

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

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

Case IPR2023-00272
Patent 10,830,397

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

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PETITIONER'S EXHIBIT LIST

Exhibit	Shorthand	Description
1001	'397 Patent	U.S. Patent No. 10,830,397
1002	Jing	Chinese Patent No. CN203036295U to Jing Certified Translation
1003	Huang	U.S. Patent No. 9,151,475 to Huang
1004	Lebby	Declaration of Dr. Michael Lebby
1005	Foo	PCT Publication No. WO2013/152485 A1 to Foo
1006	Deng	Chinese Patent No. CN203797412U to Deng Certified Translation
1007	Zhao	U.S. Patent No. 9,970,640 to Zhao
1008	Halliwell	U.S. Patent No. 9,206,970 to Halliwell
1009		Draft Litigation Stipulation
1010		Excerpts of the File History of U.S. Patent No. 10,830,397
1011		CV of Dr. Michael Lebby
1012	Choi	U.S. Patent No. 9,788,321
1013	Guang	U.S. Patent No. 9,338,853
1014	Shimasaki	U.S. Patent No. 8,833,965
1015	Van Der Wel	U.S. Patent No. 9,146,017
1016	Wilcox	U.S. Patent No. 9,726,330
1017	Luk	U.S. Patent No. 6,846,094
1018	Demuynck	U.S. Patent No. 9,328,874
1019	Bisberg	U.S. Patent No. 8,558,255
1020	Nakamura	U.S. Patent No. 6,331,891
1021	Liu	<i>LED Packaging for Lighting Applications – Design, Manufacturing and Testing</i> , Sheng Liu et al., Chemical Industry Press (2011)
1022	Schubert	<i>Light-Emitting Diodes</i> , second edition, E. Fred Schubert, Cambridge University Press (2006)
1023	Scheduling Order	Litigation Scheduling Order

Claim Listing

Claim	Limitation Identifier	Limitation
1	1[p]	An LED tube lamp, comprising:
	1[a]	a glass lamp tube, wherein at least a portion of an inner surface of the glass lamp tube is covered by a rough surface and the roughness of the rough surface is higher than that of the outer surface of the glass lamp tube;
	1[b]	two end caps, each of the two end caps coupled to a respective end of the glass lamp tube;
	1[c]	an LED light strip disposed on an inner surface of the glass lamp tube with a plurality of LED light sources mounted on the LED light strip;
	1[d]	a power supply disposed at one end or two ends of the glass lamp tube, the power supply electrically connected to the plurality of LED light sources; and
	1[e]	a reflective film disposed on a portion of the inner surface of the glass lamp tube,
	1[f]	wherein the glass lamp tube comprises a main body region and two rear end regions, each of the two rear end regions coupled to a respective end of the main body region and each of the two end caps coupled to a respective rear end region,
	1[g]	and further wherein a length of the light strip is longer than a length of the main body region of the glass lamp tube.
2	2	The LED tube lamp of claim 1, wherein a portion of the inner surface of the glass lamp tube is covered by the rough surface and another portion of the inner surface of the glass lamp tube is covered by the reflective film.
3	3	The LED tube lamp of claim 2, wherein a portion of the inner surface which is not covered by the reflective film is covered by the rough surface.

Claim	Limitation Identifier	Limitation
4	4	The LED tube lamp of claim 3, wherein the roughness of the rough surface ranges from 0.1 to 40 μm .
5	5	The LED tube lamp of claim 4, wherein each of the two end caps comprises an insulating end wall, two conductive pins and at least one opening, the insulating end wall is substantially perpendicular to an axial direction of the glass lamp tube, and the two conductive pins and the opening are arranged on the insulating end wall.
6	6	The LED tube lamp of claim 5, wherein each of the two end caps sleeves with a respective rear end region, and wherein an outer diameter of each of the end cap is substantially the same as the outer diameter of the main body region.
8	8[p]	An LED tube lamp, comprising:
	8[a]	a glass lamp tube;
	8[b]	a diffusion film coated on an inner surface of the glass lamp tube;
	8[c]	an LED light strip disposed on the inner surface of the glass lamp tube with a plurality of LED light sources mounted on the LED light strip;
	8[d]	a reflective film disposed on the inner surface of the glass lamp tube;
	8[e]	two end caps, each of the two end caps coupled to a respective end of the glass lamp tube; and
	8[f]	a power supply disposed at one end or two ends of the glass lamp tube, the power supply electrically connected to the plurality of LED light sources,
	8[g]	wherein the diffusion film has a rough surface, the roughness of the rough surface is higher than that of an outer surface of the glass lamp tube,
	8[h]	and wherein a portion of the inner surface of the glass lamp tube is covered by the rough surface and a portion of the inner surface of the glass lamp tube is covered by the reflective film,

Claim	Limitation Identifier	Limitation
	8[i]	wherein the glass lamp tube comprises a main body region and two rear end regions, each of the two rear end regions coupled to a respective end of the main body region and each of the two end caps coupled to a respective rear end region,
	8[j]	and further wherein a length of the light strip is longer than a length of the main body region of the glass lamp tube.
9	9	The LED tube lamp of claim 8, wherein a portion of the inner surface of the glass lamp tube not covered by the reflective film is covered by the rough surface.
10	10	The LED tube lamp of claim 9, wherein the glass lamp tube and the two end caps are secured by a gel, and the gel is disposed between an inner surface of each of the two end caps and an outer surface of each of the two rear end regions.
11	11	The LED tube lamp of claim 10, wherein each of the two end caps comprises an insulating end wall, two conductive pins and at least one opening, the insulating end wall is substantially perpendicular to an axial direction of the glass lamp tube, and the two conductive pins and the opening are arranged on the insulating end wall.
12	12	The LED tube lamp of claim 10, wherein each of the two end caps sleeves with a respective rear end region, and wherein an outer diameter of each of the end cap is substantially the same as an outer diameter of the main body region.
14	14[p]	An LED tube lamp, comprising:
	14[a]	a glass lamp tube having an inner surface;
	14[b]	an LED light strip disposed on the inner surface of the glass lamp tube with a plurality of LED light sources mounted on the LED light strip;
	14[c]	two end caps, each of the two end caps coupled to a respective end of the glass lamp tube; and

Claim	Limitation Identifier	Limitation
	14[d]	a power supply disposed at one end or two ends of the glass lamp tube, the power supply electrically connected to the plurality of LED light sources,
	14[e]	wherein the inner surface of the glass lamp tube is covered by a reflective layer and a rough layer, the roughness of the rough layer is higher than that of an outer surface of the glass lamp tube,
	14[f]	wherein the glass lamp tube comprises a main body region and two rear end regions, each of the two rear end regions coupled to a respective end of the main body region and each of the two end caps coupled to a respective rear end region,
	14[g]	and further wherein a length of the light strip is longer than a length of the main body region of the glass lamp tube.
15	15	The LED tube lamp of claim 14, wherein a portion of the inner surface which is not covered by the reflective layer is covered by the rough layer.
16	16	The LED tube lamp of claim 15, wherein the glass lamp tube and the two end caps are secured by a gel, wherein the gel is disposed between an inner surface of each of the two end caps and an outer surface of each of the two rear end regions.
17	17	The LED tube lamp of claim 16, wherein each of the two end caps comprises an insulating end wall, two conductive pins and at least one opening, the insulating end wall is substantially perpendicular to an axial direction of the glass lamp tube, and the two conductive pins and the opening are arranged on the insulating end wall.
18	18	The LED tube lamp of claim 16, wherein each of the two end caps sleeves with a respective rear end region, and wherein an outer diameter of each of the end cap is substantially the same as an outer diameter of the main body region.

I. INTRODUCTION

Entitled “LED Tube Lamp,” the ’397 Patent is directed to “an LED tube lamp and its components including the light sources, electronic components, and end caps.” EX1001, 1:64-67.

According to the ’397 Patent, “the present invention further provides an LED tube lamp to overcome the issue that light rays emitted from the LED light source are highly concentrated and are hard to be evenly distributed.” *Id.*, 4:20-23. “In the above-mentioned embodiments, light rays emitted from the LED light source in the lamp tube can be distributed in a more even manner by the rough surface, the reflective film, and/or the diffusion film.” *Id.*, 5:1-4.

None of the ’397 Patent’s LED tube lamp components or their configuration were new. Jing, Huang, Foo, Deng, Zhao, and Halliwell are all directed to LED tube lamps. Jing discloses each structural component of independent claims 1, 8, and 14, including the claimed light strip and glass lamp tube. To the extent the light strip of Jing does not have the claimed length “longer than a length of the main body region of the glass lamp tube,” this feature was known in the art, as evidenced by Huang and Halliwell.

II. MANDATORY NOTICES

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

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

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

The following proceeding involves the '397 Patent and may therefore affect, or be affected by, a decision in this proceeding:

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

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

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

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Petitioner consents to electronic service.

III. GROUNDS FOR STANDING

Petitioner certifies: the '397 Patent is available for IPR; Petitioner is not barred or estopped from requesting an IPR on the grounds herein. The '397 Patent has not been subject to a previous FWD in an estoppel-based AIA proceeding.

IV. STATEMENT OF PRECISE RELIEF REQUESTED

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

Petitioner requests review and cancellation of claims 1-6, 8-12, and 14-18.

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

Claims 1-6, 8-12, and 14-18 are invalid under §103 over these combinations of art:

Ground	Basis	Claims	Prior Art Combination
1	§103	1-3, 8, 9, 14, 15	Jing (EX1002), Huang (EX1003)
2	§103	1-3, 8, 9, 14, 15	Jing, Halliwell (EX1008)
3	§103	4	Jing, Huang, Foo (EX1005)
4	§103	4	Jing, Halliwell, Foo
5	§103	10, 16	Jing, Huang, Zhao (EX1007)
6	§103	10, 16	Jing, Halliwell, Zhao
7	§103	5, 6	Jing, Huang, Foo, Deng (EX1006)
8	§103	5, 6	Jing, Halliwell, Foo, Deng

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

Ground	Basis	Claims	Prior Art Combination
9	§103	11, 12, 17, 18	Jing, Huang, Zhao, Deng
10	§103	11, 12, 17, 18	Jing, Halliwell, Zhao, Deng

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

Filed December 27, 2012, Huang is prior art under §102(a)(2).

Filed April 11, 2012 and published October 17, 2013, Foo is prior art under §102(a)(1).

Filed March 17, 2014 and published August 27, 2014, Deng is prior art under §102(a)(1).

Filed June 9, 2013, Zhao is prior art under §102(a)(2).

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

None of Jing, Huang, Foo, Deng, Zhao, or Halliwell were before the Examiner during prosecution of the '397 Patent.

V. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art (“POSITA”) as of December 5, 2014²—the ’397 Patent’s earliest claimed priority date—would have had a Bachelor’s degree in electrical engineering, or an equivalent field, as well as at least 1-2 years of academic or industry experience in lighting design, including knowledge of light emitting diodes (LEDs) and related technology for driving LEDs. A person of ordinary skill in the art with a higher level of education may have fewer years of academic or industry experience, or vice versa. EX1004, ¶24. The prior art and the ’397 Patent also evidence this level of ordinary skill. *See Chore-Time Equip., Inc. v. Cumberland Corp.*, 713 F.2d 774, 779 (Fed. Cir. 1983); *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

VI. FIELD OF TECHNOLOGY

A. LED Tube Lamps

LED tube lamps are LED lighting devices used in place of fluorescent tube lamps. EX1004, ¶26. LED light sources can be disposed inside tubes that fit into existing fluorescent light sockets or fixtures. *Id.*; *see, e.g.*, EX1013, 4:16-19. LED

² All statements in this Petition about the knowledge and skills of, and what would have been obvious to, a POSITA are offered from this perspective as of this date. EX1004, ¶18.

lamp tubes have been a relatively mature technology for many years. EX1004, ¶26. Light emission from a solid state material (electroluminescence) was known in the early twentieth century, and LEDs were the subject of significant research as early as the 1960s. *See e.g.*, EX1021, 11/367, 20/367; EX1022, 13/434, 16/434; EX1004, ¶26.

LED lamp tubes can include diffusion elements applied to the tube, and a POSITA would understand that there were several methods of diffusing light from LED tube lamps, including films. *See, e.g.*, EX1014, 7:18-45, EX1004, ¶27. One known technique involved applying a diffusion layer to a substrate via adhesive. *See, e.g.*, EX1021, 294/367, Figure 6.91; EX1004, ¶27. “The diffuser/diffusion film can effectively diffuse light and uniformly mixes light before it is emitted from the lamp to make the light emitting soft and comfortable, becoming the first choice of high-quality LED indoor lamps.” EX1021, 293/367. A POSITA would have understood that all such methods diffuse light from LED tube lamps and help create a uniform light output. *See, e.g.* EX1021, 293/367; EX1015, 2:7-14; EX1004, ¶27.

B. LED Light Strips

LED light sources for use in tube lamps are typically mounted on LED light strips in arrays made of various materials, including traditional printed circuit boards (PCBs). *See, e.g.*, EX1014, 4:40-44; EX1004, ¶28. PCBs were well-known for LED

lighting applications and provided a versatile substrate for mounting LEDs. EX1004, ¶28.

LED strips were arranged in numerous ways within the tube, such as adhered directly on an inner tube surface or mounted on an intermediate structure. *See, e.g.*, EX1016, 10:46-49, EX1018, 8:9-14, 10:44-50, FIG. 6; EX1017, 1:63-66; EX1015, 6:5-39; EX1004, ¶29. Ultimately, there were many known ways of disposing an LED light strip within and on the inner surface of a lamp tube, each with the benefit of supporting and securing the LED light strip. EX1004, ¶29. A POSITA would be familiar with manufacturing methods for LED light strips and for mounting LED chips. EX1019, 7:10-55, 7:56-8:5; EX1020; EX1004, ¶29.

C. PCBs

PCBs for LED tube lamps included flexible PCBs that could be used in lighting applications with different shapes. *See, e.g.*, EX1017, 1:63-66, 6:44-54; *see also* EX1018, 7:58-61; EX1004, ¶30. Flexible circuit boards were well-known for LED lighting applications and provided a versatile substrate for mounting LEDs. EX1004, ¶30. Other types of PCBs for LED tube lamps included less flexible PCBs having a greater degree of rigidity. EX1004, ¶30. For example, it was known to use aluminum to create an aluminum-based PCB having increased strength as compared to other types of PCBs. *See, e.g.*, EX1012, 1:13-16 (“The invention is generally related to an aluminum-based printed circuit board, and, more specifically, to an

aluminum-based printed circuit board having increased heat dissipation and ***bending strength properties***.”³), 9:42-7; EX1004, ¶30. Some PCBs included a core or base layer strengthened with aluminum. *See, e.g.*, EX1012, 1:53-62; 3:30-35; 6:4-6; 7:41-43; 7:54-55; 8:35-38; claim 1; EX1004, ¶30.

D. End Caps

LED tube lamps included caps at the ends of the tube to enclose the LED strips therein. *See, e.g.*, EX1014, 5:32-39; EX1017, 5:24-30; EX1018, 1:35-2; EX1004, ¶31. The end caps included electrode pins for connecting to a lighting fixture. *See* EX1013, 7:39-46; EX1004, ¶31. It was also known to include openings in the end caps, such as to reduce pressure or heat within the tube. *See, e.g.*, EX1008, 8:61-94, FIG. 18; *see also* EX1006, ¶[0037], FIGS. 1 and 3; EX1004, ¶31.

E. Heat Dissipation

It was known that operation of an LED lighting device generates heat, which, if not dissipated, can reduce performance and damage components of an LED lighting device. EX1021, 167/367, 201/367, 203/367; EX1004, ¶32. “Therefore, it is crucial to rapidly remove the heat and keep the junction temperature below a certain limit for the maintenance of performance.” EX1021, 167/367; EX1004, ¶32.

³ All emphasis added unless otherwise indicated.

As such, a POSITA would have understood the importance of heat management in an LED lighting device. EX1004, ¶32.

VII. THE '397 PATENT

A. Background

The '397 patent is directed to “an LED tube lamp and its components including the light sources, electronic components, and end caps” (EX1001, 1:64-67), and describes certain drawbacks of “existing LED tube lamps” (*id.*, 2:21-22).

“First, the typical circuit board is rigid and...when the lamp tube is partially ruptured or broken...gives the user a false impression that the LED tube lamp remains usable and is likely to cause the user to be electrically shocked upon handling or installation of the LED tube lamp.” EX1001, 2:23-28. “Second, the rigid circuit board is typically electrically connected with the end caps by way of wire bonding, in which the wires may be easily damaged and even broken....” EX1001, 2:29-34. “Third, the existing LED tube lamps are bad in heat dissipation, especially have problem in dissipating heat resulting from the power supply components inside the end caps.” EX1001, 2:35-41. “In addition, an LED light source is a point light source. Light rays emitted from the LED light source are highly concentrated and are hard to be evenly distributed.” EX1001, 2:42-44.

B. Summary of alleged invention of the '397 Patent

The '397 Patent purports to solve one or more of the problems above. “[T]he present invention further provides an LED tube lamp to overcome the issue that light rays emitted from the LED light source are highly concentrated and are hard to be evenly distributed.” EX1001, 4:20-23. The '397 Patent purportedly solves this problem using a “reflective film... disposed on the inner surface of the lamp tube,” a “diffusion film...coated on an inner surface of the lamp tube,” and a “portion of the inner surface which is not covered by the reflective film...formed with a rough surface.” *Id.*, 4:26-27, 4:39-40, 4:64-65. “In the above-mentioned embodiments, light rays emitted from the LED light source in the lamp tube can be distributed in a more even manner by the rough surface, the reflective film, and/or the diffusion film.” *Id.*, 5:1-4.

FIG. 30 illustrates “one or more reflective films 12 disposed on the inner surface of the glass lamp tube 1”:

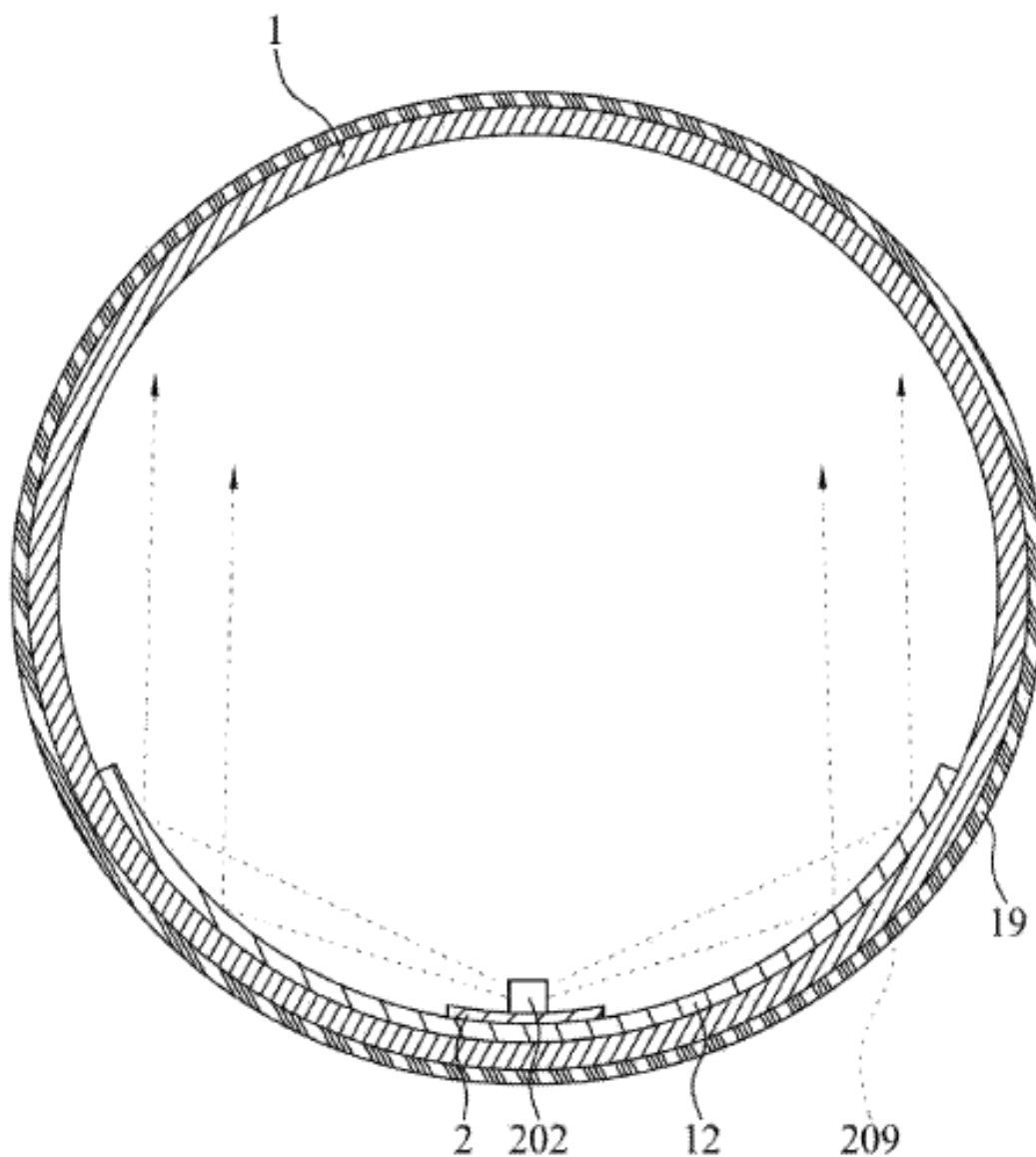


FIG.30

EX1001, 11:55-57 and FIG. 30. “In some embodiments, the part of the inner surface which is not covered by the reflective film 12 is formed with the rough surface.” *Id.*, 12:4-6.

