

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

BIOFRONTERA INC., BIOFRONTERA BIOSCIENCE GMBH,
BIOFRONTERA PHARMA GMBH, and BIOFRONTERA AG
Petitioner,

v.

SUN PHARMACEUTICAL INDUSTRIES, INC.
Patent Owner.¹

Case No. IPR2025-00287
Patent 11,446,512

**PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO.
11,446,512 UNDER 35 U.S.C. §§ 311–319 AND 37 C.F.R. § 42.100 *et seq.***

¹ Sun Pharmaceutical Industries, Inc. asserts it is the “sole owner” of U.S. Patent No. 11,446,512 and the surviving corporation after a merger with DUSA Pharmaceutical, Inc. on March 31, 2024. Ex. 1018 at 1 and 11, FN2.

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PETITIONER’S EXHIBITS²

Exhibit No.	Description
1001	U.S. Patent No. 11,446,512 by Thomas Boyajian et al. entitled “Adjustable Illuminator for Photodynamic Therapy and Diagnosis” (“’512 Patent”)
1002	File History for U.S. Patent No. 11,697,028
1003	Reserved
1004	U.S. Patent Publication No. 2005/0075703 by Eric Larsen entitled “Photodynamic Stimulation Device and Methods” (“Larsen”)
1005	Reserved
1006	Reserved
1007	Reserved
1008	U.S. Patent No. 7,033,381 (“Larsen ’381”)
1009	Office Action dated March 23, 2021, from file history of Application No. 17/009,871
1010	Office Action dated October 25, 2021, from file history of Application No. 16/791,004
1011	WO 99/56827 by Scott Lundahl et al. entitled “Illuminator for Photodynamic Therapy”
1012	Reserved
1013	U.S. Patent No. 11,179,574 by Thomas Boyajian et al. entitled “Method of administering 5-aminolevulinic acid (ALA) to a patient”
1014	U.S. Patent No. 6,223,071 (“Lundahl”)
1015	Declaration of Dr. Robert Grove
1016	Declaration of Dr. Michael Ehrenreich
1017	U.S. Pat. No. 5,079,262 (“Kennedy”)
1018	Complaint filed in <i>Sun Pharmaceutical Industries, Inc. v. Biofrontera Bioscience GmbH, Biofrontera Pharma GmbH, Biofrontera AG, and Biofrontera Inc.</i> , Civil Action No. 1:24-cv-11637 (D. Mass) (filed on June 25, 2024)

² For consistency, Petitioner has tried to maintain the same exhibit numbers as in IPR2024-01312 for identical or similar type documents. Exhibit number marked as “reserved” are exhibits not relied on in the instant IPR petition.

Exhibit No.	Description
1019	Plaintiff’s Infringement Contentions submitted as Exhibit 3 attached to complaint filed in <i>Sun Pharmaceutical Industries, Inc. v. Biofrontera Bioscience GmbH, Biofrontera Pharma GmbH, Biofrontera AG, and Biofrontera Inc.</i> , Civil Action No. 1:24-cv-11637 (D. Mass) (filed on June 25, 2024)
1020	<i>In Re Certain Photodynamic Therapy Systems, Components Thereof, And Pharmaceutical Products Used In Combination With The Same</i> , Investigation No. 337-TA-1411 (complaint filed on June 25, 2024)
1021	Agostinis et. al., <i>Photodynamic Therapy of Cancer: An Update</i> , <i>CA Cancer J Clin.</i> Author manuscript; available in PMC 2012 July 1 (also published in final edited form at <i>CA Cancer J Clin.</i> 2011 ; 61(4): 250–281)
1022	Levulan® Kerastick® (aminolevulinic acid HCl) for Topical Solution, 20% Initial U.S. Approval: 1999, Revised 3/2010
1023	Michael H, Gold, MD, <i>Therapeutic and Aesthetic Uses of Photodynamic Therapy Part two of a five-part series: Lasers and Light Treatments for Acne Vulgaris Promising Therapies</i> , <i>The Journal of Clinical and Aesthetic Dermatology</i> , Vol. 1 No. 3 (2008).
1024	Sun Pharma’s Opening Claim Construction Brief (public version), submitted in <i>In Re Certain Photodynamic Therapy Systems, Components Thereof, And Pharmaceutical Products Used In Combination With The Same</i> (filed on Nov. 22, 2024)
1025	Biofrontera’s Opening Claim Construction Brief (public version), submitted in <i>In Re Certain Photodynamic Therapy Systems, Components Thereof, And Pharmaceutical Products Used In Combination With The Same</i> (filed on Nov. 22, 2024)
1026	U.S. Patent Publication 2010/0118522 (“Hente”)
1027	U.S. Patent No. 4,823,858 by Simon G. A. Perutz entitled “Portable display panel and hinge system” (“Perutz”)
1028	Sun Pharma’s Responsive Claim Construction Brief (public version), submitted in <i>In Re Certain Photodynamic Therapy Systems, Components Thereof, And Pharmaceutical Products Used In Combination With The Same</i> (filed on Nov. 22, 2024)
1029	Biofrontera’s Responsive Claim Construction Brief (public version), submitted in <i>In Re Certain Photodynamic Therapy</i>

Petition for Inter Partes Review of
U.S. Patent No. 11,446,512

Exhibit No.	Description
	<i>Systems, Components Thereof, And Pharmaceutical Products Used In Combination With The Same</i> (filed on Nov. 22, 2024)
1030	American Heritage Dictionary Entry- Recess
1031	Merriam-Webster Collegiate Dictionary (2005)- Recess
1032	Merriam-Webster Dictionary (2024)- Recess
1033	Oxford Dictionary of Construction, Surveying, and Civil Engineering (2012)- Recess
1034	Oxford English Dictionary (2024)- Recess
1035	File History for U.S. Patent No. 11,446,512 provided in Application No. 16/791,004

I. INTRODUCTION

Biofrontera Inc., Biofrontera Bioscience GmbH, Biofrontera Pharma GmbH, and Biofrontera AG (collectively, “Petitioner”) hereby respectfully request *inter partes* review of claims 1-3, 5, 8, 17, 18 and 20 (“Challenged Claims”) of U.S. Patent No. 11,446,512 (“the ‘512 Patent”) pursuant to 35 U.S.C. §§ 311-319. There exists a reasonable likelihood that Petitioner will prevail with respect to at least one of the Challenged Claims, which are unpatentable over the prior art identified herein.

Petitioner previously filed IPR petitions challenging U.S. Patent No. 11,697,028 (“the ‘028 Patent”) which is a continuation of the ‘512 Patent. *See* IPR2024-00874 and IPR2024-01312. The independent claims of the ‘028 Patent and ‘512 Patent substantially overlap and thus some of the arguments herein are substantially similar to the arguments raised in IPR2024-01312.

II. MANDATORY NOTICES

Pursuant to 37 C.F.R. § 42.8, Petitioner provides the following disclosures:

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

The real parties-in-interest for Petitioner are Biofrontera AG, Biofrontera Bioscience GmbH, Biofrontera Pharma GmbH, and Biofrontera Inc. Additionally, Petitioner further identifies Biofrontera Neuroscience GmbH and Biofrontera Development GmbH as real parties-in-interest for the IPR requested by this Petition, solely to the extent that Patent Owner contends that these separate legal entities

should be named real parties-in-interest in the requested IPR, and Petitioner does so to avoid the potential expenditure of resources to resolve such a challenge. No unnamed entity is funding, controlling, or otherwise has an opportunity to control or direct this Petition or Petitioner's participation in any resulting IPR.

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

The '512 Patent and its continuation the '028 Patent are involved in multiple matters that may affect or be affected by this proceeding:

PTAB IPR Petitions

Biofrontera Inc., Biofrontera Bioscience GMBH, Biofrontera Pharma GMBH, and Biofrontera AG v. Dusa Pharmaceuticals, Inc., IPR2024-00874 challenging the '028 Patent (petition filed on April 30, 2024). The PTAB denied this IPR petition on November 12, 2024.

Biofrontera Inc., Biofrontera Bioscience GMBH, Biofrontera Pharma GMBH, and Biofrontera AG v. Sun Pharmaceutical Industries, Inc., IPR2024-01312 challenging the '028 Patent (petition filed on August 21, 2024).

ITC COMPLAINT

In Re Certain Photodynamic Therapy Systems, Components Thereof, And Pharmaceutical Products Used In Combination With The Same, Investigation No. 337-TA-1411 alleging infringement of the '512 and '028 Patents (complaint filed on June 25, 2024). See Ex.1020. The parties submitted claim construction briefs in this

ITC matter that may impact the Board’s consideration of the issues in this IPR. See Exs. 1024, 1025, 1028, and 1029.

DISTRICT COURT LITIGATION

Sun Pharmaceutical Industries, Inc. v. Biofrontera Bioscience GmbH, Biofrontera Pharma GmbH, Biofrontera AG, and Biofrontera Inc., Civil Action No. 1:24-cv-11637 (D. Mass) alleging infringement of the ’512 and ’028 Patents (complaint filed on June 25, 2024). See Ex.1018 and Ex.1019. This district court action has been stayed pending resolution of the ITC proceeding noted above.

C. Lead and Backup Counsel (37 C.F.R. § 42.8(b)(3))

Lead Counsel	Backup Counsel
James P. Murphy Reg. No. 55,474 Polsinelli PC 1000 Louisiana Street Suite 6400 Houston, Texas 77002 Tel: (713) 374-1631 jpmurphy@polsinelli.com	Corey Casey Reg. No. 66,950 Polsinelli PC 900 West 48 th Place Suite 900 Kansas City, Missouri 64112 Tel: (816) 572-4439 ccasey@polsinelli.com Megan Hart Reg. No. 79,202 Polsinelli PC 7676 Forsyth Blvd. Suite 800 St. Louis, Missouri 63105 Tel: (314) 622-6107 mkhart@polsinelli.com

Pursuant to 37 C.F.R. § 42.10(b), Powers of Attorney have been filed with this Petition.

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

Petitioner consents to service by e-mail at the above e-mail addresses provided above for lead and backup counsel. Physical mailing service information is as follows:

James Murphy
Polsinelli PC
1000 Louisiana Street
Suite 6400
Houston, Texas 77002

E. Payment of Fees (37 C.F.R. §§ 42.15(a) and 42.103(a))

All required fees have been paid with the filing of this Petition. Petitioner further authorizes the U.S. Patent & Trademark Office to charge Deposit Account No. 50-1662 for any fees, including the fee set forth in 37 C.F.R. § 42.15(a) for this Petition.

F. Certification of Word Count Under 37 C.F.R. § 42.24(d)

Petitioner certifies that the word count in this Petition, including all footnotes, is 13,912 words as counted by the word-processing program (Microsoft Word for Office 365) used to generate this Petition, where such word count excludes the table of contents, mandatory notices, certificate of service, list of exhibits, and this

certificate of word count. This Petition is in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24(a)(1)(i).

III. GROUNDS FOR STANDING UNDER 37 C.F.R. § 42.104(A)

Petitioner certifies that the '512 patent is available for *inter partes* review. Petitioner is not barred or estopped from requesting an *inter partes* review of the '512 patent claims on the grounds identified in this Petition. 37 C.F.R. § 42.104(a).

IV. IDENTIFICATION OF GROUNDS FOR WHICH REVIEW IS REQUESTED UNDER 37 C.F.R. § 42.104(B)(1)

Petitioner asserts that claims 1-3, 5, 8, 17, 18 and 20 of the '512 patent are unpatentable based on the following ground:

Ground 1: Claims 1-3, 5, 8, and 20 are obvious over Lundahl in view of Larsen.

Ground 2: Claims 1-3, 5, 8, 17, 18 and 20 are obvious over Lundahl in view of Larsen and Hente.

Ground 3: Claims 17 and 18 are obvious over Lundahl in view of Larsen, Hente and Perutz.

V. THE CONTESTED PATENT

A. Effective Filing Date of the '512 Patent

The '512 Patent claims priority to Provisional Application No. 62/241,902, filed on October 15, 2015. All of the prior art references were published more than one year before October 15, 2015.³

B. Specification of '512 Patent is Substantially the Same as '028 Patent

The '028 Patent is a continuation of the '512 Patent and thus discloses common subject matter. The Petitioner has already addressed the common subject matter and the Board will have already considered the same in IPR2024-00874 and/or IPR2024-01312 before the institution decision for this matter. Thus, no additional summary of subject matter of the '512 specification is provided herein.

C. Prosecution History

The '512 Patent was filed on February 14, 2020, as application number 16/791,004. Petitioner summarizes here the actions most relevant to its grounds of unpatentability. On October 25, 2021, the Examiner rejected all pending claims as being obvious over several references, including Larsen. Ex.1035, 324-334. On February 25, 2022, Applicant amended the claims in a manner that led to their

³ Petitioner does not concede that the Challenged Claims are entitled to this effective filing date.

allowance over the art cited by the Examiner. *Id.*, 199-208. The amendments that led to allowance are detailed below.

Independent claim 1 is a system claim that was amended to recite the nested hinges connecting the at least five panels of the illuminator being “on inner side surfaces of adjacent panels”; the light sources being disposed on “surfaces of the at least five panels”; and “wherein each of the at least five panels has two first edges and two second edges shorter than the two first edges, and the light sources are arranged such that a higher intensity of light is emitted proximate the second edges compared to the intensity of light emitted not proximate the second edges”. *Id.*, 199-208.

Independent claim 6 is a method claim that was amended to recite the above listed recitations of amended claim 1 as well as adding the step of “administering 5-aminolevulinic acid (ALA) to the patient. *Id.*, 199-208.

On May 16, 2022, the Examiner issued a Notice of Allowance (“NOA”) stating that the prior art of record did not anticipate or render obvious “nested hinges on inner side surfaces of adjacent panels” and “wherein each of the at least five panels has two first edges and two second edges shorter than the two first edges, and the light sources are arranged such that a higher intensity of light is emitted proximate the second edges compared to the intensity of light emitted not proximate

the second edges.” *Id.*, 199-208; *see also* Ex.1002, 114-121 (allowance of ’028 Patent claims due to some similar features).

D. Claim Construction

Solely for the purposes of this IPR, other than for term “recess” as outlined below, Petitioner has taken a view of the scope of the claims consistent with Patent Owner’s proposed claim constructions (Ex.1024 and Ex.1028) and infringement allegations (Ex.1019) in the underlying proceedings. All of the arguments presented in this IPR petition render the claims obvious assuming Patent Owner’s proposed claim constructions and infringement allegations are correct. However, Petitioner has submitted its own claim constructions in the underlying ITC matter (Ex.1025 and Ex.1027) that disagree with the constructions proposed by Patent Owner. The invalidity analysis presented in this IPR is still likely to render the claims obvious under any reasonable construction.

With respect to the term “recess,” as recited in claims 17 and 18 of the ’512 Patent, Patent Owner asserts this term requires no construction. In view of Patent Owner’s position and since claims 17 and 18 are unpatentable under any reasonable construction of “recess” the Board need not construe this term to determine the issues in this IPR. *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed.Cir.2011).

To the extent Patent Owner contends the prior art does not teach a “recess” as recited in claims 17 and 18, Petitioner proposes the construction of “recess” it advances in the ITC. Namely that “recess” be given its plain and ordinary meaning of “an indentation in a surface.” Ex.1015 ¶75; Ex.1025, 19-20. This understanding of the plain and ordinary meaning of the term is consistent with dictionary definitions. Ex.1015 ¶75; *see* Exs.1030-1034 (dictionary definitions of recess).

VI. STATE OF TECHNOLOGY AT THE TIME OF THE INVENTION

Phototherapy is the use of light - either ultraviolet, visible or infrared – for the treatment of disease. Ex.1015, ¶45. Photodynamic Therapy (PDT) is a subgroup of phototherapy that utilizes light to activate a chemical on or within the body to achieve a therapeutic effect, particularly in lesions like actinic keratosis (AK). Ex.1015, ¶45-53; Ex.1016, ¶46.

A. Actinic Keratosis

Actinic Keratosis (AK) is a tumor of the epidermis comprised of a proliferation of atypical keratinocytes confined to the lower levels of the epidermis and if untreated can develop into tumors. Ex.1016, ¶¶28-31. There are several ways to treat AK lesions, including pharmaceuticals, surgery, or photodynamic therapy. *Id.*, ¶32.

B. Photodynamic therapy

One common method of treating AK lesions is through photodynamic therapy (PDT), using a combination of a photosensitive compound, such as topical 5-aminolevulinic acid (ALA) and a photodynamic therapy light. Ex.1015, ¶50. The compound reacts only within the pathological tissue to selectively kill the cancerous tissue. Ex.1016, ¶¶33-35; *see also* Ex.1015, ¶¶46-48 (PDT allows for “selectively destroying the pre-cancerous or cancerous tissue”) (citing Ex.1021).

As far back as 1989, in a patent assigned to DUSA, the Patent Owner’s assignor in this case, Kennedy described PDT using ALA using a variety of wavelengths, including red light. Ex.1016, ¶¶47-51. At the time, in 1989, it was known that red light (600 – 700 nm) could pass through a slab of human tissue 1 cm thick, with 1 to 10% of incident red light being transmitted. Ex.1016, ¶53. Using ALA in combination with a 500-watt tungsten lamp filtered to remove both infrared (heat filter) and wavelengths below 600 nm, DUSA varied the fluence and successfully treated a variety of AK lesions on patients. Ex.1016, ¶¶44-45, 55-56.

Ideally, PDT can be completed in a single treatment session, and can destroy either a single AK or numerous AK lesions within a field with limited impact on any surrounding skin that is not actinically damaged. Ex.1016, ¶37.

