

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,

v.

LYNK LABS, INC.,
Patent Owner.

IPR2022-00101
Patent 10,750,583 B2

Before JON B. TORNQUIST, ARTHUR M. PESLAK, and
SCOTT RAEVSKY, *Administrative Patent Judges*.

RAEVSKY, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Samsung Electronics Co., Ltd. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–7, 11, 12, and 14 of U.S. Patent No. 10,750,583 B2 (Ex. 1001, “the ’583 patent”). Lynk Labs, Inc. (“Patent Owner”) filed a Preliminary Response (Paper 7, “Prelim. Resp.”). Based on these submissions, we instituted an *inter partes* review of all challenged claims (Paper 10, “Institution Decision” or “Dec.”). Subsequent filings include a Patent Owner Response (Paper 16, “PO Resp.”), a Petitioner Reply (Paper 20, “Reply”), and a Patent Owner Sur-reply (Paper 23, “Sur-reply”). We held an oral hearing on March 22, 2023, a transcript of which has been entered into the record. Paper 29 (“Tr.”).

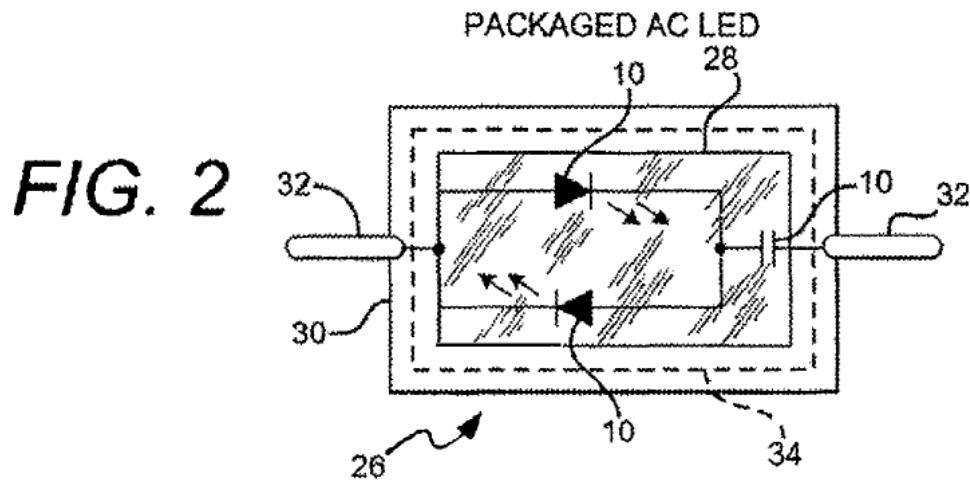
We have jurisdiction over this proceeding under 35 U.S.C. § 6(b). After considering the evidence and arguments of the parties, we determine that Petitioner has not proven by a preponderance of the evidence that any of the challenged claims are unpatentable.

II. BACKGROUND

A. The ’583 patent

The ’583 patent describes light-emitting diodes (LEDs) driven by alternating current (AC). Ex. 1001, code (57). For example, a lighting device as disclosed is capable of operating during both the positive and negative phase of an AC power supply. *Id.*

Figure 2, reproduced below, depicts light emitting device 26:



Id. at 14:1–2. Device 26 in Figure 2 includes light emitting device 10 mounted on insulating substrate 28, which may be ceramic or sapphire, and which is integrated into LED package 30. *Id.* at 14:3–8. Device 26 includes power connection leads 32 and lens 34, which may be made of a plastic, polymer, or other material used for light dispersion. *Id.* at 14:8–10. Lens 34 may be coated or doped with a phosphor or nano-particle that would produce a change in the color or quality of light emitted from device 10 through lens 34. *Id.* at 14:11–14.

B. Challenged Claims

Claim 1 is illustrative of the challenged claims:¹

1. [a] An LED lighting device comprising:
 - [b] an LED driver having an input and an output, wherein the input is configured to receive an AC voltage source, and wherein the output provides an AC voltage or a DC voltage;
 - [c] at least one LED circuit having any number of LEDs connected in series or series parallel needed to approximately match the forward voltage drop of a first input voltage to the LED driver,
 - [d] wherein the LED driver comprises a high frequency stage, the high frequency stage providing an inverter and an output frequency higher than an AC mains input frequency to the LED driver;
 - [e] a transistor, wherein the transistor is operable to control a current flow to the at least one LED circuit; and
 - [f] wherein the at least one LED circuit, the transistor, and the LED driver are all mounted on a reflective substrate.

Ex. 1001, 27:17–33.

C. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 4):

¹ We use Petitioner's element labeling for convenience. *See* Pet. 8–23.

Claim(s) Challenged	35 U.S.C. § ²	Reference(s)/Basis
1, 3, 5, 6	103	Shackle, ³ Birrell, ⁴ Schultz ⁵
7	103	Shackle, Birrell, Schultz, Smith ⁶
2, 4	103	Shackle, Birrell, Schultz, Salam ⁷
11, 12, 14	103	Shackle, Piepgras ⁸

Petitioner relies on a declaration by Dr. R. Jacob Baker (Ex. 1002).

Patent Owner relies on a declaration by Dr. Peter W. Shackle (Ex. 2001).

III. ANALYSIS

A. Principles of Law

Petitioner bears the burden to demonstrate unpatentability. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 285–88 (2011), revised 35 U.S.C. §§ 102, 103 effective March 16, 2013. The ’583 patent claims priority to applications reaching back to 2004. Ex. 1001, code (60). Petitioner applies the pre-AIA version of § 103, and Patent Owner does not dispute that the pre-AIA statutes apply. Pet. 4–5. We therefore also apply the pre-AIA versions of §§ 102 and 103.

³ U.S. Patent No. 7,019,662 B2 to Shackle, published Mar. 28, 2006 (Ex. 1021).

⁴ Australia Publication No. 2003100206 A4 to Birrell, published July 17, 2003 (Ex. 1014).

⁵ U.S. Publication No. 2005/0116235 A1 to Schultz, published June 2, 2005 (Ex. 1032).

⁶ U.S. Patent No. 6,489,724 B1 to Smith, issued Dec. 3, 2002 (Ex. 1019).

⁷ U.S. Patent No. 6,633,120 B2 to Salam, issued Oct. 14, 2003 (Ex. 1015).

⁸ U.S. Publication No. 2003/0137258 A1 to Piepgras, published July 24, 2003 (Ex. 1030).

A claim is unpatentable as obvious if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007) (quoting 35 U.S.C. § 103(a)). We resolve the question of obviousness based on underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the prior art and the claims; (3) the level of skill in the art; and (4) when in evidence, objective indicia of nonobviousness.⁹ *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We apply these principles to the Petition’s challenges.

