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Paper 31
Date: November 19, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GIESECKE+DEVRIENT GMBH, GIESECKE+DEVRIENT CURRECY TECHNOLOGY GMBH, and PAPIERFABRIKLOUISENTHAL GMBH,
Petitioner,

v.

LUMENCO, LLC,
Patent Owner.

IPR2024-00838
Patent 10,901,191 B2

Before MEREDITH C. PETRAVICK, BENJAMIN D. M. WOOD, and NABEEL U. KHAN, *Administrative Patent Judges.*

PETRAVICK, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Giesecke+Devrient GmbH Giesecke+Devrient Currency Technology GmbH, and Papierfabrik Louisenthal GmbH (collectively, "Petitioner") filed a Petition for an *inter partes* review of claims 1–12 of U.S. Patent No. 10,901,191 B2 ("the '191 patent," Ex. 1001). Paper 1 ("Pet."). Lumenco, LLC ("Patent Owner") filed a Preliminary Response (Paper 7), and, on November 25, 2024, we instituted this *inter partes* review as to all challenged claims and all grounds presented in the Petition (Paper 8).

After institution, Patent Owner filed a Response to the Petition. Paper 13 ("PO Resp.")[1]. Petitioner filed a Reply (Paper 17, "Pet. Reply"), and Patent Owner filed a Sur-Reply (Paper 18, "PO Sur-Reply"). An oral hearing was held on August 26, 2025, and a transcript appears in the record (Paper 30, "Tr.").

We have jurisdiction under 35 U.S.C. § 6. This is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of claims 1–12 of the '191 patent. For the reasons discussed below, we determine Petitioner establishes by a preponderance of the evidence that claims 1–12 are unpatentable.

A. Real Parties-in-Interest

Petitioner identifies the parties named in the caption as the real parties-in-interest. Pet. 77. Patent Owner identifies itself as the real party-in-interest. Paper 5, 2.

[1] Paper 13 was filed after institution as the Patent Owner's Response but is mistakenly titled as a Preliminary Response.

B. Related Matters

The parties identify the following related court proceedings:

Lumenco, LLC v. Giesecke+Devrient Currency Technology GmbH,vGiesecke+Devrient GmbH f/k/a Giesecke & Devrient GmbH, and Papierfabrik Louisenthal GmbH, E.D. Tex. No. 2:23-cv-00100-JRG (E.D. Tex. 2023) (dismissed), and

Lumenco, LLC v. USA, Ct. of Fed. Claims No. 1:24-cv-00139-MRS (Fed Cl 2024). Paper 5, 2; Paper 6, 1.

Petitioner also identify the following related *inter partes* reviews: IPR2024-00836, IPR2024-00837, and IPR2024-00839. Paper 1.

C. The '191 Patent

The '191 patent is titled "Method of Fabricating Arrays of Individually Oriented Micro Mirrors For Use In Imaging Security Devices" and issued on January 26, 2021. Ex. 1001, codes (45), (54). The '191 patent discloses an anti-counterfeiting device "configured to 'write' images with light in one, two, or more spatial planes above and below a surface of an array of micro mirrors." Ex. 1001, 2:38–41.

The '191 patent describes a set of micro mirrors in the array of micro mirrors having a surface oriented to reflect ambient light to write a pixel of the image. *See, e.g., id.* at code (57), 2:53–57, 3:19–27, 5:57–62, Fig. 1, item 130 (ray labeled "ambient light"), 20:59 (claim 1). "To provide a 'bright' or light pixel, the reflected *ambient light* from the twenty or more micro mirrors intersects or crosses at (or passes near to) the point corresponding to the one of the pixels (e.g., each pixel is displayed or lit by beams/rays from reflective surfaces of the micro mirrors crossing at a

common point on the image display plane)." *Id.* at 3:31–36 (emphasis added).

Figure 2 of the '191 patent is reproduced below.