C. Photodynamic Therapy in the modern LED era (post-2000)

Since at least 1989, ALA and other photosensitizers have been utilized successfully for both the effective treatment of actinic keratosis (AKs) and off-label treatment of other conditions. Ex.1016, ¶¶33-37, 42. The response of the AK or acne lesion depends on the uptake of the photosensitizer as well as the irradiance (in W/cm² or mW/cm², the rate at which energy is delivered per unit area of skin) and the wavelength of the light source. Ex.1015, ¶50.

The design of the light source plays an important role in achieving an irradiance that is as uniform as possible. Ex.1015, ¶51. To at least partially compensate for non-uniform illumination, a lamp can be designed to be “brighter” (i.e., to emit light at a greater intensity) near its edges than from its central region. *Id.* For example, if the lamp consists of a rectangular panel or panels of many LEDs, the number or density of LEDs could be increased near the upper and lower edges of the panel(s). Ex.1015, ¶52.

For illumination of the face as an example, a U-shaped collection of fluorescent tubes as in Lundahl (Ex.1004) and the Sun/DUSA Blu-U (Ex.1023,29) or an array of hinged, rectangular panels with numerous LEDs as disclosed in Larsen can be utilized. Ex.1015, ¶53. Each approach requires appropriate placement of the light sources, either tubes or LEDs, to minimize the variation in irradiance on the

face by adding additional light sources near the upper and lower horizontal edges.

Id.

VII. SUMMARY OF PRIOR ART

The prior art discloses and teaches the claimed subject matter of the ‘512 Patent as explained below. All the references are prior art under 35 U.S.C. § 102(a)(1). These references are directed to the same field as the ‘512 Patent and/or the same problems. *See e.g.*, Ex.1015, ¶¶91, 101 and 109. Neither Petitioner nor Dr. Grove are aware of any secondary considerations that support a finding of non-obviousness. *See* Ex.1015, ¶155.

A. Lundahl (Ex.1014)

U.S. Patent No. 6,223,071 (hereinafter referred to as “Lundahl”) was filed on May 1, 1998 and issued on April 24, 2001 qualifying Lundahl as prior art under 35 U.S.C §§102 and 103. Ex.1016, ¶57. Lundahl’s subject matter was previously summarized by Petitioner in IPR2024-01312. Detailed analysis for how Lundahl’s teachings in combination with the other cited prior art cited obvious the claims is provided herein.

B. Larsen (Ex.1004)

U.S. Patent Publication No. 2005/0075703 (hereinafter referred to as “Larsen”) was published on April 7, 2005 and claims priority to a foreign patent application filed on January 22, 2001 qualifying Larsen as prior art under 35 U.S.C

§§102 and 103. Lundahl’s subject matter was previously summarized by Petitioner in IPR2024-01312. Detailed analysis for how Larsen’s teachings in combination with the other cited prior art cited obvious the claims is provided herein.

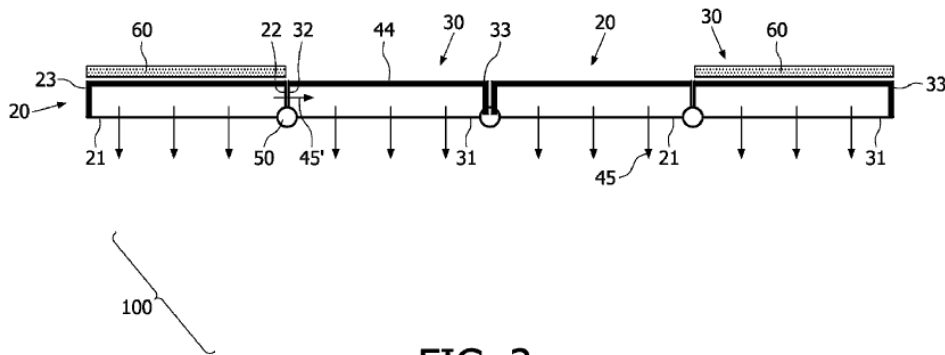
C. Hente (Ex.1026)

U.S. Patent Publication No. 2010/0118522 (hereinafter referred to as “Hente”) was published on May 13, 2010 and filed on October 26, 2009, as a §371(c) national stage filing of PCT/IB2008/051629 filed on April 28, 2008, qualifying Hente as prior art under 35 U.S.C §§102 and 103.

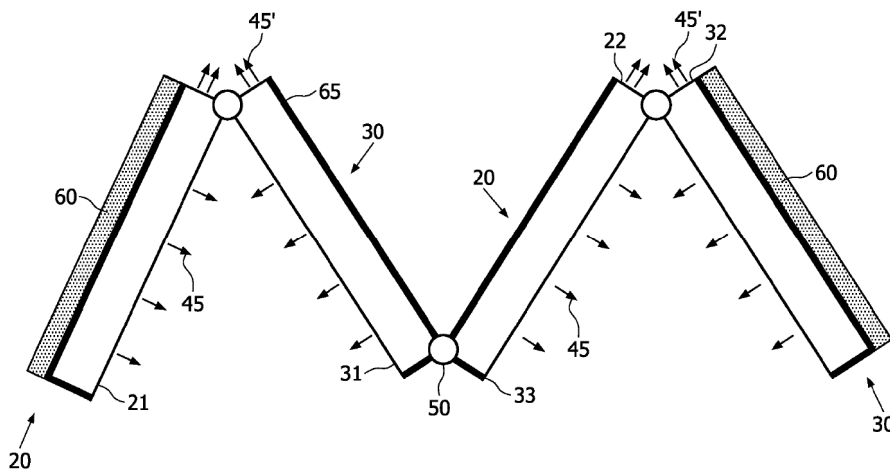
Hente is directed to light emitting devices comprising organic light emitting diodes (i.e., organic LEDs or OLEDs) that allow for adjustable and foldable orientations. Ex.1026, Title, Abstract. Hente explains that a number of illumination devices were known in the art, but that such light emitting devices were generally inefficient (in the case of gas discharged lamps) and did not have the desired flexibility to adjust for different sizes of areas to be illuminated. Ex.1026, ¶¶0002-0004.

Hente teaches light emitting devices that have the flexibility to “illuminate large and point-like limited areas.” Ex.1026, ¶0005. Specifically, Hente discloses lighting devices with at least one first section and at least one second section. Ex.1026, Abstract. Hente explains that the light emitting device can be expanded to

provide a flat illumination surface, as illustrated below in Figure 2 below. Ex.1026, ¶0036.



As seen in the figure above, Hente discloses a panel can include an indentation in an inner side surface of the panel. Ex.1015, ¶110. Hente also teaches that the light emitting device may be adjusted or folded into a smaller, “compact” position as illustrated in Figure 3 below. Ex.1026, ¶0037.

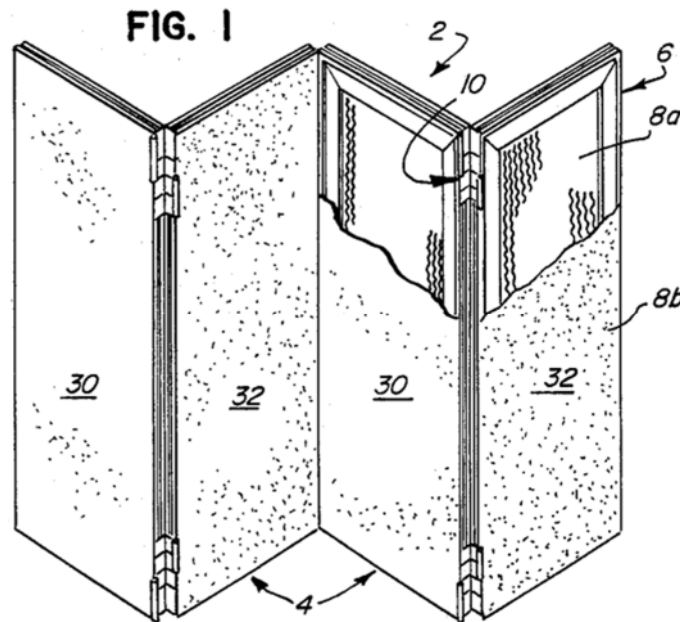


D. Perutz (Ex.1027)

U.S. Patent No. 4,823,858 (hereinafter referred to as “Perutz”) was issued on April 25, 1989 and filed on June 02, 1987, qualifying Perutz as prior art under 35 U.S.C §§102 and 103.

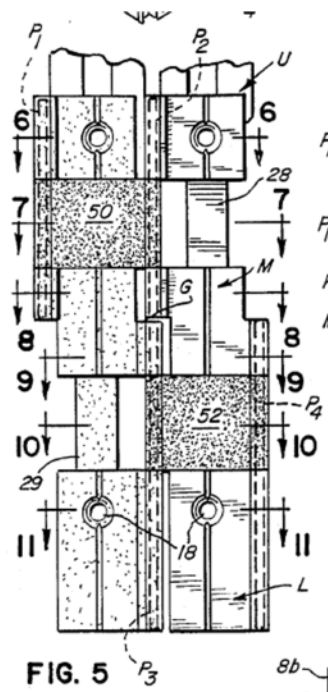
Perutz teaches a display panel and hinge system having “a plurality of display panels arranged in side by side relation and hingedly interconnected whereby one of the panels is capable of being selectively rotated relative to the other panel through a maximum arc of substantially 360°.” Ex.1027, Abstract.

Perutz teaches connecting adjoining display panels 30, 32 with hinges 10, the display panels 30, 32 having a frame 6. Ex.1027, as shown in Figure 1 below, 3:54-66 and 4:11-14.



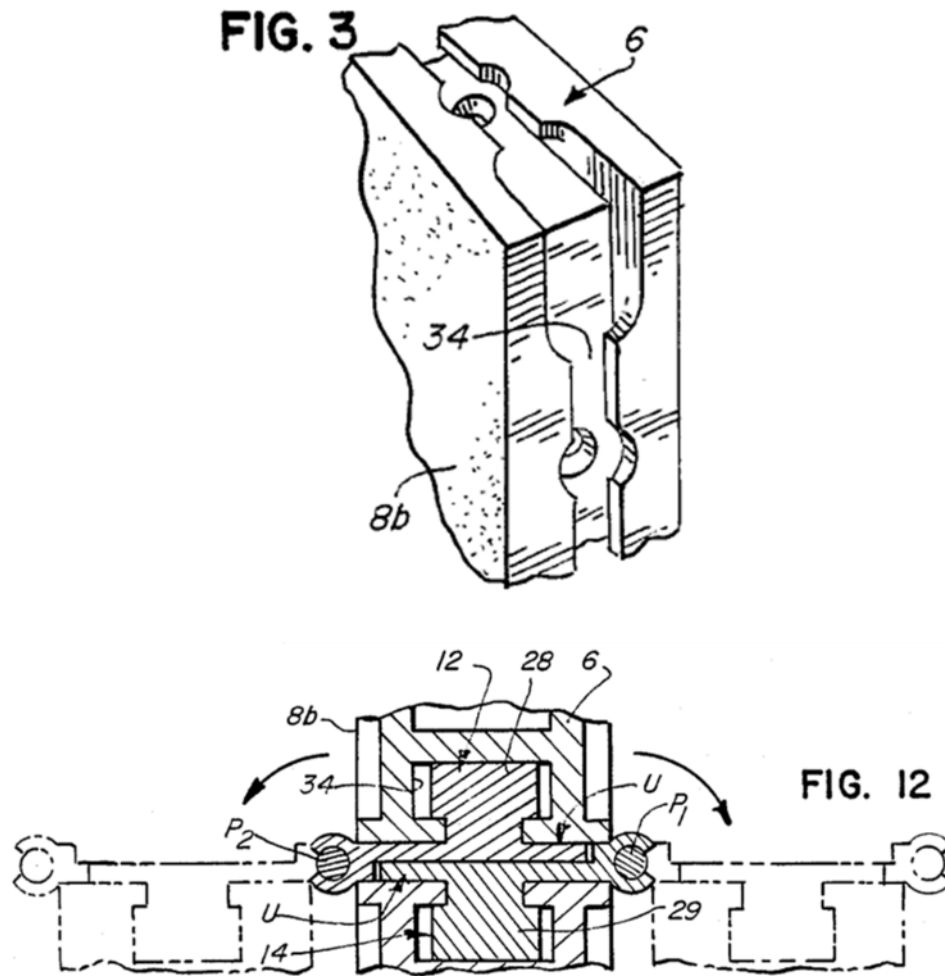
Ex.1027, Fig. 1.

Each hinge includes hinge segments with upper, middle, and lower portions “secured to corresponding sides of adjacent display panels” and “maintained in vertically spaced alignment by an elongated rib or strut 28, 29 affixed to a corresponding face of each portion,” as shown below in Figure 5. Ex.1027, 4:11-20 and 22-38.



Ex.1027, Fig. 5.

As shown in Figures 3 and 12, reproduced below, the side-mounted hinges of Perutz are received in an indentation in the side surface (e.g., slot 34) to reduce space between adjoining display panels.



Ex.1027, Figs. 3 and 12.

VIII. LEVEL OF SKILL IN THE ART

A POSITA at the time of the earliest effective filing date of the '512 Patent would have been an individual or member of a multi-disciplinary team with education of (1) at least a Bachelor of Science degree in one or more fields of electrical engineering, physics, biomedical engineering, computer engineering, chemical engineering or material science, in fields relating to optics, optoelectronics,

radiometry, photometry, photodynamic diagnosis (PD), photodynamic therapy (PDT), phototherapy (PT), and related technologies; and (2) a medical degree in fields relating to the diagnosis and treatment of skin conditions and related disease states. Alternatively, a POSITA individually or members of the multi-disciplinary team would have had at least four years of experience in one or more fields of optics, optoelectronics, radiometry, photometry, photodynamic diagnosis (PD), photodynamic therapy (PDT), or phototherapy (PT), and at least four years of experience in one or more fields of medical treatment of skin conditions and related disease states.

This petition is supported by the declarations of Dr. Grove and Dr. Ehrenreich. Dr. Grove's declaration provides testimony from the perspective of a POSITA regarding the teachings of the prior art and obviousness of the Challenged Claims which is based in part upon Dr. Grove's reading of Dr. Ehrenreich's declaration. Ex.1015, ¶119. Dr. Ehrenreich's declaration provides testimony about the background knowledge of a POSITA for medical treatments involving PDT and explains the teachings of medical treatments in the cited prior art. Ex.1016, ¶¶28-37.

IX. PROPOSED GROUNDS OF REJECTION

A. Ground 1 - Lundahl in view of Larsen Renders Obvious Claims 1-3, 5, 8, and 20

1. Motivation to Combine

A POSITA would be motivated to combine the teachings of Lundahl and Larsen to incorporate the hinged panel LED displays of Larsen into the PDT device of Lundahl. Ex.1015, ¶119. As noted in the level of skill, a POSITA would represent a team of individuals, some with engineering expertise (like Dr. Grove), and some with expertise in the medical treatment of patients (like Dr. Ehrenreich). The combined opinions based on the education and experiences of both Dr. Grove and Dr. Ehrenreich are the appropriate POSITA combination from which the motivation to combine and modify the prior art should be judged. Ex.1015, ¶119-123.

Dr. Ehrenreich sees patients diagnosed with AK every day, and routinely treats these patients with PDT. Ex.1016, ¶¶38-43. Dr. Ehrenreich notes that the Blu-U lamp device he uses often in his practice, including the years preceding 2015, resembles the lamp device described in Lundahl. Ex.1016, ¶41. Comparing the Blu-U lamp with Lundahl, Dr. Grove agrees that the Lundahl patent appears to disclose the Blu-U device, particularly given the fact that Lundahl is assigned on its face to DUSA Pharmaceuticals, Inc., the manufacturer of Blu-U. Ex. 1016, ¶¶40-41, 59; Ex.1015, ¶120. Consequently, Dr. Ehrenreich's comments regarding his experience

with Blu-U are equally applicable to the device described in Lundahl, as the two appear to be the same. Ex. 1016, ¶59.

Moreover, Dr. Ehrenreich explains that there were known issues and flaws when using the Blu-U/Lundahl design to treat patients for AK. *See* Ex.1016, ¶¶60-74. Dr. Ehrenreich points out that Lundahl discloses a fixed U-shape, that this fixed U-shape was developed based on “the average dimensions of the human head,” and, because of this, the Lundahl design may not be ideal given the variety of sizes and shapes of patients’ heads. Ex.1016, ¶67. Dr. Ehrenreich also states that the fixed U-shape design of Lundahl did not provide the flexibility needed to treat other parts of the patients’ bodies that would typically have AK lesions, including the arms, back, chest, and hands, particularly in view of the need to maintain a distance of 2-4” from the treatment surface (skin) to the lighting surface. Ex.1016, ¶¶42-43, 70.

In addition, Dr. Ehrenreich testifies as to known problems with the fluorescent tubes utilized in the Lundahl design. Ex.1016, ¶¶41-43, 72-74. For instance, Dr. Ehrenreich, citing Lundahl itself, notes that the uniformity of light from fluorescent tubes varies across the length of the tube, and the uniformity of lighting can also be affected by heat and the ability to cool the Lundahl device. Ex.1016, ¶¶68-69.