B. Level of Ordinary Skill in the Art

We review the grounds of unpatentability in view of the understanding of a person of ordinary skill in the art at the time of the invention. *Graham*, 383 U.S. at 13, 17. Petitioner asserts that

[a] person of ordinary skill in the art [“POSITA”] . . . would have had at least a bachelor’s degree in electrical engineering, computer engineering, computer science, physics, or the equivalent, and two or more years of experience with LED devices and/or related circuit design, or a related field. . . . More education can supplement practical experience and vice versa.

Pet. 5–6 (citing Ex. 1002 ¶¶ 20–21).

Patent Owner provides a slightly different level of skill definition:

a person of ordinary skill in the art (“POSITA”) is someone who, at the time of the invention in February 2004 had, at least

⁹ The parties have not filed any evidence of objective indicia of nonobviousness.

a bachelor's degree in electrical engineering, computer engineering, computer science, physics, or the equivalent, and two or more years of experience with LED devices and related LED circuit design. Lack of work experience could have been remedied by additional education, and vice versa.

PO Resp. 6 (citing Ex. 2001 ¶¶ 30–33, 35). Petitioner responds that “[t]here is no meaningful dispute over a POSITA.” Reply 1.

We are persuaded that Patent Owner's proposal is more consistent with the problems and solutions in the '583 patent and prior art of record. We agree that Petitioner's proposal is overbroad in that it encompasses artisans without LED circuit design experience (“and two or more years of experience with LED devices and/or *related circuit design* . . .” (emphasis added)). Patent Owner's definition, in contrast, requires “two or more years of experience with LED devices *and* related LED circuit design.” We therefore adopt Patent Owner's definition of the level of skill, but we note that the outcome here would not have changed had we adopted Petitioner's level of skill.

C. Claim Construction

In *inter partes* review, we construe claims using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b) (2021).

Claim 11 recites “a glass substrate” and “a flexible substrate mounted to the glass substrate, wherein at least one of the plurality of LED packages is mounted to the flexible substrate.” Ex. 1001, 28:25–28. The Petition does not construe the term “substrate,” but in our Institution Decision, we

preliminarily agreed with Patent Owner that “substrate” may mean “a surface where ‘LEDs, capacitors and/or resistors are formed or mounted.’” Pet. 7; Dec. 19 (quoting Prelim. Resp. 22). We instructed the parties to address the meaning of “substrate” more fully at trial. Dec. 19–20 n.13. Post-institution, the parties propose the following competing constructions for the term “substrate”:

Term	Patent Owner	Petitioner
substrate	a surface on which LEDs, resistors, capacitors and/or other circuit components are mounted or formed	a structure or surface that <i>can or does</i> support, host, or provide a base or foundation for, circuit components or the like (<i>e.g.</i> , circuit elements, conductive paths, material layers, <i>etc.</i>)

PO Resp. 7; Reply 21. After reviewing the full record, however, we determine that it is unnecessary to construe the term “substrate” to reach a determination in this proceeding. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

We address the parties’ dispute regarding the meaning of limitation 1(c) within our merits analysis below. *See* PO Resp. 24–26; Reply 13–18.

D. Asserted Obviousness over Shackle, Birrell, and Schultz (Ground 1)

Petitioner contends that claims 1, 3, 5, and 6 would have been obvious over Shackle, Birrell, and Schultz. Pet. 8–29.

1. Overview of Shackle

Shackle describes an LED drive, an example of which is shown in Figure 1 below:

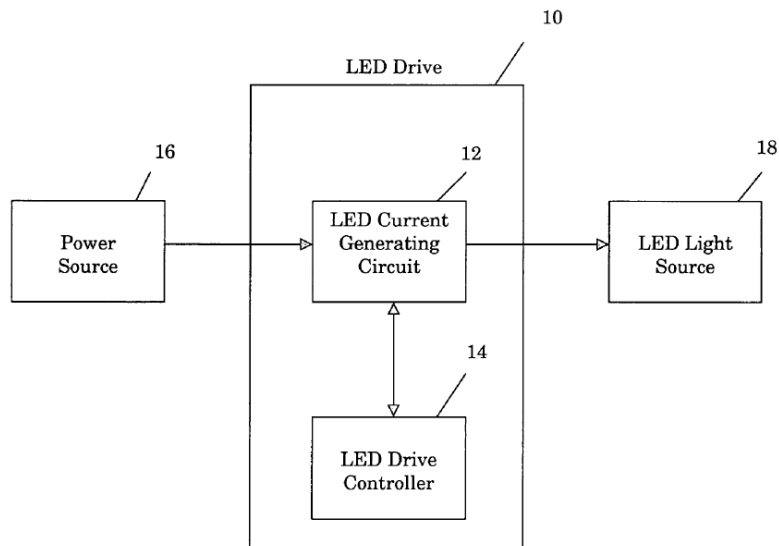


Fig. 1

Ex. 1021, 2:30–31. In Figure 1, LED drive 10 includes LED current generating circuit 12 and LED drive controller 14. *Id.* at 2:45–48. LED drive 10 receives power from power source 16 and outputs a current signal to LED light source 18. *Id.* at 2:56–58. LED drive 10 compensates for reductions or degradations in the effective light output of LED light source 18 to ensure that the effective light output remains relatively constant over the operating lifetime of LED light source 18. *Id.* at 3:6–10.

2. Overview of Birrell

Birrell describes a lighting element circuit, an example of which is shown in Figure 8 below:

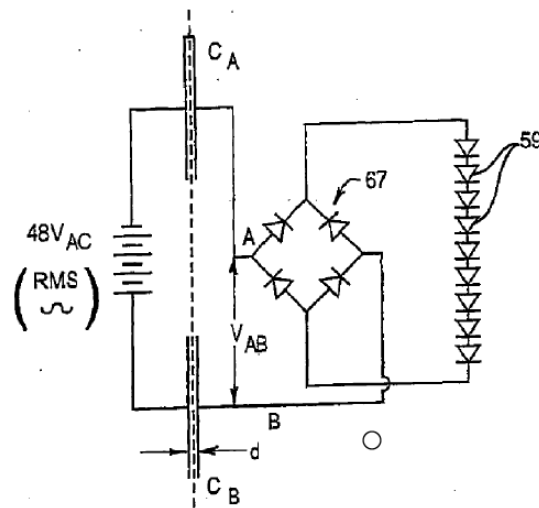


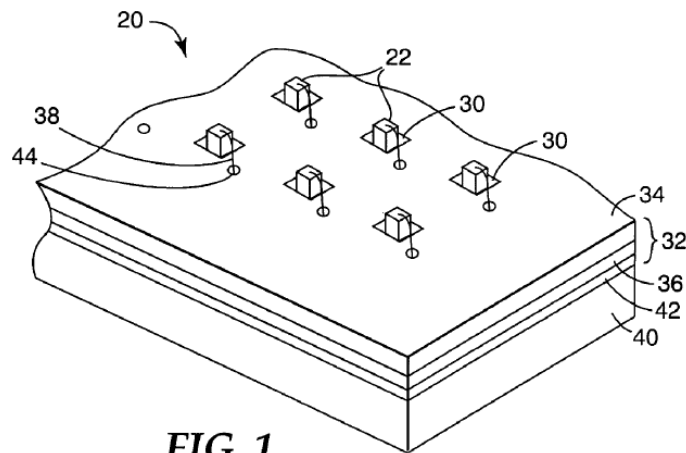
FIG 8

Ex. 1014, 20:26–27.¹⁰ In Figure 8, a simplified circuit diagram of a lighting element including nine LEDs is shown capacitively coupled to an AC power supply. *Id.* at 20:26–28. LEDs 59 receive power from a 48 VAC power source through capacitors C_A, C_B and rectifier 67. *See id.* at Fig. 8.

3. Overview of Schultz

Schultz describes an illumination assembly including a substrate having an electrically insulative layer on a first side of the substrate and an electrically conductive layer on a second side of the substrate. Ex. 1032, code (57). A plurality of LED dies is disposed on the substrate. *Id.* Each LED die is disposed in a via extending through the electrically insulative layer on the first side of the substrate to the electrically conductive layer on the second side of the substrate. *Id.* Each LED die is operatively connected through the via to the electrically conductive layer. *Id.* Figure 1 below depicts an illustrative example of the illumination assembly:

¹⁰ We follow the Petition’s lead in citing to the original page numbers of Birrell rather than to the new page numbers added by Petitioner. *See e.g.*, Pet. 14–18.



Id. ¶ 28. In Figure 1, a perspective view of illumination assembly 20 is shown having a two-dimensional configuration of LED dies 22 disposed within vias 30. *Id.* ¶¶ 28–29.

4. Independent Claim 1

Patent Owner disputes that the combination of Shackle and Birrell discloses limitation 1(c). PO Resp. 22–32.¹¹ As we find Patent Owner’s arguments for limitation 1(c) dispositive, we confine our analysis to that limitation and do not reach the parties’ other arguments on other limitations.

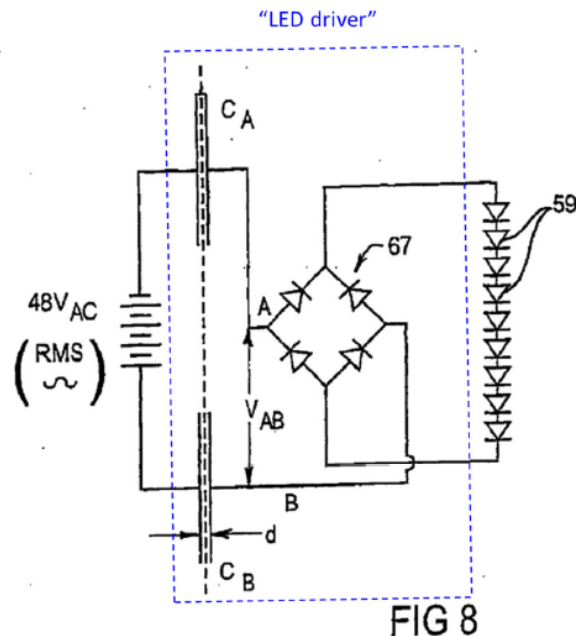
a. [c] at least one LED circuit having any number of LEDs connected in series or series parallel needed to approximately match the forward voltage drop of a first input voltage to the LED driver

Petitioner contends that the combination of Shackle and Birrell discloses or suggests this limitation. Pet. 13–18 (citing Ex. 1002 ¶¶ 91–99).

(1) The parties’ arguments

Petitioner focuses primarily on the teachings of Birrell, including Figure 8 of Birrell, reproduced below (as annotated by Petitioner):

¹¹ Patent Owner challenges limitation 1(c) for the first time post-institution. See Dec. 11–16.



Pet. 14–17. Figure 8 shows an LED lighting system including LEDs 59 coupled to a 48 AC voltage source via a rectifier (diodes 67) and coupling capacitors (C_A , C_B). *Id.* at 14 (citing Ex. 1014, 19:1–7, 20:26–31, 20:32–23:29). Petitioner asserts that the portions of Figure 8 within the blue dashed box constitute an LED driver that drives current and power to LEDs 59. *Id.* at 17 (citing Ex. 1002 ¶ 96).

Petitioner further contends that “Birrell^[12] discloses that the application of voltage matching principles (like that recited in limitation 1(c)) was known in the context of an LED circuit.” *Id.* at 16 (citing Ex. 1002 ¶ 95). To explain how voltage matching would work in Birrell, Petitioner provides the following calculations related to the voltages in the LED circuit of Figure 8:

Birrell describes that the voltage across each of the nine LEDs 59 in FIG. 8 is 3.5 V. . . . The “[t]otal voltage drop V_{AB} will be

¹² We omit Petitioner’s italicization of reference names throughout this decision.

33 volts” . . . , which a POSITA would have recognized because $1.5V$ [for diodes 67] + $(9 \text{ LEDs} \times 3.5V) = 33 \text{ V}$ Birrell explains that capacitors C_A and C_B have a voltage drop of 7.5 volts each and “a 48 Volt AC power supply . . . will satisfactorily illuminate the [LEDs] of Figure 8.”

Id. (citing, e.g., Ex. 1002 ¶ 95). Thus, Petitioner contends, “a POSITA would have understood that Birrell discloses an LED circuit having nine series-connected LEDs 59 that is needed to approximately match the forward voltage drop of a first input voltage (48V, because $33V + (2 \times 7.5V) = 48V$) to the LED driver.” *Id.* at 17 (citing Ex. 1002 ¶ 97).

Petitioner further argues that a POSITA would have found it obvious “to implement known LED circuit design principles to configure Shackle’s LED circuit to include an approximate number of LEDs connected in series or series parallel as needed to approximately match the forward voltage drop of a first input voltage to the . . . driver for limitation 1(b).”¹³ *Id.* at 17–18 (citing Ex. 1002 ¶ 98). Petitioner contends that “[s]uch configuration would have been useful for operating Shackle’s LED lighting device correctly (*e.g.*, for illuminating the LEDs without overdriving or underdriving them, which may lead to LED damage or sub-optimal illumination).” *Id.* at 18 (citing Ex. 1002 ¶ 98; Ex. 1026, 6:6–9).

Patent Owner contends that the combination of Shackle and Birrell fails to disclose limitation 1(c). PO Resp. 22–32.¹⁴ Patent Owner asserts

¹³ Limitation 1(b) states, “an LED driver having an input and an output, wherein the input is configured to receive an AC voltage source, and wherein the output provides an AC voltage or a DC voltage.”