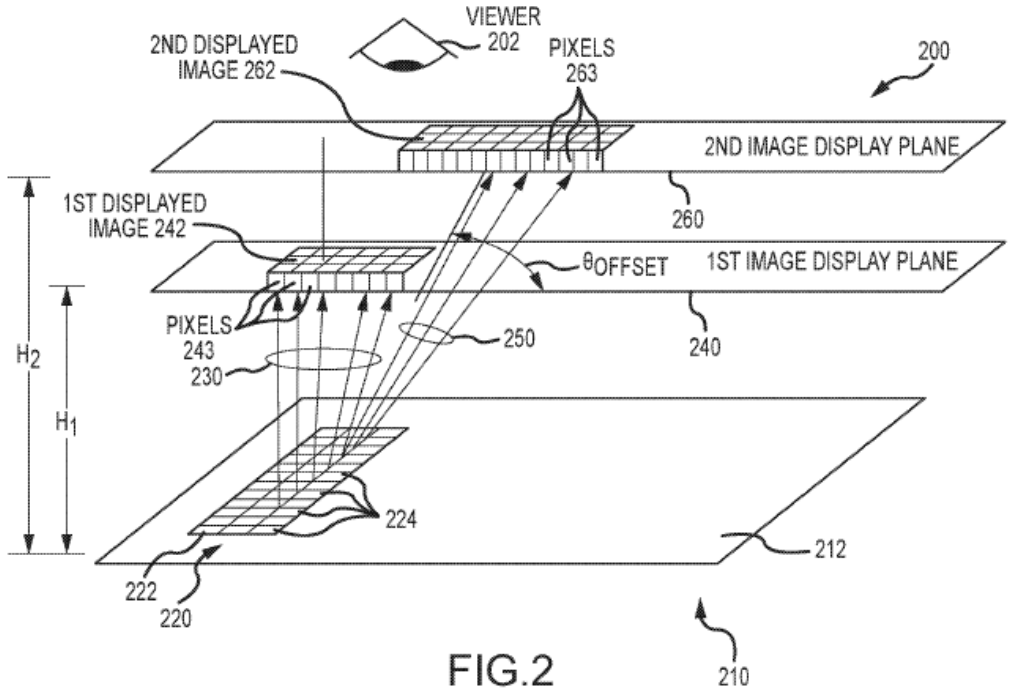


FIG.2

Figure 2 depicts a schematic of an object, such as currency, that includes the anti-counterfeiting device. *Id.* at 4:29–32; 7:28–32. Security device 220 has exposed, upper surface 222 that has an array of micro mirrors 224. *Id.* at 7:35–37. Micro mirrors 224 are "individually oriented to provide reflection of ambient light . . . so as to display one or more floating images that can be observed by a viewer 202." *Id.* at 7:37–41. First sets of micro mirrors 224 "write" pixels 243 of first display image 242, and second sets of micro mirrors 224 "write" pixels 263 of second display image 262. *Id.* at 7:42–62.

Viewer 202 sees first display image 242 floating above surface 212 and second display image 262 at a greater height above surface 212 and, because of the offset viewing image, viewer 202 typically only sees one image at a time. *Id.* at 8:1–12.

To "write" pixels by reflecting ambient light, the set of micro mirrors are aimed toward an intersection point forming a pixel of an image. *Id.* at 7:50–57. In most embodiments, the set of micro mirrors are arranged to form the base of a cone and reflect light to the apex of the cone. *Id.* at 7:54–65. The cone can be seen in Figure 4 of the '191 patent, which is reproduced below.

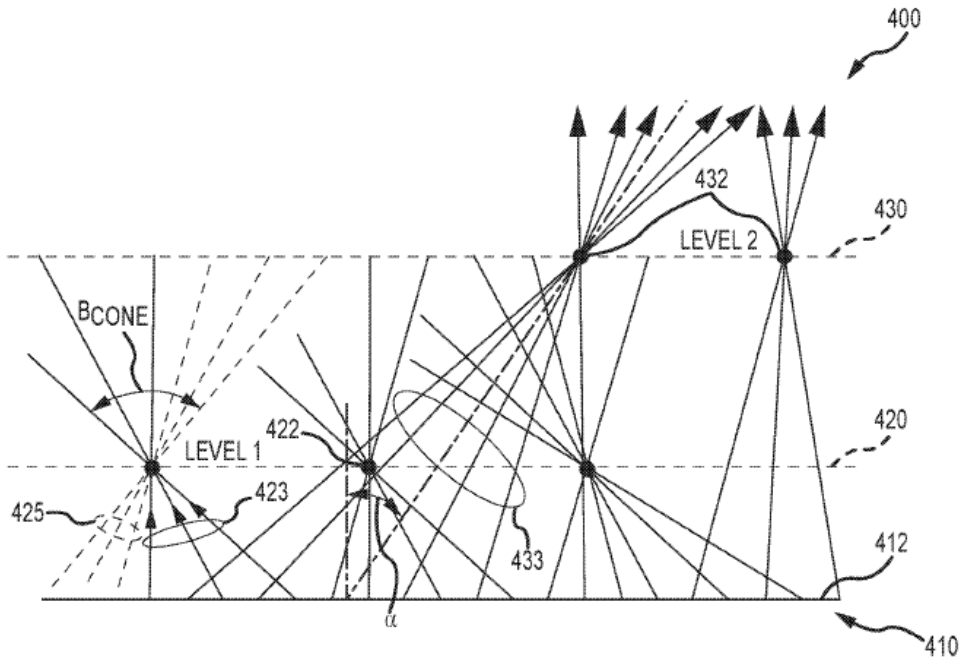


FIG.4

Figure 4 depicts a diagram of the security element providing a two-layer or level image. *Id.* at 8:61–63. The diagram shows a set of micro mirrors oriented to display pixel 422 in a first plane 420 and two sets of micro mirrors in array 412 are oriented to display pixels 432 in second plane 430. *Id.* at 8:63–9:23. Light 423, 433 is reflected to form pixels 422, 432 at an apex of the cones. *Id.*

Although the claims of the '191 patent recite the term "voxel" (*see, e.g.*, *id.* at 21:6), the specification of the '191 patent uses the term "pixel" and not "voxel." *See generally* Ex. 1001.

Patent Owner contends:

> A POSITA would have understood that a voxel is a type, or subspecies, of a pixel. Specifically, a voxel is a 3-dimensional pixel. Generally, "voxel" means "volume pixel" and "represents a quantity of 3-D data just as a pixel represents a point or cluster of points in 2-D data."