Consequently, as discussed in his expert declaration, Dr. Ehrenreich identifies certain problems associated with the Lundahl device design, which problems Dr. Ehrenreich has experienced first-hand in his use of the Blu-U device. The known

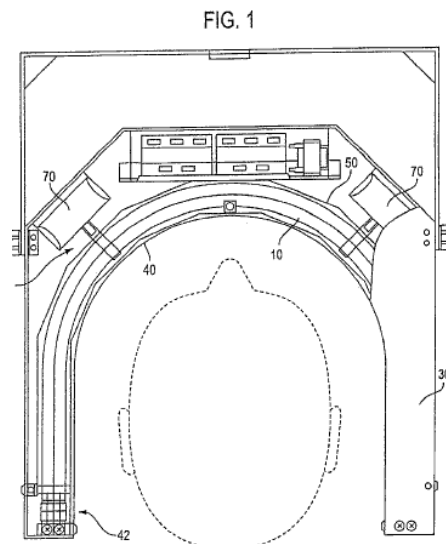
problems outlined in Dr. Ehrenreich's declaration include: (1) the inflexibility of the fixed U-shape of Lundahl not only created issues ensuring the proper 2-4" treatment distance for the wide variety of patient head sizes and shapes, but also would not allow for proper treatment of other parts of the anatomy requiring AK treatment, including the arms, back, chest, and hands; and, (2) the fluorescent tubes utilized in Lundahl had inherent shortcomings due to the lack of uniform light output across the length of the tube and sensitivity to temperature. Ex.1016, ¶¶41-44, 68-73. These treatment issues (and others) represent known problems for which the POSITA team member with a background in engineering (such as Dr. Grove) would have been motivated to improve upon. See Ex.1016, ¶¶73-74.

a. Increasing flexibility of device for use with all head sizes and shapes, as well as varying anatomies

As discussed in the declaration of Dr. Ehrenreich, the PDT device and design of Lundahl appears to be the same design utilized for Blu-U, a device publicly known and used in the treatment of AK lesions from 1999-2015. Ex.1015, ¶124; Ex.1016, ¶41. Lundahl teaches that **“[t]he U-shape minimizes the variations in distance between the emitter and the target, providing a uniform visible light distribution to the face or scalp of the patient; the tube dimensions were chosen based on the average dimensions of the adult human head.** The mounting of the tubes minimizes the impact of the non-emitting area at their ends. This allows the

present invention to be more compact and permits easier centering of the patient's head within the visible light sources. Moreover, the “U” shape provides the desired irradiance and irradiance uniformity for scalp and facial irradiation, and thus ensures that the proper visible light dosage is applied to all target areas during PDT.”

Ex.1014, 6:31-42.⁴ Lundahl illustrates the “U” shape design in Figure 1:



Ex. 1014, Fig. 1. As can be seen from Figure 1, the various points of the treatment surface (i.e., the various points on the patient's skin) will have varying distances from the light surface (e.g., the nose will be closer to the light surface than the point where the nose meets the cheek). As noted in the declaration of Dr. Ehrenreich, the FDA approved indication for the treatment of AK using LEVULAN and Blu-U requires that the light surface be 2-4” from all points on the treatment

⁴ Unless otherwise indicated, all emphasis added.

surface (i.e., all points on the patient's nose, cheeks, chin, ears, etc.). Ex.1016, ¶¶40-42, 43; Ex. 1022. While it is possible that a patient having head dimensions similar to “the average dimensions of the adult human head” would allow for positioning within the Lundahl device similar to Figure 1, a POSITA would also envision many scenarios where the shape and dimensions of the patient would not allow for the required 2-4” distance required by the FDA approved indication. Ex.1015, ¶125; Ex. 1016, ¶¶42-44.

POSITA considering Lundahl would have been motivated to increase the flexibility of the device to ensure the light surface could be maintained at a distance of 2-4” of the entire treatment surface of the patient (i.e., face, nose, forehead, ears, sides of head, etc.), particularly given the wide variety of head shapes and sizes. Additionally, a POSITA would have understood that there are other bodily anatomies that could use treatment for AK lesions, such as the arms, back, and other body parts. Ex.1016, ¶¶42-43. In fact, Lundahl expressly contemplates the treatment of other parts of the body, stating that “[t]he present invention is directed to photodynamic therapy using an illuminator that provides a uniform distribution of visible light. In particular, the present invention is directed to an apparatus and method for photodynamic treatment (PDT) or diagnosis (PD) of actinic keratosis of the scalp or facial areas of a patient. Ex.1015, ¶126. The present invention is also

directed to an apparatus and method for PDT and PD of other indications (e.g., acne) **and other areas of the patient (e.g., arms, legs, etc.).**” Ex. 1014, 1:9-17.

Consequently, POSITA would have been motivated to change the design of the system of Lundahl to allow for adjustment of the light sources to ensure a 2-4” distance from the face and from other varying anatomies. *See* Ex.1016, ¶¶70-74, 87. POSITA would have understood that the easiest way to modify the fixed, curved U-shape of Lundahl would be to incorporate hinged panels that could be individually adjusted to account for variations in head shape/size or other anatomy selected for treatment. Ex.1015, ¶127.

Larsen teaches that “[f]or the treatment of large-area tissues according to Fig. 1, **several applicators 13 are flexibly connected to each other through hinges 10, respectively connecting one edge with the other**, whereby the applicators are suitable for the treatment of for example, the backs of humans and so become adjustable for an equidistant positioning of the applicators 13 above the skin.” Ex.1004, [0072]. These teachings would have motivated POSITA to incorporate Larsen’s solution of connecting light applicators by hinges, to allow for adjustability of Lundahl’s device to provide the desired irradiance and irradiance uniformity to all target areas during PDT. Ex.1015, ¶128.

POSITA would have had a reasonable expectation of success in combining Lundahl with Larsen, because both references describe similar illuminators for using light to treat conditions on a patient's skin. Ex.1015, ¶129.

b. Increasing light output consistency by changing the light source from fluorescent tubes to LEDs

POSITA was also motivated to modify Lundahl to incorporate LEDs as taught by Larsen, rather than the fluorescent tubes. Lundahl discloses horizontally oriented fluorescent tube lights. However, by the late 2000's and early 2010's, POSITA would have been motivated to use solid-state light-emitting diodes (LEDs) as the illumination source for three reasons. First, LEDs have a lower cost and a longer lifetime than fluorescent tubes. Second, fluorescent tubes are known to have inconsistent light output within the tube itself, as acknowledged in Lundahl (the tubes have "non-emitting area at their ends" (Ex. 1014, 6:31-42) and that "tube output may vary over its length" (Ex. 1014, 4:41-42). Third, by moving to adjustable panels connected by hinges to increase flexibility, the use of LEDs would be more practical to reduce spacing between light sources and the edges of the panels, as opposed to the bulky metal couplings at the end of fluorescent tubes, to reduce optical dead space across the light surface. Fourth, the relatively narrow output spectrum of LEDs allows for an illuminator with an output wavelength ideally matched to an absorption band of the photosensitizer. Ex.1015, ¶130.

Larsen teaches that light sources are disposed on the surfaces of five applicators, the light sources being “semiconductor diodes (LED) and/or laser diodes.” Ex.1004, [0070]. The state of illumination technology as described in the previous paragraph along with this teaching of Larsen would have motivated POSITA to incorporate Larsen’s solution of disposing light sources, specifically LEDs, on the surface of the light applicators to Lundahl’s device. Ex.1015, ¶131.

POSITA would have had a reasonable expectation of success in combining Lundahl with Larsen, because both references describe similar illuminators and the conversion from fluorescent tubes to LEDs was a routine practice prior to 2015. Ex.1015, ¶132.

c. Increasing light absorption at deeper skin depths by emitting red light

Moreover, POSITA was motivated to utilize red light wavelengths in the PDT device rendered obvious by Lundahl and Larsen. As previously discussed, Lundahl expressly incorporates all teachings of Kennedy. Ex. 1014, 1:38-48 (incorporating by reference the contents of Ex.1017); Ex.1015, ¶133.

Kennedy teaches that red light was preferred for PDT, as it penetrates deeper into the skin, as compared to blue light, and PpIX (the compound produced by topical application of ALA) strongly absorbs red light. Kennedy discloses “[a] method of detecting and treating malignant and non-malignant tissue abnormalities

and lesions of the skin” in which “5-aminolevulinic acid is administered to the patient.” Ex.1017, Abstract; Ex.1016, ¶52. Kennedy states that “[i]n preferred aspects of this invention the preferred precursor of protoporphyrin IX is 5-amino-4-oxo-pentanoic acid, otherwise known as 5-aminolevulinic acid, and a preferred wavelength of the photoactivating light is in the range 350-640 nm, more preferably a red light of about 610-630 nm.” Ex.1017, 4:3-8. Kennedy also states that “[t]he wavelength of the photoactivating light is of some importance, as it has been shown that between 1 and 10 percent of incident red light (600-700 nm) can pass through a slab of human tissue 1 cm thick, whereas only 0.001 percent or less of blue light (about 400 nm) can pass through the same thickness of human tissue. The photosensitizer will, therefore, be more successful if it strongly absorbs red light. PpIX does strongly absorb red light.” Ex.1017, 4:60-69. Based on the teachings of Kennedy, POSITA would have expected red light (preferably at wavelengths of about 610-630) to more effectively penetrate skin tissue, and for PpIX to more effectively absorb the red light, resulting in greater activation of the photosensitizer. These enhancements in the penetration of light and absorption by the photosensitizer would have led POSITA to reasonably expect enhanced efficacy of the PDT device. Ex.1015, ¶134.

Additionally, Larsen teaches that its applicators are configured to output red light: “devices are available for the photodynamic stimulation of human cell energy

in the form of red and infrared radiation . . .” Ex.1004, [0024]. Larsen also teaches using light radiation within the wavelength of 300 – 2000 nm, which includes red light. *Id.*, [0025], [0071]-[0076], [0083]. Ex.1015, ¶135.

Based on the expectation of enhanced light penetration and absorption by the photosensitizer, POSITA was motivated to combine the teachings of Lundahl, incorporating Kennedy, and Larsen to use red light for PDT. Ex.1015, ¶136.

Additionally, Kennedy reports in Examples 1-4 that patients were administered PDT with a light source that was “filtered to remove both infrared (heat filter) and wavelengths below 600 nm,” meaning red light, likely with wavelengths of 600-700 nm was utilized. Ex.1017, 5:47 to 6:47. Kennedy reports that PDT with this red light demonstrated clearance of treated lesions. *Id.*; Ex.1016, ¶54, 56. In view of this, POSITA had at least a reasonable expectation that red light could be utilized in the device rendered obvious by Lundahl (incorporating Kennedy) and Larsen. Ex.1015, ¶137.

For these reasons, claim 1, 3, 5, 8, and 20 are obvious over Lundahl in view of Larsen.

2. Claim 1

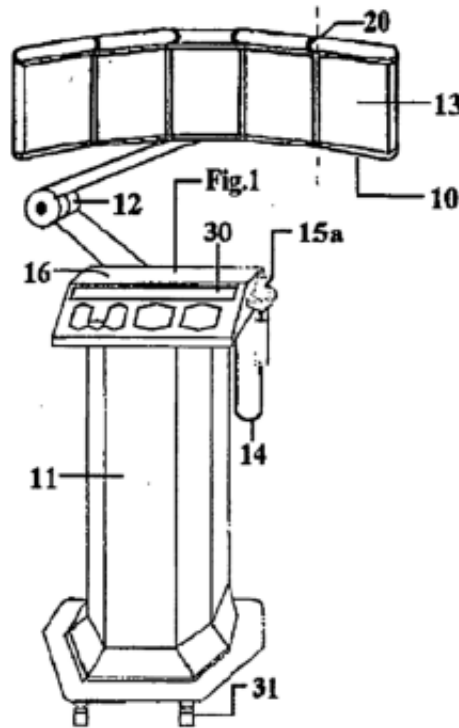
Claim 1[preamble]: “A system for photodynamically diagnosing or treating a patient, comprising:”

Lundahl discloses an “invention...directed to photodynamic therapy using an illuminator that provides a uniform distribution of visible light. In particular, the present invention is directed to an apparatus and method for photodynamic treatment (PDT) or diagnosis (PD) of actinic keratosis of the scalp or facial areas of a patient.” Ex.1014, 1:9-14. Larsen similarly discloses an “invention relat[ing] in general to electrotherapy devices and more particularly to devices and methods for photodynamic and electromagnetic stimulation of living tissue, directly and also indirectly, by stimulation of photosensitive substances introduced into or onto living tissue.” Ex.1004, [0001]. Larsen further states its device “provides multiple wavelength stimulation that is also effective in conjunction with photodynamic therapy (PDT) chemicals.” Ex.1004, [0037].

Thus, Lundahl and Larsen teaches the preamble of claim 1. Ex.1015, ¶¶156-158.

Claim 1(a): “an illuminator comprising at least five panels connected by nested hinges on inner side surfaces of adjacent panels,”

Larsen’s illuminator has five hinged panels (13):



Ex.1004, Fig. 1; Ex.1015, ¶159.

Larsen teaches that “[f]or the treatment of large-area tissues according to Fig. 1, *several applicators 13 are flexibly connected to each other through hinges 10, respectively connecting one edge with the other*, whereby the applicators are suitable for the treatment of for example, the backs of humans and so become adjustable for an equidistant positioning of the applicators 13 above the skin.” Ex.1004, [0072]; Ex.1015, ¶160. While this passage refers to “hinges 10,” it is clear from the disclosure of Larsen that this is a labeling error, and that the “10” illustrated

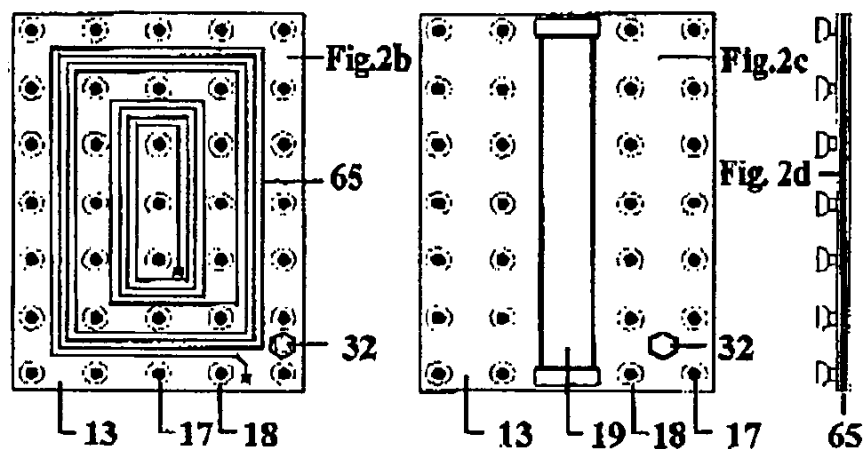
in Fig. 1 refers to the device as a whole, while the hinge component is illustrated by the dotted line labeled as “20.” Larsen states “[a]s shown in FIG. 1, **the invented device 10** for the stimulation of cells with the aid of (PDT) photodynamic light and electromagnetic fields combined with light sensitive substances consists of a stand 11, with which machine applicators 13 (in the following just called applicators 13) are connected through a jointed arm 12.” Larsen ¶0069. In view of this express statement from Larsen, it is clear to a POSITA that the “10” designation of Fig. 1 is referencing the device as a whole. Ex.1015, ¶160.

Larsen discloses that “several applicators 13 are flexibly connected to each other through hinges” (the hinges are indicated as element 10 in the specification, but shown as element 20 in Figure 1). Ex.1004, [0072]. As shown in Figure 1, the panels (13) are nearly flush with each other. Ex.1004, Fig. 1. The Office has already confirmed that the same disclosure in the Larsen ‘381 Patent taught “at least five panels [] connected by hinged structures [].” Ex.1035, 328 (citing Ex.1008, Fig. 1, 5:44-47). Similarly, during the prosecution of Application No. 17/009,871,⁵ the Examiner reviewed Larsen and determined that it taught “five panels connected by a plurality of hinges 20 . . . **on inner side surfaces of adjacent panels that connect**

⁵ This application is a continuation of the ‘512 Patent and includes substantially the same specification as the ‘512 Patent. *Compare* Ex.1001 with Ex.1013.

panels together . . .” Ex.1009, ¶4 (citing Ex.1004, Figs. 1-3, [0069], [0072], lines 1-4); Ex.1015, ¶162.

Moreover, feature “20” of the device is only referenced once throughout the disclosure of Larsen. Larsen states “According to FIGS. 2 b and 2 c the light sources 17 are placed in regular row arrangements, i.e., 20 equidistant from each other, whereby, according to FIG. 2 c, one applicator 13, in addition to the diodes 17, has a light source 19.” Larsen [0071]. Figs. 2b and 2c are provided below:

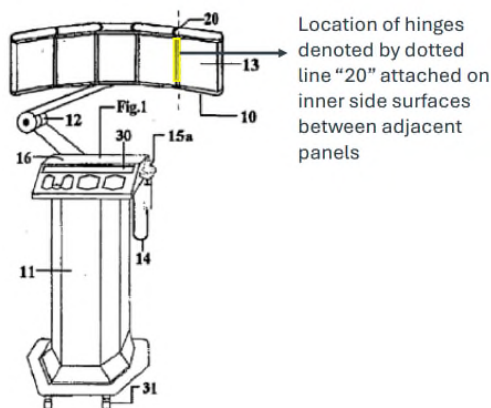


As shown above, there is no feature “20” illustrated in either Fig. 2b or 2c. Ex.1015, ¶163.