¹⁴ At least once, Patent Owner mistakenly refers to “Piepgras” in its arguments for this ground but elsewhere correctly refers to “Birrell.” *E.g.*, PO Resp. 24. Petitioner does not address this apparent typographical error,

that the claim language is straightforward: “the LEDs in the circuit must be connected to have a voltage drop matching the forward voltage drop of the input voltage to the LED driver.” *Id.* at 24 (citing Ex. 2001 ¶ 76). The “first input voltage” to Birrell’s LED driver is 48 VAC, Patent Owner explains. *Id.* at 25. Birrell’s LEDs have a voltage drop of 31.5 V, Patent Owner asserts, agreeing with Petitioner’s computation. *Id.*; Pet. 16. Patent Owner argues that this 31.5 V voltage drop does not “approximately match” the 48 V voltage source, according to limitation 1(c), because “it falls nearly thirty-five percent short.” *Id.* at 25–26.

In the Reply, Petitioner charges Patent Owner with rewriting the limitation by “demand[ing] that the voltage drop derive *solely from the LEDs* in the LED circuit and thus preclud[ing] other potential (non-LED) components from contributing to the matching condition.” Reply 1–2. Petitioner points to the specification’s statement that “[t]he *present invention . . . enables an LED circuit to be made with any number of LEDs . . . by using, where desired, transformers, capacitors, or RC networks to reduce the number of LEDs needed to as few as one single LED.*” *Id.* at 2 (citing Ex. 1001, 8:20–24). According to Petitioner, this statement means that capacitors and resistors can drop the voltage in the circuit to appropriately match the voltage. *Id.*

Petitioner then points to the following example of this concept in the specification:

[I]n order to drop higher voltages *any number of LEDs* may be connected in series or parallel in a device *to match a desired voltage* and light output. For example, in a lighting device that

and we view Patent Owner’s arguments as properly addressed toward Birrell, not Piepgras, for this ground.

is run off of a 120 V source and contains LEDs having a forward operating voltage of 3V each ***connected to a bridge rectifier having diodes*** also having a forward operating voltage of 3V each, approximately 38 LEDs may be placed in series to drop the required voltage.

Id. at 2–3 (citing Ex. 1001, 16:64–17:7). In this example, Petitioner explains, 38 LEDs have a total voltage drop of 114 V, and the bridge rectifier has a total voltage drop of 6 V, resulting in a total voltage drop (114 V from the LEDs and 6 V from the rectifier) that “matches” the 120 V input. *Id.* at 3. Petitioner asserts that Birrell likewise explains to a POSITA how to “approximately match” the input voltage. *Id.* Petitioner contends that “all together [Birrell’s] circuit has a total drop of 48V (33 V [LEDs + bridge rectifier] + 15V [capacitors])—matching the 48V from the power source—just like in the above ’583 patent example.” *Id.*

Petitioner also disputes that Birrell must teach this limitation alone, as the Petition relies on a POSITA designing Shackle’s LED circuit with an appropriate number of LEDs connected in series to avoid overdriving or underdriving. *Id.* at 4–5 (citing, e.g., Pet. 17–18; Ex. 1002 ¶¶ 98–99).

In the Sur-reply, Patent Owner argues that it is Petitioner, not Patent Owner, who rewrites the claim. Sur-reply 6. Patent Owner asserts that the claim “unambiguously provides that the voltage drop from the ‘number of LEDs’ ‘approximately matches’ the voltage input to the LED drive.” *Id.* Petitioner does not assert any disclaimer or redefinition, Patent Owner states. *Id.* Further, “approximately matche[s]” does not preclude other circuit elements (such as the recited transistor or other circuit elements) from having voltage drops, Patent Owner argues. *Id.* at 7. Patent Owner further asserts that the specification example Petitioner cites does not alter the claim’s meaning. *Id.* (citing Reply 2–3; Ex. 1001, 16:64–17:7).

Consequently, Patent Owner explains, Petitioner’s argument that Birrell discloses that “**all together** the circuit has a total drop of 48V (33V + 15V)—matching the 48V from the power source” is inapposite, as limitation 1(c) requires “the voltage drop **from the LEDs** ‘approximately match[es]’ the input voltage.” *Id.*

Patent Owner further asserts that “[t]he Reply vaguely argues . . . that somehow the combination of Shackle and Birrell would lead ‘a [POSITA] [to] have designed *Shackle’s LED circuit* with an appropriate number of LEDs connected in series to avoid overdriving/underdriving.’” *Id.* at 9. This analysis is conclusory and unsupported by evidence, Patent Owner asserts. *Id.* at 10.

(2) *Our analysis*

We agree with Patent Owner. Patent Owner’s plain reading of limitation 1(c) is correct, and under this reading, the combination of Shackle and Birrell fails to disclose or suggest limitation 1(c).

Limitation 1(c) states in part: “at least one LED circuit having *any number of LEDs . . . needed to approximately match* the forward voltage drop of a first input voltage to the LED driver.” Ex. 1001, 27:22–25 (emphasis added). We have omitted the language “connected in series or series parallel” to highlight the grammatical relationship between the noun phrase “any number of LEDs” and the verb phrase “needed to approximately match.” The plain reading of this limitation is that the at least one LED circuit has any number of LEDs needed to approximately match the forward voltage drop of the LED driver input. Petitioner’s reading, that “the at least one LED circuit,” rather than “any number of LEDs,” must approximately

match the forward voltage drop of the LED driver input, is strained and not grammatically plausible. *See* Reply 1–3.

Petitioner does not assert there is an express disclaimer or disavowal in the specification that supports its position; Petitioner instead relies on examples disclosed in the specification to support its faulty interpretation of limitation 1(c). *See* Reply 2–3. These arguments are unpersuasive. It is axiomatic that we must not “limit[] the claimed invention to preferred embodiments or specific examples in the specification.” *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1346–47 (Fed. Cir. 2015). Not only that, but Petitioner’s citations to the specification better support Patent Owner’s position. In Petitioner’s view, the specification requires other non-LED components to be combined with one or more LEDs to “appropriately match the voltage.” Reply 2. The main example Petitioner relies on describes 38 LEDs having a total voltage drop of 114 V in a circuit with a bridge rectifier having a 6 V voltage drop. *Id.* at 2–3 (citing Ex. 1001, 16:64–17:7). Yet the 114 V voltage drop of the LEDs alone “approximately matches” the input voltage of 120 V, without the contribution of the bridge rectifier (6 V). *Id.* Indeed, 114 V out of 120 V is a 95% match. Thus, this example supports Patent Owner’s view that it is the voltage drop of the LEDs themselves, not the LED circuit as a whole, that must approximately match the LED driver input. *See* Sur-reply 6–7.