PO. Resp. 14 (citing Ex. 2002, 1; quoting Ex. 2003, 575). Petitioner agrees that a voxel is a pixel that has volume. Pet. Reply 5; *see also* Ex. 1003 ¶ 176 (Dr. Hesselink's testimony that "[w]hile [the] '191 patent does not use the term 'voxel,' voxels generally have a volume"), Ex. 1003 ¶ 176.

D. Illustrative Claims

Petitioner challenges claims 1–12 of the '191 patent. Claims 1 and 6 are independent. Claims 2–5 depend from claim 1, and claims 7–12 depend from claim 6. Claim 1 is illustrative and reproduced below, with Petitioner's labeling added in brackets.

> 1. [1Pre] A method of fabricating a security element useful on paper and coin currency and product labels, comprising:
>
> [1a] providing a substrate; and
>
> [1b.1] forming an array of micro mirrors on a surface of the substrate,
>
> wherein the array of micro mirrors is configured for receiving ambient light and, [1.b.2] in response, displaying an image in a plane spaced a distance apart from the surface of the substrate,
>
> wherein the image comprises a plurality of pixels,
>
> [1b. 3] wherein the array of micro mirrors includes for each of the pixels a different set of the micro mirrors each having a reflective surface oriented, in a fixed manner, with a body of each of the micro mirrors rotated about at least one of first and second rotation axes extending

through the body, to reflect the ambient light toward a point on the plane corresponding to one of the pixels,

[1b.4] wherein each of the different sets concurrently reflect the ambient light to concurrently generate the plurality of pixels,

[1b.5] wherein a voxel is created at each of the point on the plane via intersection of two or more beams of the reflected ambient light, and

[1b.6] wherein each of the created voxels produces an effect of a point source of light floating above the surface of the substrate in the plane.

Ex. 1001, 20:53–21:11.

E. Prior Art and Asserted Grounds

Petitioner asserts that claims 1–12 would have been unpatentable on the following grounds:

Ground	Claims Challenged	35 U.S.C. §	Basis
1	1, 6	103	Fuhse262[2]
2	1, 6	103	Fuhse262, Fuhse925[3]
3	2–4, 7–11	103	Fuhse262, Fuhse395[4]
4	2–4, 7–11	103	Fuhse262, Sauvage-Vincent[5]
5	5, 12	103	Fuhse262, Morford[6]

[2] DE102010048262A1 (Ex. 1005). We cite to the English language translation at Exhibit 1006.
[3] U.S. Patent No. 10,639,925 (Ex. 1008).
[4] U.S. Patent Application Publication No. 2012/0319395 (Ex. 1010).
[5] U.S. Patent Application Publication No. 2014/0285892 (Ex. 1033)
[6] Robert Morford, Wu-Sheng Shih, and JoElle Dachsteiner "Press-patterned UV-curable high refractive index coatings," Proc. SPIE 6123, Integrated Optics: Devices, Materials, and Technologies X, 612301 (15 February 2006), available at https://doi.org/10.1117/12.643164 (Ex. 1024).

Ground	Claims Challenged	35 U.S.C. §	Basis
6	2–4, 7–11	103	Fushse262, Fuhse925, Fuhse395
7	2–4, 7–11	103	Fuhse262, Fuhse925, Sauvage-Vincent
8	5, 12	103	Fuhse262, Fuhse925, Morford

Pet. 7.

Petitioner provides the Declaration of Lambertus Hesselink, Ph.D. to support its unpatentability challenges. Ex. 1003.

Patent Owner provides the Declaration of Mikael Lindstrand to supports its arguments. Ex. 2004.

II. ANALYSIS

A. Legal Standards

In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d, 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")); *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review). Although we may indicate in this Decision that certain Patent Owner arguments are not persuasive; in doing so we do not shift the ultimate burden from Petitioner.

A claim is unpatentable under § 103 if the differences between the claimed invention and the prior art are such that the claimed invention, as a whole, would have been obvious before the effective filing date of the

claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. "[W]hen a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007) (citing *U.S. v. Adams*, 383 U.S. 39, 50–51 (1966)). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) when in evidence, objective indicia of non-obviousness (i.e., secondary considerations). *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). The record contains no evidence of objective indicia of non-obviousness.

B. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (internal quotation marks and citation omitted).

Petitioner proposes that a person of ordinary skill in the art (POSITA) in the field "would have had a minimum of an undergraduate degree in electrical engineering, mechanical engineering, or physics and at least 2 years of experience in micro-optic based security features." Pet. 15 (citing Ex. 1003 ¶¶ 82–87).

Patent Owner proposes that a POSITA "as of the date of alleged invention of the '191 patent, would have had an undergraduate degree in electrical engineering, mechanical engineering, physics, or a similar field and at least 2 years of experience with diffusive light micro-optic security features." PO Resp. 8 (citing Ex. 2004 ¶ 23). Patent Owner argues that a "similar field" would "include at least computer science degrees with engineering coursework." PO Resp. 8.