Patent Owner filed a patent owner preliminary response in IPR2024-00874, and argued that another Larsen patent application (AU 2001/43869) includes a similar figure to Figure 1 of Larsen, including feature “27” which similarly points to the bottom of the panel arrangement, and is referred to in a claim as “individual [sic] hinged (27) flat elements.” See IPR2024-00874, Paper No. 7, pp25-26. As an initial

matter, AU 2001/43869 is not expressly related to Larsen, and, in fact, appears to be focused on an entirely different device (see Figures 1a-1c). The express disclosure provided in Larsen itself indicates that feature “10” is directed to “the invented device” as a whole. Ex.1015, ¶164. Consequently, the disclosure of AU 2001/43869 does not impact Dr. Grove’s opinion on the typographical error in Figure 1 of Larsen. *Id.*

As such, a POSITA would understand that the passage from Larsen above, referencing “hinges 10” is a typographical error, and that the hinges described in the specification of Larsen are illustrated as “20” in Figure 1. Ex.1015, ¶165. Based on this understanding, Larsen discloses an illuminator comprising at least five panels connected by hinges on inner side surfaces of adjacent panels. The figure below illustrates this arrangement. *Id.*



Even if the Board determines that Larsen’s hinges are not expressly (or inherently) disclosed on the inner side surfaces of the panels, POSITA would have

found it obvious and would have been motivated with a reasonable expectation of success to locate Larsen's hinges on the inner side surfaces of adjacent panels. Ex.1015, ¶166. First, Figure 1 of Larsen shows that the inner edges of each of the panels (13) are nearly flush with each other. This disclosure would have motivated POSITA to place the hinges on the inner side surfaces of Larsen's panels in order to facilitate this nearly flush arrangement. *Id.* Such a modification would have involved nothing more than the use of a known prior art element according to known methods to yield predictable results. *Id.* Second, there were finite number of known, predictable solutions for Larsen's panels to be "flexibly connected to each other through hinges," and POSITA would have found it obvious to try placing the hinges on the inner side surfaces of the panels. *Id.* And POSITA would have had a reasonable expectation of success, since POSITA would have known that hinges located on the inside surfaces of the applicator would allow them to be positioned in a nearly flush arrangement as shown in Figure 1. *Id.*

Lastly, regarding the requirement that the at least five panels are connected by "nested" hinges on inner side surfaces of adjacent panels (assuming this term is not indefinite), Larsen discloses it in view of the Patent Owner's alleged claim scope in its claim construction brief that "nested hinges on inner side surfaces of adjacent panels" should be construed as "hinges that fit on inner side surfaces of adjacent

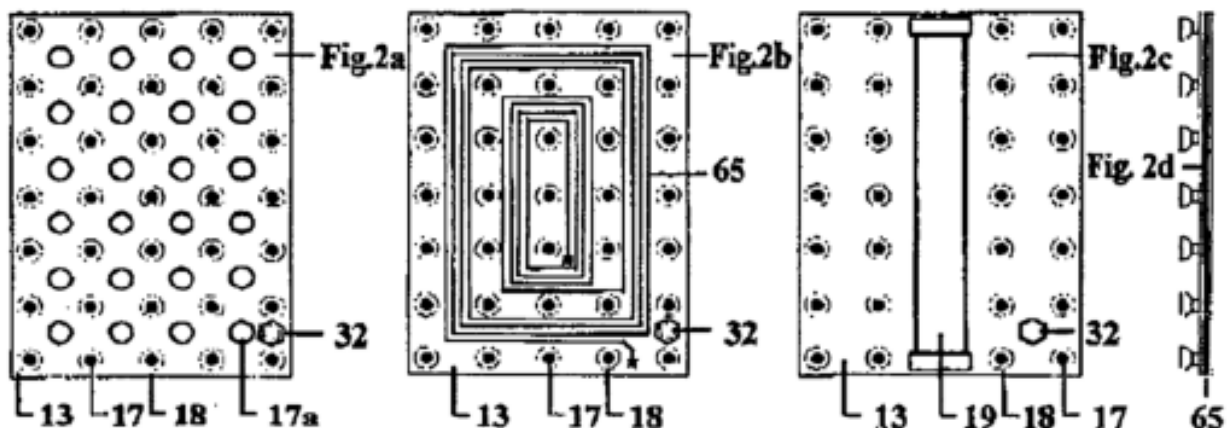
panels.” Ex.1024, 21; Ex.1015, ¶167; *see also* Ex. 1019, 7-9 (Patent Owner’s infringement contentions.

However, using the ‘512 patent owner’s assertions of what is required by “nested hinges on inner side surfaces of adjacent panels,” (i.e., hinges that fit on inner side surfaces of adjacent panels), Larsen discloses this limitation to a POSITA for the reasons discussed above addressing how Larsen discloses or renders obvious an illuminator comprising at least five panels connected by hinges that fit on inner side surfaces of adjacent panels. Ex.1015, ¶168.

Thus, Larsen teaches the limitations of claim 1(a). Ex.1015, ¶169.

Claim 1(b): “*light sources disposed on surfaces of the at least five panels,*”

Larsen discloses that light sources are disposed on the surfaces of five applicators. Figs. 2a-2c of Larsen show “plain surfaced printed circuit boards with light sources mounted in the applicators 13.” Ex.1004, [0070]; Ex.1015, ¶170.



Ex.1004, Figs. 2a-2c. The applicators are mounted in a shifting order “with semiconductor diodes (LED) and/or laser diodes 17 and 17a (in the following called light sources), whereby shifting the order of the light sources 17 means, that the respective light source 17a of one row is placed at the point of intersection of the two diagonals through the two respective light sources 17, which are placed adjoining on both sides.” *Id.*, [0070]. The light sources can be placed in regular row arrangements. *Id.*, [0071]⁶; Ex.1015, ¶171.

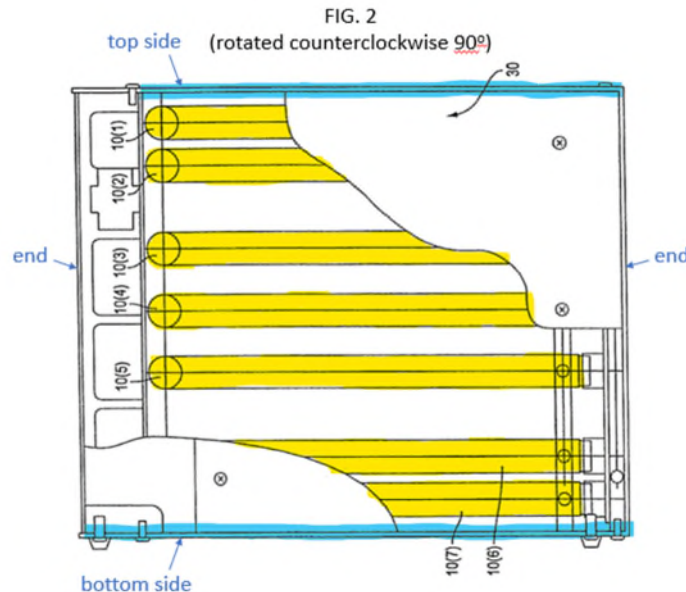
Thus, Larsen teaches the limitations of claim 1(b). Ex.1015, ¶172.

Claim 1(c): “*the illuminator being configured to uniformly illuminate a treatment surface of the patient via the light sources,*”

Lundahl teaches uniform illumination of the head of a patient via photodynamic therapy. Lundahl states “[t]he present invention is directed to photodynamic therapy using an illuminator that provides a uniform distribution of visible light.” Ex.1014, at 1:9-11. To achieve this uniformity, Lundahl utilizes the

⁶ One embodiment of Larsen shows that the lights are inside of flattened oval tubes. Ex.1004, [0102], Fig. 17b. This is just one of many embodiments, and the light sources themselves are still individually controllable just like other light sources. Ex.1004, [0106].

light distribution pattern illustrated in Figure 2 (which has been rotated 90° to better illustrate):



Ex.1014, Fig. 2; Ex.1015, ¶173. Lundahl explains that “[t]o avoid uniformity problems, one embodiment, of the present invention utilizes a plurality of U-shaped tubes 10(1)-10(7)...[An] advantage of the arrangement is that uniformity can also be adjusted by varying the lateral spacing of the tubes (relative horizontal spacing as shown in FIG. 2). This is important since it is necessary to compensate for the fact that the output from a flat plane emitting light source drops near the edges. Varying the lateral spacing of the tubes creates the same effect as folding the edges of a larger illuminator in on itself, thus emulating an infinite plane emitter with a compact unit.” Ex.1014, 6:16-30; Ex.1015, ¶174.

Lundahl states that the spacing of lights and greater density of lighting near the top and bottom of the panel provide for uniform illumination, stating “[t]he number of tubes used and the spacing between them were chosen to achieve desired uniformity and power output specifications...The present invention provides a highly uniform output irradiance without the use of an additional diffusing element.” Ex.1014, 6:43-57; Ex.1015, ¶175. As further discussed below with respect to claim 1(f), the combination of Lundahl and Larsen maintains Lundahl’s light distribution pattern using LEDs instead of fluorescent tubes and thus maintains a highly uniform output irradiance. Ex.1015, ¶¶191-192.

In addition to Lundahl’s express disclosure that the device described therein provides uniform illumination of the patient’s head, Patent Owner and Petitioner have agreed that the terms “uniformly illuminate a treatment surface”/“uniformly illuminating a treatment surface” are to be construed as “irradiating light over the active emitting area such that the measured irradiance at a treatment surface of the patient is at least within 60% of the measured maximum.” Ex.1024, 9-10. Thus, Lundahl discloses this limitation, stating “[i]t has been found that, according to a preferred embodiment of the present invention, the measured output over the active emitting area is within 70% of the measured maximum when measured with a cosine response detector at distances of 4” and 2”, and within 60% of the measured maximum over all operation distances.” Ex.1014, 15:22-26; Ex.1015, ¶176.

Consequently, in addition to routinely stating that the devices described therein provide “uniform” illumination, Lundahl discloses that the measured output over the active emitting area is within 70% of the measured maximum at distances of 4” and 2”, and within 60% of the measured maximum over all operation distances, meeting the construed requirement “irradiating light over the active emitting area such that the measured irradiance at a treatment surface of the patient is at least within 60% of the measured maximum.” *Id.*

Larsen teaches that its panels (applicators) are configured to uniformly illuminate a treatment surface of the patient via the light sources. Larsen teaches that “[i]n each applicator the printed circuit board carrying the light sources is connected to a small electrical scan engine 66, which can move the light sources with linear movements, whereby a correctly adjusted scan length and frequency gives the radiated surface a total radiation at the necessary wavelengths without leaving any unradiated gaps.” Ex.1004, [0072]. During prosecution of Application No. 16/791,004 (the “ ’004 Application”), which is the direct parent of the ‘512 Patent, the Examiner reviewed this same disclosure of Larsen and confirmed that it taught “the illuminator being configured to uniformly illuminate a treatment surface of the patient via the light sources.” Ex.1010, ¶23 (citing Ex.1004, [0072]); Ex.1015, ¶177.

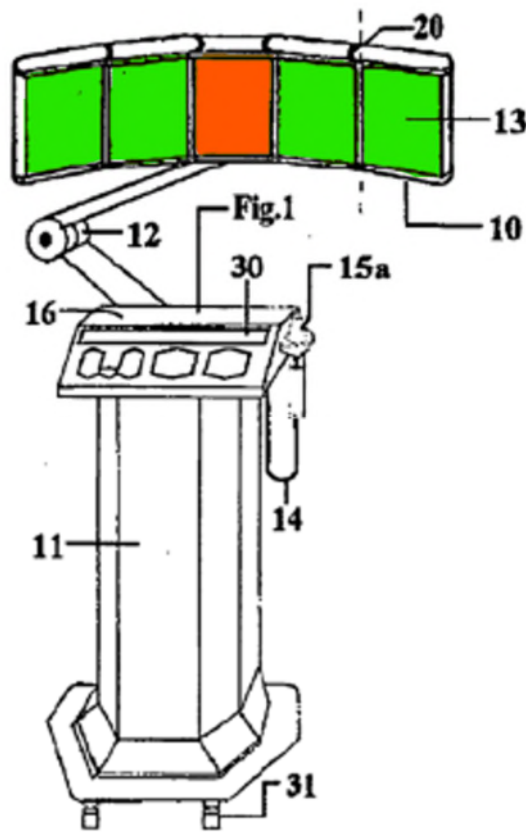
Larsen also teaches that its applicators “*permit[] an even and gap-free radiation* of the surface with multiple wavelengths of light.” Ex.1004, [0028]. An

“even and gap-free radiation of the surface” would uniformly illuminate the treatment surface. Ex.1015, ¶178. Larsen also describes measurements taken by sensors 32 that measure “the amount of energy radiated away from the skin surface, which is indicative of the total energy penetrating into the tissue.” Ex.1004, [0079]. Larsen teaches that “[t]aking into account individual variations from patient to patient, the exposure can be determined according to the measurements taken by the sensors 32 so that the correct amount of therapeutic energy (Joule/cm²) reaches the tissue.” *Id.* POSITA would have understood that Larsen’s applicator is configured to uniformly illuminate a treatment surface of the patient. Ex.1015, ¶178.

Thus, Lundahl and Larsen teach the limitations of claim 1(c). Ex.1015, ¶179.

Claim 1(d): “one of the at least five panels positioned as a center panel configured to face the treatment surface, and two or more of the at least five panels being configured to be angled relative to the center panel,”

As shown in Figure 1 of Larsen, one of the five panels is positioned as the center panel, with two or more of the remaining panels configured to be angled relative to the center panel.

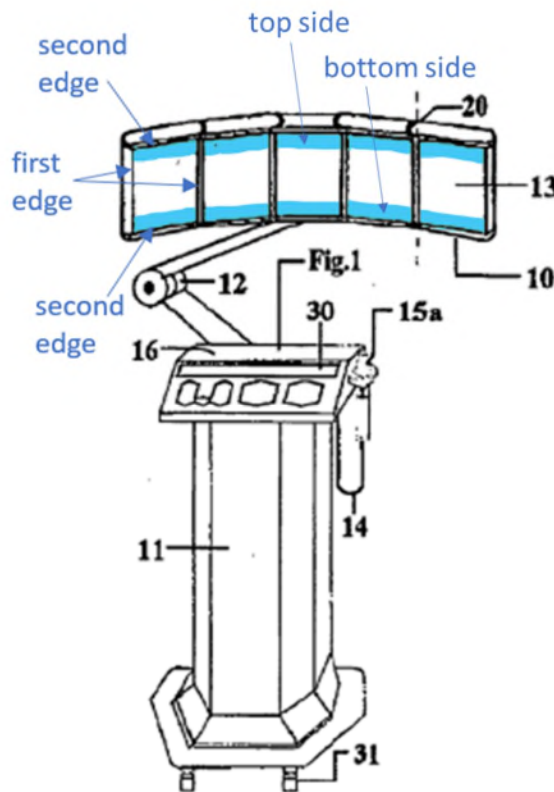


Ex.1004, Fig. 1; Ex.1015, ¶180. Larsen teaches that “the applicators are suitable for the treatment of, for example, the backs of humans and so become adjustable for an equidistant positioning of the applicators 13 above the skin.” *Id.*, [0072]. As shown above, the center panel (annotated in red) is positioned to illuminate the center of the patient’s back, with each adjacent side panel (annotated in green) angled relative to the center panel to accomplish the equidistant positioning described in Larsen. *Id.*, Fig. 1, [0072]; *see also* Ex.1035, 330 (finding this limitation disclosed by Figure 1 in the Larsen ‘381 Patent). Ex.1015, ¶181.

Thus, Larsen teaches the limitations of claim 1(d). Ex.1015, ¶182.

Claim 1(e): “wherein each of the at least five panels has two first edges and two second edges shorter than the two first edges, and”

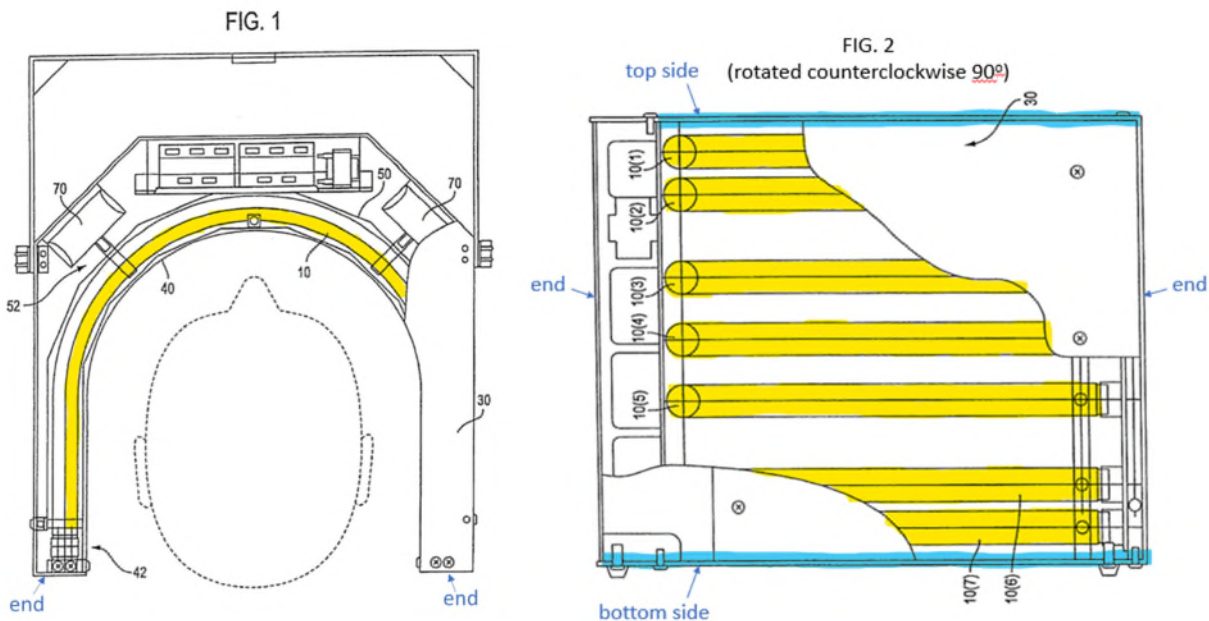
As shown in the annotated Figure 1 of Larsen below, each of the five panels (13) has two first edges (vertical edges) and two second edges (horizontal edges on the top and bottom of each panels that extend along the top and bottom sides of the panel arrangement). The two second edges are shorter than the two first edges. Ex.1004, Fig. 1; Ex.1015, ¶183.