FIG. 31 illustrates diffusion film 13:

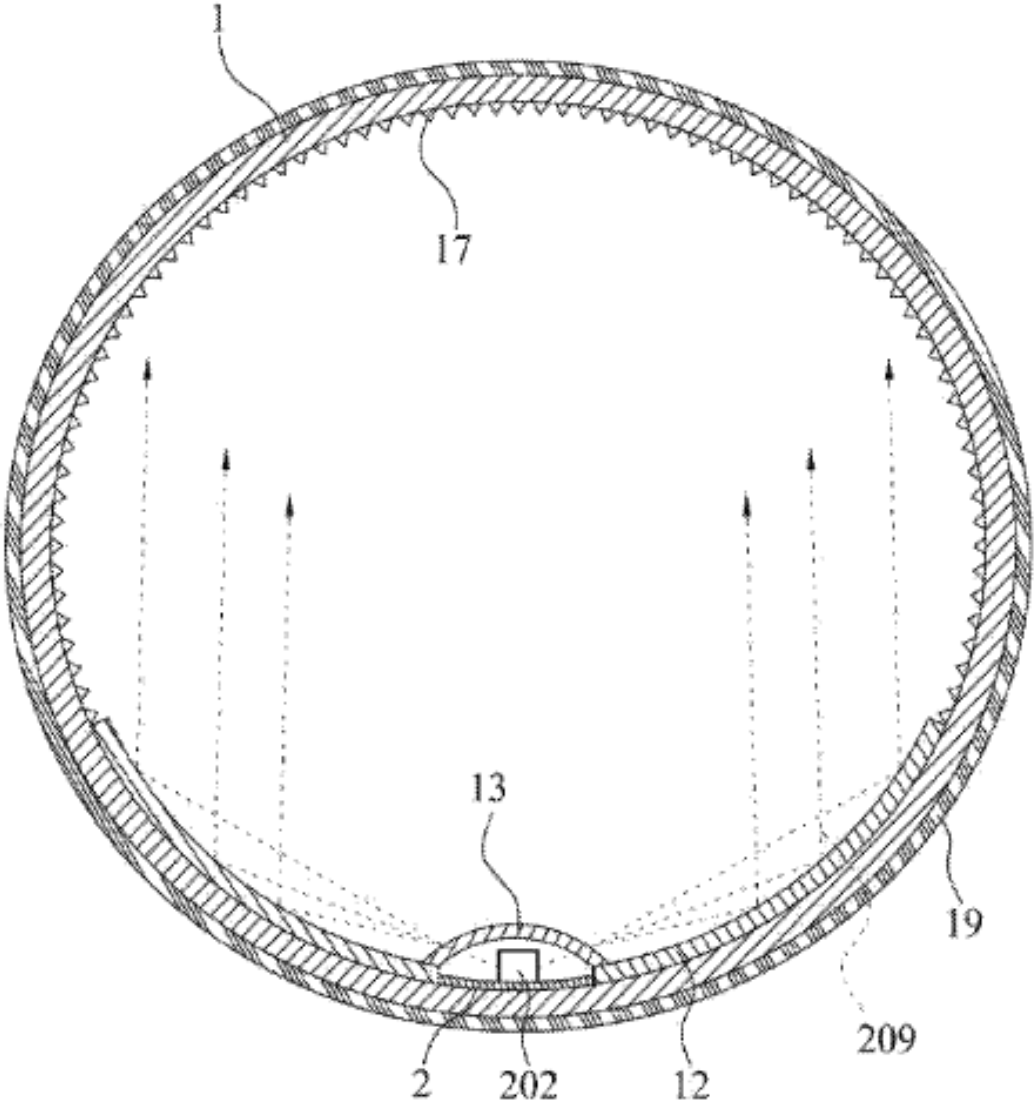


FIG.31

EX1001, 12:10-14, FIG. 31.

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

Petitioner does not believe any explicit constructions are necessary to resolve the proposed grounds.

1. “disposed on”

Petitioner does not believe this term needs explicit construction, but notes that “disposed on” should be understood to include the possibility an intervening structure, such as an adhesive. The ’397 specification acknowledges this: “...the other side of the LED light strip 2 being opposite to the side of mounting the LED light sources 202 is bonded and affixed to the inner surface of the lamp tube 1 by an adhesive sheet.” EX1001, 14:22-33. The ’397 specification also describes LED light strip 2 as being “disposed on” lamp tube 1. *See, e.g.*, EX1001, Abstract, 4:30-33, 4:30-43; 4:56-59.

The ’397 specification differentiates between “disposed on” and “in contact with.” *See, e.g.*, EX1001, 12:21-25. In light of the ’397 specification, a POSITA would understand “disposed on” to be broader than “in contact with”—i.e., including structures directly disposed on, as well as indirectly disposed on (e.g., via an intervening structure or material), a surface or other structure. EX1004, ¶93. FIG. 30 of the ’397 patent illustrates one such example in which LED light strip 2 is indirectly disposed on glass tube 1 via reflective film 12:

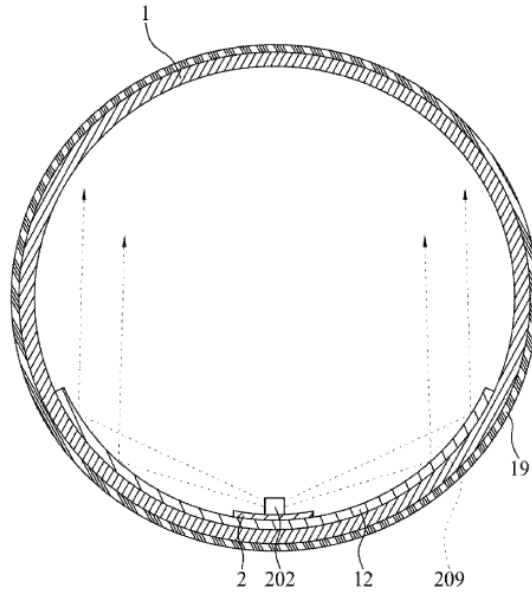
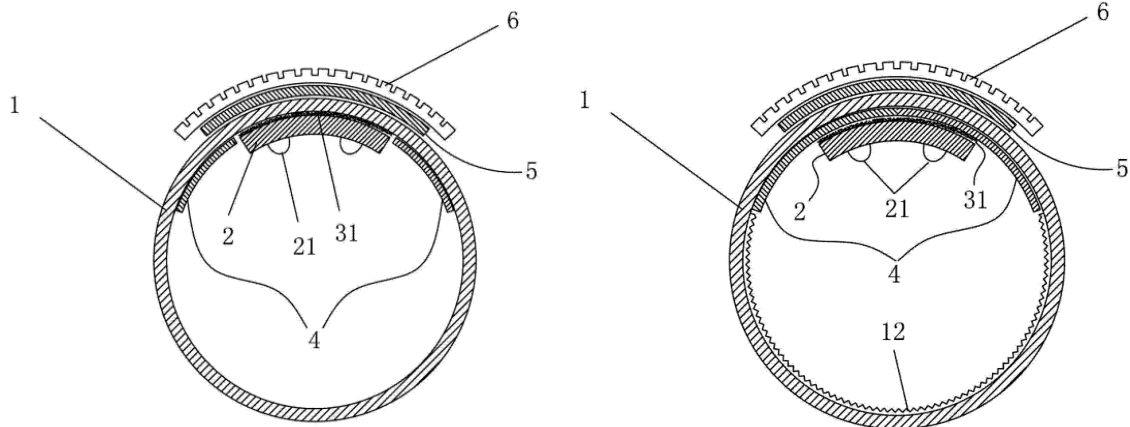


FIG.30

EX1001, FIG. 30. Moreover, to the extent Patent Owner may attempt to construe “disposed on” as requiring either a direct or indirect relation, the proposed grounds below address both options. Specifically, as explained below, Jing discloses the claimed LED light strip both directly and indirectly “disposed on” the claimed inner surface of the glass lamp tube. *See* EX1002, FIG. 4 (illustrating circuit board 2 indirectly disposed on lamp tube 1 via inner reflective film layer 4); *see also* §VIII.A.3(a) (citing FIG. 2 of Jing, in which circuit board 2 is directly disposed on lamp tube 1).



EX1002, FIGS. 2 and 4.

2. “electrically connected”

“Electrically connected” is found in claims 1, 8, and 14. Petitioner does not believe this term needs explicit construction, but notes that the specification expressly indicates that the term is broad enough to cover both direct and indirect connections. Specifically, the ’397 Patent teaches that “the LED light sources 202 and the power supply 5 are electrically connected by the LED light strip 2.” EX1001, 14:31-33; EX1004, ¶95.

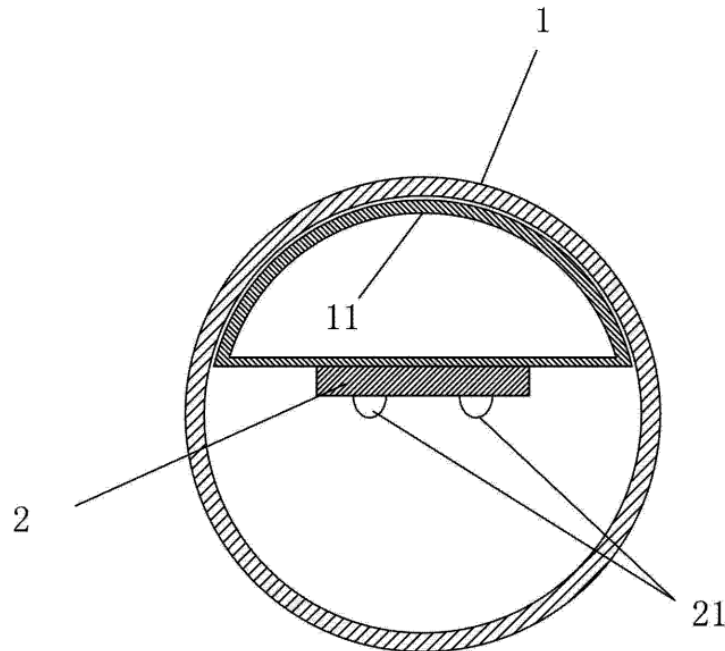
VIII. REASONS FOR THE RELIEF REQUESTED UNDER 37 C.F.R. §§ 42.22(A)(2) AND 42.104(B)(4)

A. Ground 1 – Claims 1-3, 8, 9, 14, and 15 Are Obvious Over Jing and Huang

1. Jing

Jing describes an “LED fluorescent lamp in the prior art is composed of a glass lamp tube 1 [and] a light emitting component arranged in the lamp tube 1.... The light emitting component includes a bracket 11...and a circuit board 2 fixed on

the bracket, which extends along the axis of the lamp tube and is equipped with LED lamp beads 21.” EX1002, ¶[0002].

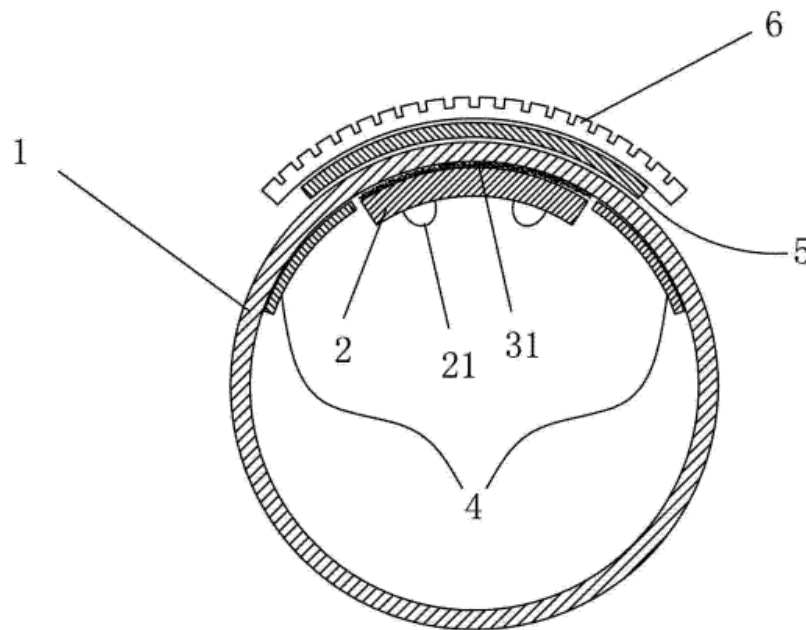


EX1002, FIG. 1.

“This structure has the following shortcomings: 1) Each fluorescent lamp needs to be equipped with a bracket with the same length as the lamp tube, so the manufacturing cost is high. 2) Due to the barrier of the bracket, when the LED light source in the enclosed space inside the lamp tube works, the heat generated is transferred to the bracket through the circuit board, and then transferred from the bracket to the external space through the glass wall of the lamp tube. In this way, the heat resistance will be larger through two heat conduction exchange layers.” EX1002, ¶¶[0004]-[0005].

In “Invention Content,” Jing states that “[t]he technical problem to be solved is to reduce the manufacturing cost.” EX1002, ¶[0006]. “This Utility Model sets reflective film layers...so that the light emitted from the LED light source to the back of the lamp tube can be fully utilized due to reflection, thereby correspondingly enhancing the luminance of the LED fluorescent lamp.” EX1002, ¶¶ [0018], [0032].

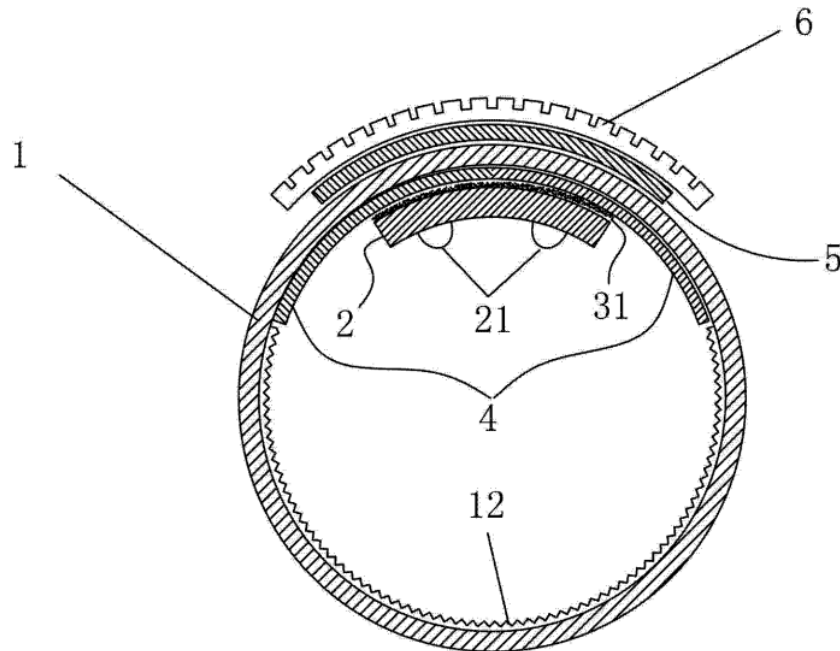
FIG. 2 of Jing illustrates an example of reflective film layer 4:



EX1002, FIG. 2.

The LED fluorescent lamp is composed of lamp tube 1, circuit board 2, and a plug with a driver on both ends of the lamp tube 1. EX1002, ¶[0027]. “The inner wall of lamp tube 1 can be...an inner wall with all or part of the rough surface treatment (the rough surface treated inner wall is called sanding layer 12),” where “rough surface treatment refers to the treatment of sanding or spraying the inner wall

of the lamp tube to make the light emitted by the lamp tube diffuse evenly and softly.” *Id.*



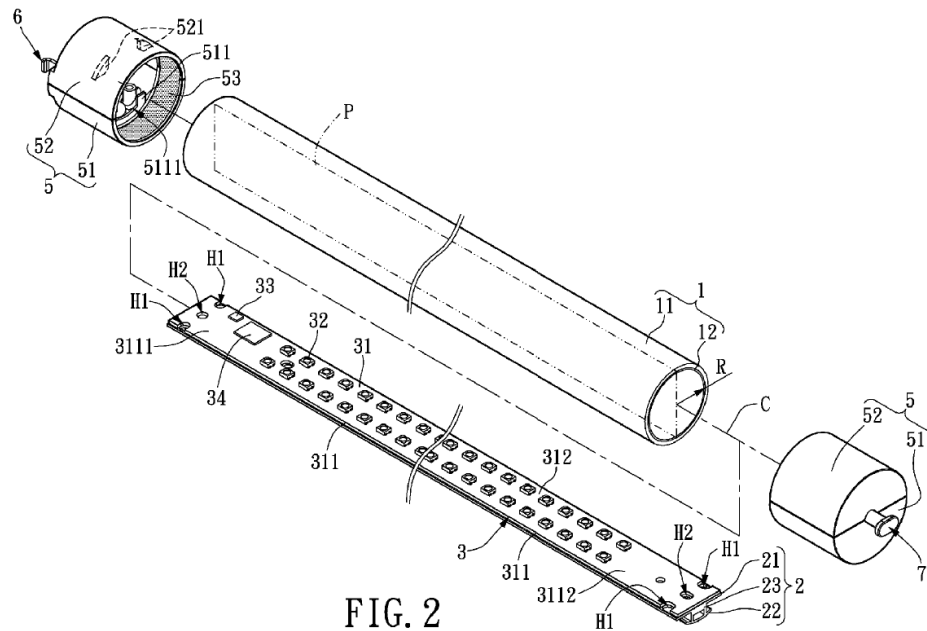
EX1002, FIG. 4.

Jing teaches that inner reflective film layer 4 “has two settings in the circumference direction of the inner wall of the lamp tube 1, that is continuous film layer or discontinuous film layer respectively.” *See* EX1002, ¶[0032] *see also id.*, FIG. 2, above (illustrating the “discontinuous” configuration of inner reflective film layer 4) and FIG. 4, above (illustrating the “continuous” configuration of inner reflective film layer 4).

2. *Huang*

Huang describes “an LED glass tube light is easily broken or damage[d] due to non-uniform external force.” EX1003, 1:9-11.

Huang discloses an LED tube light that includes a glass tube 1, a base 2, and a light emitting unit 3. EX1003, 2:27-32. “The light emitting unit 3 includes a circuit board module 31, a plurality of LEDs 32, a socket connector 33, and an electronic unit 34.” *Id.*, 3:33-35. “The light emitting unit 3 takes a back surface of the circuit boards 311 to dispose on the mounting surface 211 of the base 2, and the circuit boards 311 are fixed on the base 2 by screws, adhesives, or other suitable means.” *Id.*, 3:60-63.



EX1003, FIG. 2.

Huang discloses that the length of light emitting unit 3 is longer than the length of the main body region of glass tube 1. *Id.*, FIG. 3:

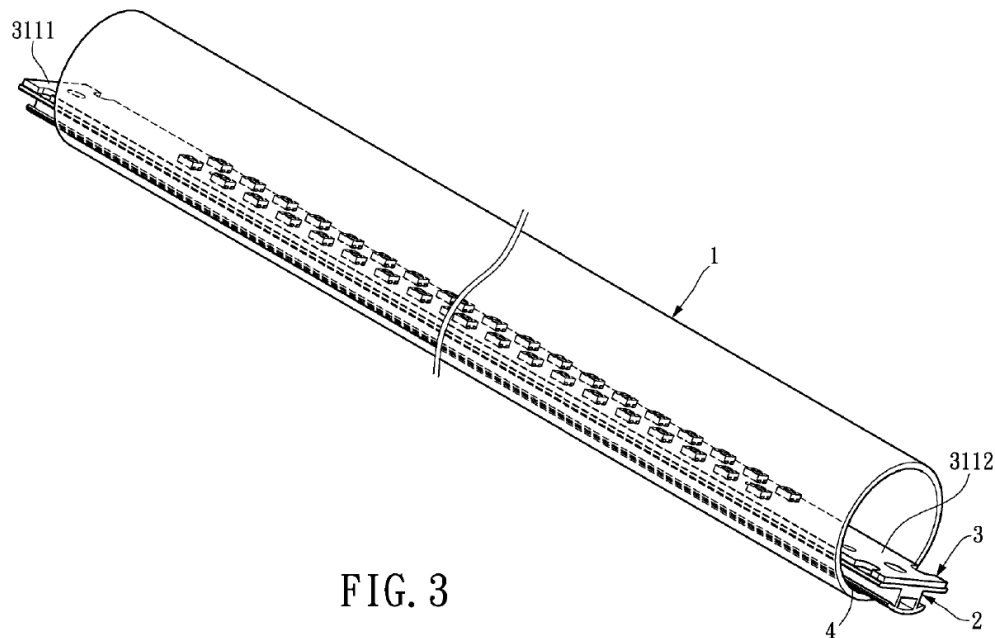


FIG. 3

EX1003, FIG. 3.

