 and driver stage 26, and the anodes of diodes 32 and 36 are electrically connected to the lighting unit 28 through driver stage 26.

(s) ***Claim 38 - [The LED lamp of claim 23,] wherein the current limiting circuit comprises at least a capacitor***

168. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Claim 31 above.

(t) ***Claim 39 - [The LED lamp of claim 23,] wherein the filament-simulating circuit comprises a first filament-simulating circuit connected between a first pin and a second pin pin [sic] of the first bi-pin terminal, and a second filament-simulating circuit connected between a first pin and a second pin of the second bi-pin terminal***

169. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitation 32[a] above.

- (u) ***Limitation 40[a] – [The LED lamp of claim 23, furthering comprising:] an LED module comprising the at least one LED, wherein the filament-simulating circuit comprises a first filament-simulating circuit comprising an impedance element electrically connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit comprising an impedance element electrically connected between two pins of the second bi-pin terminal***

170. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitations 33[a] and 33[b] above.

- (v) ***Limitation 40[b] - a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel***

171. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitation 33[c] above.

- (w) ***Limitation 41[p] - An LED lamp, comprising***

172. To the extent the preamble is limiting, the LED lamp of Tao's light apparatus 60 satisfies this preamble. See Limitation 23[p] above.

- (x) ***Limitation 41[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal***

173. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitation 1[b] above.

- (y) ***Limitation 41[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit***

174. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitation 1[c] above.

- (z) ***Limitation 41[c] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier***

175. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitation 1[d] above.

- (aa) ***Limitation 41[d] - a first filament-simulating circuit electrically connected to a first bi-pin terminal of the LED lamp and a second filament-simulating circuit electrically connected to a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals arranged to have a current flowing from one pin to the other pin of the respective bi-pin terminal via the respective first or second filament-simulating circuit during a pre-heat process executed by a ballast***

176. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitations 1[a] and 32[a] above.

- (bb) ***Limitation 42[p] - An LED lamp, comprising***

177. To the extent it is limiting, Tao satisfies the preamble. See Limitation 23[p] above.

- (cc) *Limitation 42[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal*

178. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitation 1[b] above.

- (dd) *Limitation 42[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit*

179. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitation 1[c] above.

- (ee) *Limitation 42[c] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier*

180. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitation 1[d] above.

- (ff) *Limitation 42[d] - a first filament-simulating circuit electrically connected to a first bi-pin terminal of the LED lamp, and a second filament-simulating circuit electrically connected to a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals arranged to have a current flowing from one pin to the other pin of the respective bi-pin terminal via the respective first or second filament-simulating circuit after the LED lamp is connected to a ballast and before a normal operation state of the LED lamp*

181. The LED lamp of Tao's light apparatus 60 satisfies this limitation.

See Limitations 1[a] and 32[a] above. A POSITA would have recognized that each of the first input terminals 12, 14 and the second input terminals 18, 20 are

arranged to have a current flowing from one pin to the other pin through input circuitries 48 and 52 after the LED lamp is connected to a ballast and before a normal operation state of the LED lamp. *See* Tao, [0045] (“The programmed start high frequency ballast 68 provides a heating current to preheat the light apparatus 60 *before* ignition of the high voltage....”); Section V.B above.

(gg) *Limitation 43[a] – [The LED lamp of claim 42, further comprising:] an LED module comprising the at least one LED, wherein the first filament-simulating circuit comprises an impedance element electrically connected between two pins of the first bi-pin terminal, and the second filament-simulating circuit comprises an impedance element electrically connected between two pins of the second bi-pin terminal*

182. The LED lamp of Tao’s light apparatus 60 satisfies this limitation.

See Limitations 33[a] and 33[b] above.

(hh) *Limitation 43[b] - a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel*

183. The LED lamp of Tao’s light apparatus 60 satisfies this limitation.

See Limitation 33[c] above.

C. Ground 3 – Tao-Langovsky Renders Obvious Claims 1, 9, 15, 23, 31-33, and 38-43

(a) *Limitation 1[p] - A power source module for an LED lamp, comprising*

184. To the extent it is limiting, Tao-Langovsky renders the preamble obvious. Tao discloses a power source module, which includes input circuitry 48 and 52, input capacitor 54, inrush protection circuits 22, filter capacitors 72 and 74, rectifier unit 22, capacitor 76, inductance 78, driver stage 26, and filter capacitor 56. *See* Ground 2 Limitation 1[p] above.