Thus, Larsen teaches the limitations of claim 1(f). Ex.1015, ¶184.

Claim 1(f): “the light sources are arranged such that a higher intensity of light is emitted proximate the second edges compared to the intensity of light emitted not proximate the second edges.”

Lundahl teaches that “[t]he number of tubes used and the spacing between them were chosen to achieve desired uniformity and power output specifications.” Ex.1014, 6:43-45. As shown in the annotated Figures 1 and 2 of Lundahl below (with the light tubes highlighted yellow, the top and bottom sides highlighted blue, and Figure 2 rotated to show the apparatus as oriented during operation), “[o]ptimum output distribution has been found to occur when seven tubes 10(1)-10(7) are placed in the chassis in a symmetric pattern with respect to opposite edges of the unit”. Ex.1014, 6:45-48; Ex.1015, ¶188.



Ex.1014, Figs, 1, 2; Ex.1015, ¶188.

Lundahl includes the “following approximate lateral spacing: 7 cm between the center tube 10(4) and each of the two tubes 10(3),10(5) adjacent to the center tube 10(4); 5 cm between the tubes 10(3),10(2) and 10(5),10(6), i.e., the next pairs of tubes out from the center; and 3.5 cm between tubes 10(2),10(1) and 10(6),10(7), i.e., the outermost pairs of tubes at the sides of the unit.” Ex.1014, 6:48-54. Lundahl also states that “[t]he outermost tubes 10(1),10(7) are approximately 2.5 cm from the edges of the housing” and “[t]he present invention provides a highly uniform output irradiance without the use of an additional diffusing element.” Ex.1014, 6:54-57. POSITA would have understood that the tubes of Lundahl are spaced to emit a higher intensity of light proximate the top and bottom sides compared to the intensity of light emitted not proximate the top and bottom sides. Ex.1015, ¶189.

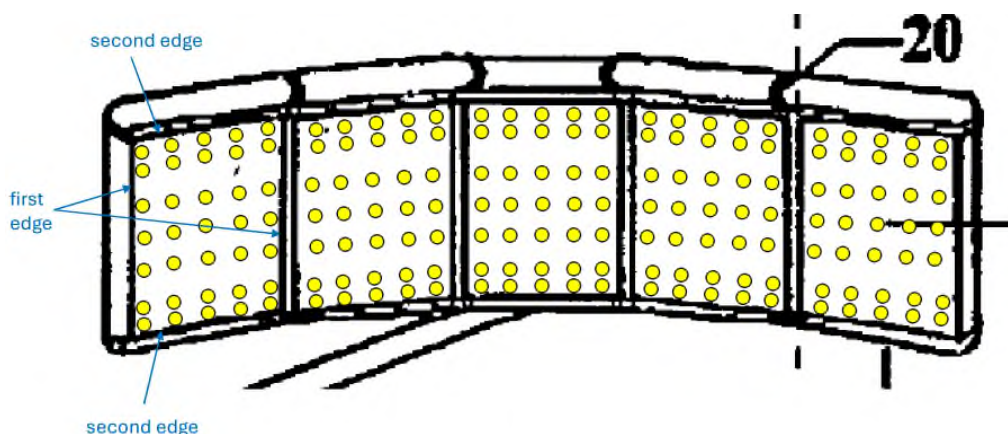
A POSITA would know from the Lundahl disclosure (including the combined disclosure of Figs. 1 and 2 shown above), that these curved tubes extend from one side of the “U” shape to the other. Ex.1015, ¶190. The picture below illustrates this understanding, and how a POSITA would expect to view the Lundahl device if viewed from the front, instead of the top (as in Fig. 1 of Lundahl):



Ex.1015, ¶190 (citing Ex.1023, 29). The tubes in the illustration above are situated in the same distribution pattern illustrated in Fig. 2 of Lundahl, but with a perspective that allows one to visualize the three-dimensional shape of the fixed “U” shape of Lundahl. *Id.*

As shown in the annotated figures of Larsen and Lundahl above with respect to claim 1(f) and claim 1(g), POSITA would have found it obvious and would have been motivated with a reasonable expectation of success to incorporate the uneven spacing of light sources of Lundahl for all the reasons described above at Section XI(A)(1). Ex.1015, ¶195. In particular, a motivation existed to combine the teachings of Lundahl and Larsen to: (1) incorporate the hinged panels of Larsen into the PDT device of Lundahl to increase the adaptability of the device; and (2) replace

the fluorescent bulbs of Lundahl with LEDs. Ex.1015, ¶191 By combining the design principles of Larsen related to hinged panels and LED lights with the PDT device and light distribution of Lundahl, a POSITA would expect the resulting device to have a design similar to the below (yellow circles representing LEDs):



Id.

The annotated figure above demonstrates a rendering whereby the hinged panels and LEDs taught by Larsen are incorporated into the device of Lundahl, while maintaining the same light distribution pattern Lundahl utilized for the fluorescent bulbs, as shown in Figure 2 above and the accompanying disclosure. Ex.1015, ¶192.

Lastly, it is noted that Patent Owner has asserted that a similar distribution/arrangement of light sources in Biofrontera's RhodoLED® XL allegedly meets this claim limitation, stating "The BF-RhodoLED XL's LEDs each have 'a fixed LED light intensity.' Ex.1019, 14-16; Ex.1015, ¶194. The LEDs are arranged such that a higher intensity of light is emitted proximate the second edges

(i.e., the shorter edges) compared to the intensity of light emitted not proximate the second edges. For example, the ‘LEDs are distributed on each panel in a specific way (see Figure 1), such that they are more densely packed towards the upper and lower edges than in the center region of each panel.’” *Id.* Patent Owner provides the below pictures of the BF-RhodoLED XL that Patent Owner asserts meet this limitation.



Ex. 13, Fig. 14.

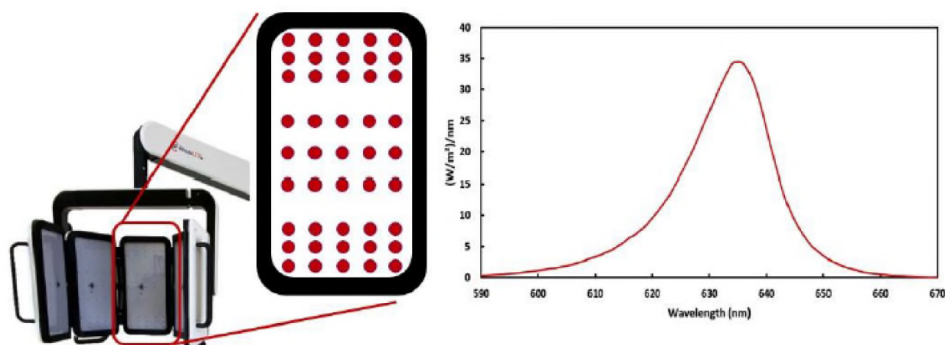
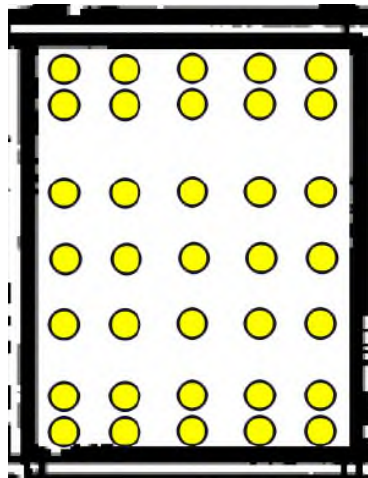


Figure 1: LED panels with LED distribution and emission spectrum of RhodoLED® XL LEDs.

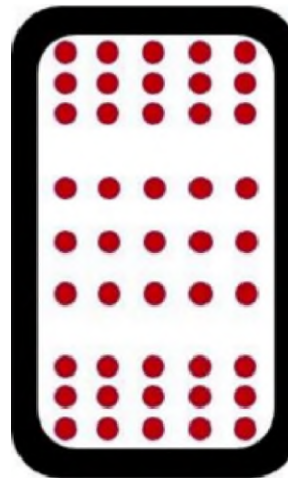
Id.

The light distribution illustrated in the annotated figure above is nearly identical to the light distribution in BF-RhodoLED XL alleged to infringe the '512 Patent. Ex.1015, ¶193. To illustrate, below is a side-by-side comparison of the light distribution/arrangement rendered obvious by the combination of Lundahl and Larsen compared to the light distribution/arrangement in BF-RhodoLED XL. *Id.*

Lundahl and Larsen



BF-RhodoLED XL



Thus, Lundahl in view of Larsen renders obvious the limitations of claim 1(g).
Ex.1015, ¶196.

For these reasons, Lundahl and Larsen teach claim 1. Ex.1015, ¶197.

3. Claim 3

Claim 3: *“The system of claim 1, wherein the illuminator is configured to output red light at a dose of about 30 J/cm² to about 150 J/cm².”*

The combination of Lundahl in view of Larsen renders obvious the system of claim 1, for all the reasons given above. Lundahl also teaches and renders obvious the use of red light *at a dose of 30 J/cm² to 150 J/cm²*. Ex.1015, ¶198.

Lundahl teaches that “[s]ince total light Dose (J/cm²) = Irradiance (W/cm²) × Time (sec), the only additional parameter that needs to be controlled for delivery of the correct treatment light dose is exposure time”, which is “accomplished in a preferred embodiment of the present invention by the timer which controls electrical power to the ballasts and which can be set by the physician.” Ex.1014, 15:55-61; Ex.1015, ¶199. As previously discussed, Lundahl expressly incorporates all teachings of Kennedy. Ex. 1014, 1:38-48 (incorporating by reference the contents of Ex.1017).; Ex.1015, ¶200.

Kennedy teaches that red light was preferred for PDT, as it penetrates deeper into the skin, as compared to blue light, and PpIX (the compound produced by topical application of ALA) strongly absorbs red light. Kennedy states “[a] method of detecting and treating malignant and non-malignant tissue abnormalities and lesions of the skin” in which “5-aminolevulinic acid is administered to the patient.” Ex.1017, Abstract. Kennedy states that “[i]n preferred aspects of this invention the

preferred precursor of protoporphyrin IX is 5-amino-4-oxo-pentanoic acid, otherwise known as 5-aminolevulinic acid, and a preferred wavelength of the photoactivating light is in the range 350-640 nm, more preferably a red light of about 610-630 nm.” Ex.1017, 4:3-8. Kennedy also states that “[t]he wavelength of the photoactivating light is of some importance, as it has been shown that between 1 and 10 percent of incident red light (600-700 nm) can pass through a slab of human tissue 1 cm thick, whereas only 0.001 percent or less of blue light (about 400 nm) can pass through the same thickness of human tissue. The photosensitizer will, therefore, be more successful if it strongly absorbs red light. PpIX does strongly absorb red light.” Ex.1015, ¶201; Ex.1017, 4:60-69.

Further, Kennedy’s incorporated disclosure teaches and renders obvious a red light dose of 30 J/cm^2 to 150 J/cm^2 . Ex.1015, ¶202, Ex.1016, ¶¶55-56. Examples 1-4 of Kennedy provide PDT treatment of patients with various skin conditions and disease states, including light doses ranging from 17 mWhr/cm^2 to 52.5 mWhr/cm^2 . Ex.1017, 5:46-6:47; Ex.1015, ¶202, Ex.1016, ¶¶55-56. As $1 \text{ mWhr/cm}^2 = 3.6 \text{ J/cm}^2$, examples 1-4 of Kennedy provide PDT treatment with light doses ranging from

approximately 61 J/cm² to 189 J/cm², a range that overlaps with the claimed range of 30 J/cm² to 150 J/cm² in the ‘512 Patent.⁷ Ex.1015, ¶202.

Further, as noted above, total light Dose (J/cm²) = Irradiance (W/cm²) × Time (sec), meaning the dose is simply a function of the amount of time the patient is exposed to the light at the specific irradiance. Ex.1015, ¶203. Consequently, a POSITA knew and understood that any of the doses reported in Examples 1-4, that is, 52.5 mWhr/cm² (Example 1); 26 mWhr/cm² (Example 2); 17, 26, and 50 mWhr/cm² (Example 3); and 37 mWhr/cm² (Example 4) could be changed to a different light dose of any value in the range from 30 J/cm² to 150 J/cm² simply by increasing or decreasing the light exposure time. *Id.* Because of this ability to routinely optimize the light dose, the claimed range of 30 J/cm² to 150 J/cm² is also rendered obvious by Kennedy’s disclosure incorporated by reference into Lundahl. Ex.1015, ¶203.

Larsen teaches that its applicators are configured to output red light: “devices are available for the photodynamic stimulation of human cell energy in the form of

⁷ When a prior art reference recites a range overlapping or touching the claimed range, the claim is anticipated if the range of the prior art reference discloses the claimed range with “sufficient specificity.” *Atofina v. Great Lakes Chem. Corp.*, 441 F.3d 991, 999 (Fed. Cir. 2006)

red and infrared radiation . . .” Ex.1004, [0024]. Larsen also teaches using light radiation within the wavelength of 300 – 2000 nm, which includes red light. *Id.*, [0025], [0071]-[0076], [0083]. Ex.1015, ¶204. As such, Larsen’s teachings render obvious the use of red light at a dose of about 30 J/cm² to about 150 J/cm². *Id.*

Thus, Lundahl and Larsen teach the limitations of claim 3. Ex.1015, ¶205.

4. Claim 5

Claim 5: “*The system of claim 1, wherein a plurality of the light sources are configured to emit light having a wavelength in a range of 400 nm to 700 nm.*”

The combination of Lundahl in view of Larsen renders obvious the system of claim 1, for all the reasons given above. Lundahl teaches that “[a]ccording to one preferred embodiment of the present invention, blue light having wavelengths exceeding 400 nm (nanometers) is particularly advantageous for certain diagnostic purposes and treatments, especially when ALA is the photoactivatable agent used for PD and PDT of actinic keratosis” and that “visible light in other ranges of the spectrum, particularly in the green and red ranges between 400 and 700 nm, may also be used.” Ex.1014, 2:18-26; Ex.1015, ¶206. Lundahl further states that, in certain embodiments, “the visible light has a nominal wavelength of 417 nm.” Lundahl, 15:53-54. Thus, Lundahl discloses the claimed requirement that “a plurality of the light sources are configured to emit light having a wavelength in a range of 400 nm to 700 nm.” Ex.1015, ¶206.

Thus, Lundahl and Larsen teach the limitations of claim 5. Ex.1015, ¶207.

5. Claim 8

Claim 8[preamble]: “A *method of photodynamically diagnosing or treating a patient, comprising.*”

Lundahl discloses a “method for photodynamic treatment (PDT) or diagnosis (PD) of actinic keratosis of the scalp or facial areas of a patient” and “PDT and PD of other indications (e.g., acne) and other areas of the patient (e.g., arms, legs, etc.).” Ex.1014, 1:9-17. Larsen similarly discloses a method for photodynamically diagnosing or treating a patient: “[t]he present invention relates in general to electrotherapy devices and more particularly to devices and methods for photodynamic and electromagnetic stimulation of living tissue, directly and also indirectly, by stimulation of photosensitive substances introduced into or onto living tissue.” Ex.1004, [0001]; Ex.1015, ¶208.

Thus, Lundahl and Larsen teach the preamble of claim 5. Ex.1015, ¶209; Ex.1016, ¶¶75-76.

Claim 8(a): “*administering 5-aminolevulinic acid (ALA) to the patient;*”

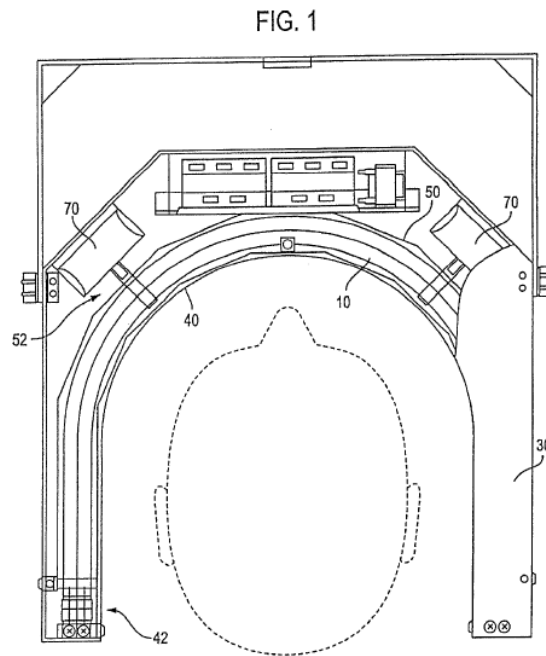
Lundahl teaches that “[a]ccording to one preferred embodiment of the present invention, blue light having wavelengths exceeding 400 nm (nanometers) is particularly advantageous for certain diagnostic purposes and treatments, especially when ALA is the photoactivatable agent used for PD and PDT of actinic keratosis”

and that “visible light in other ranges of the spectrum, particularly in the green and red ranges between 400 and 700 nm, may also be used.” Ex.1014, 2:18-26. Lundahl describes applying ALA to a patient for the treatment of actinic keratosis, stating “[o]ne example of a treatment method for precancerous lesions, such as actinic keratosis, by PDT utilizing an illuminator described above in conjunction with 5-aminolevulinic acid (ALA) will now be described. Essentially anhydrous ALA is admixed with a liquid diluent just prior to its use. The ALA admixture is topically applied to the lesions using a point applicator to control dispersion of the ALA admixture.” *Id.*, 15:30-37; Ex.1015, ¶210.