During the hearing, Petitioner’s counsel even agreed with Patent Owner’s interpretation in the following exchange:

JUDGE RAEVSKY: I’d like to understand why you believe that the plain and ordinary meaning supports your interpretation, particularly when it appears that the word

“needed” modifies any number of LEDs rather than the at least one LED circuit.

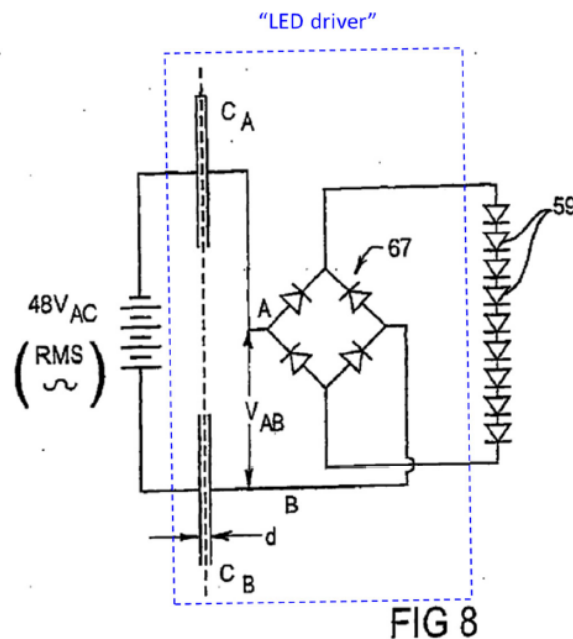
MR. CONSILVIO: The “needed” I think word in that phrase, I think it does refer to the any number of LEDs. I think that’s correct, Your Honor.

Tr. 46:7–12. Petitioner later qualified this concession, stating, “What the full phrase states is at least one circuit having that any number of LEDs that are needed to approximately match.” *Id.* at 46:17–19. Yet Petitioner’s first candid comment, that “needed . . . does refer to the any number of LEDs,” is the less strained view of the claim language.

No evidence in the record supports a finding that Birrell discloses or suggests “any number of LEDs . . . needed to approximately match the forward voltage drop of a first input voltage to the LED driver.” Dr. Baker testifies that the total voltage drop from the combination of Birrell’s capacitors, bridge rectifier, and LEDs—and not the LEDs alone—matches the driver input in Figure 8. Ex. 1002 ¶¶ 95–96; *see also id.* ¶ 97 (“Birrell discloses an LED circuit having nine series-connected LEDs 59 that are needed to approximately match the forward voltage drop of a first input voltage (48V, because 33V [from the LEDs and bridge rectifier] + $2 * 7.5\text{ V}$ [from the capacitors] = 48 V ”). Mr. Credelle, on the other hand, testifies, and we agree, that the 31.5 V voltage drop of the LEDs in Birrell “does not ‘approximately match’ the 48 V voltage source, according to limitation 1(c).” Ex. 2001 ¶ 79. Petitioner confirmed at the hearing that it is not its position that Birrell’s LED voltage drop alone (31.5 volts) approximately matches the 48 volt input to the driver. Tr. 55:18–26 (“JUDGE RAEVSKY: If we take this from Patent Owner’s point of view for a moment . . . and look at the 31.5 volts that are dropped across the LEDS in Birrell, is it your

position that that 31.5 volts approximately matches the 48 volt input to the driver in Birrell? MR. CONSILVIO: We did not have to address the approximately language in that regard I think because I think our position is that's not exactly how to read the claim.”¹⁵

Even under Petitioner's erroneous claim interpretation, the combination of Shackle and Birrell fails to teach or suggest limitation 1(c). If we were to assume that the entire “at least one LED circuit” must “approximately match the forward voltage drop” of the LED driver input voltage, such a teaching is still not present in the combination. This can be seen from Birrell Figure 8, as annotated by Petitioner:



See Pet. 17. Figure 8 above shows an LED lighting system, which Petitioner has annotated with a blue dashed box to show an LED driver containing

¹⁵ Petitioner also admitted that it does not “have a good sense of what approximately means,” Tr. 56:26–57:3, which calls into question Petitioner’s argument about what “approximately” matches in Birrell.

capacitors C_A , C_B and bridge rectifier 67. *Id.* Petitioner has excluded LEDs 59 from this blue dashed box, so they are not part of the LED driver. *See id.* Petitioner also refers to Birrell disclosing “an LED circuit having nine series-connected LEDs 59,” which further confirms that Petitioner views the LED circuit (of LEDs 59) as separate from Birrell’s LED driver. *Id.* (citing Ex. 1002 ¶ 97).

Significantly, Dr. Baker relies on the summation of voltage drops from elements of Birrell’s *driver* (i.e., the capacitors and bridge rectifier) *plus* the voltage drops of the LEDs in the *LED circuit* for limitation 1(c)’s “approximately match” language. Ex. 1002 ¶¶ 95–98. This analysis is flawed because claim 1 separately recites “an LED driver” and “at least one LED circuit,” yet Dr. Baker relies on *both* Birrell’s driver and LED circuit for limitation 1(c). Petitioner acknowledged in the hearing, “the best way I can put it is that the LED circuit is what ultimately needs to match the input to the LED driver.” Tr. 50:26–51:5. This concession underscores Dr. Baker’s error of mapping *both* Birrell’s driver and LED circuit to limitation 1(c).

Finally, we address Petitioner’s arguments that Birrell need not teach this limitation alone, as the Petition relies on a POSITA designing Shackle’s LED circuit with an appropriate number of LEDs connected in series to avoid overdriving or underdriving. Reply 4–5. Although Petitioner relies on Shackle for the claimed driver, Pet. 11, the combination does not disclose or suggest limitation 1(c). The only teaching of matching Petitioner relies on is in Birrell, which does not teach the claimed matching as explained above.¹⁶

¹⁶ When asked at the hearing if the only teachings of matching Petitioner relies on are in Birrell, Petitioner’s counsel could not supply any such

Pet. 13–18; Reply 1–5. Thus, we disagree with Petitioner that the combination somehow teaches this limitation even if Birrell does not. *See* Reply 4–5 (citing Pet. 17–18; Ex. 1002 ¶¶ 98–99). Combining Birrell with Shackle still results in a combination where there is no teaching of “having any number of LEDs . . . needed to approximately match the forward voltage drop of a first input voltage to the LED driver,” as claimed.

Thus, Petitioner has failed to establish that the combination of Shackle and Birrell discloses or suggests limitation 1(c).

b. Summary as to Claim 1

Because Petitioner has failed to establish that the combination of Shackle and Birrell discloses or suggests limitation 1(c), we find that Petitioner has not proven by a preponderance of the evidence that claim 1 would have been obvious over the combination of Shackle, Birrell, and Schultz.