Huang describes that “[o]ne embodiment of the invention provides an LED tube light having better structural durability and lower breakage probability. The LED tube light is assembled by a glass tube, a base, a light emitting unit, and two lateral cover assemblies. The base has a length larger than the length of the glass tube.” EX1003, 1:19-24. “Base[d] on the above, when the lateral cover assemblies is loaded [with] a force, the force is transferred to the base and then uniformly dispersed to the glass tube by installing the lateral cover assemblies on the base, so that the reliability of the glass tube is improved and the broken probability [sic] of the glass tube is reduced.” *Id.*, 1:41-46.

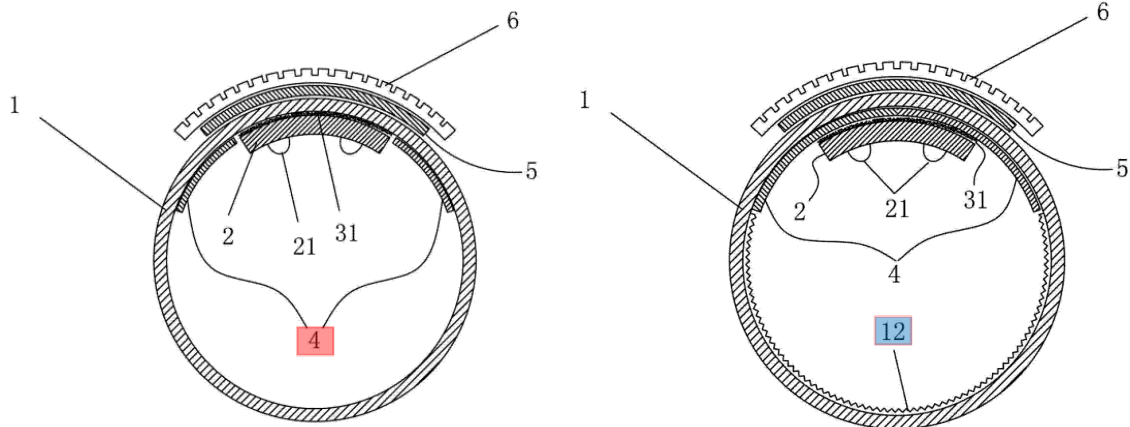
A POSITA would understand that both base 2 and circuit board module 31 are longer than glass tube 1. EX1004, ¶¶44, 45, 46. For example, as shown in FIGS.

2 and 3 of Huang (above), both base 2 (including mounting surface 211) and light emitting unit 3 (including circuit board module 31) extend out of each end of, and are longer than, glass tube 1. EX1003, FIGS. 2, 3, 3:33-35; EX1004, ¶46. Further, a POSITA would understand that base 2 provides mounting surface 211 for light emitting unit 3, and that because “[t]he base has a length larger than the length of the glass tube,” light emitting unit 3 (and circuit board module 31) are also longer than glass tube 1. EX1003, FIG. 3, 1:19-24; EX1004, ¶46.

3. *Motivation to combine*

(a) *Jing*

A POSITA would understand that various figures and examples disclosed by Jing are illustrative and that a POSITA could combine different teachings of Jing with a reasonable expectation of success. EX1004, ¶96. To the extent that Patent Owner may contend that FIGS. 2 and 4 of Jing represent distinct embodiments, a POSITA would understand that the discontinuous configuration of inner reflective film layer 4 shown in FIG. 2 (red) could be combined with frosted layer 12 of FIG. 4 (blue) with a reasonable expectation of success based on at least the following. EX1004, ¶96.



EX1002, FIGS. 2 and 4.

A POSITA would have been motivated to use discontinuous inner reflective film layer 4 shown in FIG. 2 (red) with frosted layer 12 of FIG. 4 (blue) with the expectation of success for several reasons. EX1004, ¶97. First, a POSITA would understand that modifying the configuration shown in FIG. 2 to include frosted layer 12 of FIG. 4 would achieve the benefits disclosed by Jing by “mak[ing] the light emitted by the lamp tube diffuse evenly and softly.” EX1002, ¶[0027]; EX1004, ¶97. Therefore, a POSITA would be motivated to modify the configuration shown in FIG. 2 to include frosted layer 12 of FIG. 4 in order to enhance distribution and uniformity of emitted light. EX1002, ¶[0027] (describing FIGS. 2, 3, 4, and 5 as “the LED fluorescent lamp of the Utility Model”); EX1004, ¶97.

Further, a POSITA would recognize that discontinuous inner reflective film layer 4 of FIG. 2 (red) is not between board 2 and lamp tube 1. EX1002, FIG. 4; EX1004, ¶98. As a result, the configuration shown in FIG. 2 has greater

manufacturing ease and flexibility (as compared to the configuration in FIG. 4) because a different layer or material (other than inner reflective film layer 4) could be disposed between board 2 and lamp tube 1, such as an adhesive or other material, instead of inner reflective film layer 4. EX1004, ¶98; *see also* EX1002, FIG. 3 (showing fixing layer 3 (thermally conductive adhesive layer 3) between board 2 and lamp tube 1).

In addition, Jing explicitly discloses that a length and configuration of inner reflective film layer 4 can be changed: “[t]he specific length can be determined according to the special use of LED fluorescent lamps. For example, when consumers need a small light emission angle, the length of the inner reflective film layer 4 can be longer.” EX1002, ¶[0034]; EX1004, ¶99.

(b) Jing and Huang

A POSITA would have been motivated to search for ways to reduce increase reliability of the LED fluorescent lamp through routine experimentation. EX1004, ¶100. Huang teaches one such technique for improving reliability. *Id.* Huang teaches extending a structure outside the glass tube to increase reliability of an LED tube light: “Thus, the length of the base 2 is larger than the length of the glass tube 1 for providing the lateral cover assemblies 5 to be fixed on the end portions of the base 2 by a fixing means (e.g., screw or buckled). The force is transferred from the lateral cover assemblies 5 to the glass tube 1 via the base 2, so that the force is

uniformly dispersed to the glass tube 1 for preventing the glass tube 1 from loading the force directly and reducing the broken possibility of the glass tube 1 resulted from concentrating the force on a specific point.” EX1003, 6:59-67; *see also id.*, 1:22-24, 1:41-46, 8:15-22, FIG. 3. Thus, a POSITA would have understood that one way of increasing reliability is to lengthen a structure in order to disperse force applied to the glass tube, improving reliability. EX1004, ¶100.

Because Jing teaches omitting a metal bracket (or base) for the LED lamp, a POSITA would have been motivated to search for another way of improving force dispersion and increasing reliability (instead of using base 2 of Huang). EX1002, Summary, ¶[0018]; EX1004, ¶101. A POSITA would have known that aluminum structures can provide rigidity and force dispersion for the glass tube, since for example both Jing and Huang teach that a base or bracket may be formed of aluminum. EX1002 ¶[0003] (“a bracket 11 made of aluminum profiles extend[s] from one end of the lamp tube to the other end”); EX1003, 2:44-47 (“base 2 may be made of materials ... such as metallic material (e.g., aluminum)”); EX1004, ¶101. A POSITA would therefore have searched for another component, such as an aluminum component, to lengthen in order to achieve the benefits of Huang, such as improved force dispersion and increased reliability. EX1004, ¶101.

A POSITA would have identified the circuit board 2 of Jing as such a component. EX1004, ¶102. A POSITA would also have known that one or more

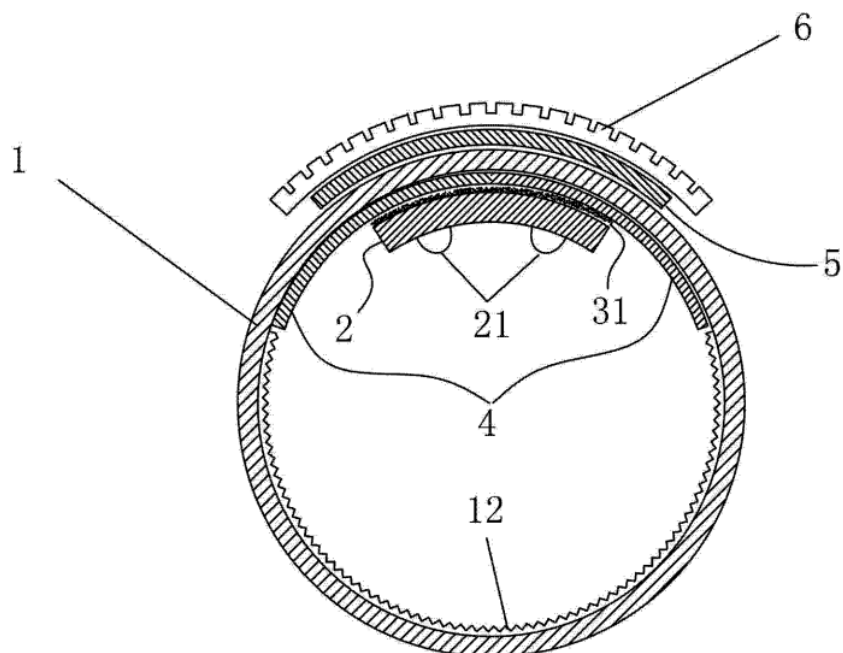
configurations of circuit board 2 disclosed by Jing be used to improve force dispersion and reliability. *Id.* For example, because Jing discloses that circuit board 2 may be “made of aluminum-based printed circuit board PCB, flexible PCB or glass fiber PCB,” a POSITA would have known that circuit board 2 has rigidity sufficient to support the lengthening without introducing breakage or a large amount of bending. EX1002, ¶¶[0016], [0027], [0028], claim 10; EX1004, ¶102; *see also* §VI.C (discussing EX1012, 1:13-16).

A POSITA would have known that an aluminum PCB can provide strength, as discussed in §VI.C, above. EX1004, ¶103. Accordingly, a POSITA would have understood that circuit board 2 of Jing can support lengthening without suffering breakage or other such effects. *Id.*

Therefore, a POSITA would have found it obvious to lengthen circuit board 2 of Jing to achieve the reliability benefits disclosed by Huang. EX1004, ¶104. A POSITA would have arrived at this design through routine experimentation and with a reasonable expectation of success. *Id.*

4. *Modification of Jing with Huang*

Combining the LED fluorescent lamp of Jing with the circuit board length taught by Huang would produce an LED lamp tube (e.g., the LED fluorescent lamp of Jing) that includes at least a light strip (e.g., board 2 of Jing) and a glass lamp tube (e.g., lamp tube 1 of Jing). EX1004, ¶105; EX1002, FIG. 4.



EX1002, FIG. 4.

The light strip would be longer than a main body region of the glass lamp tube, as disclosed by Huang. EX1004, ¶106; EX1003, FIG. 3.

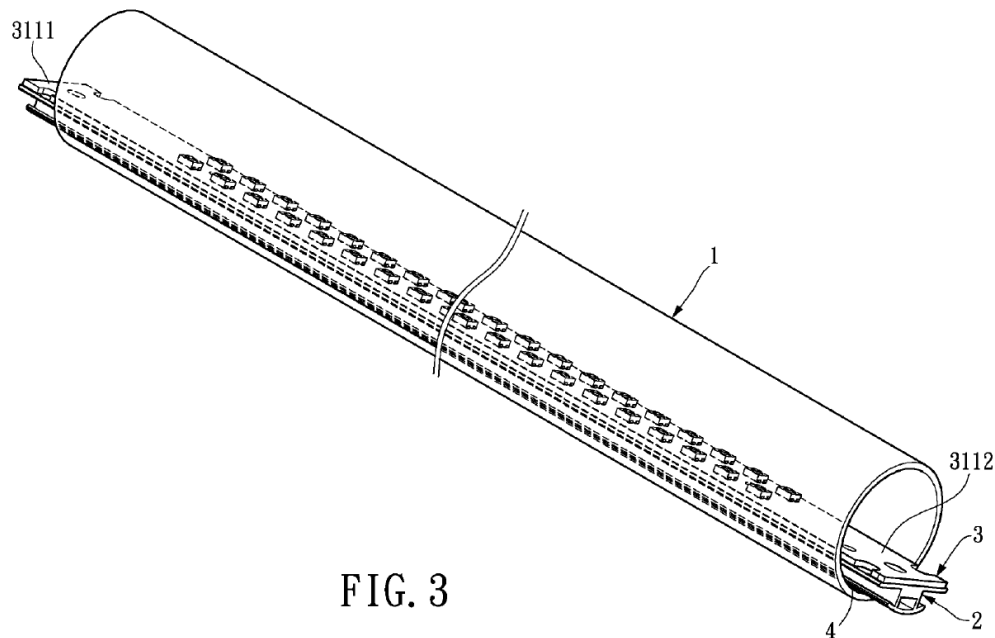


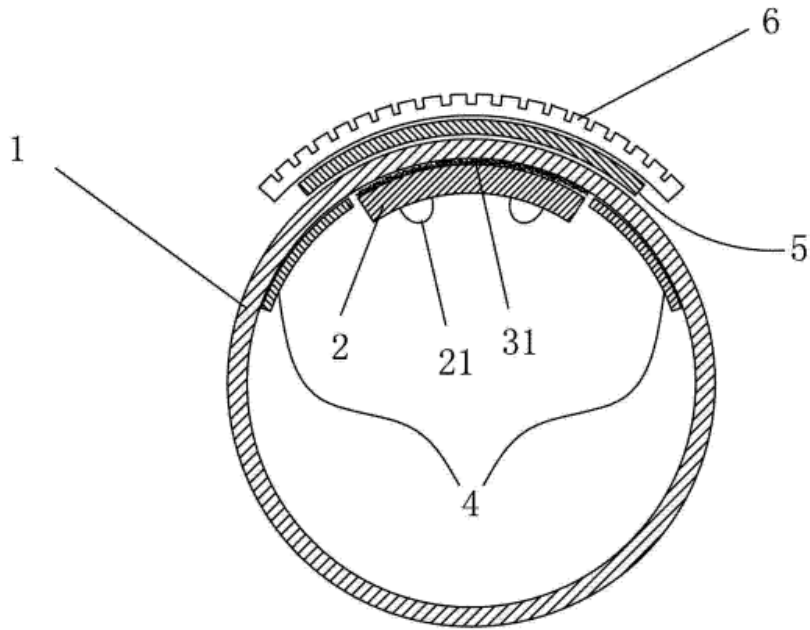
FIG. 3

EX1003, FIG. 3.

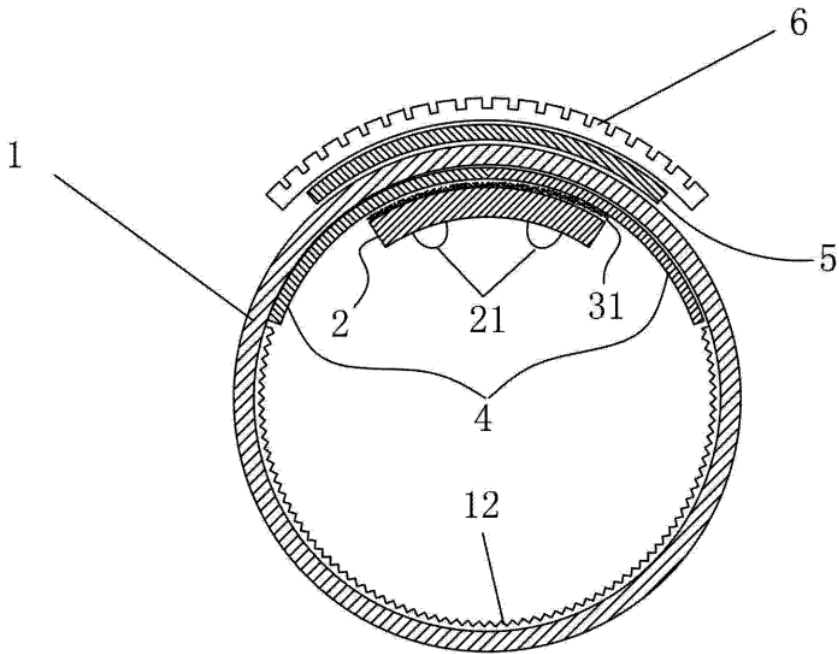
5. *Element-by-Element Analysis*

(a) *Limitation 1[p]*

To the extent it may be limiting, Jing-Huang teaches an LED tube lamp. EX1004, ¶¶107-108. Jing describes that “[t]his Utility Model covers a fluorescent lamp, in particular to an assembly structure of an LED component in a fluorescent lamp tube.” EX1002, ¶[0001]. “As shown in Figure 2, 3, 4 and 5, the LED fluorescent lamp ... is composed of a lamp tube 1 with a circular section and glass material” *Id.*, ¶[0027]; *see also id.*, Summary, ¶¶[0008], [0011], [0012], [0014], [0018]-[0024], FIGS. 2, 4.

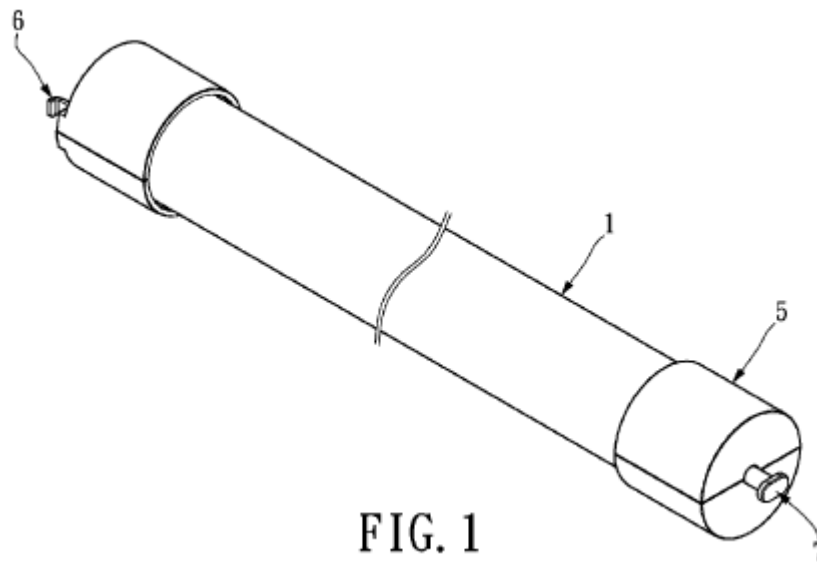


EX1002, FIG. 2.



EX1002, FIG. 4.

Huang describes that “[t]he invention relates to an elongated shape LED tube; more particularly to an LED glass tube light.” EX1003, 1:6-7. Huang describes that “FIGS. 1 and 2 ... show a perspective view and an exploded view of an LED tube light EX1003, 2:27-32; *see also id.*, Abstract, 1:6-7, 1:19-52, 7:1-48, FIGS. 1-3:



EX1003, FIG. 1.

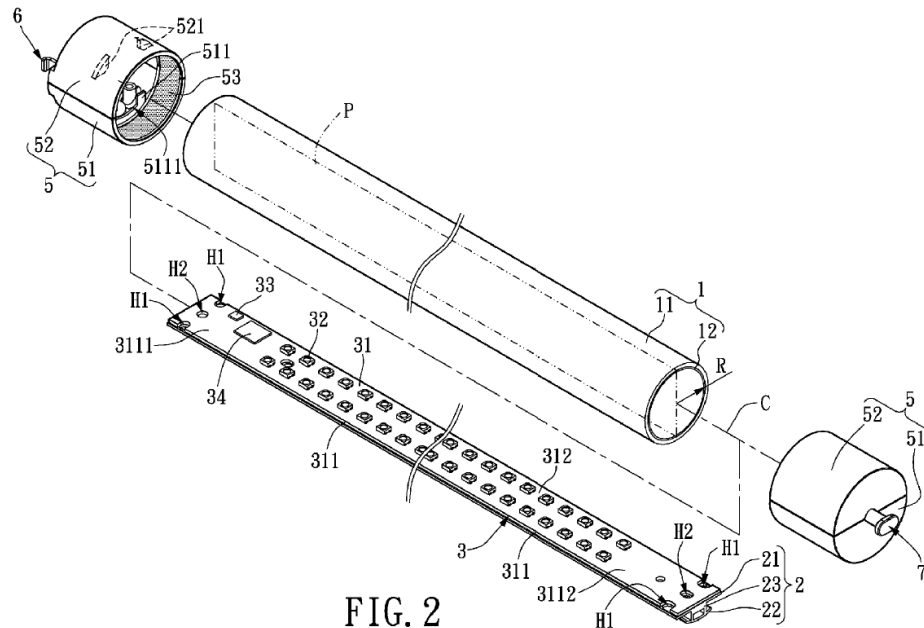


FIG. 2

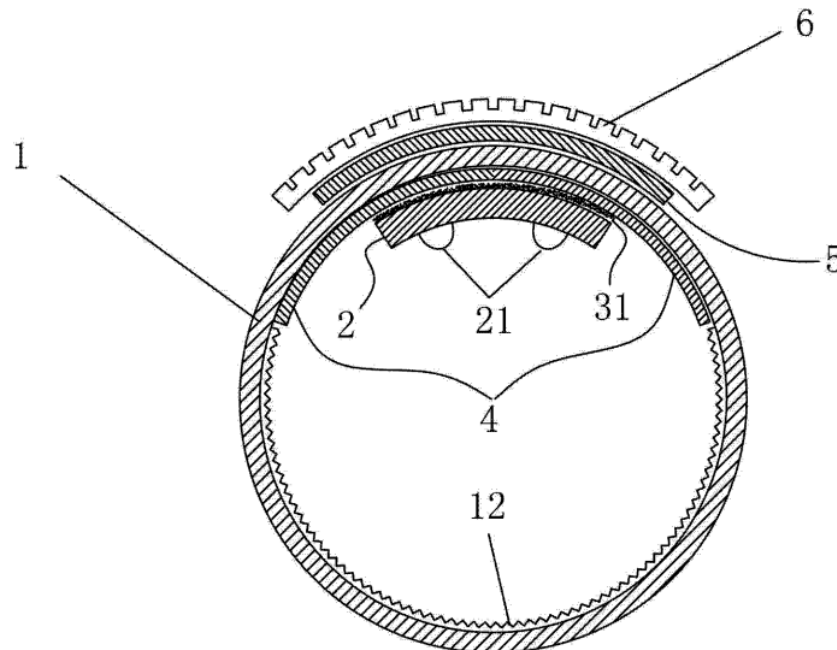
EX1003, FIG. 2.