Thus, Lundahl teaches the limitations of claim 5(a). Ex.1015, ¶211, Ex.1016, ¶¶77-78.

Claim 8(b): “*positioning an illuminator proximate to the patient,*”

Lundahl teaches positioning the PDT device proximate to the patient’s head for treatment. Lundahl states “the present invention uses a U-shaped emitting surface that more closely follows the contours of the human face and scalp, and minimizes lamp to target distance variations which in turn minimizes irradiance variations at the target.” Ex.1014, 4:33-38. Additionally, Lundahl illustrates the positioning of the PDT device proximate to the patient’s head in Figure 1:



Ex.1014, Fig. 1; Ex.1015, ¶¶212-213.

Thus, Lundahl teaches claim 5(b). Ex.1015, ¶214, Ex.1016, ¶¶79-81.

Claim 8(c): “the illuminator comprising at least five panels connected by nested hinges on inner side surfaces of adjacent panels; and”

Lundahl and Larsen teach claim 8(c) for the same reasons given for claim 1(a) above. Ex.1015, ¶215; Ex.1016, ¶82.

Claim 8(d): “uniformly illuminating a treatment surface of the patient”

Lundahl and Larsen teach claim 8(d) for the same reasons given for claim 1(c) above. Ex.1015, ¶217; Ex.1016, ¶82.

Claim 8(e): “with light sources disposed on the at least five panels of the illuminator,”

Lundahl and Larsen teach claim 8(e) for the same reasons given for claim 1(b) above. Ex.1015, ¶218; Ex.1016, ¶82.

Claim 8(f): “wherein each of the at least five panels has two first edges and two second edges shorter than the two first edges, and”

Lundahl and Larsen teach claim 8(g) for the same reasons given for claim 1(e) above. Ex.1015, ¶219.

Claim 8(g): “the light sources are arranged such that a higher intensity of light is emitted proximate the second edges compared to the intensity of light emitted not proximate the second edges.”

Lundahl and Larsen teach claim 8(f) for the same reasons given for claim 1(f) above. Ex.1015, ¶¶220-221.

6. Claim 20

Claim 20[preamble]: “A system for photodynamically diagnosing or treating a patient, comprising:”

Lundahl and Larsen teach the preamble of claim 20, for all the reasons given above with respect to the preamble of claim 1. Ex.1015, ¶222.

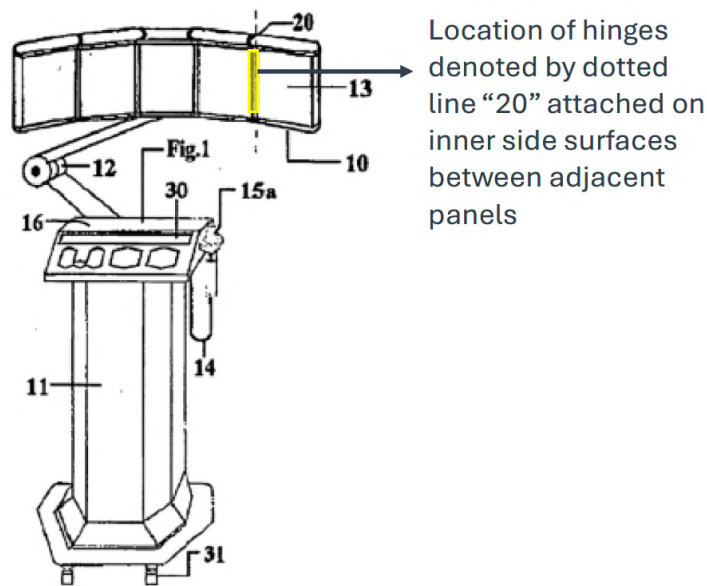
Claim 20(a): “an illuminator comprising at least five panels connected by nested hinges on inner side surfaces of adjacent panels,”

Lundahl and Larsen teach claim 20(a) for the same reasons given for claim 1(a) above. Ex.1015, ¶223; Ex.1016, ¶82

Claim 20(b): “*the nested hinges being configured so as to allow continuous illumination across the at least five panels,*”

As an initial matter, the '512 patent does not state or define what is meant by “continuous illumination” across the at least five panels. However, a POSITA understands that the “continuous illumination across the at least five panels” is the result of the configuration of the “nested hinges,” which the Patent Owner alleges to simply be “hinges that fit on inner side surfaces of adjacent panels.” Ex.1015, ¶224. In view of this, a POSITA would understand that “nested hinges” configured in a way to minimize the gap between adjacent panels would “allow continuous illumination across the at least five panels.” Larsen discloses or renders obvious this limitation. Ex.1015, ¶224.

Fig. 1 of Larsen illustrates that the adjacent panels are connected by “nested hinges” fit on the inner side surfaces of the adjacent panels, as illustrated below:



The orientation of adjacent panels illustrated in Figure 1, with “nested” hinges that fit on the inner side surfaces between adjacent panels demonstrates minimal/no gap between the adjacent panels, which is a configuration that would “allow continuous illumination across the at least five panels.” Ex.1015, ¶225.

Additionally, Larsen teaches that “[i]n each applicator the printed circuit board carrying the light sources is connected to a small electrical scan engine 66, which can move the light sources with linear movements, whereby a correctly adjusted scan length and frequency gives the radiated surface a total radiation at the necessary wavelengths without leaving any *unradiated gaps*.” Larsen, [0072]. By preventing any “unradiated gaps” on the radiated surface (i.e., the treatment surface), Larsen teaches that the “nested hinges” connected to the inner side surfaces of the

adjacent panels (as illustrated in Fig. 1) are “configured so as to allow continuous illumination across the at least five panels.” Ex.1015, ¶226

Thus, Lundahl and Larsen teach the limitations of claim 20(b). Ex.1015, ¶227.

Claim 20(c): “*light sources disposed on surfaces of the at least five panels,*”

Lundahl and Larsen teach claim 20(c) for all the reasons given above with respect to claim 1(b). Ex.1015, ¶228.

Claim 20(d): “*the illuminator being configured to uniformly illuminate a treatment surface of the patient via the light sources.*”

Lundahl and Larsen teach claim 20(c) for all the reasons given above with respect to claim 1(c). Ex.1015, ¶229.

Claim 20(e): “*one of the five panels being positioned as a center panel configured to face the treatment surface, and two or more of the five panels being configured to be angled relative to the center panel,*”

Lundahl and Larsen teach claim 20(e) for all the reasons given above with respect to claim 1(d). Ex.1015, ¶230.

Claim 20(f): “*wherein each of the at least five panels has two first edges and two second edges shorter than the two first edges, and*”

Lundahl and Larsen teach claim 20(f) for all the reasons given above with respect to claim 1(e). Ex.1015, ¶231.

Claim 20(g): “and the light sources are arranged such that a higher intensity of light is emitted proximate the second edges compared to the intensity of light emitted not proximate the second edges.”

Lundahl and Larsen teach claim 20(g) for all the reasons given above with respect to claim 1(f). Ex.1015, ¶232.

For these reasons, claim 20 is obvious over the combination of Lundahl in view of Larsen. Ex.1015, ¶233.

B. Ground 2 - Lundahl in view of Larsen, and further in view of Hente Render Obvious Claims 1, 3, 5, 8, 17, 18 and 20

As set forth in Ground 1, Lundahl and Larsen render obvious claims 1, 3, 5, 8 and 20. However, Hente provides additional support for the motivation to combine and teachings on claim limitations reciting an “illuminator comprising at least five panels connected by nested hinges on inner side surfaces of adjacent panels” recited in independent claims 1, 8 and 20. For these limitations, Hente’s teachings are in addition to what Lundahl and Larsen already teach as discussed in Ground 1 with respect to claims 1, 3, 5, 8 and 20. Ex.1015, ¶234.

In addition, the teachings of Hente viewed in combination with Lundahl and Larsen render obvious claims 17 and 18.

1. Motivation to Combine

Lundahl and Larsen disclose and render obvious the inclusion of hinged panels as taught by Larsen in the illumination device taught by Lundahl via attachment to the inner side surface of adjacent panels, as doing so would allow for

flexibility in the arrangement of panels to allow for adjustment based on the variations in size/dimensions of patient heads, and also would allow for treatment of other parts of the body (e.g., chest, arms, etc.). Ex.1015, ¶139. However, based on the teachings of Lundahl and Larsen, uniformity of illumination is still a key design motivation, as a POSITA would want to minimize gaps between the adjacent panels (appreciable gaps between panels might impact the ability to produce uniform illumination). *Id.* Hente teaches hinges that allow for movement and adjustment of adjacent panels/sections, while also minimizing the gap between the adjacent panels/sections. *Id.*

Hente is directed to light emitting devices comprising organic light emitting diodes (i.e., organic LEDs or OLEDs) that allow for adjustable and foldable orientations. Ex.1026, Title, Abstract; Ex.1015, ¶140. Hente teaches light emitting devices that have the flexibility to “illuminate large and point-like limited areas.” Ex.1026, ¶0005. Specifically, Hente discloses lighting devices with at least one first section and at least one second section. Ex.1026, Abstract; Ex.1015, ¶140. Hente explains that the light emitting device can be expanded to provide a flat illumination surface, stating “In FIG. 2 the light emitting device 10 is shown in an expanded position 100...In the expanded position 100 the first section 20 and the second section 30 are arranged in such a way, that they form a longish stretched sheet like light emitting device 10. The artificial light 45 is primarily emitted

through the bottom sides 21, 31 of each section 20, 30. In this position 100 the light emitting device 10 can be used to illuminate large areas...” Ex.1026, ¶0036.

Fig. 2 of Hente is provided below.

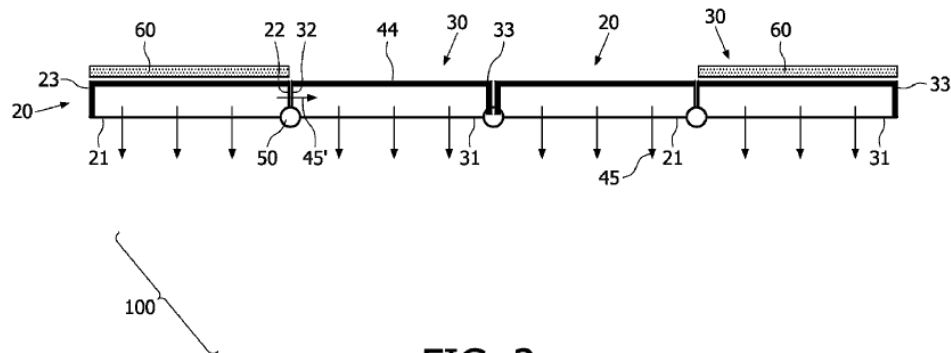
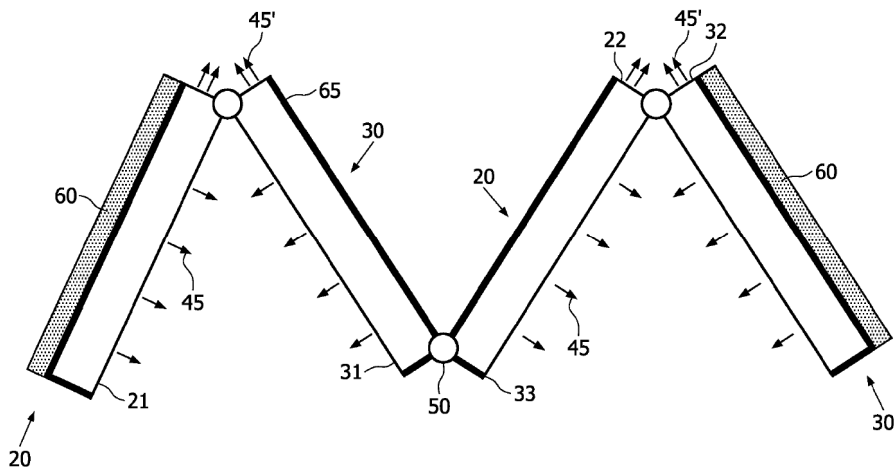


FIG. 2

Ex.1026, Fig. 2.

Hente also teaches that the light emitting device may be adjusted or folded into a smaller, “compact” position, stating “[t]o enable the light emitting device to be converted from the expanded position 100 into the compact position 110 the sections 20, 30 are connected through a connection mean 50. As shown in FIG. 3 the connection mean may be a hinges [sic], being located at the outer ends of each section 20, 30.” Ex.1026, ¶0037; Ex.1015, ¶141. Hente’s Fig. 3 is illustrated below.



Ex.1026, Fig. 3.

Hente is from the same field of endeavor as the '512 Patent, which also describes illuminators having multiple adjacent sections/panels incorporating light emitting diodes, that can be rotated relative to each other. Ex.1001, 1:24-2:4; Ex.1015, ¶142. A POSITA would be well aware of the potential benefits related to maintaining close proximity between illuminator panels to minimize the distance between the panels, enhancing the uniformity of illumination (by reducing spaces or zones with no light). Ex.1015, ¶142. Consequently, a POSITA would be motivated to utilize hinges similar to those described in Hente, attached to inner side surfaces of adjacent sections/panels. *Id.* Given this knowledge, a POSITA would be motivated to combine the hinge system of Hente with the panels of Larsen, and would have a reasonable expectation that the hinges of Hente could be successfully utilized in the Larsen device. *Id.*

Furthermore, Hente teaches that at least one panel includes a recess configured to receive a flange of one of the “nested hinges.” Based on a construction of the term “a recess” as the plain and ordinary meaning of “an indentation in a surface,” Hente teaches this limitation. Ex.1015, ¶143.

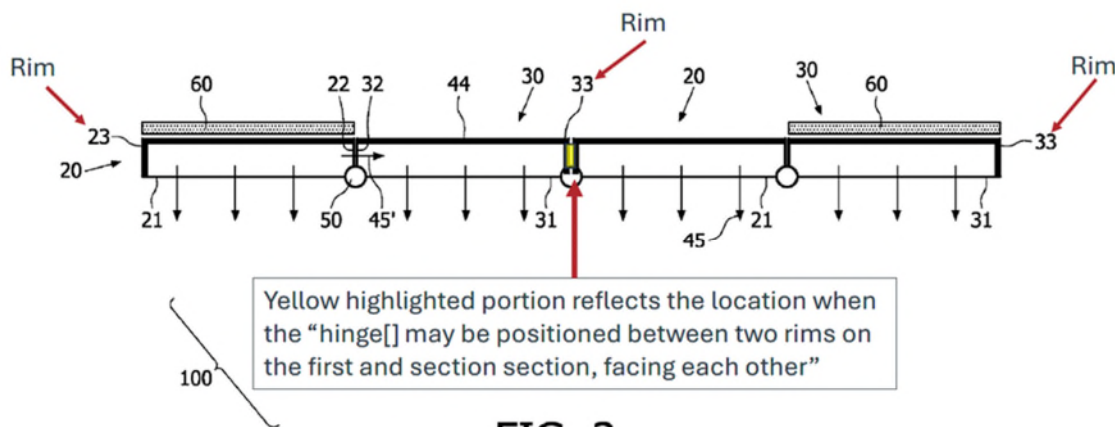
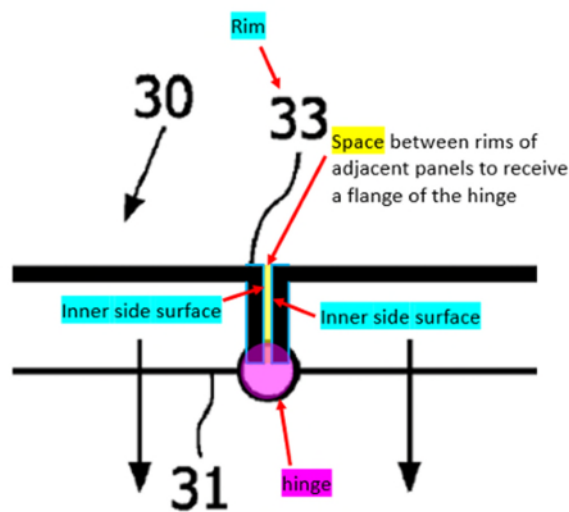


FIG. 2

As shown in the enlarged annotated figure below, there is a space between the rims of adjacent panels of Hente to receive a flange of the hinge. Ex.1015, ¶144.



2. Limitations 1(a), 8(b) and 20(a)

Claim 1(a), 8(b), and 20(a): “an illuminator comprising at least five panels connected by nested hinges on inner side surfaces of adjacent panels”

As discussed previously for Ground 1, Larsen discloses an illuminator comprising at least five panels with nested hinges within the scope of Patent Owner’s claim construction and infringement allegations. See Ex.1024, 21 and Ex.1019, 7-10. Hente also discloses this limitation in view of Patent Owner’s claim construction and infringement allegations. Ex.1015, ¶235.

Hente teaches a light emitting device with at least one first section and at least one second section. Ex.1026, Abstract. Hente states that the lighting device can be used in multiple orientations, including flat and angled (folded) orientations, stating “the disclosed light emitting device possesses two different positions, each resulting in a different type of illumination. In the expanded position the light emitting device forms a longish stretched large area illumination device. In this context the longish stretched arrangement is not limited to a rectangular form but can also include slightly curved or spherically bent arrangements. The sections of the light emitting device may also be arranged in a V- or a W-form, depending on the type of use.” Ex.1026, ¶0011; Ex.1015, ¶236. “To achieve the object of the invention the light emitting device 10 can either be used as a large area illumination device or as a small point like light source. In FIG. 2 the light emitting device 10 is shown in an expanded

position 100...In the expanded position 100 the first section 20 and the second section 30 are arranged in such a way, that they form a longish stretched sheet like light emitting device 10...To enable the light emitting device to be converted from the expanded position 100 into the compact position 110 the sections 20, 30 are connected through a connection mean 50.” Ex.1026, ¶0036-0037.