We adopt Petitioner's proposed definition of a POSITA because Petitioner's definition is consistent with the types of problems encountered in the art, the prior art solutions to those problems, and the sophistication of the technology. For example, the '191 patent provides, as relevant background, a discussion of anti-counterfeiting devices made up of arrays of lenses used to display unique images, placed on currency and labels for retail products. Ex. 1001, 1:27–42. The '191 patent also discusses using lenses to create holograms. *Id.* at 2:6–21. Similarly, the prior art in this field, such as Fuhse262, relates to the use of lenses and mirrors to create hologram images for security purposes. Ex. 1006 ¶¶ 1–7. These descriptions demonstrate, consistent with Petitioner's proposed definition, that a POSITA would need an educational background to understand optics, lenses, and mirrors along with professional experience with optical security features to understand the creation of holograms and images using lenses and mirrors for the purpose of preventing counterfeiting of currency and other valuable products.

Patent Owner's proposed definition differs from Petitioner's in that it includes "or a similar field" when describing the education level of a POSITA and it includes "with diffusive light" when describing the experience level of a POSITA.

As to the first difference, the addition of "similar field" introduces vagueness and unnecessary uncertainty into the definition. Patent Owner does not explain what aspects of computer science would make it a field similar to the others listed, or what additional engineering coursework would suffice to make a person a POSITA. *See* Ex. 2004 ¶ 25. Nor does Patent Owner explain, generally, what makes a field "similar" to the ones listed or how to make that determination.

As to the second difference, the addition of "with diffusive light" would be inconsistent with the '191 patent's disclosure and claims. The '191 patent does not mention "diffusive light." The '191 patent describes using ambient light (*see, e.g.,* Ex. 1001, code (57), 2:53–57, 3:19–27, 5:57–62, Fig. 1, item 130 (ray labeled "ambient light")), and, likewise, the claims recites ambient light (*id.* at 20:59 (claim 1), 21:41 (claim 6)). Ambient light, for example sunlight, includes both parallel and diffuse light. *See* Ex. 1055, 97:21–98:8; Ex. 1006 ¶ 54 (describing the use of sunlight or ceiling light). The '191 patent discusses ambient light and does not discuss any distinctions between parallel light and diffuse light or give any significance to the nature of diffuse light and its effects on the invention.

We, therefore, adopt Petitioner's definition of a POSITA except that we find that the phrase "at least" in Petitioner's proposed definition creates a vague, open-ended upper bound for the level of ordinary skill, and we therefore do not adopt that aspect of the proposal.

C. Whether Dr. Hesselink is a POSITA

Patent Owner argues that Dr. Hesselink is not a POSITA because "[t]here is no evidence that Dr. Hesselink has any experience working with

diffusive light systems like those disclosed by the '191 patent" and, thus, is "unqualified to offer opinions regarding the '191 patent." PO Resp. 10–13 (citing Ex. 1003 ¶ 6).

Patent Owner did not move to exclude Dr. Hesselink's testimony. *See* 37 C.F.R. § 42.62; Pet. Reply 2 (arguing that Patent Owner waived its ability to challenge Dr. Hesselink's qualification.). At the hearing, Patent Owner explained that its argument that Dr. Hesselink is not a POSITA "goes to [the] weight" of Dr. Hesselink's testimony. Tr. 37:8.

In any event, Patent Owner's argument is based on its proposed definition of a POSITA, which we do not adopt. We, therefore, are not persuaded that Dr. Hesselink testimony should be given little or no weight.

D. Claim Construction

In this *inter partes* review, we apply the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). In applying this standard, we generally give claim terms their ordinary and customary meaning as would be understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *See id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc).

Petitioner contends that "no claim terms require express construction." Pet. 15. "Patent Owner agrees that the terms do not require construction for purposes of evaluating the Petition." PO Resp. 13.

We do not need to construe any terms explicitly to reach our decision on institution. *See Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed.

Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)); *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (approving Board decision not to construe claim language where construction is not material to the dispute).

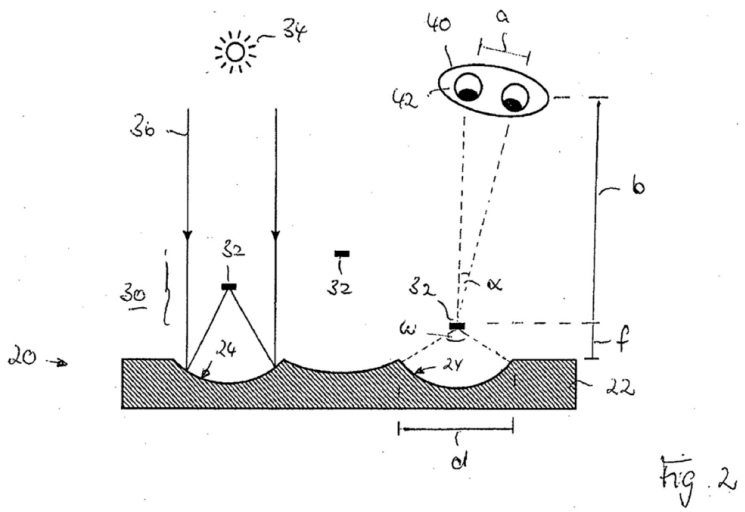
E. Ground 1

Petitioner contends that claims 1 and 6 would have been obvious over the combination of the embodiment of Figure 2 and embodiment of Figures 8, 9, and 10 of Fushe262. Pet. 16–34.