5. Dependent Claims 3, 5, and 6

Petitioner contends that claims 3, 5, and 6, which depend from independent claim 1, would have been obvious over the combination of Shackle, Birrell, and Schultz. Pet. 26–29. Because Petitioner has not established that claim 1 would have been obvious over these references,

teachings in Shackle. Tr. 53:19–54:1 (“JUDGE RAEVSKY: . . . [I]t seems that the only teachings that you have of any kind of matching whatsoever are in Birrell; correct? MR. CONSILVIO: I don’t think that’s correct but, Your Honor, I may be hard pressed to give you off the top of my head some other examples of matching. I’d have to kind of go back and check. But certainly you have Dr. Baker’s testimony which described or alluded to other references, Birrell being one of them I know in particular.”).

Petitioner has also not established that claims 3, 5, and 6 would have been obvious over these references.

E. Grounds 2 and 3

Petitioner contends that the combination of Shackle, Birrell, Schultz and Smith would have rendered obvious claim 7 and that the combination of Shackle, Birrell, Schultz, and Salam would have rendered obvious claims 2 and 4. Pet. 30–37. Because claims 2, 4, and 7 depend from independent claim 1 and Petitioner has not established that claim 1 would have been obvious over Shackle, Birrell, and Schultz, Petitioner has also not established that claims 2, 4, and 7 would have been obvious over Shackle, Birrell, and Schultz, in further combination with Smith (for claim 7) or Salam (for claims 2 and 4).¹⁷

F. Asserted Obviousness over Shackle and Piepgras (Ground 4)

Petitioner further contends that claims 11, 12, and 14 would have been obvious over Shackle and Piepgras. Pet. 38–56.

1. Overview of Piepgras

Piepgras describes multi-colored lighting systems using LEDs. Ex. 1030 ¶¶ 31–32. The disclosed systems use high-brightness, processor-controlled LEDs in combination with diffuse materials to produce color-changing effects. *Id.* ¶ 32. Figure 1 of Piepgras, reproduced below, depicts an example lighting system:

¹⁷ Petitioner does not rely on Salam or Smith for limitation 1(c), not taught by Shackle and Birrell. Pet. 30–37.

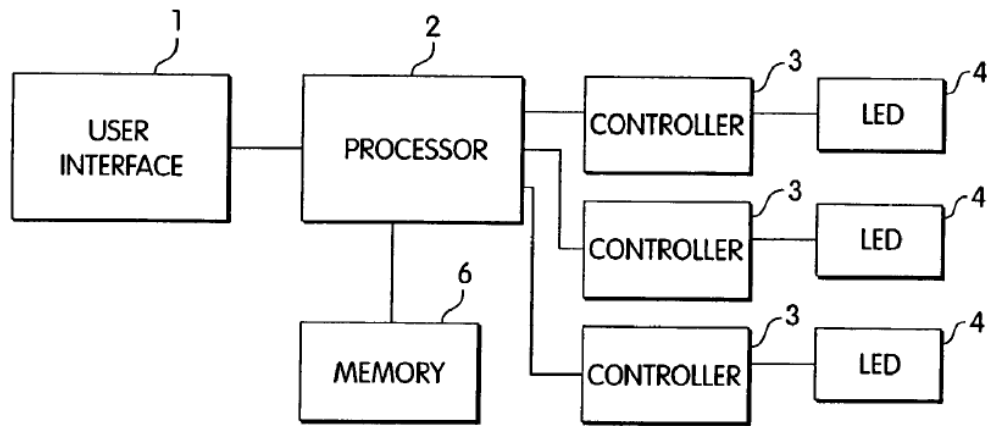


Fig. 1

Id. ¶ 88. Figure 1 depicts user interface 1, processor 2, controllers 3, memory 6, and LEDs 4. *Id.* In general, processor 2 executes a program stored in memory 6 to generate signals that control stimulation of LEDs 4. *Id.* The signals may be converted by the controllers 3 into a form suitable for driving the LEDs 4. *Id.*

2. Independent Claim 11

Claim 11 is similar to claim 1 in several respects but also includes two entirely different limitations (11(c) and 11(d)), which Patent Owner disputes are disclosed by Petitioner's proposed combination. We focus our analysis on limitation 11(d), as Patent Owner's arguments for this limitation are dispositive. We agree with Patent Owner that Petitioner has not established that one of ordinary skill in the art would have combined Shackle and Piepgras to arrive at limitation 11(d).

a. [d] a flexible substrate mounted to the glass substrate, wherein at least one of the plurality of LED packages is mounted to the flexible substrate

Petitioner contends that limitation 11(d) would have been obvious over Shackle in view of Piepgras. Pet. 45–49 (citing Ex. 1002 ¶¶ 147–151).

Limitation 11(d) refers in part to “the glass substrate,” which is first recited in limitation 11(c). Before discussing limitation 11(d), we therefore first summarize Petitioner’s arguments for limitation 11(c) to provide context for the parties’ arguments on limitation 11(d).

For limitation 11(c), Petitioner argues that Piepgras discloses the “glass substrate.” Pet. 43–45 (citing, e.g., Ex. 1002 ¶¶ 143–146). Petitioner refers to Piepgras’s “optic 4202,” shown below in Petitioner’s annotated copy of Figure 42, as teaching a glass substrate:

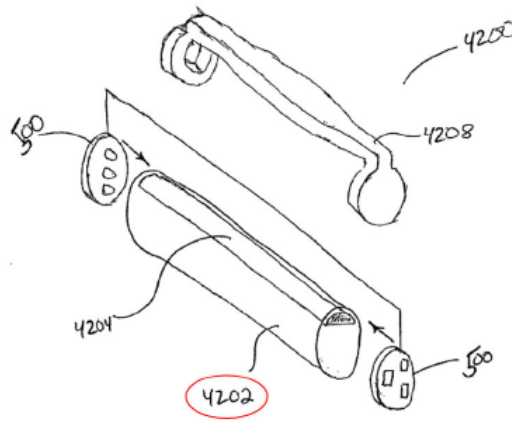
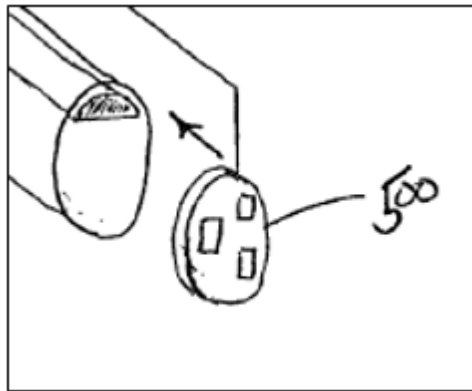