Fig. 2 is provided below, and represents the arrangement described by Hente that “can include slightly curved spherically bent arrangements,” as well a “V-form”:

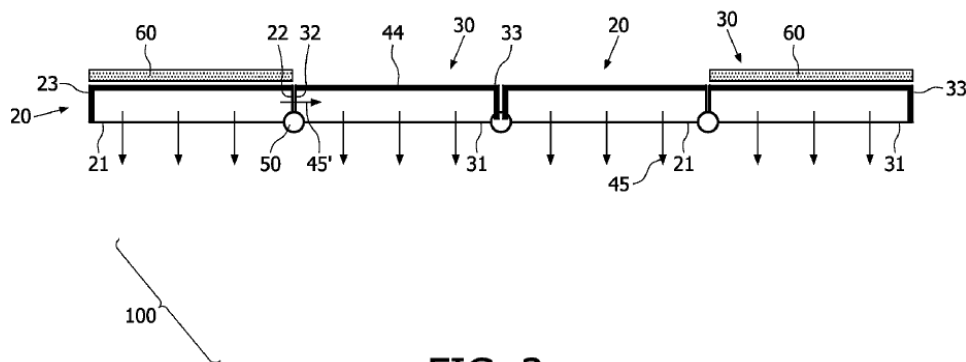


FIG. 2

Hente further explains that connection mean 50 may be a hinge, stating “[i]n a preferred embodiment the connection mean may be a hinges [sic], being positioned at the outer rims of the light emitting device respectively sections. Depending on the position of the side surfaces, ***the hinges may be positioned between two rims of the first and the second section, facing each other.***” Ex.1026, ¶0015; Ex.1015, ¶237. The “first and second section” referenced in the passage above is understood to represent the first section 20 and the second section 30 illustrated in Fig. 2. Ex.1015, ¶237. Additionally, Hente explains that the “rim” components are represented by 23

and 33 in the figures. Ex.1026, ¶¶0048 and 0052; Ex.1015, ¶237. Consequently, the annotated version of Fig. 2 below illustrates the location of the rims and the hinge “positioned between two rims of the first and second section, facing each other”:

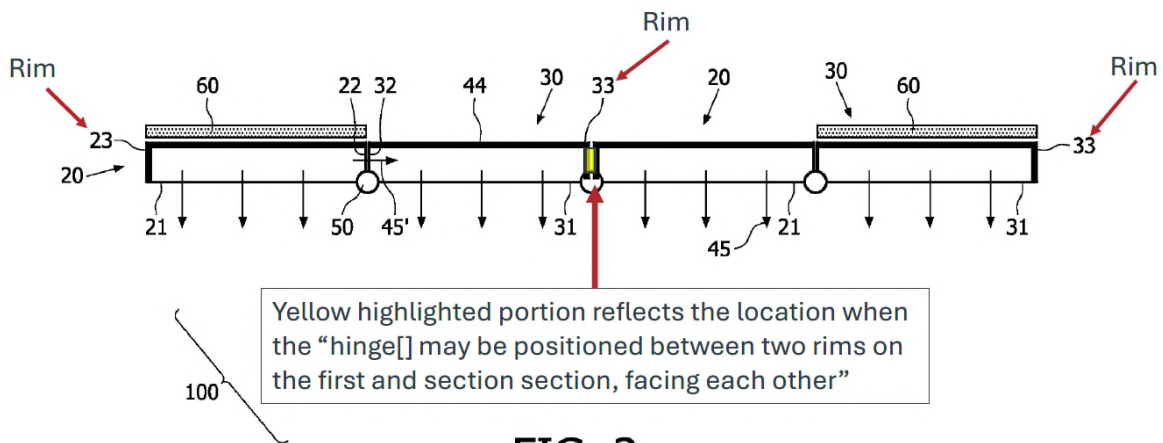
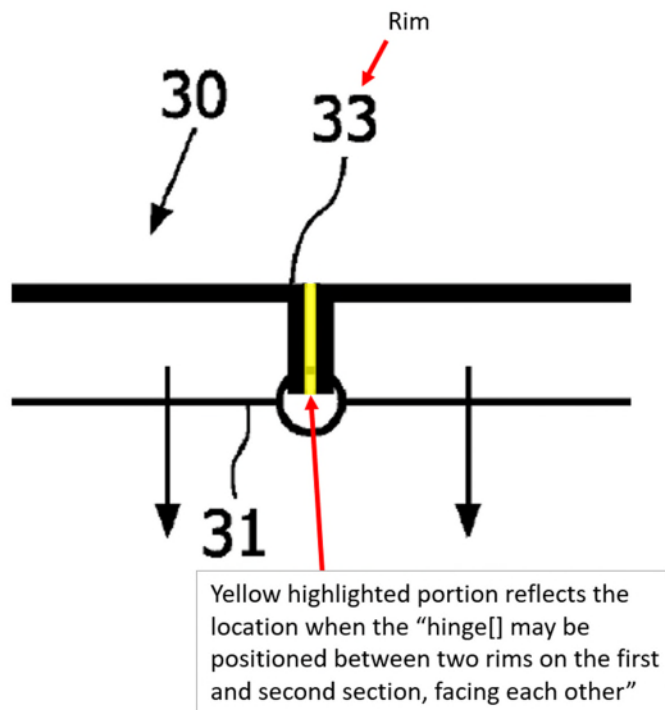


FIG. 2



As shown in the annotated Figure 2 above, Hente discloses the placement of a hinge between two rims of the first and second section, facing each other, meeting

the requirement of a “hinge[] that fits on inner side surfaces of adjacent panels,” which Sun alleges to meet the claimed “nested hinge.” Ex.1015, ¶238.

A POSITA would have found it obvious and would have been motivated with a reasonable expectation of success to place Hente’s hinges in a location that fits on the inner side surfaces of adjacent sections. Ex.1015, ¶239. First, Figure 2 of Hente illustrates that the inner edges of adjacent sections 20 and 30 are nearly flush with each other. This disclosure would have motivated a POSITA to fit the hinges on the inner side surfaces of Larsen’s panels in order to facilitate this nearly flush arrangement. *Id.* To a POSITA, this is nothing more than applying a known prior art design element to a known device (i.e., the panels of Larsen) to predictably decrease the space between the adjacent panels. There is nothing novel or non-obvious about this design process. *Id.*

Hente is from the same field of endeavor as the ’512 Patent, which also describes illuminators. ’512 Patent, 1:24-2:4; Ex.1015, ¶240. A POSITA would be well aware of the potential benefits related to maintaining close proximity between illuminator panels to minimize the distance between, and thereby improve the uniformity of light from, the panels. Ex.1015, ¶240. Hente describes a number of “folding” orientations whereby certain examples (e.g., Figure 2) involve the folding of adjacent light surfaces/sections toward one another, and certain other orientations whereby adjacent light surfaces/sections fold away from one another (e.g., Figure

3). Regardless, the principles associated with the placement of hinges on inner side surfaces of adjacent sections/panels apply to the panels of Larsen and a POSITA would be motivated to do so to enhance the adjustability of the illuminator taught by the Lundahl and Larsen combination. *Id.* Given this knowledge, a POSITA would be motivated to combine the hinge system of Hente (i.e., hinges that fit and attach on inner side surfaces of adjacent panels) with the panels of Larsen. *Id.* Thus, Larsen in view of Hente renders obvious this requirement of a “nested” hinge, and the claim limitation requiring “an illuminator comprising at least five panels connected by nested hinges on inner side surfaces of adjacent panels” is taught and rendered obvious by the prior art.

Therefore, Lundahl in view of Larsen and Hente further teach the limitations of claims 1(a), 8(b), and 20(a).

3. Claim 17

Claim 17: “The method of claim 8, wherein at least one panel includes a recess configured to receive a flange of one of the nested hinges”

As discussed previously for Ground 1, Lundahl in view of Larsen renders obvious claim 8. The combined teachings of Lundahl, Larsen and Hente render obvious claim 17 as set out below. Ex.1015, ¶243.

The term “a recess” recited in claim 17 should be construed consistent with its plain and ordinary meaning of “an indentation in a surface.” Ex.1015, ¶244.

Based on this construction, claim 17 requires “an indentation in a surface configured to receive a flange of one of the nested hinges.”

As shown in the annotated figure 2 of Hente below, Hente discloses the placement of a hinge in a location that fits on the inner side surfaces between adjacent sections. Ex. 1016, Fig. 2; Ex.1015, ¶245.

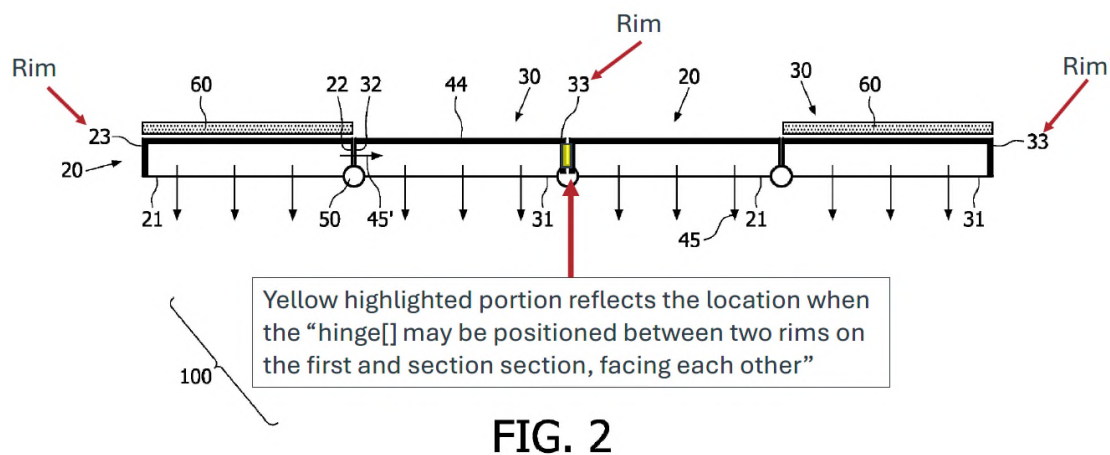
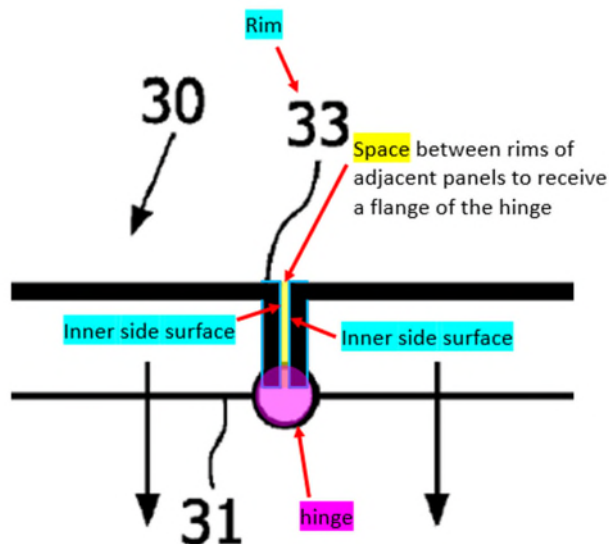
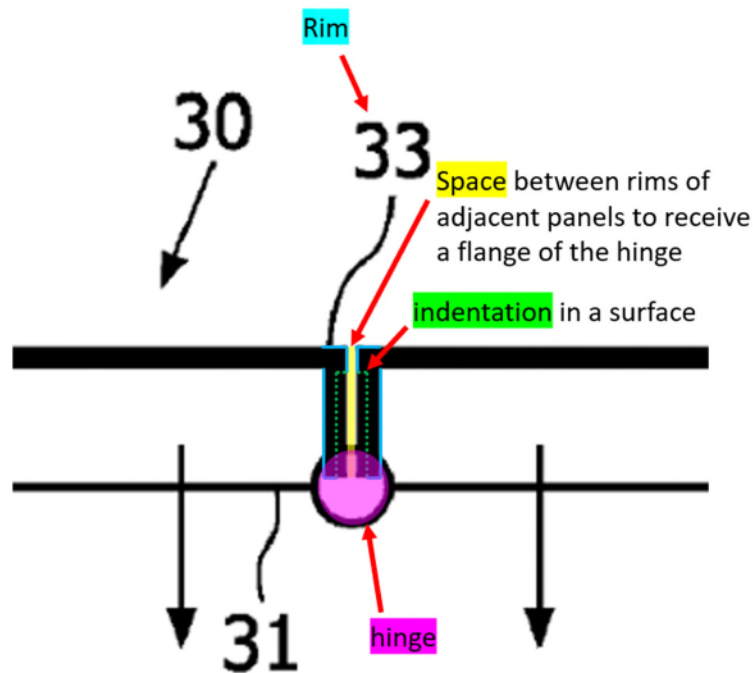


FIG. 2

As shown in the enlarged annotated figure below, there is a space between the rims of adjacent panels of Hente to receive a flange of the hinge. Ex.1015, ¶246.



A POSITA would have been motivated with a reasonable expectation of success to include an indentation at the inner side surfaces between adjacent sections to receive a flange of a hinge, as shown in the annotated figure below. Ex.1015, ¶247.



As illustrated in Figure 2 of Hente, the inner edges of adjacent sections 20 and 30 are nearly flush with each other. This disclosure would have motivated a POSITA to place the flange of the hinges in an indentation at the inner side surfaces of Larsen's panels in order to facilitate this nearly flush arrangement, and to minimize the space between the adjacent sections, which was a well-established design motivation from the teachings of Hente and Larsen. Ex.1015, ¶248. This is nothing more to a POSITA than applying known design elements and strategies to a known

device (i.e., the panels of Larsen) to predictably decrease the space between the adjacent panels. *Id.*

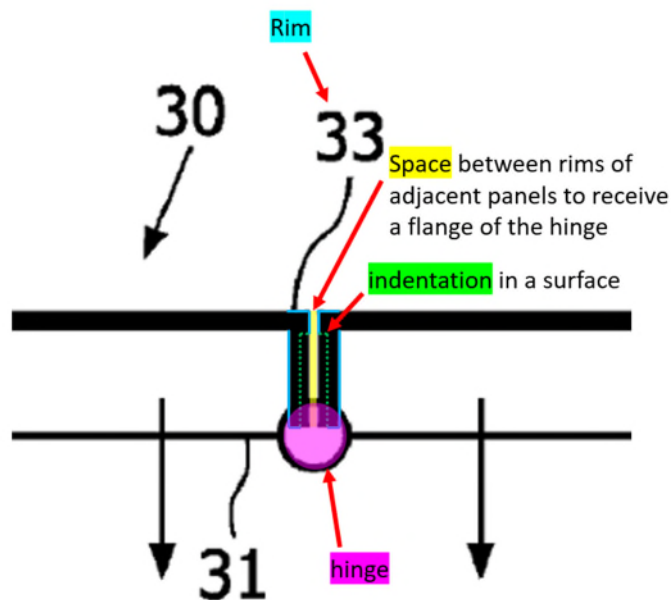
Therefore, Lundahl in view of Larsen and Hente teach the limitations of claim 17. Ex.1015, ¶249.

4. Claim 18

Claim 18: “The method of claim 17, wherein the recess is positioned at an inner side surface of the at least one panel.”

As discussed above, Lundahl in view of Larsen and Hente renders obvious claim 18. Ex.1015, ¶250.

As discussed previously, a POSITA would have found it obvious and would have been motivated with a reasonable expectation of success to include an indentation at the inner side surfaces between adjacent sections to receive a flange of a hinge, as shown in the annotated figure below. Ex.1026, Fig. 2; Ex.1015, ¶251.



As shown in the annotated figure above, Hente renders obvious the placement of the indentations at the inner side surfaces of the adjacent section, meeting the claimed requirement that “the recess is positioned at an inner side surface of the at least one panel.” Ex.1015, ¶252.

Therefore, Lundahl in view of Larsen and Hente teach the limitations of claim 18. Ex.1015, ¶253.

5. Remaining limitations and claims

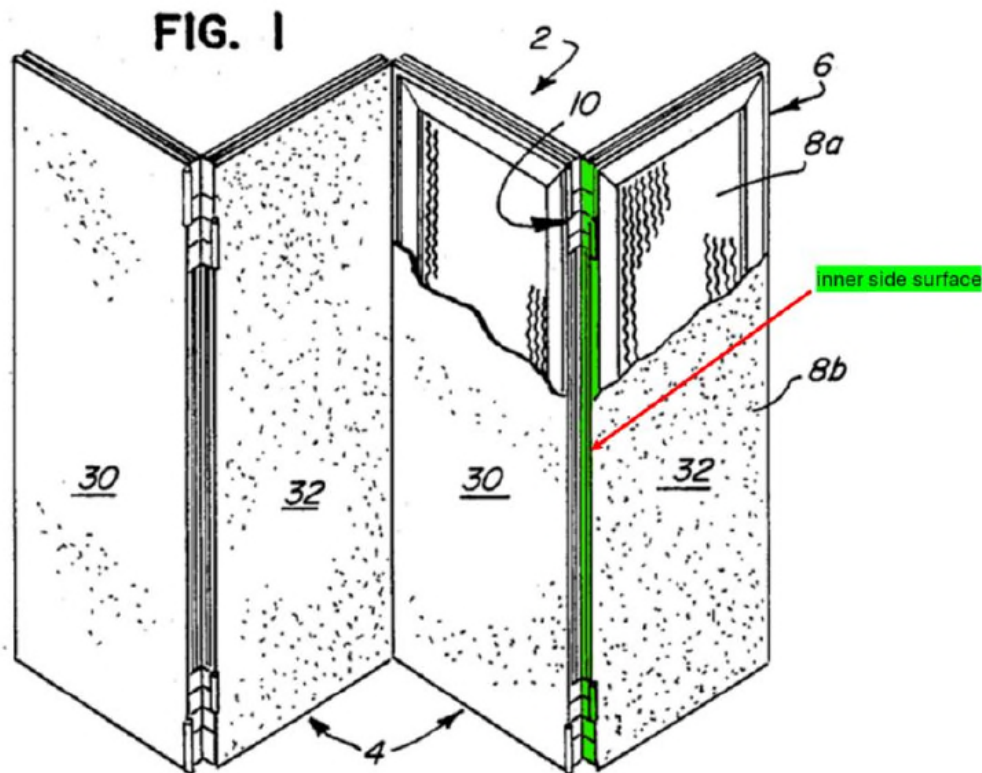
For the remaining limitations of claims 1, 8 and 20 as well as the limitations of claims 3 and 5, the analysis is the same as set out in Ground 1. For these reasons, Lundahl in view of Larsen and Hente renders obvious claims 1, 3, 5, 8, 17, 18 and 20.