1. Summary of Fuhse262

Fuhse262 is a German patent application titled "Depiction Element" and published on April 12, 2012. Ex. 1006, codes (12), (19), (43), (54). Fuhse262 discloses a depiction element on a substrate that creates a light-spot image when illuminated. *Id.* ¶ 10. The light-spot image is composed of a plurality of light spots and appears to float above or below the surface of the substrate. *Id.*

Figure 2 of Fuhse262 is reproduced below.



Fuhse262's Figure 2 depicts a first embodiment "with concave mirrors as reflective optical elements." Ex. 1006 ¶ 42. Figure 2 shows security element 20 having a three-dimensional motif 30 formed by three image points 32 (i.e., light spots). *Id.* ¶ 56. Substrate 22 has concave mirrors 24 which produce light spots 32, when illuminated by light source 34, such as the sun or a ceiling lamp. *Id.* ¶¶ 54, 57.

Figure 10 of Fuhse262 is reproduced below.

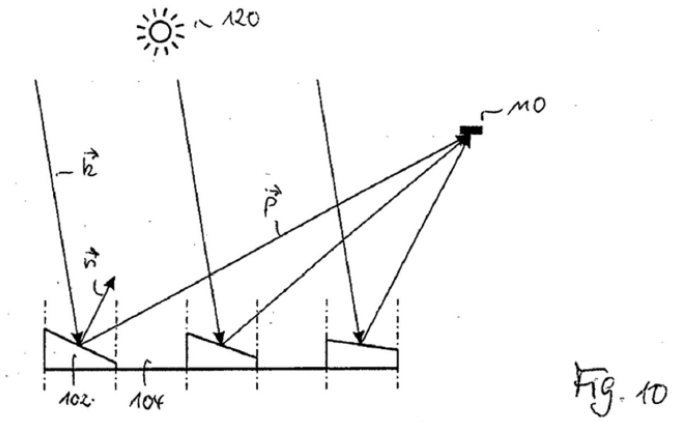


Figure 10 depicts another embodiment in which the concave mirror is "broken down into micro-optical elements" that are flat mirror surfaces and "illustrates the calculation of the flat mirror surfaces." *Id.* ¶¶ 48, 50. "The

advantage is that micro-optic elements with flat surfaces are easier to calculate and produce." *Id.* ¶ 86. As Figure 10 illustrates, micromirrors 102 form light spot 110. *Id.* ¶ 91–92.

2. Analysis of Independent Claim 1

Petitioner contends that the combination of the embodiment of Figure 2 of Fushe262 and embodiment of Figures 8, 9, and 10 of Fushe262 teaches the preamble and limitations 1a–1b.6. Pet. 16–34. For limitation 1b.1, Petitioner also contends that it would have been obvious to a POSITA to replace the curved mirrors of the embodiment of Figure 2 with the micro mirrors of the embodiment of Figures 8, 9, and 10 in order to achieve a higher resolution and provide for easier calculation and production. *Id.* at 17 (citing Ex. 1006 ¶¶ 83, 86–87; Ex. 1003 ¶ 115), 21–22.

Patent Owner does not specifically dispute Petitioner's contentions regarding the preamble, limitations 1a–1b.4, limitation 1b.6, and the motivation to combine the different embodiments. *See generally* PO Resp. We have reviewed Petitioner's contentions and supporting evidence and are persuaded that Fuhse262 teaches the preamble and undisputed limitations 1a–1b.4 and 1b.6.

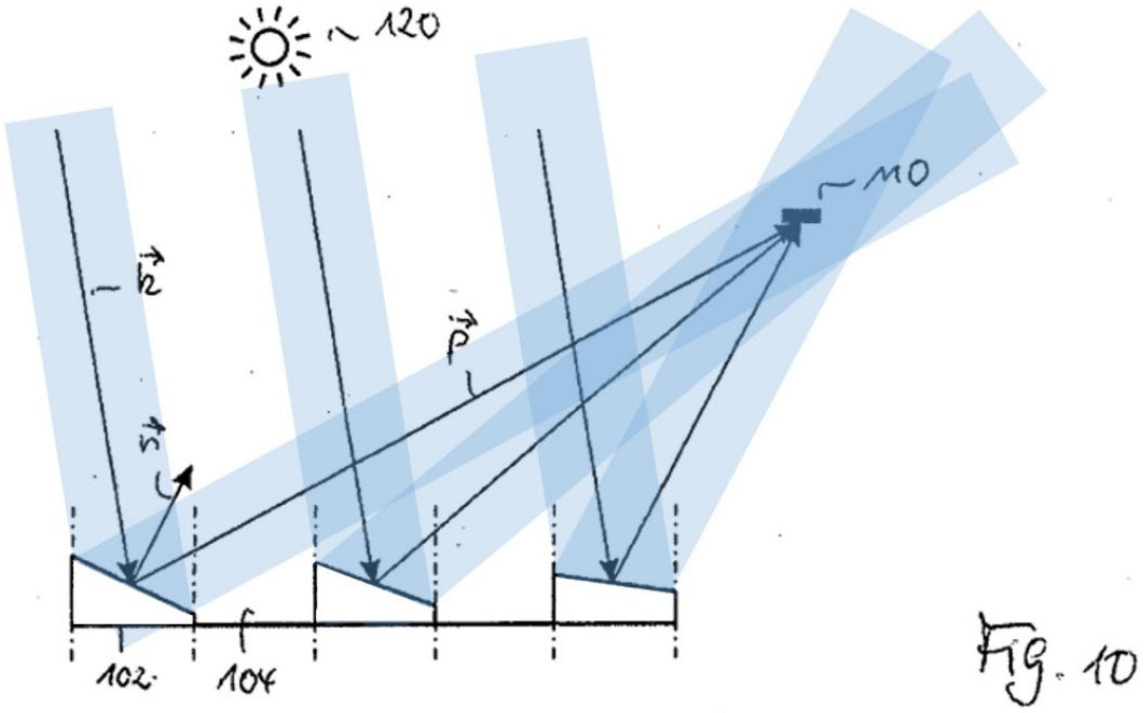
Patent Owner disputes that limitations 1b.5 is disclosed by Fushe262. PO Resp. 14–20. We address this limitation below.