(b) Limitation 1[a]

Jing-Huang teaches a glass tube lamp with an inner surface covered by a rough surface with a roughness higher than the outer surface. EX1004, ¶¶109-114. “As shown in Figure 2, 3, 4 and 5, the LED fluorescent lamp ... [includes] a lamp tube 1 with a circular section and glass material” EX1002, ¶[0027]; *see also id.*, Summary, ¶¶[0008], [0011], [0012], [0014], [0018]-[0024], FIGS. 2, 4. Huang discloses that “[t]he invention relates to an elongated shape LED tube; more particularly to an LED glass tube light.” EX1003, 1:6-7; *see also id.*, Abstract, 1:6-7, 1:19-52, 7:1-48, FIGS. 1-3.

Jing discloses that “[t]he inner wall of lamp tube 1 can be ... an inner wall with all or part of the rough surface treatment (the rough surface treated inner wall is called sanding layer 12).” EX1002, ¶[0027]. “[R]ough surface treatment refers to the treatment of sanding or spraying the inner wall of the lamp tube to make the light emitted by the lamp tube diffuse evenly and softly.” *Id.*

Jing also refers to sanding layer 12 as “frosted layer 12.” EX1002, ¶¶[0026], [0013], [0035], claim 6. “On the inner wall of the lamp tube 1, the area without inner reflective film layer [4] can be the inner wall of the frosted layer.” *Id.*, ¶[0035].



EX1002, FIG. 4.

A POSITA would understand that sanding (frosted) layer 12 of Jing has a roughness higher than that of the outer surface of lamp tube 1 of Jing. *See* EX1004, ¶112. First, Jing illustrates that no sanding layer 12 is applied to the outer surface

of lamp tube 1. *See* EX1002, FIG. 4. A POSITA would understand that the outer surface of lamp tube 1 is therefore glass material and that such glass material is of less roughness than sanding layer 12. *See* EX1002, ¶[0027]; *see also* EX1004, ¶112. A POSITA would also understand that the glass material of the outer surface of the lamp tube 1 is of less roughness than sanding layer 12 due to performing “rough surface treatment [that] refers to the treatment of sanding or spraying the inner wall of the lamp tube.” *See* EX1002, ¶[0027]; *see also* EX1004, ¶112.

Second, FIG. 4 of Jing also discloses that sanding layer 12 has a roughness greater than that of the outer surface of lamp tube 1 of Jing. EX1004, ¶113. As illustrated in FIG. 4 of Jing, sanding layer 12 has a jagged surface not present on the outer surface of lamp tube 1, which a POSITA would understand to mean that sanding layer 12 has a roughness greater than that of the outer surface of lamp tube 1. EX1004, ¶113.

Third, based on Jing’s disclosure that the rough surface treatment of the inner wall of lamp tube 1 “make[s] the light emitted by the lamp tube diffuse evenly and softly,” a POSITA would understand the roughness of the inner surface of lamp tube 1 to be greater than that of the outer surface of lamp tube 1. EX1004, ¶114. For example, because light travels from inside lamp tube 1 to outside lamp tube 1, a POSITA would understand that the inner surface of lamp tube 1 is rougher than the

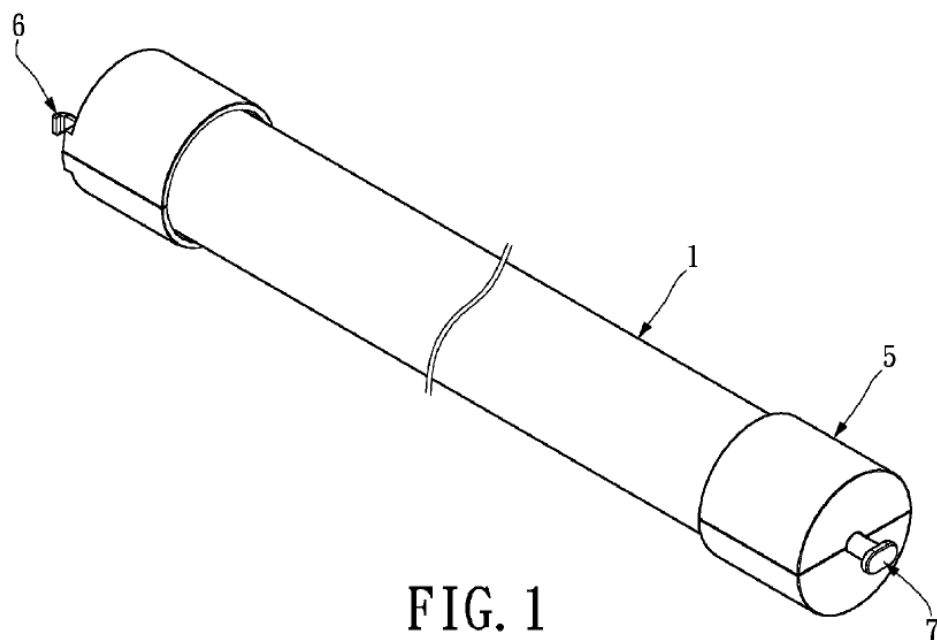
outer surface of lamp tube 1 to enable light diffusion from inside lamp tube 1 to outside lamp tube 1. EX1004, ¶114.

(c) Limitation 1[b]

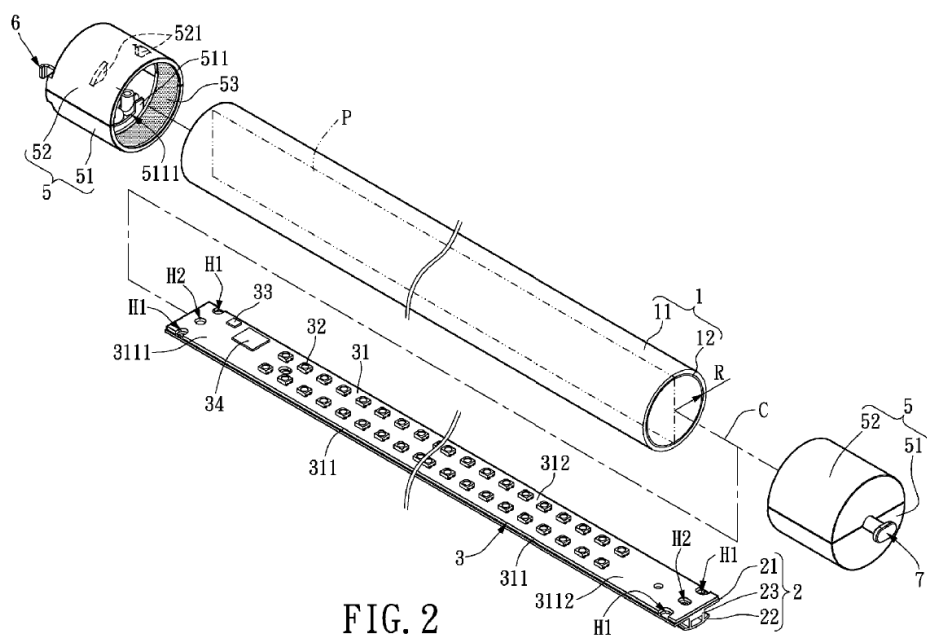
Jing-Huang teaches two end caps coupled to the ends of the glass lamp tube. EX1004, ¶¶115-116.

Jing discloses “a plug with a driver arranged on both ends of the lamp tube 1.” EX1002, ¶[0027]; *see also id.*, ¶[0003] (“...the LED fluorescent lamp in the prior art is composed of a glass lamp tube 1, a light emitting component arranged in the lamp tube 1, and a plug with a driver electrically connected to the light emitting component at both ends of the lamp tube.”) A POSITA would therefore understand that the plugs at both ends of lamp tube 1 disclose the claimed two end caps each coupled to a respective end of the glass lamp tube. EX1004, ¶115.

Huang additionally discloses an LED tube light that includes glass tube 1 and two lateral cover assemblies 5. EX1003, 2:27-32; *see also id.*, Abstract, 1:22-46, 2:44-61, 5:18-35, 6:18-23, 6:51-57, claims 1, 8, 10, 13, 14. As illustrated in FIGS. 1 and 2, the two cover assemblies 5 are end caps coupled to respective ends of glass tube 1:



EX1003, FIG. 1.

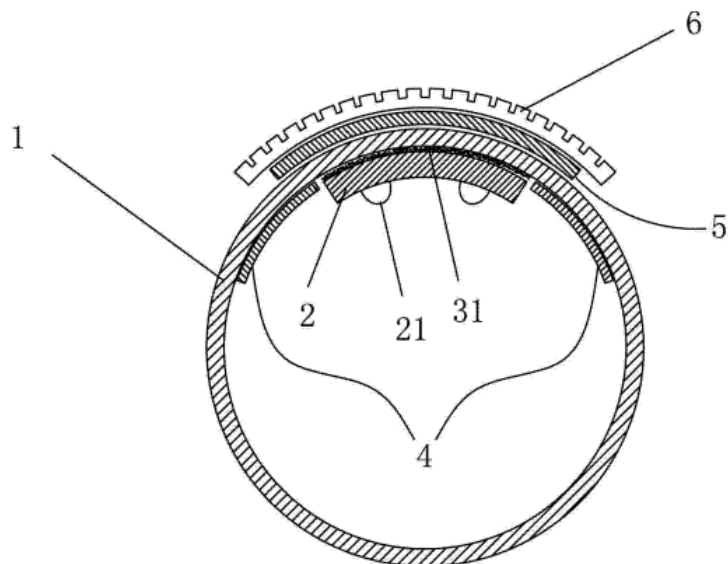


EX1003, FIG. 2.

(d) Limitation 1[c]

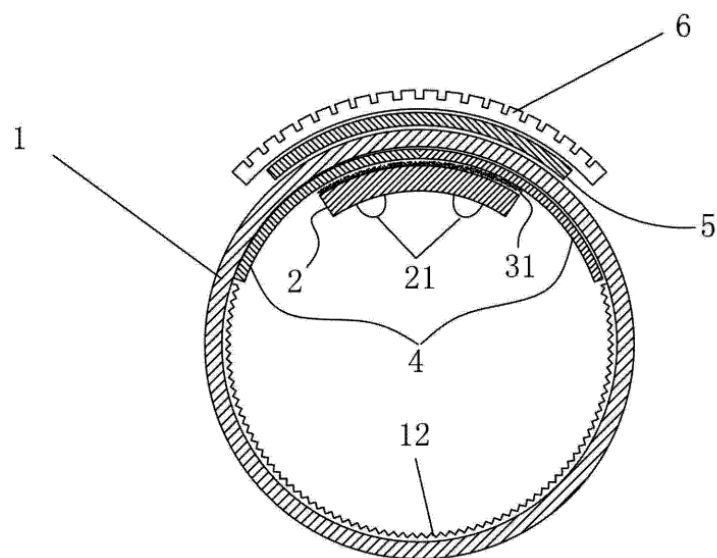
Jing-Huang teaches an LED light strip with a plurality of LED light sources disposed on an inner surface of the tube. EX1004, ¶¶117-122. Jing discloses that “one to three rows of light strips composed of LED lamp beads 21 are welded” on circuit board 2. EX1002, ¶[0027]. “The circuit board 2 extends from one end of the lamp tube 1 to the other end.” EX1002, ¶[0028]. Further, “circuit board 2 is fixedly connected with the inner wall of the lamp tube 1; similarly, when the circuit board 2 is made of flexible PCB, the circuit board 2 can be fixedly connected with the inner wall of the lamp tube 1 through the fixing layer 3. This structure can fix the circuit board 2 onto the inner wall of the lamp tube 1 without using the tube bracket, thereby greatly reducing the manufacturing cost of the LED fluorescent lamp.” EX1002, ¶[0028].

FIG. 2 of Jing illustrates that board 2 is disposed on lamp tube 1:



EX1002, FIG. 2.

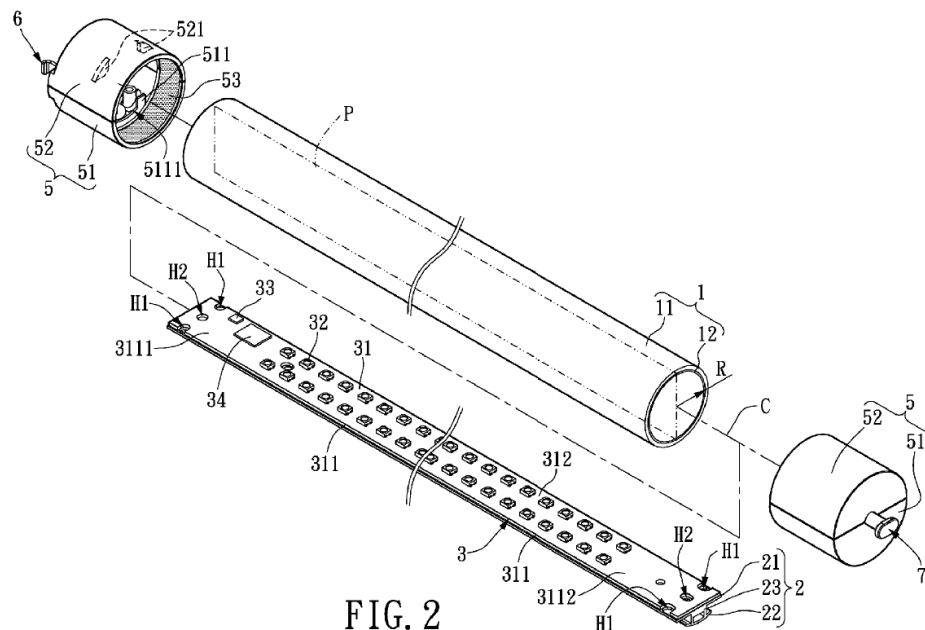
FIG. 4 of Jing illustrates also illustrates that board 2 is disposed on lamp tube 1 (via inner reflective film layer 4):



EX1002, FIG. 4.

As such, Jing discloses an LED light strip disposed on an inner surface of lamp tube 1 with a plurality of LED light sources mounted on the LED light strip. EX1002, FIGS. 2-6; *see also id.*, Summary, [0008], claim 1, FIG. 2, 5; EX1004, ¶120.

Huang discloses an LED tube light that includes glass tube 1, base 2, light emitting unit 3, and glue 4, where light emitting unit 3 includes a plurality of LEDs 32. EX1003, 2:27-32, 3:33-35; *see also id.*, 3:42-49, 4:34-36, FIGS. 2 and 3. “The base 2 and the light emitting unit 3 are inserted into the glass tube 1, and the circular arc surface 221 of the connecting portion 22 is adhered to the inner surface of the glass tube 1 by the glue 4 (e.g., silica gel).” EX1003, 3:64-67.



EX1003, FIG. 2.

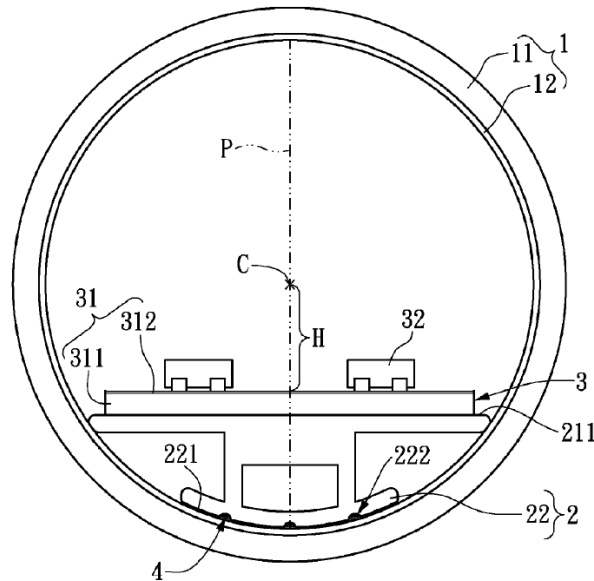


FIG. 3A

EX1003, FIG. 3A.

A POSITA would understand that light emitting unit 3 of Huang discloses an LED light strip disposed (e.g., via base 2 and glue 4) on an inner surface of glass tube 1 with a plurality of LED light sources (LEDs 32) mounted on the LED light strip. EX1003, FIG. 2; EX1004, ¶122.

(e) Limitation 1[d]

Jing-Huang teaches a power supply disposed at one end of the tube and electrically connected to the LED light sources. EX1004, ¶¶123-125. Jing discloses “a plug with a driver arranged on both ends of the lamp tube 1 and electrically connecting the circuit board 2 with the external power supply (Or one end is an open end, the other end is a closed LED horizontal insertion lamp 7, that is, the circuit board is installed into the lamp tube through the open end of the horizontal insertion

lamp tube, and then the plug with the driver electrically connected to the external power supply is blocked on the open end, as shown in Figure 6).” EX1002, ¶[0027]; *see also id.*, ¶[0003], [0008]. Claim 1, FIG. 6:

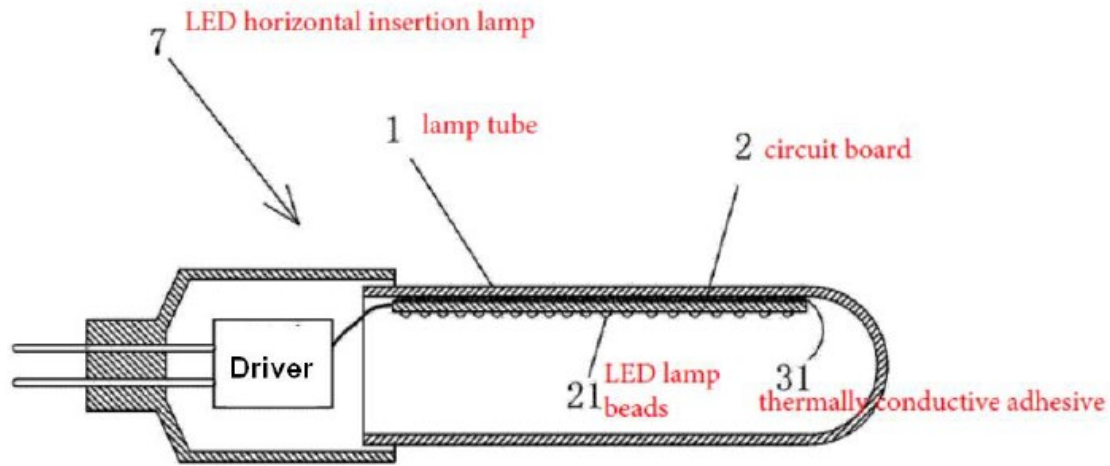


Figure 6

EX1002, FIG. 6⁴. Jing also discloses that, “a plug with a driver [is] arranged on both ends of the lamp tube 1.” EX1002, ¶[0027]; *see also id.*, ¶[0003] (“...the LED fluorescent lamp in the prior art is composed of a glass lamp tube 1, a light emitting component arranged in the lamp tube 1, and a plug with a driver electrically connected to the light emitting component at both ends of the lamp tube.”).

A POSITA would understand that the driver of Jing discloses a power supply. EX1004, ¶124. For example, a POSITA would understand that the “external power supply” of Jing is an electricity source providing electricity to the driver via the plug

⁴ All colorized drawings herein are annotated.

and that the driver performs functions such as rectification and filtering to provide the electricity to circuit board 2 and LED lamp beads 21. *Id.* Further, Jing discloses that the driver may be disposed either at “one end” of lamp tube 1 or at “both ends of the lamp tube 1.” EX1002, ¶[0027]. Therefore, a POSITA would understand that the driver of Jing discloses a power supply that is disposed at one end or two ends of lamp tube 1 and that is electrically connected to the LED lamp beads 21. EX1002, ¶[0027]; EX1004, ¶124.