Figure 42

Id. at 43–44 (citing Ex. 1002 ¶ 143). Figure 42 depicts lighting device 4200 having an optic 4202 (red), which may be an elongated optic, tubular optic, or the like and which may be made of glass. Ex. 1030 ¶ 188. Petitioner points us to Piepgras’s disclosure that illumination device 500, which includes LEDs, “may be epoxied or otherwise attached to **the various types of optics** to minimize the loss of light.” Pet. 44 (citing Ex. 1030 ¶ 197; Ex. 1002 ¶ 144); *see also* Ex. 1030, Fig. 1 (depicting system 500 with LEDs). Because Piepgras’s device 500 with LEDs is attached to an optic integrated with reflective material, Petitioner contends, this optic is a glass

substrate. Pet. 44–45 (citing Ex. 1002 ¶ 145). Petitioner concludes that a POSITA would have implemented Piepgras’s glass substrate in the modified Shackle device because a POSITA “would have found it beneficial to use a *glass* substrate in order to permit transmission of light (emitted by LEDs . . .) through it and thus promote enhanced illumination.” *Id.* at 45 (citing Ex. 1002 ¶ 146).

Turning to limitation 11(d), Petitioner first refers to Piepgras’s illumination device 500 in a portion of Figure 42, shown below:



Id. at 46. The portion of Figure 42 shown above depicts illumination device 500, which Petitioner also refers to as the “reflective platform” or “lighting system 500.” *Id.* at 45–46, 48.¹⁸ “Given that the ‘platform’ is described with reference to illumination devices 500 generally (*e.g.*, lighting system 500 of Figure 1),” Petitioner argues, “a POSITA would have understood that Piepgras’ disclosure regarding the reflective platform [500] is applicable to all of its configurations.” *Id.* (citing Ex. 1002 ¶ 147).

¹⁸ Piepgras first uses the reference numeral 500 to refer to “lighting system or device 500” of Figure 1. Ex. 1030 ¶ 88. In the context of Figure 42, Piepgras uses the reference numeral 500 to refer to “illumination devices 500.” *Id.* ¶ 197.

One of these configurations relates to Piepgras’s disclosure of a “rope light,” Petitioner argues. *Id.* at 46. This “rope light” is described with reference to Figure 31, below:

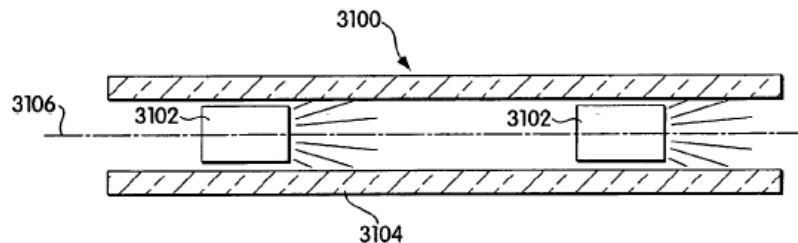


Fig. 31

Id. at 45–47. Piepgras’s rope light 3100 in Figure 31 includes LEDs or LED subsystems 3102 and a flexible and transparent tube 3104. *Id.* at 47 (citing Ex. 1030 ¶ 160). Petitioner asserts that a POSITA would have understood that the rope light would need to be flexible:

A POSITA would have understood that because the LED subsystems 3102 (according to the descriptions of Figures 1, 2A-2B) are within the flexible tube 3104, the platform on which the LED subsystems 3102 are mounted would likewise need to be flexible to accommodate the flexible characteristics (and applications) of a rope light. (Ex. 1002, ¶148.) *Indeed, without such properties, the rope light would need to be rigid where subsystems 3102 were located, which can be, e.g., “every six inches.”* (Ex. 1030, ¶[0160].) *Such rigidity across a length of rope lighting, which can be “several feet or more” (id.), would detract from the flexible application of such a lighting device, and would lend the device to be prone to failure by bending of the platform (substrate) that mounts subsystems 3102.* (Ex. 1002 ¶ 148.)

Id. (emphasis added).

Petitioner also contends that a POSITA would have understood that tube 3104 is a flexible substrate because the tube wall acts as a “platform” for mounting lighting system 500, or for mounting the subsystems 3102. *Id.*

at 47–48 (citing Ex. 1002 ¶¶ 148–49). Petitioner asserts that “a POSITA would have found it predictable to configure the Shackle-Piepgras device to implement a flexible substrate mounted to the glass substrate, wherein at least one of the plurality of LED packages is mounted to the flexible substrate.” *Id.* at 48 (citing Ex. 1002 ¶ 150). Petitioner further asserts that “[a] POSITA would have found mounting a flexible substrate to the glass substrate to be useful, *e.g.*, for promoting versatility, efficiency, and performance characteristics of the lighting device.” *Id.* Moreover, Petitioner argues that “[a] POSITA would have been motivated to mount at least one of the plurality of LED packages to the flexible substrate, in order to secure the packages spatially.” *Id.* at 49 (citing Ex. 1002 ¶ 151).

Patent Owner contends, for example, that there is no combination of Piepgras’s Figures 31 and 42 that meets limitation 11(d). PO Resp. 64. “It is not clear what combination the Petitioner proposes,” Patent Owner contends. *Id.* In Patent Owner’s view, “Petitioner vaguely propos[es] to ‘configure the Shackle-Piepgras device to implement a flexible substrate mounted to the glass substrate,’ but ‘Patent Owner can only guess’ at Petitioner’s actual combination. *Id.* Patent Owner further argues that to the extent Petitioner proposes applying the rope light’s flexible tube 3104 to the tube light of Figure 42, “that combination is impossible because optical tube 4202 could not be a rope-like tube that hangs and flexes.” *Id.* And to the extent that Petitioner proposes applying the optic 4202 to the rope light 3100 of Figure 31, Patent Owner argues, Figure 42’s “rigid optical tube 4202 could not be applied because the rope light would not work,” as it would not “behave like a rope” due to the optic 4202’s rigidity. *Id.* (citing Ex. 2001 ¶ 141).

In response, Petitioner’s Reply asserts that “[c]ontrary to [Patent Owner’s] suggestion, subsystems 3102 in the flexible tube 3104 can include the LED system 500.” Reply 24 (citing Pet. 46; Ex. 1030 ¶ 160 (“LED subsystems 3102 according to the description provided in reference to FIGS. 1 and 2A–2B.”)). Petitioner then contends that Patent Owner is mistaken that the Petition looks to combine Figures 31 and 42 of Piepgras. Reply 24. Instead, Petitioner contends,

Piepgras’ disclosures would have provided teachings/ suggestions that would have motivated a POSITA to configure the modified Shackle device to implement a flexible substrate mounted to the glass substrate of the modified Shackle device (*as discussed for limitation 11(c)*), wherein at least one LED package is mounted to the flexible substrate “in order to secure the packages spatially.”