3. Limitation 1b.5

Limitation 1b.5 recites "wherein a voxel is created at each of the point on the plane via intersection of two or more beams of the reflected ambient light." Ex. 1001, 21:6–8.

Relying upon the testimony of Dr. Hesselink, Petitioner contends that a POSITA would know that Fuhse262's system forms voxels. Pet. 32–34.

Dr. Hesselink testifies that Fuhse262's Figure 10 shows "chief rays" for each micromirror 102 forming light spot 110. Ex. 1003 ¶ 178. According to Dr. Hesselink, "[a]mbient light reflects from the entire surface of the mirrors and forms reflected beams of light, not just the rays aimed at the center point." *Id*. To illustrate this, Dr. Hesselink annotated Fushe262's Figure 10 to show the light beams. *Id.* ¶ 178. Annotated Figure 10 is reproduced below. *Id.* ¶ 178.



Annotated Figure 10 shows light beams in blue, reflecting from the entire surface of micromirrors 102. *Id.* Dr. Hesselink testifies that a voxel is formed at the intersection of the light beams, with light spot 110 as the voxel's center point. *Id.* ¶¶ 177–182.

Patent Owner argues that Fuhse262 does not disclose voxels and does not teach or suggest the creation of pixels with volume. PO Resp. 15. According to Patent Owner, "Fuhse262 does not use the term 'voxel' and does not mention 'pixels with volume' or '3D pixels' or any similar term."

Id. Instead, according to Patent Owner, Fuhse262 "consistently and unambiguously refers to the creation of 'pixels Pj,' which it also refers to as 'image ***points*** P_j.'" *Id.* (citing Ex. 1006 ¶¶ 36, 126–128). Consequently, Patent Owner argues that "[a] POSITA would understand Fuhse262's consistent description of a pixel as an 'image ***point***' as disclosure of a 2d pixel" rather than a voxel. *Id*.

Patent Owner asserts that the "Petition appears to argue that Fuhse262 inherently discloses the creation of voxels" and argues that the marked-up version of Figure 10 provided by Petitioner does not meet the high standard required to show that Fuhse262 inherently discloses voxels. PO Resp. 15–16; *see also* PO Sur-Reply 2. Patent Owner argues that, at best, Petitioner has shown that the micro mirror array of Fuhse262 might result in overlapping light beams, but does not show how light beams overlapping with an irregular shape or in an unintentional or haphazard manner would necessarily form a voxel. PO Resp. 16. According to Patent Owner, creating a voxel in an ambient light environment is a "highly technical endeavor" that requires more than just pointing two mirrors towards each other, because the light rays that create the voxel encounter interference from other light rays in an ambient environment and are degraded as they approach the intersection point. PO Resp. 17–18 (citing Ex. 2004 ¶¶ 45, 47). Because of the interference, voxels require more intense and focused light rays than pixels do (which require less information than voxels to create), and thus, add more complexity and costs to the system, argues Patent Owner. PO Resp. 18 (citing Ex. 2004 ¶¶ 49–50). Patent Owner argues that Dr. Hesselink fails to address these concerns because of lack of experience with diffusive light environments leading to a failure to understand the

complexities in creating a voxel. PO Resp. 18–19 (citing Ex. 2004 ¶¶ 52–55). Patent Owner further argues that if voxels were necessarily the result of the Fuhse262 system, then all images produced by Fuhse262 would be three-dimensional and the system would not be able to create the two-dimensional images disclosed by Fuhse262. PO Resp. 19–20 (citing Ex. 1006 ¶¶ 26–27, 117; Ex. 2004 ¶ 58).

Contrary to Patent Owner's argument, however, this not a situation where an element is missing from the applied prior art. We are persuaded by Petitioner's argument and evidence that Fuhse262 teaches limitation 1b.5. Even though Fuhse262 does not expressly use the term "voxel," a POSITA would have understood from Fushe262's disclosure that its mirrors form voxels *Merck & Co. v. Biocraft Labs., Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989) ("[T]he question under 35 USC 103 is not merely what the references expressly teach but what they would have *suggested* to one of ordinary skill in the art at the time the invention was made") (quoting *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976)) (emphasis added); *Syntex LLC v. Apotex, Inc.*, 407 F.3d 1371, 1380 (Fed. Cir. 2005) ("What a reference teaches a person of ordinary skill is not . . . limited to what a reference specifically 'talks about' or what is specifically 'mentioned' or 'written' in the reference.")