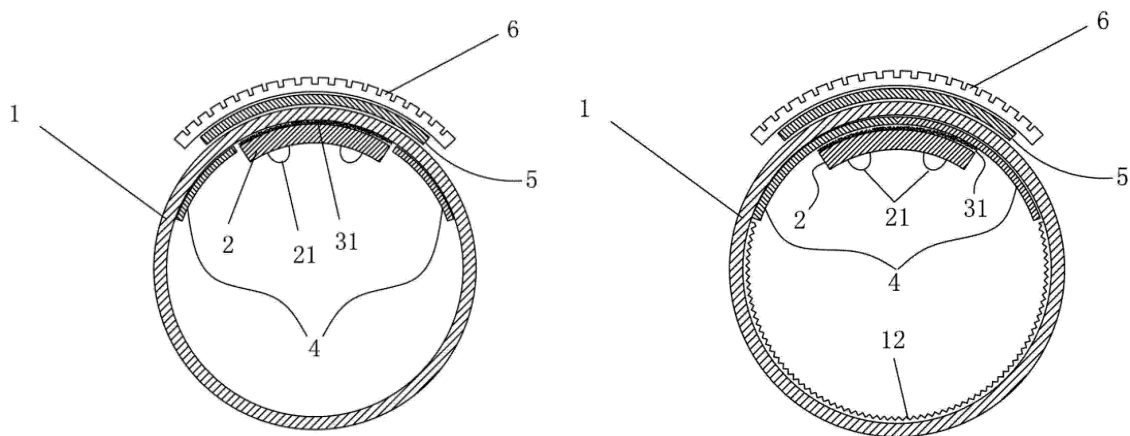
Huang similarly teaches that “*two conductive terminals installed to one of the lateral cover assemblies*, wherein the circuit board module has a socket connector and *an electronic unit mounted on the circuit board and arranged between the conductive terminals and the LEDs*, and wherein the socket connector is electrically connected to the LEDs by the circuit board and the terminals by at least one wire.” EX1003, claim 8, 3:33-35, 3:50-55, 8:33-36, FIGS. 2, 4A.

(f) Limitation 1[e]

Jing-Huang teaches a reflective film disposed on a portion of the inner surface of the tube. EX1004, ¶¶126-127. Jing discloses that “reflective film layers on the inner and outer walls of the lamp tube, so that the light so that the light emitted from the LED light source to the back of the lamp tube can be fully utilized due to reflection, thereby correspondingly enhancing the luminance of the fluorescent lamp.” EX1002, Summary. Jing further describes that “[a]n inner reflective film

layer is arranged on the inner wall of the lamp tube corresponding to the back of the circuit board. The inner reflective film layer is set as a continuous film layer or a discontinuous film layer in the circumference direction of the inner wall of the lamp tube.” EX1002, ¶[0012]. “The inner and external reflective film layer are electric coating, spray coating, vacuum coating or aluminum foil layer.” EX1002, ¶[0016].

“The further improvement ... is that the inner wall of the lamp tube 1 corresponding to the back of the circuit board 2 is coated with a film that can reflect light by electroplating, spraying or vacuum coating. An aluminum foil layer can also be pasted, hereinafter referred to as inner reflective film layer 4. The inner reflective film layer 4 can be either a metal film layer or a PVC reflective film layer made by a new process in the prior art.” EX1002, ¶[0032]; *see also id.*, ¶¶[0013], [0018], [0026], [0032], [0034], [0035], claims 5, 6, 9, FIGS. 2, 4.



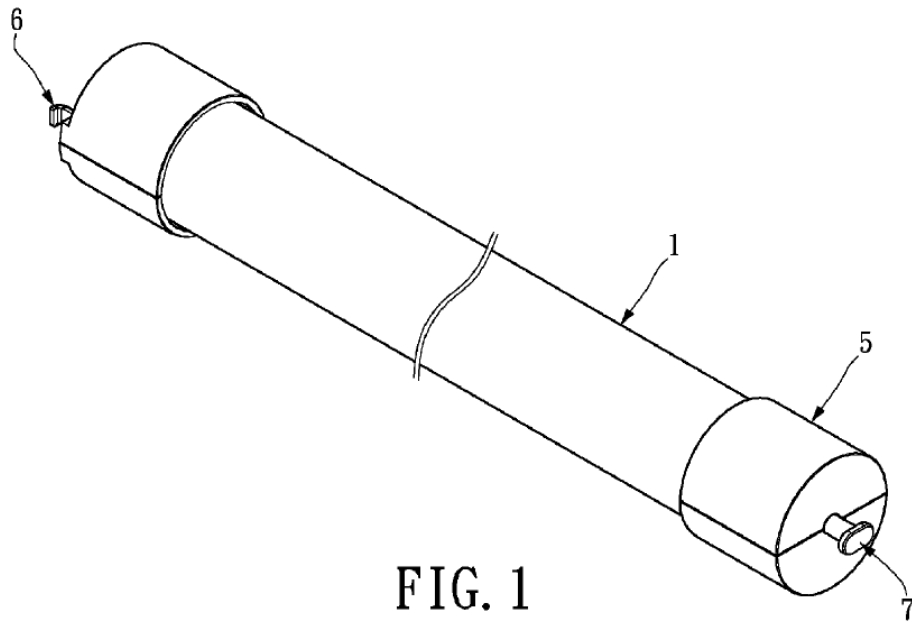
EX1002, FIGS. 2 and 4.

(g) Limitation 1[f]

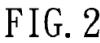
Jing-Huang teaches a tube with a main body region coupled to two rear end regions and the end caps coupled to the rear end regions. EX1004, ¶¶128-129. Jing describes that “the LED fluorescent lamp of the Utility Model is composed of a lamp tube 1 with a circular section and glass material, a circuit board 2 arranged in the lamp tube 1 extending along the axis, and a plug with a driver arranged on both ends of the lamp tube 1 EX1002, ¶[0027]. Jing also teaches that “the LED fluorescent lamp in the prior art is composed of a glass lamp tube 1, a light emitting component arranged in the lamp tube 1, and a plug with a driver electrically connected to the light emitting component at both ends of the lamp tube.” EX1002, ¶[0003]; *see also id.*, [0028]. A POSITA would understand that ends of the lamp tube 1 covered by the end caps of Jing are “two rear end regions” and that the portion of the lamp tube 1 between the ends of the lamp tube 1 are a “main body region” of the lamp tube 1. EX1004, ¶128.

Huang likewise discloses an LED tube light that includes glass tube 1 and two lateral cover assemblies 5, where “[t]he two lateral cover assemblies are respectively covered around the two end portions of the glass tube.” EX1003, 1:24-28, 2:27-32; *see also id.*, Abstract, 2:44-61, 5:18-35, 6:18-23, 6:51-57. A POSITA would understand that the glass tube 1 of Huang includes two end portions, covered by the two lateral cover assemblies 5, and a main body region. EX1004, ¶129. For

example, a POSITA would understand that the “two end portions of the glass tube” of Huang disclose the claimed two rear end regions and that the portion of the glass tube between (or other than) the “two end portions of the glass tube” discloses the claimed main body region. *Id.*; EX1003, 1:24-28.



EX1003, FIG. 1.

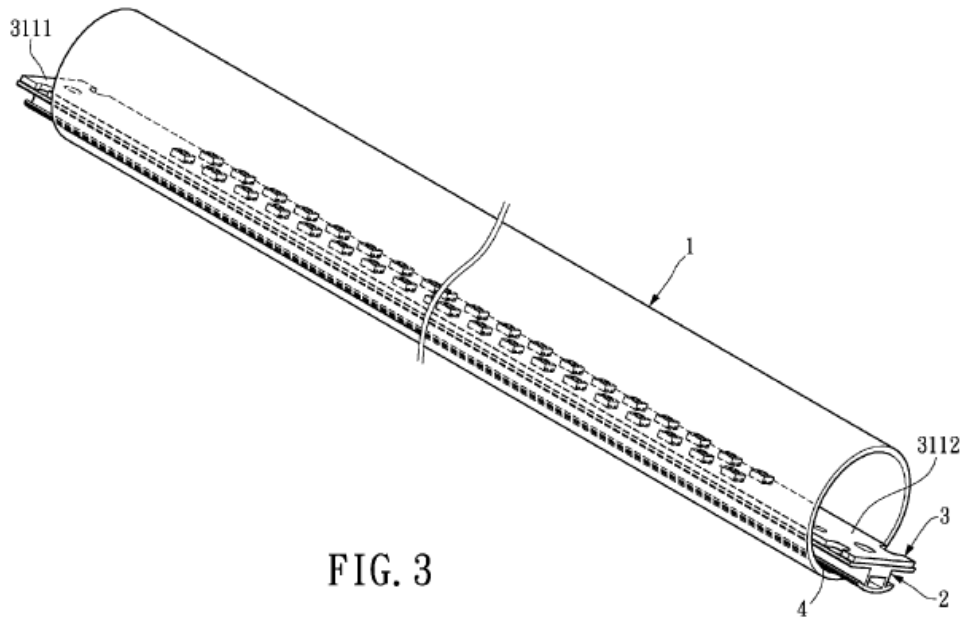


EX1003, FIG. 2.

(h) Limitation 1[g]

Jing-Huang teaches the length of the light strip is longer than the main body region of the tube. EX1004, ¶¶130-132. As discussed in §VIII.A.5(g), a POSITA would understand that the glass tube 1 of Huang includes two end portions and a main body region. For example, a POSITA would understand that the “two end portions of the glass tube” of Huang disclose the claimed two rear end regions and that the portion of the glass tube between (or other than) the “two end portions of the glass tube” discloses the claimed main body region. EX1004, ¶130; EX1003, 1:24-28.

Huang discloses that the length of light emitting unit 3 is longer than the length of the main body region of glass tube 1. EX1004, ¶131; EX1003, FIG. 3.



EX1003, FIG. 3; *see also id.*, FIG. 2, 2:44-58.

As shown in FIG. 3 of Huang, light emitting unit 3 extends within and outside of glass tube 1. EX1003, FIG. 3.; *see also id.*, Abstract (“The base has a length larger than the length of the glass tube, wherein two opposite end portions of the base are arranged out of a region defined by orthographically projecting from the glass tube to the base.”); 1:24-28 (“The base has a length larger than the length of the glass tube.”); 2:52-56 (“The length L2 of the base 2 is larger than the length L1 of the glass tube 1. Specifically, the two opposite end portions of the base 2 are arranged out of a region defined by orthographically projecting from the glass tube 1 to the base 2.”), claim 10. A POSITA would therefore understand that light emitting unit 3, mounted on base 2, is longer than the entirety of glass tube 1. EX1004, ¶132; EX1003, 1:24-28; 3:60-63 (“The light emitting unit 3 takes a back

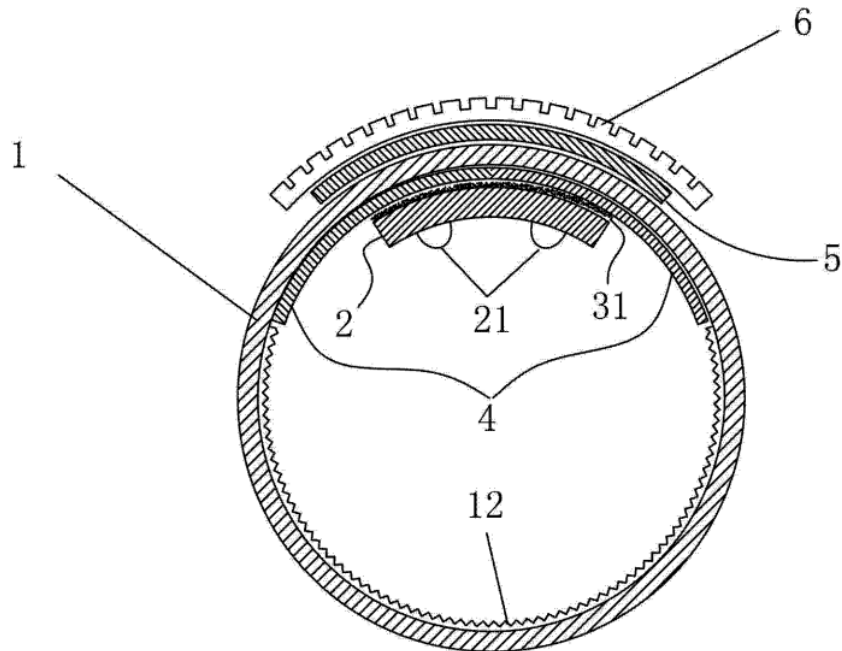
surface of the circuit boards 311 to dispose on the mounting surface 211 of the base 2, and the circuit boards 311 are fixed on the base 2 by screws, adhesives, or other suitable means.”); 6:18-23. Further, because light emitting unit 3 is longer than the entirety of glass tube 1, a POSITA would also understand that light emitting unit 3 is longer than the portion of the glass tube between (or other than) the “two end portions of the glass tube” (i.e., the claimed main body region). EX1004, ¶132; EX1003, 1:24-28.

(i) Claim 2

Jing-Huang teaches a portion of the inner surface of the tube is covered by the rough surface and another portion is covered by the reflective film. EX1004, ¶133. As discussed in §§VIII.A.5(b) and VIII.A.5(f), Jing discloses the claimed rough surface (frosted layer 12, also referred to as sanding layer 12) and the claimed reflective film (inner reflective film layer 4). Further, “[o]n the inner wall of the lamp tube 1, the area without inner reflective film layer [4] can be the inner wall of the frosted layer.” EX1002, ¶[0035]. “The inner wall of the lamp tube without the inner reflective film layer is the inner wall of the frosted layer.” EX1002, ¶[0013]; *see also id.*, claims 5, 6, 9, Summary, ¶¶[0012], [0013], [0016], [0018], [0026], [0032], [0034], FIGS. 4, 5. A POSITA would understand that a portion of the inner surface of lamp tube 1 of Jing includes frosted layer 12 and that another portion of

the inner surface of the lamp tube 1 of Jing is covered by inner reflective film layer

4. EX1004, ¶133.

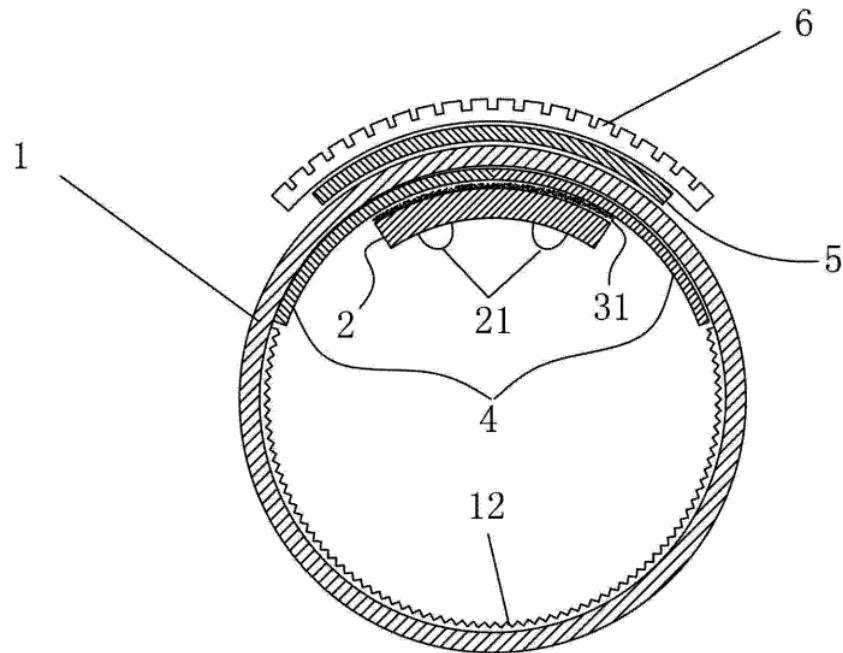


EX1002, FIG. 4.

(j) Claim 3

Jing-Huang teaches the portion of the inner surface not covered by the reflective film is covered by the rough surface. EX1004, ¶134. As discussed in §§VIII.A.5(b) and VIII.A.5(f), Jing discloses the claimed rough surface (frosted layer 12, also referred to as sanding layer 12) and the claimed reflective film (inner reflective film layer 4. Further, “[o]n the inner wall of the lamp tube 1, the area without inner reflective film layer [4] can be the inner wall of the frosted layer.” EX1002, ¶[0035]. “The inner wall of the lamp tube without the inner reflective film layer is the inner wall of the frosted layer.” EX1002, ¶[0013]; *see also id.*, claims 5,

6, 9, Summary, ¶¶[0012], [0013], [0016], [0018], [0026], [0032], [0034], FIGS. 4, 5. A POSITA would understand that a portion of the inner surface of lamp tube 1 of Jing includes frosted layer 12 and that another portion of the inner surface of the lamp tube 1 of Jing is covered by inner reflective film layer 4. EX1004, ¶134.



EX1002, FIG. 4.

(k) Limitation 8[p]

See Limitation 1[p], §VIII.A.5(a).

(l) Limitation 8[a]

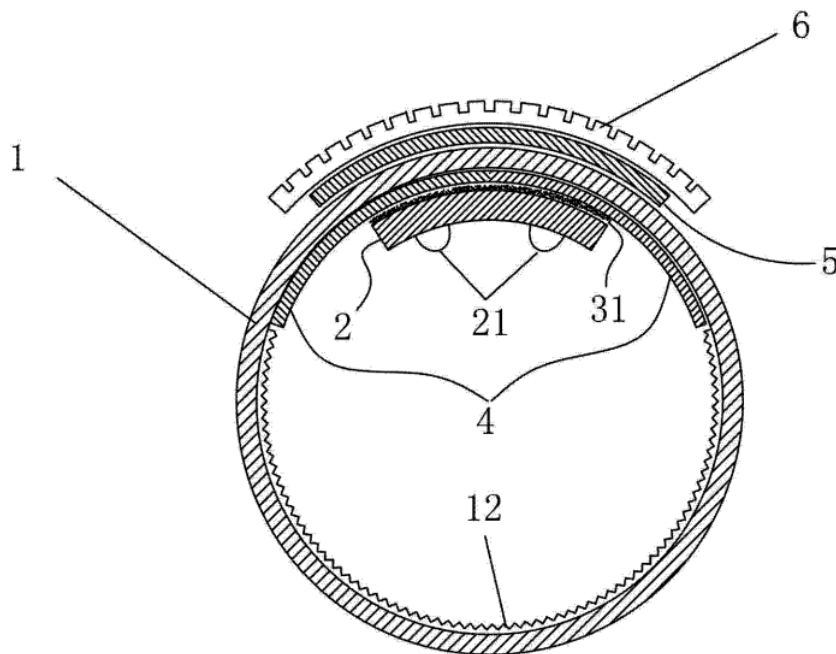
See Limitation 1[a], §VIII.A.5(b).

(m) Limitation 8[b]

Jing-Huang teaches a diffusion film coated on an inner surface of the tube.

EX1004, ¶¶137-138. “The inner wall of lamp tube 1 can be ... an inner wall with all

or part of the rough surface treatment (the rough surface treated inner wall is called sanding layer 12),” where “rough surface treatment refers to the treatment of sanding or spraying the inner wall of the lamp tube to make the light emitted by the lamp tube diffuse evenly and softly.” EX1002, ¶[0027]; see also *id.*, Claim 6, ¶¶[0013], [0026], [0035].



EX1002, FIG. 4.

By “mak[ing] the light emitted by the lamp tube diffuse evenly and softly,” and by being formed by “sanding or spraying the inner wall of the lamp tube,” sanding layer 12 is a diffusion film that is coated on the inner surface of lamp tube 1 (by “). EX1004, ¶138; EX1002, [0027]. Hence, a POSITA would understand that sanding layer 12 discloses the claimed diffusion film coated on an inner surface of the glass lamp tube. EX1004, ¶138; EX1002, [0027].

(n) Limitation 8[c]

See Limitation 1[c], §VIII.A.5(d).

(o) Limitation 8[d]

See Limitation 1[e], §VIII.A.5(f).

(p) Limitation 8[e]

See Limitation 1[b], §VIII.A.5(c).

(q) Limitation 8[f]

See Limitation 1[d], §VIII.A.5(e).

(r) Limitation 8[g]

Jing-Huang teaches the diffusion film has a rough surface where the roughness is higher than that of the outer surface of the tube. EX1004, ¶143. As discussed for Limitation 8[b], §VIII.A.5(m), sanding layer 12 of Jing discloses the claimed diffusion film. Further, as discussed for Limitation 1[a], §VIII.A.5(b), sanding layer 12 discloses the claimed rough surface having a roughness higher than that of an outer surface of the lamp tube 1. A POSITA would understand that sanding layer 12 discloses the claimed diffusion film having a rough surface, the roughness of the rough surface is higher than that of an outer surface of the glass lamp tube. EX1004, ¶143.

(s) Limitation 8[h]

Jing-Huang teaches a portion of the inner surface of the tube is covered by the rough surface and a portion is covered by the reflective film. EX1004, ¶144. As

discussed for Limitation 8[b], §VIII.A.5(m), sanding layer 12 of Jing discloses the claimed diffusion film having the claimed rough surface. Further, as discussed for Claim 2, §VIII.A.5(i), a portion of the inner surface of lamp tube 1 is covered by sanding layer 12, and a portion of the inner surface of lamp tube 1 is covered by inner reflective film layer 4 (the claimed reflective film). A POSITA would therefore understand that Jing discloses the claimed portion of the inner surface of the glass lamp tube covered by the rough surface and the claimed portion of the inner surface of the glass lamp tube covered by the reflective film. EX1004, ¶144.

(t) Limitation 8[i]

See Limitation 1[f], §VIII.A.5(g).

(u) Limitation 8[j]

See Limitation 1[g], §VIII.A.5(h).

(v) Claim 9

See Claim 2, §VIII.A.5(i).

(w) Limitation 14[p]

See Limitation 1[p], §VIII.A.5(a).

(x) Limitation 14[a]

See Limitation 1[a], §VIII.A.5(b).

(y) Limitation 14[b]

See Limitation 1[c], §VIII.A.5(d).

(z) Limitation 14[c]

See Limitation 1[b], §VIII.A.5(c).

(aa) Limitation 14[d]

See Limitation 1[d], §VIII.A.5(e).