Id. (citing Pet. 47–49).

In the Sur-reply, Patent Owner asserts that “Petitioner is relying on some (unarticulated) combination of teachings from the rope light 3100 of Figure 31 (having a flexible element but no glass element) and the fluorescent lighting device 4200 of Figure 42 (having a glass element but no flexible element).” Sur-reply 24. Patent Owner asserts that “Petitioner acknowledges that the rope light 3100 cannot have a modification that ‘would detract from the flexible application of such a [light rope] lighting device, and would lend the device to be prone to failure by bending of the platform (substrate) that mounts subsystems 3102.’” *Id.* at 25 (citing Pet. 47).

Turning to our analysis, we find two problems with Petitioner’s combination. The first is that the proposed combination is not at all clear. Although Petitioner need not propose a bodily incorporation of different

embodiments, Petitioner must provide a “reasoned analysis” explaining what the combination is. *See DSS Tech. Mgmt., Inc. v. Apple Inc.*, 885 F.3d 1367, 1377 (Fed. Cir. 2018); *In re Keller*, 642 F.2d 413, 425 (CCPA 1981); *see also Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1368 (Fed. Cir. 2012) (“We must be careful not to allow hindsight reconstruction of references to reach the claimed invention without any explanation as to how or why the references would be combined to produce the claimed invention.”) (citation omitted). But the Petition never explains how or where Piepgras’s glass substrate would be combined with Piepgras’s alleged flexible substrate, the rope light of Figure 31. At most, Petitioner suggests incorporating the illumination device 500 of Figure 42 in the rope light of Figure 31. Pet. 48 (“Piepgras provides for configurations where a reflective platform (reflective substrate) mounts lighting system 500 in a manner applicable generally to the inventions of Piepgras . . . , and thus including the rope lighting application discussed above.”). As for the glass substrate, Petitioner merely states that “a POSITA would have found it predictable to configure the Shackle-Piepgras device to implement a flexible substrate mounted to the glass substrate, wherein at least one of the plurality of LED packages is mounted to the flexible substrate.” *Id.* (citing Ex. 1002 ¶ 150). This vague statement just parrots the claim language and does not explain anything about how the glass substrate would be included in the combination.

One might surmise that the Petition meant to say—although it does not—that the glass substrate of Figure 42 would have been attached to the illumination device 500 of Figure 42 and then inserted into the rope light of Figure 31. But Petitioner’s Reply disavows this interpretation, arguing that

“[Patent Owner] is mistaken that the Petition looks to combine Figures 31 and 42 of Piepgras.” Reply 24. This statement only further confuses the proposed combination because, as explained above, the Petition explicitly relies on both Figures 31 and 42 of Piepgras for limitation 11(d). *See* Pet. 46 (reproducing a portion of Piepgras Figure 42), 47 (reproducing Piepgras Figure 31). We also find unhelpful Petitioner’s assertion that “Piepgras’ disclosures would have provided teachings/suggestions that would have motivated a POSITA to configure the modified Shackle device to implement a flexible substrate mounted to the glass substrate of the modified Shackle device.” Reply 24 (citing Pet. 47–49). This statement vaguely asserts that the glass substrate would end up somewhere in Shackle’s device without providing any details whatsoever on how or where this would be done.

The second problem with the combination is that to the extent the Petition could be read to propose combining Piepgras’s glass optic of Figure 42 in the rope light of Figure 31, Petitioner does not establish that one of ordinary skill in the art would have made this combination. Petitioner emphasizes that adding any rigidity to the rope light of Figure 31 would detract from its flexibility. Pet. 47 (“the LED subsystems 3102 . . . would likewise need to be flexible to accommodate the flexible characteristics (and applications) of a rope light. . . . *Indeed, without such properties, the rope light would need to be rigid where subsystems 3102 were located*, which can be, *e.g.*, “every six inches. . . . Such rigidity across a length of rope lighting . . . *would detract from the flexible application* of such a lighting device” (emphasis added)). Petitioner’s statement that “the LED subsystems 3102 . . . would likewise need to be flexible” undermines a combination

where the glass substrate is part of, or attached to, the LED subsystems 3102, as glass is not flexible.

Dr. Shackle testifies, and we agree, that the glass optic of Figure 42 would add the very rigidity that Petitioner claims is undesirable. Ex. 2001 ¶ 144. We credit Dr. Shackle’s testimony that the “combination is impossible because rope light 3100 has to behave like a rope—it has to be able to hang, flex and bend into different paths, angles and shapes—and the rigid optical tube 4202 could not be applied because the rope light would not work.” *Id.* ¶ 141. We raised similar concerns with the combination in our Institution Decision, but the Reply neither addresses these concerns nor addresses Patent Owner’s related arguments and expert testimony. Dec. 23; PO Resp. 63–64; Reply 24. We are therefore not persuaded that one of ordinary skill in the art would have combined the rigid glass optical tube of Piepgras Figure 42 with the rope light of Figure 31, as the Petition implies. *See* Pet. 46–47.

In summary, the Petition is unclear as to where the glass optic of Piepgras would be included in the proposed combination, whether in the combination of Piepgras’s embodiments or in Shackle. To the extent the Petition implies that the glass optic would have been combined with Piepgras’s rope light, Petitioner’s arguments urging the flexibility of the rope light undermine that combination. The combination is therefore neither clear nor workable, and thus, Petitioner has not established that one of ordinary skill in the art would have combined Shackle and Piepgras to arrive at limitation 11(d).

b. Summary as to Claim 11

Based on the full record, we determine that Petitioner has not proven by a preponderance of the evidence that the combination of Shackle and Piepgras would have rendered claim 11 obvious.

3. Dependent Claims 12 and 14

Petitioner contends that claims 12 and 14, which depend from claim 11, would have been obvious over the combination of Shackle and Piepgras. Pet. 51–56. As Petitioner has not proven that claim 11 would have been obvious over Shackle and Piepgras, Petitioner has also not proven that claims 12 and 14 would have been obvious over Shackle and Piepgras. We therefore need not reach Patent Owner’s arguments addressing claim 12. *See* PO Resp. 66–68.

IV. CONCLUSION

In summary:

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1, 3, 5, 6	103	Shackle, Birrell, Schultz		1, 3, 5, 6
7	103	Shackle, Birrell, Schultz, Smith		7
2, 4	103	Shackle, Birrell, Schultz, Salam		2, 4
11, 12, 14	103	Shackle, Piepgras		11, 12, 14
Overall Outcome				1–7, 11, 12, 14

V. ORDER

It is, therefore,

ORDERED that Petitioner has not shown by a preponderance of the evidence that claims 1–7, 11, 12, and 14 of the '583 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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Patent 10,750,583 B2

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