Fuhse262 discloses mirrors that reflect light rays converging at a light spot. Ex. 1006 ¶¶ 95–96, Fig. 10. Dr. Hesselink credibly testifies that while Fuhse262 depicts rays that form a light spot, the rays depicted are "chief rays" that depict only the center rays of light for each optical element. Ex. 1003 ¶¶ 178–179. Ambient light, however, reflects from the entire surface of the mirrors and forms reflected beams of light, not just the center rays aimed at the center point. *Id.* ¶ 178. According to Dr. Hesselink, the "chief

ray" is representative of the larger bundle of rays that form the beams of light reflected off of the mirrors. *See Id.* ¶ 44. The volume of the voxel is set by the intersection of these beams and the center of the voxel is the point at which the center rays of each beam intersect. *Id.* ¶ 179.

Although Dr. Lindstrand testifies "a POSITA would not have understood Fuhse262 to disclose creating a voxel" (Ex. 2004 ¶ 43), Dr. Lindstrand does not dispute Dr. Hesselink's testimony that light would reflect off of the entire surface of Fuhse262's mirrors and form reflected beams of light. *See* Ex. 2004 ¶¶ 42–58; Ex. 1055, 112:15–21 ("You also agree the ambient light would not just strike the center of the surface, it would strike the entire surface, correct? . . . THE WITNESS: I would say that that is a fair and accurate description.")

Dr. Hesselink's testimony explaining that light beams would reflect off the entire surface of Fuhse262's micromirrors and would create a voxel when they intersect with each other, provides sufficient support demonstrating how a POSITA would have understood Fuhse262's disclosure of light rays being reflected off of mirrors and converging at a light spot shown in Figure 10. *See Unification Techs. LLC v. Micron Tech. Inc.*, 2024 WL 3738401 at *7 (Fed. Cir. Aug. 9, 2024) (affirming the use of expert testimony to demonstrate how a skilled artisan would have understood a prior art reference's disclosure as teaching a claim limitation).

Patent Owner argues that light beams that intersect in an irregular or unintentional manner would not necessarily form a voxel, but does not explicitly show that Fuhse262's light beams do, in fact, intersect in an irregular manner. PO Resp. 19. Petitioner has shown, as supported by Fuhse262's disclosure, that Fuhse262's mirrors are each oriented

intentionally to point to a spot that allows them to create a light spot at the intended coordinates. *See* Pet. 27 ("In particular, Fuhse262 explains that '[t]he position of the mirror surfaces, i.e. the normal vector n, is to be determined in such a way that the light incident from a specified direction $\vec{k}$ is reflected onto the focal point (x_0, y_0, z_0) for all micromirrors 102 assigned to light spot 110.'") (quoting Ex. 1006 ¶¶ 96–97). This disclosure, combined with Dr. Hesselink's testimony that the intersection of light beams from the mirrors would create not just a spot but a voxel due to light reflecting off the entire surface of Fuhse262's mirrors demonstrates that Fuhse262 teaches limitation 1b.5.

Patent Owner argues that creating voxels requires more than just pointing mirrors towards each other and that it requires added complexity and cost to create voxels due to interference from ambient light. PO Resp. 17–18. As explained above, Petitioner demonstrates that Fuhse262 discloses mirrors that are oriented intentionally to point to a spot that allows them to create a light spot at the intended coordinates. *See* Pet. 26. Petitioner also contends that in some embodiments up to 50 micromirrors may be assigned to a single light spot and contribute together to the creation of a voxel. Pet. 26 (citing Ex. 1006 ¶¶ 87, 91–92, Figs. 8b, 9b). Dr. Hesselink credibly testifies that the ordinary artisan would have understood Fuhse262's disclosure as teaching the creation of voxels.

Patent Owner does not rebut these points and does not explain what more is required of Fuhse262 to disclose the creation of voxels, other than requiring that Fuhse262 use the same words as recited in the claim.[7] *Teva*

[7] At the hearing Patent Owner was unable to identify any structural characteristics that would help explain why Fuhse262 would not be able to

Pharm. Indus. Ltd. v. AstraZeneca Pharms. LP, 661 F.3d 1378, 1384 (Fed. Cir. 2011) ("The prior inventor does not need to . . . . conceive of its invention using the same words as the patentee would later use to claim it.").

Similarly, Dr. Lindstrand also does not identify specific deficiencies in Fuhse262 that would prevent it from creating voxels or identify the additional complexity required to modify Fuhse262 to allow it to create voxels. Ex. 2004 ¶¶ 43–58. Instead, the portions of Dr. Lindstrand's testimony that Patent Owner relies on merely repeats Patent Owner's allegations nearly verbatim without sufficient additional explanation or citations to evidence. *Id.* Such testimony is entitled to little weight in our patentability analysis. *See* 37 C.F.R. § 42.65(a) ("Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight."); *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 at 15–17 (PTAB Aug. 24, 2022) (precedential) ("We have reviewed this excerpt from Dr. Jones' declaration and note that it merely repeats, *verbatim*, the conclusory assertion for which it is offered to support. . . . [T]he cited declaration testimony is conclusory and unsupported, adds little to the conclusory assertion for which it is offered to support, and is entitled to little weight."); *Upjohn Co. v. Mova Pharm. Corp.*, 225 F.3d 1306, 1311 (Fed. Cir. 2000) ("Lack of factual support for