(bb) Limitation 14[e]

Jing-Huang teaches an inner surface of the tube covered by a rough surface with a roughness higher than the outer surface and a reflective layer. EX1004, ¶153. As discussed for Limitation 1[a], §VIII.A.5(b), sanding layer 12 of Jing discloses the claimed rough surface of claim 1. A POSITA would also understand sanding layer 12 to disclose the claimed rough layer. EX1004, ¶153. Further, as discussed for Limitation 1[e] and claim 2, §§VIII.A.5(f) and VIII.A.5(i), Jing discloses a reflective layer on an inner portion of the glass tube.

(cc) Limitation 14[f]

See Limitation 1[f], §VIII.A.5(g).

(dd) Limitation 14[g]

See Limitation 1[g], §VIII.A.5(h).

(ee) Claim 15

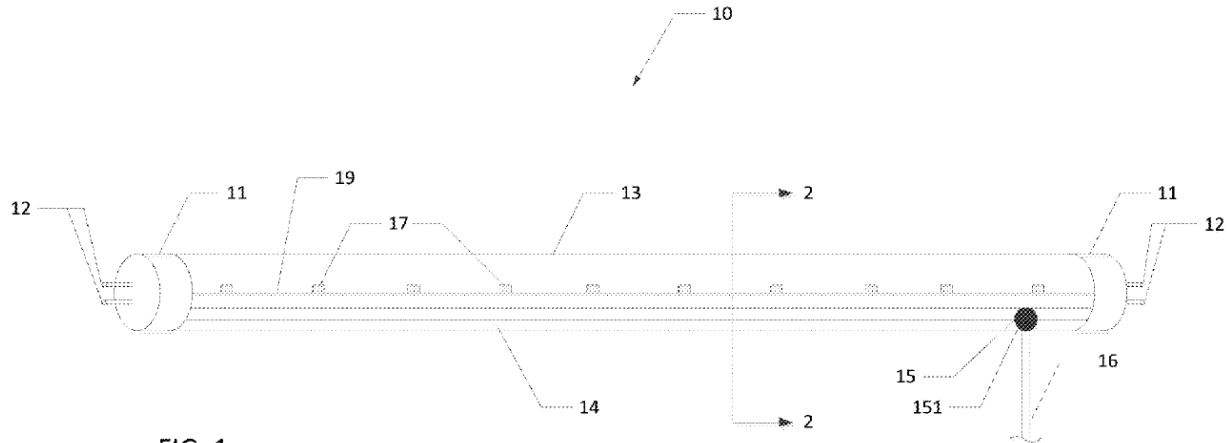
See Claim 2, §VIII.A.5(i).

B. Ground 2 – Claims 1-3, 8, 9, 14, and 15 Are Obvious Over Jing and Halliwell

See §§VIII.A.1, VIII.A.3(a) for a discussion of Jing.

1. Halliwell

Halliwell discloses an LED lamp tube 10 that “comprises at least one light emitting diode (LED) 17).” EX1008, 11:31-33. “The LEDs are mounted on reflective back plate 19...in certain embodiments, reflective back plate 19 may divide the tube into two chambers of nearly equal volume.” *Id.*, 11:48-54. End caps 11 are secured to the reflective back plate 19. *Id.*, 8:56-58.



EX1008, FIG. 1.

“[T]he body of the lamp tube 10 comprises a lens 13.” EX1008, 4:62-66. “[T]he lens 13 may be made of Smart Glass, or some other material that can transition from clear to frosted and/or vice versa.” *Id.*, 5:49-53.

“[D]river circuitry 18 is disposed within the body of LED lamp tube 10.” EX1008, 12:11-12. “[D]river circuitry 18 may comprise a circuit portion configured to convert the input alternating current (AC) line voltage to a direct current (DC)

voltage.” *Id.*, 12:12-15, 12:15-29, 12:59-66, 13:25-33. Halliwell describes that “the driver circuitry may be mounted on the reflective back plate 19” and “the driver circuitry may be mounted in an end cap 11 disposed on an end of LED tube lamp 10.” *Id.*, 12:30-37 Driver circuitry 18 can also be “disposed within the chamber defined by the back cover 14 and reflective back plate 19” (*id.*, 12:30-32) and, as shown in FIG. 16, interior electrical wires 165 and 166 are “coming up from the chamber defined by the back cover 14 and the reflective back plate 19 and soldered onto an electrical contact point on reflective back plate 19” (*id.*, 13:44-61).

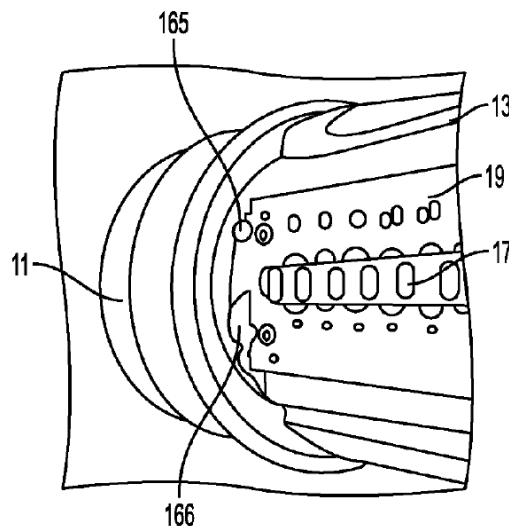


FIG. 16

As shown in FIGS. 7-9, 16, and 17, reflective back plate 19 extends into end caps 11:

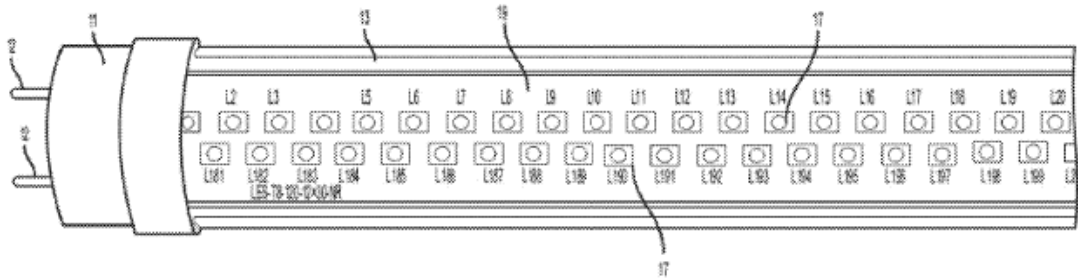


FIG. 7

EX1008, FIG. 7.

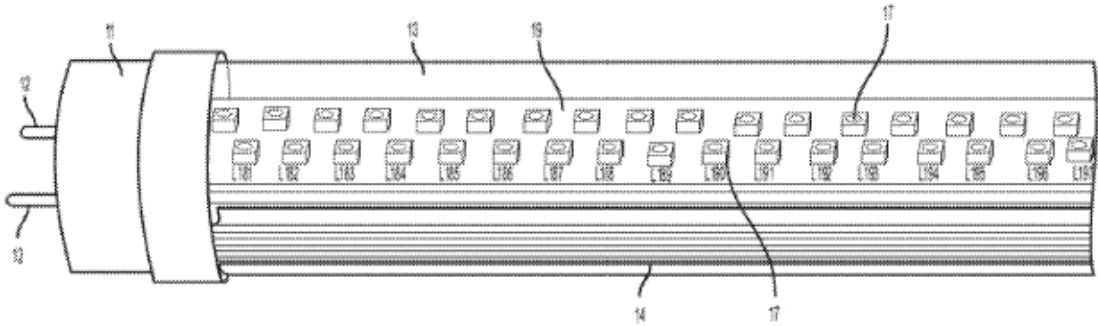


FIG. 8

EX1008, FIG. 8.

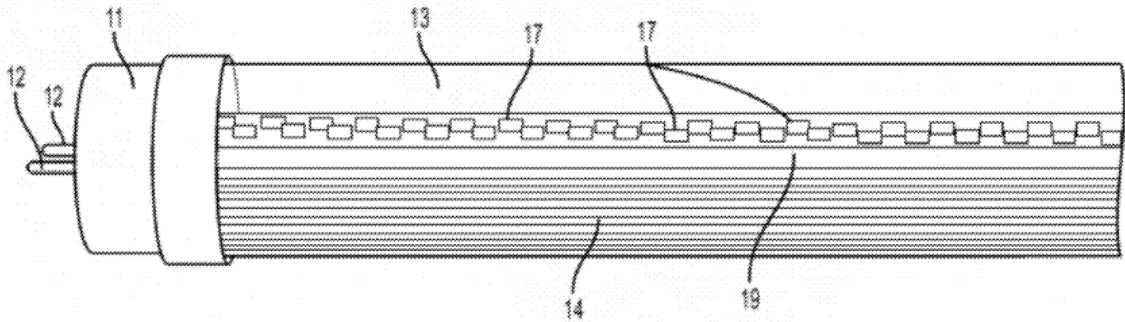


FIG. 9

EX1008, FIG. 9.

FIG. 17 illustrates that reflective back plate 19 may include an identifier or other information:

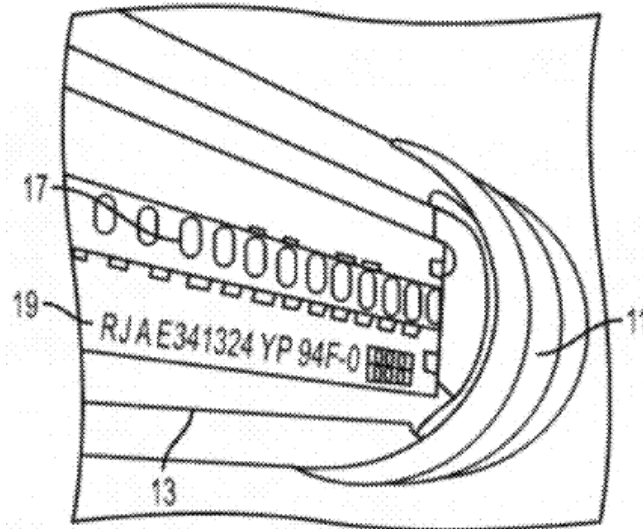


FIG. 17

EX1008, FIG. 17.

2. *Motivation to combine*

A POSITA would have been motivated to search for ways to improve performance and reliability of the LED fluorescent lamp of Jing through routine experimentation. EX1004, ¶157. For example, Jing discloses that heat resistance is one problem that can exist in an LED lamp, resulting in poor heat dissipation for the LED lamp. EX1002, ¶[0005]; EX1004, ¶157. A POSITA would know that poor heat dissipation can result in damage to or failure of one or more components of an LED lamp. EX1004, ¶157; *see also* §VI.E (discussing EX1021, 167/367, 201/367, 203/367).

Halliwell discloses that an internal component of an LED lamp (in the form of back cover 14) can be configured to more efficiently dissipate heat. EX1008, 7:45-60; EX1004, ¶158. A POSITA would have known that other internal components of an LED lamp can also be used to dissipate heat from circuit board 2 of Jing. EX1004, ¶158. A POSITA would have recognized that increasing the length of circuit board 2 of Jing could improve performance by improving heat distribution and reducing heat resistance. *Id.* For example, a POSITA would have known that increasing the length of circuit board 2 would enable greater spacing between components on circuit board 2. *Id.* A POSITA would have known that the greater spacing between the components would reduce heat transfer between the components. *Id.* The POSITA would also have known that the reduced heat transfer would reduce likelihood of component failure (e.g., due to overheating or heat damage), improving reliability. *Id.*; *see also* §VI.E (discussing EX1021, 167/367, 201/367, 203/367).

A POSITA would have also known that increasing the length of circuit board 2 of Jing would increase the surface area of circuit board 2. EX1004, ¶159. The POSITA would have known that the increased surface area would enable the POSITA to increase the quantity or size of components on circuit board 2 (such as LEDs). *Id.* As a result, by increasing the length of circuit board 2, a POSITA would have been able to modify parameters of the LED fluorescent lamp, such by

increasing brightness or to adding different types (e.g., colors) of LEDs, improving performance. *Id.*

A POSITA would have also understood that increasing the length of circuit board 2 would be an area available for other purposes. EX1004, ¶160. For example, the POSITA would have known that by increasing the length of circuit board 2, area may be available for marking circuit board 2 or displaying information on circuit board 2. *Id.* A POSITA would have known that such information can simplify some manufacturing processes, such as by identifying a model number of the LED fluorescent lamp or placement of components on circuit board 2, potentially reducing manufacturing cost. *Id.*

A POSITA would have understood that increasing the length of circuit board 2 would not substantially increase manufacturing cost of the LED fluorescent lamp and that the proposed benefits substantially outweigh any increased cost resulting from the increased length. EX1004, ¶161. The POSITA would therefore have attempted to increase the length of circuit board 2. *Id.*

A POSITA would have found it obvious to try to increase the length of circuit board 2 with an expectation of success. EX1004, ¶162. For example, a POSITA would have realized that, as shown on the left of FIG. 6 of Jing, circuit board 2 can be lengthened by at least a distance D :

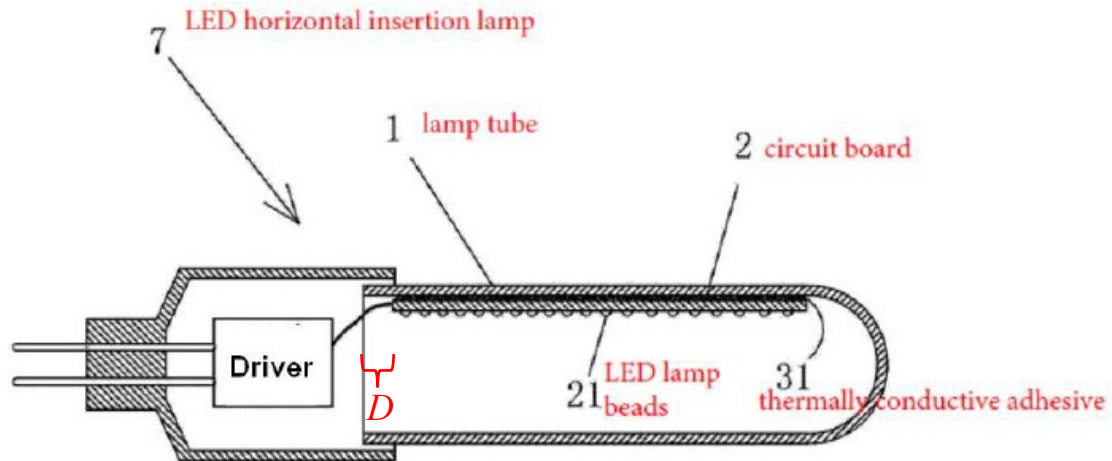


Figure 6

EX1002, FIG. 6; EX1004, ¶162. Similarly, circuit board 2 of Jing can be similarly lengthened on the right side when in a configuration having two end caps. EX1002, ¶[0027] (the LED lamp “is composed of ... a plug with a driver arranged on both ends of the lamp tube 1 and electrically connecting the circuit board 2 with the external power supply”); EX1004, ¶162.

A POSITA would have known that circuit board 2 of Jing has rigidity sufficient to support the lengthening. EX1004, ¶163. For example, because Jing discloses that circuit board 2 may be “made of aluminum base PCB,” a POSITA would have known that circuit board 2 has rigidity sufficient to support the lengthening without introducing breakage or a large amount of bending. EX1002, ¶¶[0016], [0027], [0028], claim 10; EX1004, ¶163; *see also* §VI.C (discussing EX1012, 1:13-16).

In lengthening circuit board 2, a POSITA would have looked to Halliwell. EX1004, ¶164. A POSITA would have found it obvious to modify the length of circuit board 2 of Jing with the length taught by Halliwell to achieve one or more of the above-described benefits that would have been known to the POSITA, such as improved performance and reliability. *Id.* A POSITA would have known, for example, and as illustrated in FIG. 17 of Halliwell, that the additional surface area of circuit board 2 would allow for marking the circuit board 2 with an identifier or other information, which may assist during a manufacturing process and which may potentially reduce manufacturing cost, or for the mounting of all or portions of driver circuit or connections to the driver circuit, as taught by Halliwell:

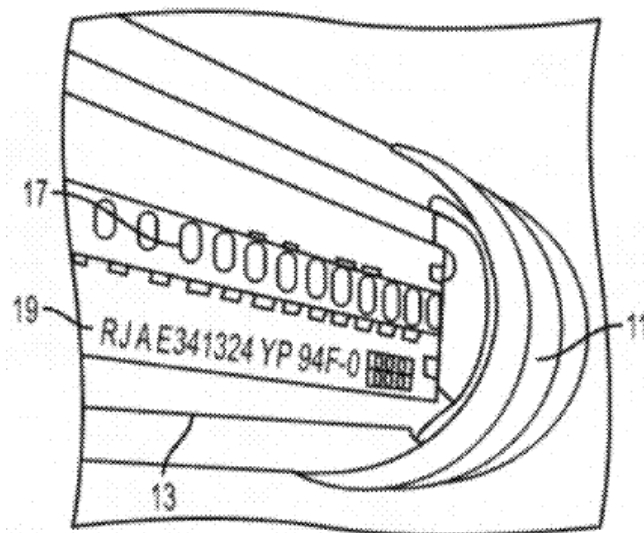


FIG. 17

EX1008, FIG. 17, FIG. 16, 12:30-45, 13:44-61; EX1004, ¶164.

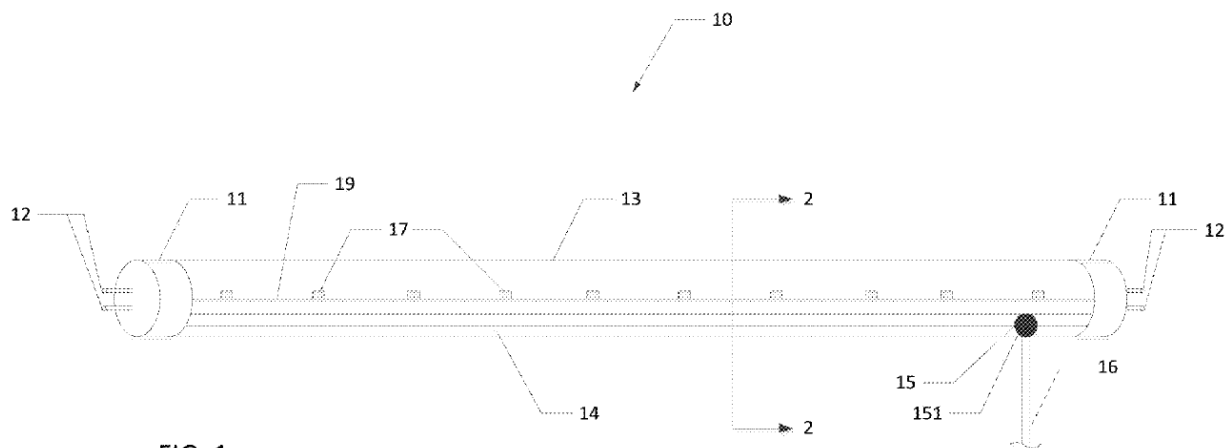
3. *Modification with Halliwell*

Combining the LED fluorescent lamp of Jing with the length taught by Halliwell would produce an LED lamp tube (e.g., the LED fluorescent lamp of Jing) that includes at least a light strip (e.g., board 2 of Jing) and a glass lamp tube (e.g., lamp tube 1 of Jing). EX1004, ¶165; EX1002, FIG. 4. The light strip would be longer than a main body region of the glass lamp tube, as disclosed by Halliwell. EX1004, ¶165; EX1008, FIGS. 7-9 and 17.

4. *Element-by-Element Analysis*

(a) *Limitation 1[p]*

To the extent it may be limiting, Jing-Halliwell teaches an LED tube lamp. EX1004, ¶166. *See* Limitation 1[p], §VIII.A.5(a) (discussion of Jing). Halliwell likewise discloses an LED lamp tube 10 that “comprises at least one light emitting diode (LED) 17).” EX1008, 11:31-33.



EX1008, FIG. 1.

(b) Limitation 1[a]

Jing-Halliwell teaches a glass tube lamp with an inner surface covered by a rough surface with a roughness higher than the outer surface. *See* Limitation 1[a], §VIII.A.5(b); EX1004, ¶167.

(c) Limitation 1[b]

Jing-Halliwell teaches two end caps coupled to the ends of the glass lamp tube. *See* Limitation 1[b], §VIII.A.5(c) (discussion of Jing); EX1004, ¶168. Halliwell likewise teaches “the LED lamp tube 10 may further comprise an end cap 11 disposed on each end the body of the LED lamp tube 10.” EX1008, 8:10-12; FIGS. 1, 6-12, 16-18.

(d) Limitation 1[c]

Jing-Halliwell teaches an LED light strip with a plurality of LED light sources disposed on an inner surface of the tube. *See* Limitation 1[c], §VIII.A.5(d) (discussion of Jing); EX1004, ¶169. Halliwell further teaches that “[t]he LEDs are *mounted on reflective back plate 19* by any of various methods generally known and understood in art.” EX1008, 11:48-54. As shown in FIG. 2, “reflective back plate 19 may be *disposed along a diameter of the cross section of LED lamp tube 10*.” *Id.*; FIG. 2.