C. Ground 3 - Lundahl in view of Larsen, Hente and further in view of Perutz Render Obvious Claims 17 and 18

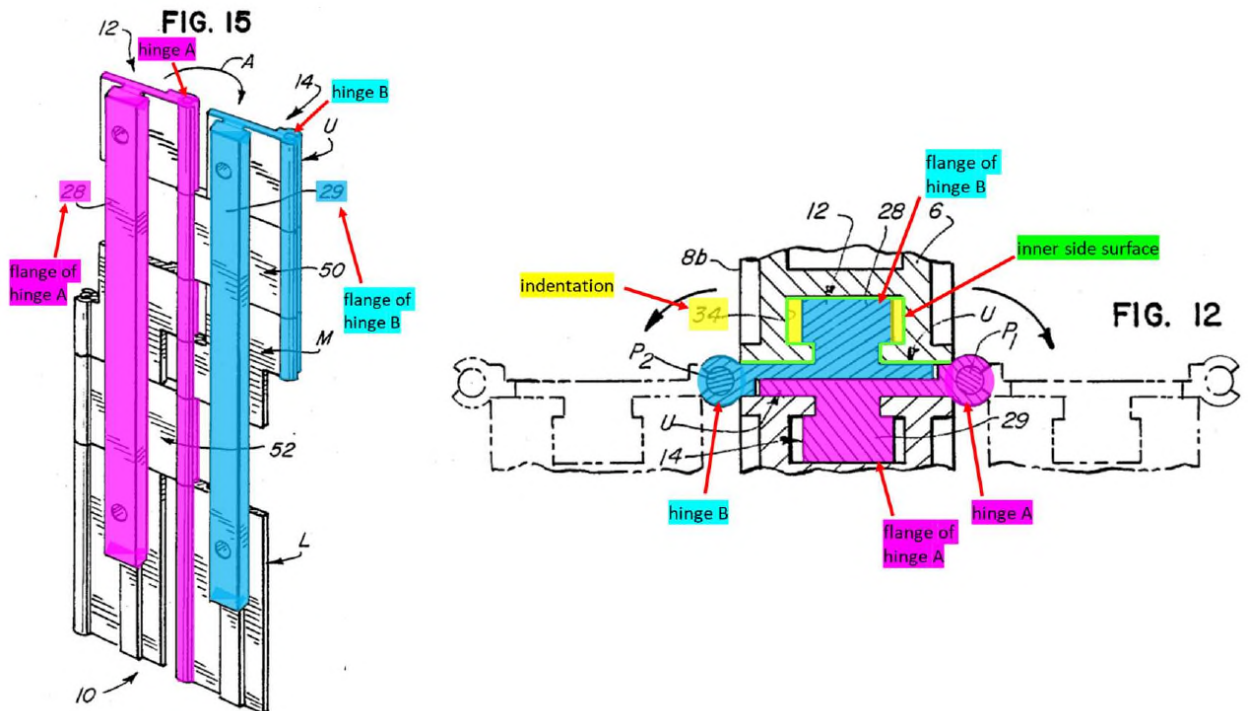
As set forth in Grounds 1 and 2, Lundahl in view of Larsen and Hente render obvious at least claims 8, 17 and 18. Ex.1015, ¶254. However, Perutz provides additional support for the motivation to combine and teachings on claims 17 and 18, which depend on claim 8. For these limitations, Perutz’s teachings are in addition to what Lundahl, Larsen and Hente already teach as discussed in Grounds 1 and Ground 2 with respect to claims 8, 17, and 18.

1. Motivation to Combine

Perutz teaches a display panel and hinge system having “a plurality of display panels arranged in side by side relation and hingedly interconnected whereby one of the panels is capable of being selectively rotated relative to the other panel through a maximum arc of substantially 360°.” Ex.1027, Abstract; Ex.1015, ¶255. Perutz teaches connecting adjoining display panels 30, 32 with hinges 10, the display panels 30, 32 having a frame 6. Ex.1027, 3:54-66. As shown in annotated Figure 1 below, the hinges 10 connect adjoining display panels 30, 32 at an inner side surface of the display panels 30, 32. Ex.1015, ¶255.



Perutz states that the segments of the hinge 10 “are maintained in vertically spaced alignment by an elongated rib or strut 28, 29,” with the ribs 28, 29 being received within slots 34 “formed in the corners of the frame 6 of the adjacent display panels.” Ex.1027, 4:16-20 and 33-38; Ex.1015, ¶256. As shown in annotated Figures 12 and 15 below, the side surface of adjoining display panels includes and indentation in a surface (e.g., slot 34 in frame 6) to receive the side-mounted hinges, specifically a flange (e.g., ribs 28, 29) of the hingers 10, to reduce space between adjoining display panels.



A POSITA would be well aware of the potential benefits related to maintaining close proximity between panels, whether the panels are light panels of

an illuminator or adjacent panels of a display panel assembly, to minimize the distance between, and improve the alignment of, the panels. Ex.1015, ¶257.

Thus, Perutz teaches that at least one panel includes a recess configured to receive a flange of one of the hinge structures. Ex.1015, ¶258. Based on a construction of the term “a recess” as the plain and ordinary meaning of “an indentation in a surface,” Perutz discloses at least one display panel including an indentation in a surface. *Id.* As shown in annotated Figures 12 and 15 above, at least one panel of Perutz includes an indentation in a surface (slot 34 in frame 6) to receive a flange (ribs 28, 29) of the hinge (hinge 10). *Id.*

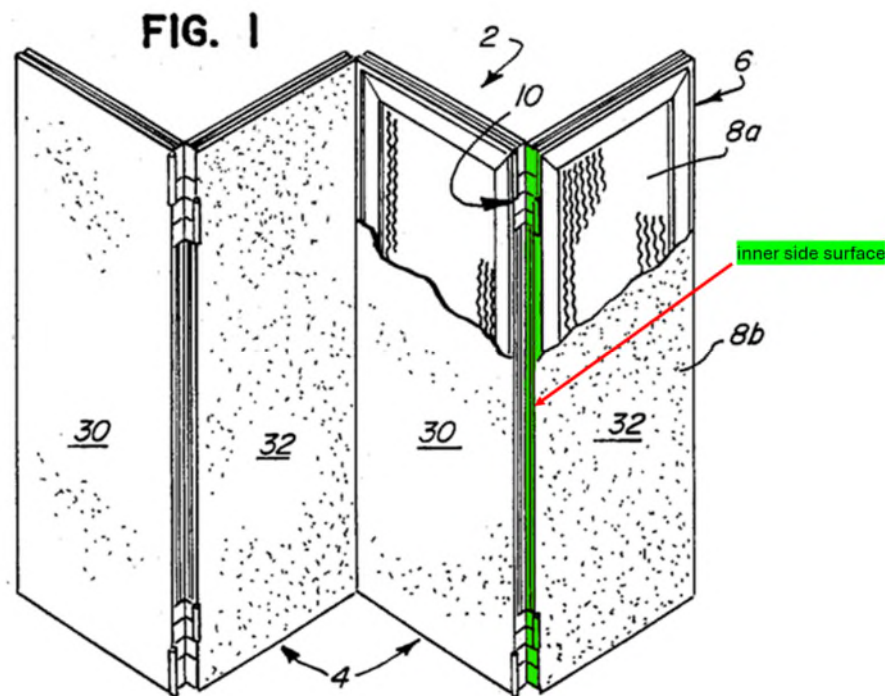
Given this knowledge, a POSITA would be motivated to combine the hinge system of Perutz with the panels of Larsen, and would have a reasonable expectation that the hinges of Perutz could be successfully utilized in the device rendered obvious by Lundahl and Larsen. Ex.1015, ¶151.

2. Claim 17

Claim 17: “The method of claim 8, wherein at least one panel includes a recess configured to receive a flange of one of the nested hinges”

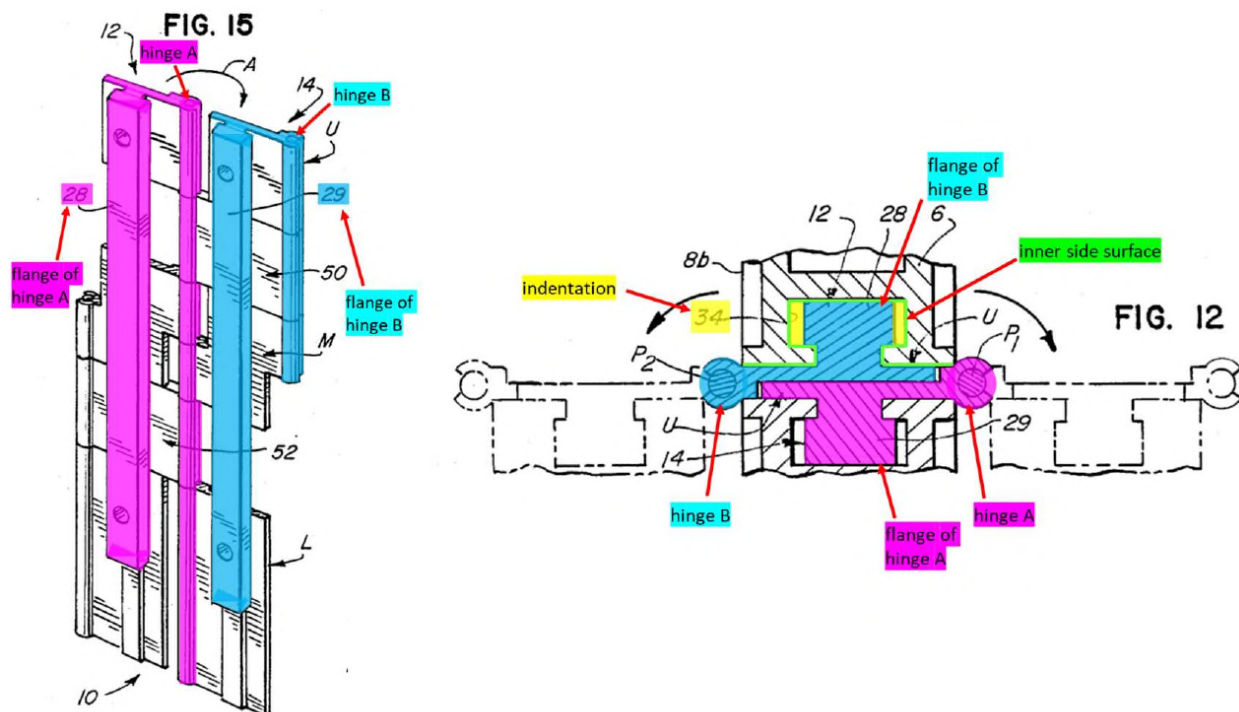
As discussed previously for Grounds 1 and Ground 2, Lundahl in view of Larsen and Hente renders obvious claim 8. Ex.1015, ¶243. The combined teachings of Lundahl, Larsen, Hente and Perutz render obvious claim 17 as set out below.

Perutz teaches a display panel and hinge system having “a plurality of display panels arranged in side by side relation and hingedly interconnected whereby one of the panels is capable of being selectively rotated relative to the other panel through a maximum arc of substantially 360°.” Ex.1027, Abstract. Perutz teaches connecting adjoining display panels 30, 32 with hinges 10, the display panels 30, 32 having a frame 6. Ex.1027, 3:54-66. As shown in annotated Figure 1 below, the hinges 10 connect adjoining display panels 30, 32 at an inner side surface of the display panels 30, 32. Ex.1027, Fig. 1; Ex.1015, ¶255.



Perutz states that the segments of the hinge 10 “are maintained in vertically spaced alignment by an elongated rib or strut 28, 29,” with the ribs 28, 29 being received within slots 34 “formed in the corners of the frame 6 of the adjacent display

panels.” Ex.1027, 4:16-20 and 33-38; Ex.1015, ¶256. As shown in annotated Figures 12 and 15 below, the side surface of adjoining display panels includes an indentation in a surface (e.g., slot 34 in frame 6) to receive the side-mounted hinges, specifically a flange (e.g., ribs 28, 29) of the hinges 10, to reduce space between adjoining display panels. Ex.1027, Fig. 12 and 15; Ex.1015, ¶256



A POSITA would be well aware of the potential benefits related to maintaining close proximity between panels, whether the panels are light panels of an illuminator or adjacent panels of a display panel assembly, to minimize the distance between, and improve the alignment of, the panels. Ex.1015, ¶257.

Thus, Perutz teaches that at least one panel includes a recess configured to receive a flange of one of the hinge structures. Ex.1015, ¶258. Based on a construction of the term “a recess” as the plain and ordinary meaning of “an indentation in a surface,” Perutz discloses at least one display panel including an indentation in a surface. *Id.* As shown in annotated Figures 12 and 15 above, at least one panel of Perutz includes an indentation in a surface (slot 34 in frame 6) to receive a flange (ribs 28, 29) of the hinge (hinge 10). *Id.*

Therefore, Lundahl in view of Larsen, Hente and Perutz teach the limitations of claim 17. Ex.1015, ¶259.

3. Claim 18

Claim 18: “The method of claim 17, wherein the recess is positioned at an inner side surface of the at least one panel.”

As discussed above, Lundahl in view of Larsen, Hente and Perutz renders obvious claim 17. Ex.1015, ¶260.

Additionally, as demonstrated in annotated Figures 1, 12, and 15 above (Figure 12 being a top view of Figure 1), the indentations in the surfaces of the adjacent panels of Perutz (i.e., the “recesses” of the adjacent panels) are located on the inner side surfaces of the adjacent panels, meeting the claimed requirement that “the recess is positioned at an inner side surface of the at least one panel.” Ex.1027, Fig. 1, 12 and 15; Ex.1015, ¶260.

Therefore, Lundahl in view of Larsen, Hente and Perutz teach the limitations of claim 18. Ex.1015, ¶261.

D. 35 U.S.C. § 325(d)

When evaluating a petition under § 325(d), the Board must determine “(1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of challenged claims.” *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential).

First, neither Hente nor Perutz were cited during the prosecution of the ‘512 Patent and thus could not have been considered by the examiner. Ex.1001, Cover. Grounds 2 and 3 and this IPR petition rely on Hente and Perutz and address all the claims challenged in this IPR. Thus, at least one proposed rejection for every claim relies on prior art never before considered by the Patent Office.

While Lundahl and a related Larsen patent were previously presented to the examiner, there is no indication the examiner considered their teachings cited in this IPR petition either individually or as combined herein. Ex.1014, 6:16-57. In addition, Petition provides the testimony of Drs. Grove and Ehrenreich to explain

how a POSITA would view the teachings of these references. See Ex.1015 and Ex.1016. Therefore, part one of the *Advanced Bionics* test favors institution, as the Grounds set forth herein were not considered by the Examiner even if some individual references were previously cited. See *Thorne Res., Inc. v. Trs. of Dartmouth Coll.*, IPR2021-00491, Paper 18 at 8 (PTAB Aug. 12, 2021).

Further, under part two of *Advanced Bionics*, assuming the examiner was aware of the relevant teachings in the cited prior art, then the examiner erred in a manner material to the patentability. For example, as discussed in this petition, the proposed combinations teach all the claim limitations, including the examiner's reasons for allowance of "nested hinges on inner side surfaces of adjacent panels" and "wherein each of the at least five panels has two first edges and two second edges shorter than the two first edges, and the light sources are arranged such that a higher intensity of light is emitted proximate the second edges compared to the intensity of light emitted not proximate the second edges." See *supra* Section V(C). Thus, the arguments presented in this IPR demonstrate the Office materially erred in issuing the Challenged Claims.

E. *Fintiv*

As set forth in the related matters discussion, the '512 Patent is the subject of an ITC proceeding and a District Court proceeding. The District Court proceeding has been stayed pending the outcome of the ITC matter per 35 U.S.C. §1659(a). As

set forth in Director's Interim Guidance Memorandum, the PTAB will not discretionarily deny petitions based on applying *Fintiv* to a parallel ITC proceeding.

X. CONCLUSION

Petitioner requests this petition for *inter partes* review be granted and that the Challenged Claims be cancelled as unpatentable under 35 U.S.C. § 318(b).

Dated: December 27, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on December 27, 2024, complete copies of this Petition for *Inter Partes* Review including all supporting exhibits, and Petitioner's Power of Attorney are being served by FedEx® on the following counsel of record for U.S. Patent 11,446,512:

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