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create voxels. *See* Tr. 42:22–43:5 ("I have nothing to rely on, other than I think our expert has worked in this field and there's an opinion that Fuhse262 would not necessarily display a voxel, and I understand their expert opines otherwise. As to structure . . . it's not described in our specification, but my understanding is the random selection of the mirrors assists with limiting the interference that you get from the regular grid pattern, of Fuhse262, for example. But we haven't relied heavily on that because we don't talk about that in the specification in detail, Your Honor.")

expert opinion going to factual determinations, however, may render the testimony of little probative value in a validity determination.") (quoting *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 294 (Fed. Cir. 1985)).

Moreover, Patent Owner's argument is not commensurate with the scope of the claim. Even if the light beams do encounter interference and degrade as they travel to the intersection point (PO Resp. 17), the claims do not exclude degraded or faint voxels, or otherwise require the production of voxels having any particular intensity.

Patent Owner finally argues that if voxels were necessarily the result of the Fuhse262 system, then all images produced by Fuhse262 would be three-dimensional and the system would not be able to create the two-dimensional images disclosed by Fuhse262. PO Resp. 19–20 (citing Ex. 1006 ¶¶ 26–27, 117; Ex. 2004 ¶ 58). Fuhse262, however, refers to two-dimensional images as those where its light spots are all in the same plane. Ex. 1006 ¶ 117 (describing a "two-dimensional motif" as a motif "in which all image points are at the same height.") Thus, even if Fuhse262's light spots are three-dimensional voxels, this fact does not prevent them from being in the same plane and does not prevent Fuhse262 from having two-dimensional images.

a) Conclusion

We determine that Petitioner has shown by a preponderance of the evidence that claim 1 is unpatentable over Fuhse262.

4. Analysis of Claim 6

Independent claim 6 is similar to independent claim 1 and, in particular, independent claim 6 recites limitations substantially the same as limitation 1b.5. Pet. 35; PO Resp. 13–14.

Petitioner's analysis and evidence challenging claim 6 is substantially the same as the analysis and evidence challenging claim 1. *See* Pet. 35–41.

Patent Owner makes the same arguments for the patentability of claim 6 as for claim 1. PO Resp. 13–14.

For the same reasons as discussed above in our analysis for claim 1, we determine that Petitioner has shown by a preponderance of the evidence that claim 6 is unpatentable over Fuhse262.

F. Ground 2

Petitioner challenges claims 1 and 6 based upon a combination of Fuhse262 and Fuhse925. Pet. 41–51. Fuhse925 is relied upon to teach the preambles and limitation [1b.3] of claim 1 and the corresponding limitations of claim 6 and not relied upon to teach limitation 1b.5. *Id.* at 41–48.

Patent Owner argues that Petitioner does not rely upon Fuhse925 to teach limitation 1.b5 and that Fuhse925 does not cure the deficiency of Fush262. PO Resp. 14. Patent Owner argues that "claims 1 and 6 are therefore valid for at least the same reasons as those detailed with respect to Ground 1." *Id.*

As discussed above in connection with Ground 1, Patent Owner's arguments that Fuhse262 fails to disclose limitation 1b.5 is unpersuasive. After reviewing Petitioner's analysis and evidence, we determine that

Petitioner has shown by a preponderance of the evidence that claims 1 and 6 are unpatentable over Fuhse262 and Fuhse925.

G. Grounds 3–8

Petitioner challenges dependent claims 2–5 and 7–12 based upon combinations of Fushe262 with Fushe395, Sauvage-Vincent, or Morford and combinations of Fushe262 and Fushe925, with Fushe395, Sauvage-Vincent, or Morford. Pet. 7.

Claims 2–5 depend from claim 1, and claims 7–12 depend from claim 6. Patent Owner argues that the dependent claims are patentable based on their dependency from claims 1 and 6 and makes no arguments directed to the additional limitations of claims 2–4 and 7–12. PO Resp. 14–17.

After reviewing Petitioner's analysis and evidence, we determine that Petitioner has shown by a preponderance of the evidence that claims 2–5 and 7–12 are unpatentable.

III. CONCLUSION[8]

We determine that Petitioner shows by a preponderance of the evidence that claims 1–12 of the '191 patent are unpatentable.

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[8] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1, 6	103	Fuhse262	1, 6	
1, 6	103	Fuhse262, Fuhse925	1, 6	
2–4, 7–11	103	Fuhse262, Fuhse395	2–4, 7–11	
2–4, 7–11	103	Fuhse262, Sauvage-Vincent	2–4, 7–11	
5, 12	103	Fuhse262, Morford	5, 12	
2–4, 7–11	103	Fushse262, Fuhse925, Fuhse395	2–4, 7–11	
2–4, 7–11	103	Fuhse262, Fuhse925, Sauvage-Vincent	2–4, 7–11	
5, 12	103	Fuhse262, Fuhse925, Morford	5, 12	
Overall Outcome			1–12	

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–12 of U.S. Patent No. 10,901,191 B2 are unpatentable; and

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

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