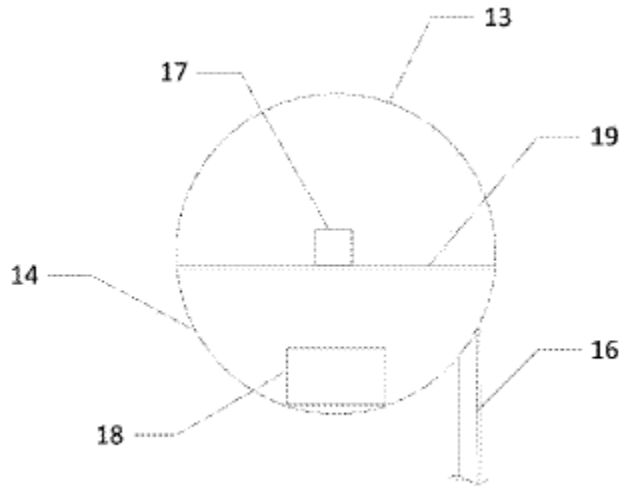


FIG. 2

(e) Limitation 1[d]

Jing-Halliwell teaches a power supply disposed at one end of the tube and electrically connected to the LED light sources. *See* Limitation 1[d], §VIII.A.5(e) (discussion of Jing); EX1004, ¶170. Halliwell further teaches that “driver circuitry 18 may comprise a circuit portion configured to convert the input alternating current (AC) line voltage to a direct current (DC) voltage.” EX1008, 12:12-15, 12:15-29, 12:59-66. “The output of the driver circuitry 18 is fed to one or more LEDs 17 which may be connected in series or in parallel.” The LEDs 17 use the electrical power to emit light.” *Id.*, 13:25-33. Halliwell describes that “the driver circuitry may be mounted in an end cap 11 disposed on an end of LED tube lamp 10.” *Id.*, 12:30-37.

(f) Limitation 1[e]

Jing-Halliwell teaches a reflective film disposed on a portion of the inner surface of the tube. *See* Limitation 1[e], §VIII.A.5(f); EX1004, ¶171.

(g) Limitation 1[f]

Jing-Halliwell teaches a tube with a main body region coupled to two rear end regions and the end caps coupled to the rear end regions. *See* Limitation 1[f], §VIII.A.5(g) (discussion of Jing); EX1004, ¶172. Halliwell teaches that “the LED lamp tube comprises: a substantially elongate member comprising a first end surface, a second end surface, and an intermediate surface substantially between the first and second end surfaces.” EX1008, 2:14-19, 2:26-3:57. “The first and second end surfaces may likewise comprise the at least one end cap 11.” *Id.*, 5:10-15. “[T]he LED lamp tube 10 may further comprise an end cap 11 disposed on each end the body of the LED lamp tube 10.” EX1008, 8:10-12; FIGS. 1, 6-12, 16-18. A POSITA would understand that ends of LED lamp tube 10 covered by the end caps 11 are “two rear end regions” and that the portion of LED lamp tube 10 between the ends are a “main body region” of LED lamp tube 10. EX1004, ¶172.

(h) Limitation 1[g]

Jing-Halliwell teaches the length of the light strip is longer than the main body region of the tube. EX1004, ¶¶173-175. As discussed in §VIII.B.4(g), a POSITA would understand that LED lamp tube 10 of Halliwell includes two rear end regions and a main body region. For example, a POSITA would understand that the “first and second end surfaces” covered by the end caps 11 of Halliwell disclose the claimed two rear end regions and that the “intermediate surface substantially

between the first and second end surfaces” discloses the claimed main body region.

EX1004, ¶173; EX1008, 5:10-15; 2:14-19, 2:26-3:57.

As shown in FIGS. 7-9, 16, and 17, Halliwell teaches that reflective back plate 19 extends into the portion of LED tube lamp 10 covered by end caps 11 (the rear end region):

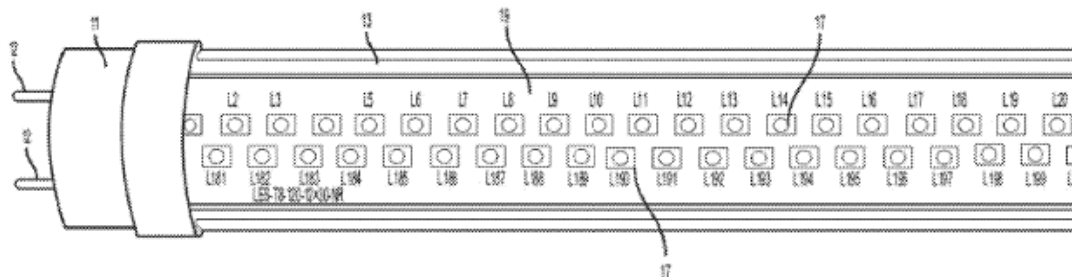


FIG. 7

EX1008, FIG. 7.

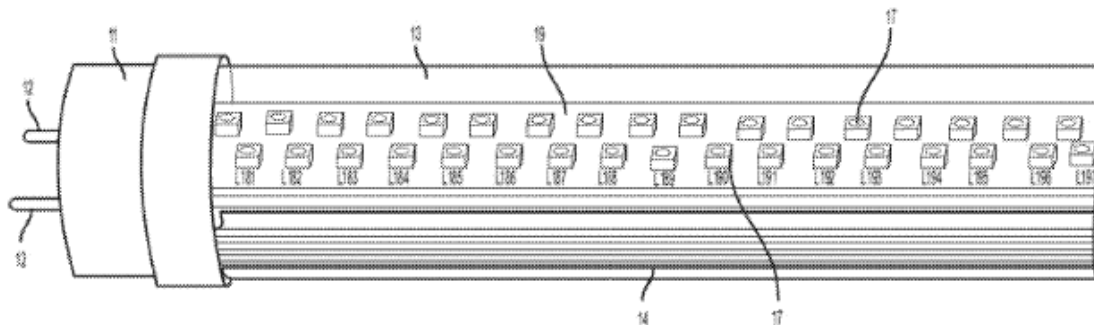


FIG. 8

EX1008, FIG. 8.

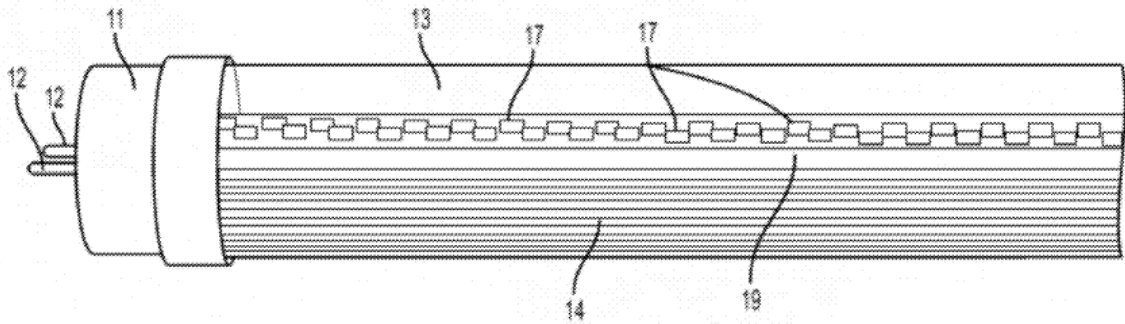


FIG. 9

EX1008, FIG. 9.

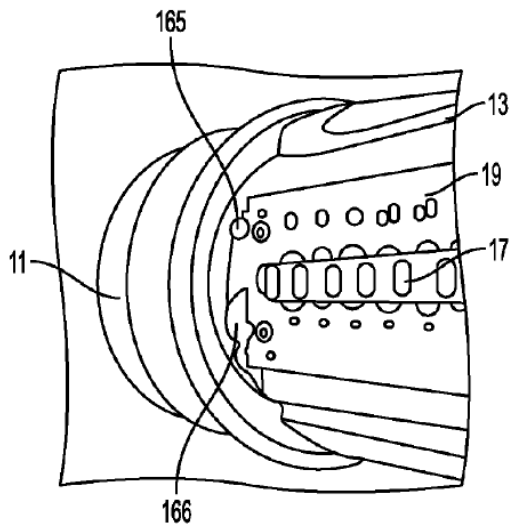


FIG. 16

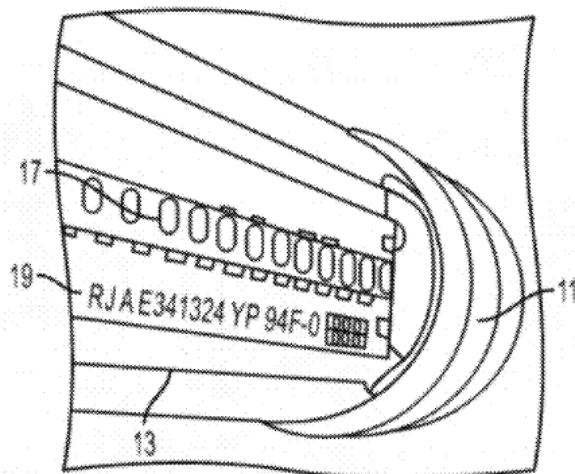


FIG. 17

EX1008, FIGS. 16, 17.

A POSITA would have understood that reflective back plate 19 with mounted LEDs 17 disclose an LED light strip. EX1004, ¶175. A POSITA would also have understood that because reflective back plate 19 extends into the region of LED tube

lamp 10 covered by end caps 11, reflective back plate 19 is longer than a main body region of LED tube lamp 10. EX1004, ¶175.

(i) Claims 2, 3, 8, 9, 14, and 15

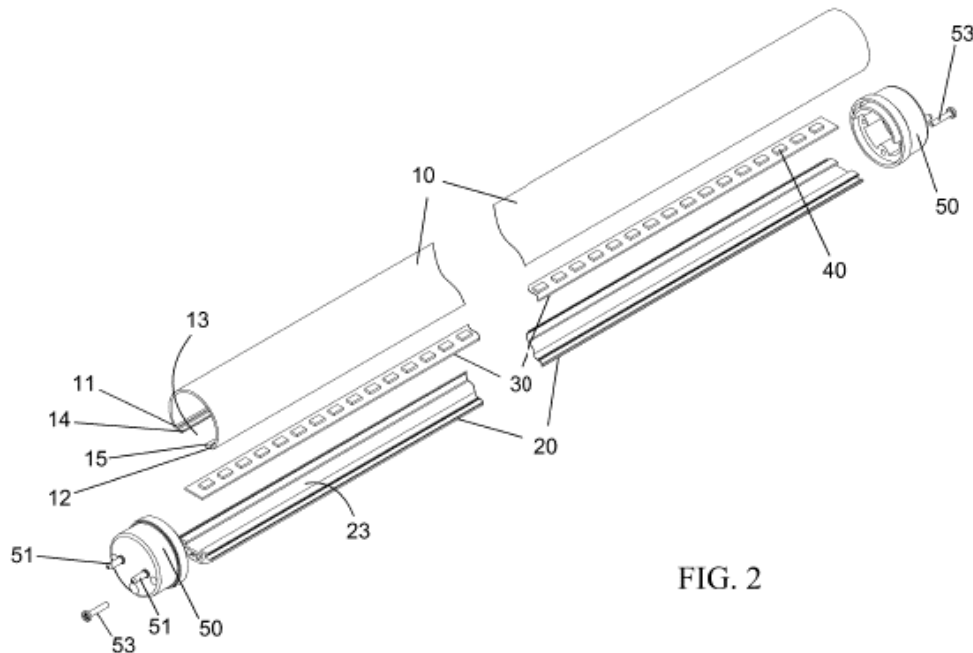
Claims 2, 3, 8, 9, 14, and 15 are rendered obvious by Jing-Halliwell based on the following:

Claim/ Limitation	Disclosure in Jing-Halliwell
2	<i>See Claim 2, Ground 1, §VIII.A.5(i)</i>
3	<i>See Claim 3, Ground 1, §VIII.A.5(j)</i>
8[p]	<i>See Limitation 1[p], Ground 2, §VIII.B.4(a)</i>
8[a]	<i>See Limitation 1[a], Ground 2, §VIII.B.4(b)</i>
8[b]	<i>See Limitation 8[b], Ground 1, §VIII.A.5(m)</i>
8[c]	<i>See Limitation 1[c], Ground 2, §VIII.B.4(d)</i>
8[d]	<i>See Limitation 1[e], Ground 2, §VIII.B.4(f)</i>
8[e]	<i>See Limitation 1[b], Ground 2, §VIII.B.4(c)</i>
8[f]	<i>See Limitation 1[d], Ground 2, §VIII.B.4(e)</i>
8[g]	<i>See Limitation 8[g], Ground 1, §VIII.A.5(r)</i>
8[h]	<i>See Limitation 8[h], Ground 1, §VIII.A.5(s)</i>
8[i]	<i>See Limitation 1[f], Ground 2, §VIII.B.4(g)</i>
8[j]	<i>See Limitation 1[g], Ground 2, §VIII.B.4(h)</i>
9	<i>See Claim 2, Ground 1, §VIII.A.5(i)</i>
14[p]	<i>See Limitation 1[p], Ground 2, §VIII.B.4(a)</i>
14[a]	<i>See Limitation 1[a], Ground 2, §VIII.B.4(b)</i>
14[b]	<i>See Limitation 1[c], Ground 2, §VIII.B.4(d)</i>
14[c]	<i>See Limitation 1[b], Ground 2, §VIII.B.4(c)</i>
14[d]	<i>See Limitation 1[d], Ground 2, §VIII.B.4(e)</i>
14[e]	<i>See Limitation 14[e], Ground 1, §VIII.A.5(bb)</i>
14[f]	<i>See Limitation 1[f], Ground 1, §VIII.A.5(g)</i>
14[g]	<i>See Limitation 1[f], Ground 2, §VIII.B.4(g)</i>
15	<i>See Claim 2, Ground 1, §VIII.A.5(i)</i>

C. Grounds 3 and 4 – Claim 4 Is Obvious Further in View of Foo

1. Foo

Foo describes an LED light tube 100 that includes casing 10, a plurality of LED light sources, and two end caps 50. EX1005, 6:10-22. “The inner surface of the casing 10 may be constructed to have *a surface roughness of smaller than 0.8μm to enhance the reflectance and reflux of the light.*” EX1005, 10:18-20. Foo discloses that “the casing has an inner surface with a surface roughness smaller than 0.8μm.” EX1005, claim 8. “By selecting a material having an appropriate combination of light diffusion, transmission and reflection characteristics, the casing can produce an evenly-distributed illumination along the length of the tube with high luminous efficiency.... [A]dvantageously the material is constructed to have a surface roughness smaller than 0.8μm, e.g. 6μm or 7μm” (*sic*). EX1005, 3:17-22.



EX1005, FIG. 2.

2. *Motivation to combine*

As explained in Sections VIII.A.3-VIII.A.5 for Ground 1, Jing-Huang renders obvious claim 3.

As explained in Sections VIII.B.2-VIII.B.4 for Ground 2, Jing-Halliwell renders obvious claim 3.

A POSITA would also have been motivated to combine Jing-Huang (Ground 3) or Jing-Halliwell (Ground 4) with the surface roughness taught by Foo with a reasonable expectation of success for several reasons. EX1004, ¶177.

Jing discloses that the inner wall of lamp tube 1 can be covered partially or entirely with a “rough surface treatment (the rough surface treated inner wall is called sanding layer 12).” EX1002, ¶[0027]. Jing’s “rough surface treatment refers

to the treatment of sanding or spraying the inner wall of the lamp tube to make the light emitted by the lamp tube diffuse evenly and softly.” *Id.* However, Jing does not specify a particular value or degree of that surface roughness. *Id.* A POSITA therefore would have been motivated to look elsewhere for specifics. EX1004, ¶178.

Foo likewise teaches that “[b]y selecting a material having an appropriate combination of light diffusion, transmission and reflection characteristics, *the casing can produce an evenly-distributed illumination along the length of the tube with high luminous efficiency.*” EX1005, 3:17-22. Foo also teaches that “advantageously the material is constructed to have a surface roughness smaller than 0.8μm” *Id.*

Incorporating Foo’s material with specific roughness characteristics would have been a known use of existing technology to provide capability for LED lamps. EX1004, ¶180. A POSITA would have been familiar with the uses and characteristics of rough films and treatments to improve lighting performance in LED tube lamps and to improve evenness of light distribution. EX1004, ¶180. Thus, when a POSITA selected a material to provide a rough surface on the interior surface of the LED lamp, the POSITA would have had a reasonable expectation that such an implementation would be successful. EX1004, ¶180. Therefore, a POSITA would have been motivated to use the surface roughness disclosed by Foo in an LED lamp as taught by Jing and Huang. EX1004, ¶180.

3. *Modification with Foo*

Combining the LED fluorescent lamp of Jing with the circuit board length taught by Huang or Halliwell and the surface roughness of Foo, would produce an LED lamp tube (e.g., the LED fluorescent lamp of Jing) that includes at least a light strip (e.g., board 2 of Jing) and a glass lamp tube (e.g., lamp tube 1 of Jing). EX1004, ¶181; EX1002, FIG. 4. The light strip would be longer than a main body region of the glass lamp tube, as disclosed by Huang and Halliwell. EX1004, ¶181; EX1003, FIG. 3. A portion of an inner surface of the glass lamp tube would be covered by a rough surface having a roughness from 0.1 to 40 μm , as taught by Foo. EX1004, ¶181.

4. *Element-by-Element Analysis*

(a) *Claim 4*

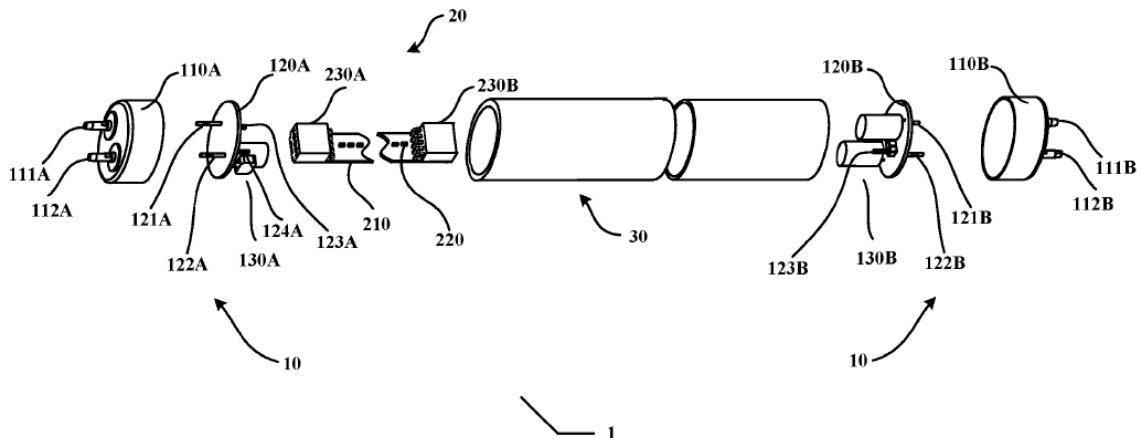
Jing-Huang-Foo (Ground 3) and Jing-Halliwell-Foo (Ground 4) teach a roughness of the rough surface that ranges from 0.1 to 40 μm . EX1004, ¶182. Foo describes an LED light tube 100 that includes casing 10, a plurality of LED light sources, and two end caps 50. EX1005, 6:10-22. “The inner surface of the casing 10 may be constructed to have a surface roughness of smaller than 0.8 μm to enhance the reflectance and reflux of the light.” EX1005, 10:18-20. Foo discloses that “the casing has an inner surface with a surface roughness smaller than 0.8 μm .” EX1005, claim 8. “By selecting a material having an appropriate combination of

light diffusion, transmission and reflection characteristics, the casing can produce an evenly-distributed illumination along the length of the tube with high luminous efficiency [A]dvantageously the material is constructed to have a surface roughness smaller than $0.8\mu\text{m}$, e.g. $6\mu\text{m}$ or $7\mu\text{m}$ ” (*sic*). EX1005, 3:17-22.

D. Grounds 5 and 6 – Claims 10 and 16 Are Obvious Further in View of Zhao

1. Zhao

Zhao describes LED incandescent lamp 1 that includes tube body 30 and end caps 110A, 110B. EX1007, 8:26-29, FIG. 4. Zhao describes “enclosing both ends of the incandescent lamp tube body by the end cap 110 with the aid of adhesives such as light mud.” EX1007, 6:36-42. “When the assembly of LED incandescent lamp 1 is completed, the end caps 110A and 110B of the LED drive power supply 10 enclose both ends of the tube body 30. In the present embodiment, inner surfaces of the end caps 110A and 110B and the outer surface of the tube body 30 can be adhered together by using adhesives (e.g., light mud), and meanwhile, the base plate can be also fixed to inside the end caps.” *Id.*, 8:42-50.



EX1007, FIG. 4.

2. *Motivation to combine*

As explained in Sections VIII.A.3-VIII.A.5 for Ground 1, Jing-Huang renders obvious claims 9 and 15.

As explained in Sections VIII.B.2-VIII.B.4 for Ground 2, Jing-Halliwell renders obvious claims 9 and 15.

A POSITA would have also been motivated to combine Zhao with Jing-Huang (Ground 5) or Jing-Halliwell (Ground 6) with a reasonable expectation of success for several reasons. EX1004, ¶185.

A POSITA would have understood the importance of securing components within an LED lamp in order to create a reliable and operational product. EX1004, ¶186. Further, a POSITA would have known that a gel can be used to secure such components to realize known benefits. EX1004, ¶186. For example, Huang teaches that components can be secured using a glue 4 (e.g., silica gel) and that components

can be secured to the glass tube using glue 4. EX1003, 1:29-31, 2:29-32, 3:64-4:21, 6:18-23. In addition to maintaining relative positions of components, Huang teaches that glue 4 provides further benefits, such as force dispersion and heat dissipation. EX1003, 4:4-12, 7:8-18.