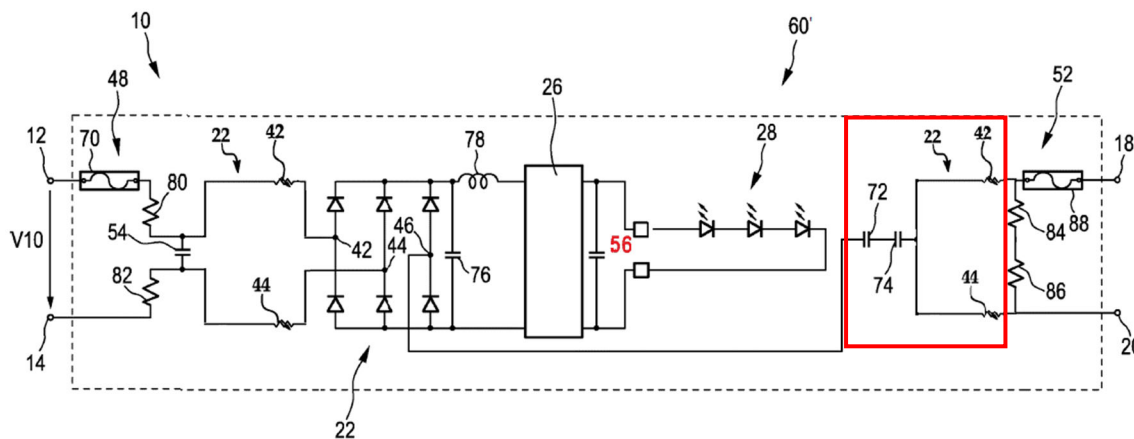
185. Langovsky's inrush protection circuit 22, being obviously positioned between input circuitry 52 and filter capacitor 74 on one side and between rectifier 22 and capacitor 54 on the other side, would have been included in that power module.

(b) *Limitation 1[a] - a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, each of the first bi-pin terminal and the second bi-pin terminal configured to allow a current to flow from one pin to the other pin via the filament-simulating circuit during a pre-heat process executed by a ballast*

186. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. *See* Ground 2 Limitation 1[a] above.

(c) Limitation 1[b] - a current limiting circuit electrically connected to the filament-simulating circuit and configured to limit a current from the filament-simulating circuit

187. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. As illustrated below in the red rectangle, inrush protection circuit 22 plus filter capacitors 72 and 74 together comprise a current limiting circuit.



Tao, FIG. 4; Langovsky, FIG. 2. Inrush protection circuit 22 includes inrush current limiters 42 and 44. Langovsky, 3:51-52. Langovsky states that the inrush current limiters 42 and 44 may comprise “negative temperature coefficient (NTC) resistors.” Langovsky, 3:67 – 4:2.

188. Inrush protection circuit 22 and filter capacitors 72 and 74 are electrically connected to input circuitry 48 through rectifier 22 and capacitor 54. Tao, FIG. 4; Langovsky, FIG. 2. And inrush protection circuit 22 and filter

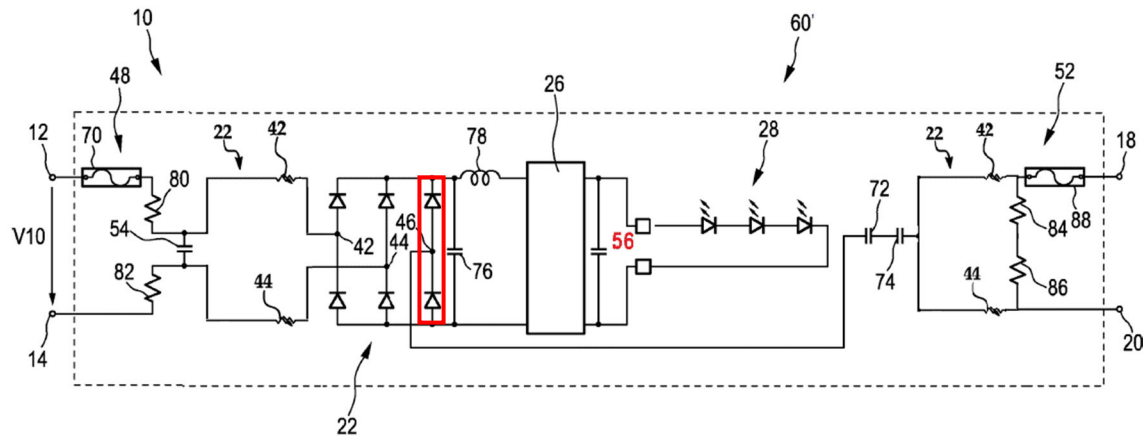
capacitors 72 and 74 are directly connected to input circuitry 52. Tao, FIG. 4; Langovsky, FIG. 2.