A POSITA would also have understood the need to secure end caps to an LED lamp because the end caps perform several important functions for an LED lamp. EX1004, ¶187. For example, the end caps may provide stability for the glass tube, may house or support LED components, may provide a fastening mechanism for securing the LED lamp to a fixture, and may provide electrical connections to the LEDs. *Id.* A POSITA would therefore have been motivated to find a solution for securing the end caps to the glass tube in order to avoid loosening of the end caps from the LED lamp, which could cause undesired effects or poor performance, such as reduced stability for the glass tube, reduced support for LED components, loosening of the LED lamp from a fixture, inability to secure the LED lamp to a fixture, a poor electrical connection to the LEDs, or damage to the LED lamp. *Id.*

However, Jing, Huang, and Halliwell do not disclose using an adhesive to secure the end caps to the glass tube. A POSITA therefore would have been motivated to look elsewhere for a solution. EX1004, ¶188.

A POSITA would have been motivated to use an adhesive to secure the end caps to the glass tube, such as by using the adhesive taught by Zhao. EX1004, ¶189.

Zhao teaches that “end caps 110A and 110B of the LED drive power supply 10 enclose both ends of the tube body 30. In the present embodiment, inner surfaces of the end caps 110A and 110B and the outer surface of the tube body 30 can be adhered together by using adhesives (e.g., light mud), and meanwhile, the base plate can be also fixed to inside the end caps.” EX1007, 8:42-50. A POSITA would also understand that adhesives (such as the adhesive of Zhao) may be provided as gels and that such an adhesive would secure the end caps to the glass tube without substantially increasing cost of fabricating the LED lamp. EX1004, ¶189.

A POSITA would have been familiar with the use of adhesives and gels secure components of LED lamps. EX1004, ¶190. A POSITA would have recognized that Zhao’s adhesive would secure the end caps to the glass tube and would have been motivated to improve the LED lamp of Jing-Huang or Jing-Halliwell by securing the end caps of the LED lamp to the glass tube using the adhesive of Zhao. *Id.* A POSITA would have recognized that Zhao’s adhesive would provide a mechanism for securing the end caps of the LED lamp to the glass tube of the LED lamp. *Id.* A POSITA would have understood that an LED lamp could easily be modified to include such an adhesive because adhesives were well known and such a modification would have been a straight-forward implementation of known technology. *Id.* It would have been obvious to a POSITA to try adhesive of Zhao

with an LED lamp because in doing so, a POSITA would have expected this implementation to be successful based on the stability of the technology. *Id.*

Further, a POSITA would have been motivated to implement Zhao's adhesive in an LED lamp to improve the cost efficiency of the lamp. EX1004, ¶191. A POSITA would have known that adhesives are relatively inexpensive and are generally simpler to implement as compared to other fastening mechanisms, such as a screw. *Id.* Further, some fastening mechanisms (such as a screw) may subject the glass tube to force (potentially causing breakage) and could also potentially short or puncture electrical components of the LED lamp. *Id.* This modification would have yielded a predictable result because a POSITA would have known that the adhesive of Zhao can be added to the LED lamp of Jing-Huang or Jing-Halliwell without degrading the performance of the LED lamp. *Id.*

3. *Modification with Zhao*

Combining the LED fluorescent lamp of Jing with the circuit board length taught by Huang or Halliwell with the adhesive of Zhao would produce an LED lamp tube (e.g., the LED fluorescent lamp of Jing) that includes at least a light strip (e.g., board 2 of Jing) and a glass lamp tube (e.g., lamp tube 1 of Jing). EX1004, ¶192; EX1002, FIG. 4. The light strip would be longer than a main body region of the glass lamp tube, as disclosed by Huang and Halliwell. EX1004, ¶192; EX1003, FIG.

3. The glass lamp tube would be secured to end caps via a gel, such as the adhesive taught by Zhao. EX1004, ¶192.

4. Element-by-Element Analysis

(a) Claim 10

Jing-Huang-Zhao (Ground 5) and Jing-Halliwell-Zhao (Ground 6) teach the two end caps secured to the tube by a gel disposed between the inner surface of the end caps and outer surface of the tube. EX1004, ¶193. Zhao discloses “enclosing both ends of the incandescent lamp tube body by the end cap 110 with the aid of adhesives such as light mud.” EX1007, 6:36-42. “When the assembly of LED incandescent lamp 1 is completed, the end caps 110A and 110B of the LED drive power supply 10 enclose both ends of the tube body 30. In the present embodiment, inner surfaces of the end caps 110A and 110B and the outer surface of the tube body 30 can be adhered together by using adhesives (e.g., light mud), and meanwhile, the base plate can be also fixed to inside the end caps.” *Id.*, 8:42-50. A POSITA would understand that Zhao’s description that “inner surfaces of the end caps 110A and 110B and the outer surface of the tube body 30 can be adhered together by using adhesives (e.g., light mud)” discloses the claimed gel is disposed between an inner surface of each of the two end caps and an outer surface of each of the two rear end regions. EX1004, ¶193.

(b) Claim 16

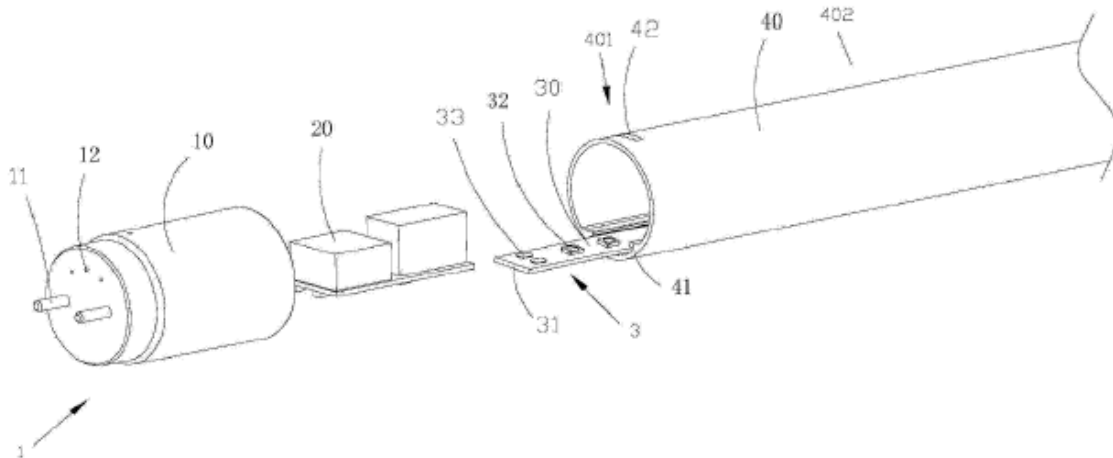
This claim is rendered obvious by Jing-Huang-Zhao (Ground 5) or Jing-Halliwell-Zhao (Ground 6). *See* Claim 10, §VIII.D.4(a).

E. Grounds 7-10 – Claims 5, 6, 11, 12, 17, and 18 Are Obvious Further in View of Deng

1. Deng

Deng describes LED 1 that includes “hollow tube body 40, end covers 10 connecting the ends of the tube body 40, and a light source 3 fixedly mounted inside the tube body 40.” EX1006, ¶[0024]. “In order to dissipate heat of the LED tube 1, air vents 12 for heat dissipation are opened on the end faces of the end covers 10. Air vents 12 in an appropriate quantity and size can be opened on the end faces of the end covers 10 according to the power and heat output of the LEDs 32.” *Id.*, ¶[0037], claim 10.

“In order to improve the overall resistance of the LED tube 1 to electric leakage, the end covers 10 are also made of an insulating material, and copper pins 11 for power-on are arranged on the end faces of the end covers 10. Each of the copper pins 11 runs through the end face of the corresponding end cover 10, one end of the copper pin 11 is connected to the driver power supply unit 20 in the tube body 40, and the other end is for connecting an external power supply. In this way, the insulating effect of the LED tube 1 can be improved comprehensively, making the LED tube 1 safer in the installation and use processes.” EX1006, ¶[0036].



EX1006, FIG. 1.

2. *Motivation to combine*

As explained in Sections VIII.C.2-VIII.C.4(a) for Grounds 3 and 4, Jing-Huang-Foo and Jing-Halliwell-Foo each renders obvious claim 4.

As explained in Sections VIII.D.2-VIII.D.4 for Grounds 5 and 6, Jing-Huang-Zhao and Jing-Halliwell-Zhao each renders obvious claims 10 and 16.

A POSITA would have also been motivated to combine Deng with Jing-Huang-Foo (Ground 7), Jing-Halliwell-Foo (Ground 8), Jing-Huang-Zhao (Ground 9), Jing-Halliwell-Zhao (Ground 10) and with a reasonable expectation of success for several reasons. EX1004, ¶195.

A POSITA would have understood the importance of heat dissipation within an LED lamp. EX1004, ¶196. Heat is generated inside an LED lamp as the LEDs within the lamp operate. *Id.* Jing provides one such example by disclosing that heat resistance is a problem that can exist in an LED lamp, resulting in poor heat

dissipation for the LED lamp. EX1002, ¶[0005]; EX1004, ¶196. If the heat is allowed to continue to build, the excess heat could damage the lamp. EX1004, ¶196. Thus, a POSITA would have been motivated to look to other solutions for preventing the LED lamp from suffering from a build-up of heat inside the tube lamp. *Id.*

Deng describes multiple “air vents 12” in each end cap. EX1006, ¶[0037]; EX1004, ¶197. A POSITA would have been motivated to look to Deng, which teaches that “[i]n order to dissipate heat of the LED tube 1, air vents 12 for heat dissipation are opened on the end faces of the end covers 10.” EX1006, ¶[0037]; EX1004, ¶197. A POSITA would additionally understand that the use of a larger single hole or multiple small holes would have the same beneficial effect in reducing the heat inside the tube lamp. EX1004, ¶197.

A POSITA would have been familiar with the use of vents to provide air flow through an LED lamp to dissipate heat. EX1004, ¶198. A POSITA would have recognized that Deng’s air vents 12 would provide air flow through the LED lamp and would have been motivated to improve an LED lamp with at least an air vent to improve air flow in the LED lamp. *Id.* A POSITA would have understood that an LED lamp could easily be modified to include air vents in the end cap described by Deng because venting for improved air flow was well known and such a modification would have been a straight-forward implementation of known technology. *Id.* It would have been obvious to a POSITA to try the air vents

described in Deng with an LED lamp because in doing so, a POSITA would have expected this implementation to be successful based on the stability of the technology. *Id.*

Further, Deng also describes the end caps of an LED light being made of an insulating material: “end covers 10 are also made of an insulating material.” EX1006, ¶¶[0036], [0015]. A POSITA would have been motivated to implement Deng’s insulating end covers in the LED lamp to improve the cost efficiency of the lamp. EX1004, ¶199. Specifically, Deng teaches that forming the end covers from an insulating material improves “overall resistance of the LED tube 1 to electric leakage” and results in safer “installation and use processes.” EX1006, ¶[0036]. Such a combination would have been a simple substitution Jing’s end caps for Deng’s end caps. EX1004, ¶199. This substitution would have yielded a predictable result because a POSITA would have known that the end caps are physical components that can be substituted for one another without degrading the performance of the LED lamp. *Id.*

3. *Modification with Deng*

Combining the LED fluorescent lamp of Jing with the circuit board length taught by Huang or Halliwell, the air vents of Deng, and/or the adhesive of Zhao, and/or the surface roughness of Foo would produce an LED lamp tube (e.g., the LED fluorescent lamp of Jing) that includes at least a light strip (e.g., board 2 of Jing) and

a glass lamp tube (e.g., lamp tube 1 of Jing). EX1004, ¶200; EX1002, FIG. 4. The light strip would be longer than a main body region of the glass lamp tube, as disclosed by Huang. EX1004, ¶200; EX1003, FIG. 3. End caps of the LED lamp tube of Jing would be replaced with end covers 10 of Deng, which would each include an insulating end wall, two conductive pins, and at least one opening in the form of air vents 12. EX1004, ¶200.

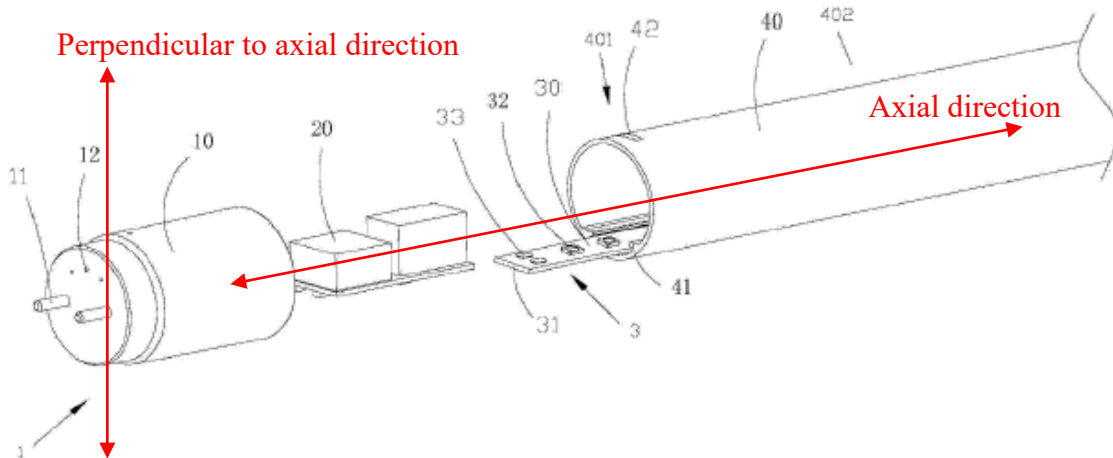
4. Element-by-Element Analysis

(a) Claim 5

Jing-Huang-Foo-Deng (Ground 7) and Jing-Halliwell-Foo-Deng (Ground 8) teach two end caps with insulating end walls, which are perpendicular to an axial direction of the tube, and that have two conductive pins and openings. EX1004, ¶¶201-204. Deng discloses that “end covers 10 are also made of an insulating material, and copper pins 11 for power-on are arranged on the end faces of the end covers 10. Each of the copper pins 11 runs through the end face of the corresponding end cover 10, one end of the copper pin 11 is connected to the driver power supply unit 20 in the tube body 40, and the other end is for connecting an external power supply.” EX1006, ¶[0036]. A POSITA would understand that the insulating material of end covers 10 of Deng discloses the claimed insulating end wall, and that copper pins 11 of Deng disclose the claimed two conductive pins. EX1004, ¶201.

Deng discloses that “air vents 12 for heat dissipation are opened on the end faces of the end covers 10. Air vents 12 in an appropriate quantity and size can be opened on the end faces of the end covers 10 according to the power and heat output of the LEDs 32.” EX1006, ¶[0037]. Deng further describes that “air vents for heat dissipation are opened on the end faces of the end covers.” *Id.*, claim 10. A POSITA would understand that air vents 12 of Deng disclose the claimed at least one opening. EX1004, ¶202. A POSITA would also understand that such openings and the benefits of such openings were known in the art. *Id.*; *see also* §VI.D (*citing* EX1008, 8:61-94, FIG. 18).

As shown in annotated FIG. 1, below, Deng discloses that the “end faces” of the end covers 10 (the claimed insulating end wall) are substantially perpendicular to an axial direction of hollow tube body 40, and that pins 11 and air vents 12 are arranged on the end faces of end covers 10. EX1006, ¶[0037], FIG. 1; EX1004, ¶203.



EX1006, FIG. 1; *see also id.*, FIG. 3.

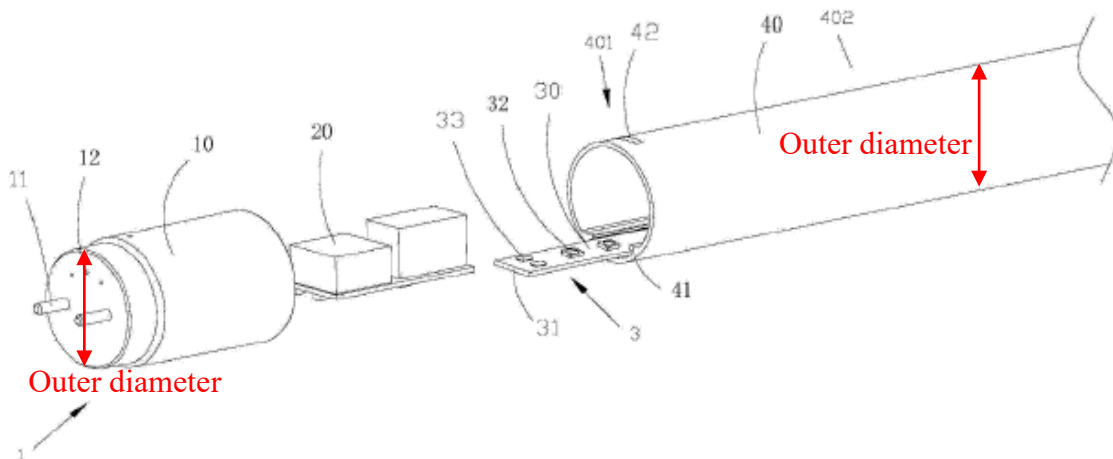
Although FIG. 1 of Deng illustrates one cover 10 at the left side of the LED 1, and the right side of LED 1 is not shown, the description of Deng makes clear that LED 1 includes “end covers 10,” and that “end covers 10 connect[] the ends of the tube body 40.” EX1006, ¶[0024]; *see also id.*, ¶¶[0027], [0029], [0036], [0037]. A POSITA would understand that both the left side and right side of LED 1 include a cover 10 having the claimed insulating end wall, two conductive pins and at least one opening, the insulating end wall substantially perpendicular to an axial direction of the glass lamp tube, and the two conductive pins and the opening arranged on the insulating end wall. EX1004, ¶204.

(b) Claim 6

Jing-Huang-Foo-Deng (Ground 7) and Jing-Halliwell-Foo-Deng (Ground 8) teach two end caps sleeves with a respective rear end region, and an outer diameter of each end cap is substantially the same as the outer diameter of the main body

region. EX1004, ¶¶205-206. Deng discloses “end covers 10 connecting the ends of the tube body 40” and “covering the ends of the tube body.” EX1006, ¶[0007], [0024]. A POSITA would understand that each end cover 10 (the claimed two end caps) “sleeves with” a respective rear end region of tube body 40. EX1004, ¶205.

“As shown in Fig. 1 and Fig. 2, the cross section of the tube body 40 is round, an end cover 10 is connected to each of the two ends of the tube body 40, the cross sections of the end covers 10 match the cross section of the tube body 40 in shape, and the inner diameters of the end covers 10 are slightly close to the outer diameter of the tube body 40.” EX1006, ¶[0027]. A POSITA would understand that an outer diameter of each end cover 10 is “substantially the same as” (to the extent that term is understood) the outer diameter of tube body 40. EX1004, ¶206.



EX1006, FIG. 1; *see also id.*, FIG. 3.

(c) Claim 11

This claim is rendered obvious by Jing-Huang-Zhao-Deng (Ground 9) or Jing-Halliwell-Zhao-Deng (Ground 10). *See* Claim 5, §VIII.E.4(a).

(d) Claim 12

This claim is rendered obvious by Jing-Huang-Zhao-Deng (Ground 9) or Jing-Halliwell-Zhao-Deng (Ground 10). *See* Claim 6, §VIII.E.4(b).

(e) Claim 17

This claim is rendered obvious by Jing-Huang-Zhao-Deng (Ground 9) or Jing-Halliwell-Zhao-Deng (Ground 10). *See* Claim 5, §VIII.E.4(a).

(f) Claim 18

This claim is rendered obvious by Jing-Huang-Zhao-Deng (Ground 9) or Jing-Halliwell-Zhao-Deng (Ground 10). *See* Claim 6, §VIII.E.4(b).

IX. FINTIV FACTORS WEIGH AGAINST DISCRETIONARY DENIAL

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

Factor 2 weighs in favor of institution. Trial is currently scheduled for April 17, 2024. EX1023. However, the Litigation involves 11 patents and the median

time-to-trial for the Western District of Texas is 28.3 months,⁵ meaning trial likely will not occur until at least October 2024—about 4 months *after* a decision here.

Factor 3 weighs in favor of institution. The Litigation is in its early stages. PO filed its original complaint on May 24, 2022, and amended its complaint in September to add patents. *Markman* is not scheduled to occur until April 19, 2023, and fact discovery does not open until April 20, 2023. EX1023.

Factor 4 weighs in favor of institution. If the IPR is instituted, Petitioner will stipulate not to rely on the same grounds in the Litigation. EX1009.

Factor 5. The parties are the same.

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

⁵ <https://www.uscourts.gov/statistics/table/na/federal-court-management-statistics/2022/06/30-2>

⁶ https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf

X. CONCLUSION

For these reasons, all challenged claims are invalid.

Dated: December 14, 2022

Respectfully submitted,

/Eagle H. Robinson/

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Reg. No. 61,361

Lead Counsel for Petitioner

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(a)(i), the undersigned certifies that this Paper—exclusive of the table of contents, mandatory notices under § 42.8, certificate of service, and this certificate of word count—includes 13,938 words.

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

CERTIFICATE OF SERVICE

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

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