189. Inrush protection circuit 22 and filter capacitors 72 and 74 limit the current from input circuitry 52. Regarding inrush protection circuit 22, Langovsky discloses that “[w]hen signal source 14 is initially connected, high inrush current can pass from the output of ballast 16 to components of power converter 18. High inrush currents may be moderated by placing inrush current limiters 42 and 44 in series with the current flow.” Langovsky, 3:63-67; *see also* Langovsky, 4:2-4 (“When signal source 14 is first connected, for example, NTC resistors can be cool and have a high resistance value thereby limiting inrush current.”). And filter capacitors 72 and 74 provide an impedance and thus limit the current from input circuitry 52. See Ground 2 Limitation 1[b] above.

190. Likewise, inrush protection circuit 22 and filter capacitors 72 and 74 limit the current from input circuitry 48. As discussed in the paragraph above, inrush protection circuit 22 provides an impedance and limits inrush current. And filter capacitors 72 and 74 provide an impedance and limit the current from input circuitry 48. See Ground 2 Limitation 1[b] above.

(d) Limitation 1[c] - a first rectifier electrically connected to the current limiting circuit and configured to rectify the current from the current limiting circuit

191. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 1[c] above. As illustrated below in the red rectangle, the power source module includes what Tao calls a third rectifier path (diodes 38 and 40), which a POSITA would have recognized is a rectifier, i.e., the "first rectifier."



Tao, FIG. 4; Langovsky, FIG. 2. As illustrated in the figure above, diodes 38 and 40, i.e., the third rectifying path, are directly connected to the right inrush protection circuit 22 and filter capacitors 72, 74.

(e) Limitation 1[d] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp and configured to smooth the current from the first rectifier

192. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 1[d] above.

(f) Claim 9 - [The power source module of claim 1,] wherein the power source module is configured inside a casing of the LED lamp

193. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Claim 9 above.

(g) Claim 15 - [The power source module of claim 1,] wherein the filter comprises a filtering capacitor electrically connected to the at least one LED

194. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Claim 15 above.

(h) Limitation 23[p] - An LED lamp, comprising

195. To the extent it is limiting, Tao-Langovsky renders the preamble obvious. See Ground 2 Limitation 23[p] above.

(i) Limitation 23[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal

196. The LED lamp of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Limitation 1[b] above.

(j) Limitation 23[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit

197. The LED lamp of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 23[b] above.

- (k) Limitation 23[c] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier**

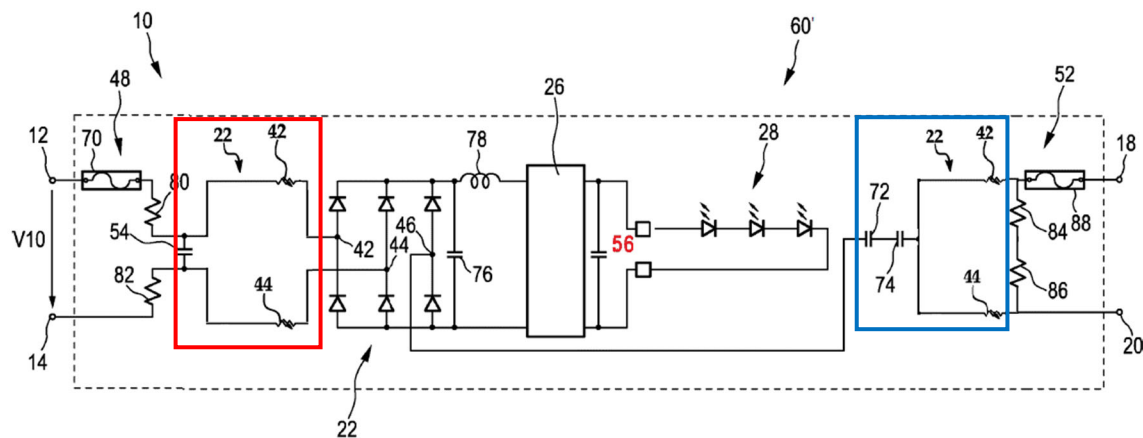
198. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 23[c] above.

- (l) Limitation 23[d] - a filament-simulating circuit electrically connected to a first bi-pin terminal and a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals having a current flowing from one pin to the other pin of the respective bi-pin terminal via the filament-simulating circuit during a pre-heat process executed by a ballast**

199. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 23[d] above.

- (m) Claim 31 - [The power source module of claim 1,] wherein the current limiting circuit comprises at least a capacitor**

200. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. That power source module's current limiting circuit includes a capacitor. As illustrated below in the red rectangle, the current limiting circuit comprises filter capacitors 72 and 74.



Tao, FIG. 4; Langovsky, FIG. 2.

(n) Limitation 32[a] - [The power source module of claim 1, wherein:] wherein the filament-simulating circuit comprises a first filament-simulating circuit connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit connected between two pins of the second bi-pin terminal

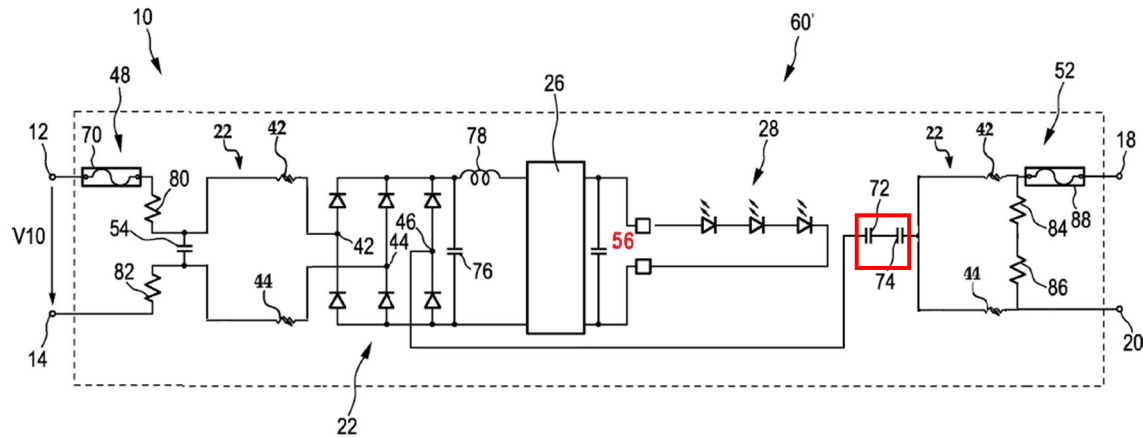
201. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 32[a] above.

(o) Limitation 32[b] - the current limiting circuit comprises at least a capacitor connected to the first filament-simulating circuit, and at least a capacitor connected to the second filament-simulating circuit

202. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. Filter capacitors 72 and 74 are capacitors. See Claim 31 above. As illustrated below in the red rectangle, capacitor 74 is directly connected to input circuit 52, i.e., the first filament-simulating circuit, and capacitor 72 is electrically connected to input circuit 48, i.e., the second filament-

simulating circuit, via rectifier unit 22, inrush protection circuit 22, and capacitor

54. See Ground 2 Limitation 32[b] above.



Tao, FIGS. 4 & 5; Langovsky, FIG. 2.

(p) Limitation 33[a] – [The power source module of claim 1, wherein:] the LED lamp comprises an LED module comprising the at least one LED

203. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 33[a] above.

(q) Limitation 33[b] - the filament-simulating circuit comprises a first filament-simulating circuit comprising an impedance element electrically connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit comprising an impedance element electrically connected between two pins of the second bi-pin terminal

204. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies met this limitation. See Ground 2 Limitation 33[b] above.

(r) Limitation 33[c] - the power source module further comprises a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel

205. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 33[c] above.

(s) Claim 38 - [The LED lamp of claim 23,] wherein the current limiting circuit comprises at least a capacitor

206. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Claim 31 above.

(t) Claim 39 - [The LED lamp of claim 23,] wherein the filament-simulating circuit comprises a first filament-simulating circuit connected between a first pin and a second pin pin [sic] of the first bi-pin terminal, and a second filament-simulating circuit connected between a first pin and a second pin of the second bi-pin terminal

207. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Claim 39 above.

- (u) ***Limitation 40[a] - [The LED lamp of claim 23, furthering comprising:] an LED module comprising the at least one LED, wherein the filament-simulating circuit comprises a first filament-simulating circuit comprising an impedance element electrically connected between two pins of the first bi-pin terminal, and a second filament-simulating circuit comprising an impedance element electrically connected between two pins of the second bi-pin terminal***

208. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 40[a] above.

- (v) ***Limitation 40[b] - a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel***

209. The power source module of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 40[b] above.

- (w) ***Limitation 41[p] - An LED lamp, comprising***

210. To the extent it is limiting, Tao-Langovsky renders the preamble obvious. See Ground 2 Limitation 41[p] above.

- (x) ***Limitation 41[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal***

211. The LED lamp of Tao-Langovsky's modified light apparatus 60' satisfies this limitation. See Limitation 1[b] above.

- (y) ***Limitation 41[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit***

212. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 41[b] above.

- (z) ***Limitation 41[c] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier***

213. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 41[c] above.

- (aa) ***Limitation 41[d] - a first filament-simulating circuit electrically connected to a first bi-pin terminal of the LED lamp and a second filament-simulating circuit electrically connected to a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals arranged to have a current flowing from one pin to the other pin of the respective bi-pin terminal via the respective first or second filament-simulating circuit during a pre-heat process executed by a ballast***

214. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 41[d] above.

- (bb) ***Limitation 42[p] - An LED lamp, comprising***

215. To the extent it is limiting, Tao-Langovsky renders the preamble obvious. See Ground 2 Limitation 42[p] above.

(cc) Limitation 42[a] - a current limiting circuit electrically connected to a first terminal of the LED lamp for limiting a current from the first terminal

216. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Limitation 1[b] above.

(dd) Limitation 42[b] - a first rectifier electrically connected to the current limiting circuit for rectifying the current from the current limiting circuit

217. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 42[b] above.

(ee) Limitation 42[c] - a filter electrically connected between the first rectifier and at least one LED of the LED lamp for smoothing the current from the first rectifier

218. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 42[c] above.

(ff) Limitation 42[d] - a first filament-simulating circuit electrically connected to a first bi-pin terminal of the LED lamp, and a second filament-simulating circuit electrically connected to a second bi-pin terminal of the LED lamp, each of the first and the second bi-pin terminals arranged to have a current flowing from one pin to the other pin of the respective bi-pin terminal via the respective first or second filament-simulating circuit after the LED lamp is connected to a ballast and before a normal operation state of the LED lamp

219. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 42[d] above.

(gg) Limitation 43[a] –[The LED lamp of claim 42, further comprising:] an LED module comprising the at least one LED, wherein the first filament-simulating circuit comprises an impedance element electrically connected between two pins of the first bi-pin terminal, and the second filament-simulating circuit comprises an impedance element electrically connected between two pins of the second bi-pin terminal

220. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 43[a] above.

(hh) Limitation 43[b] - a second rectifier coupled between the second filament-simulating circuit and the LED module, wherein the second rectifier is electrically connected to the second filament-simulating circuit in parallel and is electrically connected to the LED module in parallel

221. The LED lamp of Tao-Langovksy's modified light apparatus 60' satisfies this limitation. See Ground 2 Limitation 43[b] above.

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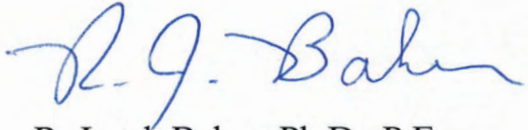
XI. CONCLUSION

222. For the foregoing reasons, it is my opinion that Claims 1, 2, 5-7, 9, 10, 15-18, 21, 23, 24, 29, and 31-43 of the '662 Patent are invalid.

223. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: December 19, 2022

Respectfully submitted,



R. Jacob Baker, Ph.D., P.E.