

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GIESECKE+DEVRIENT GMBH, GIESECKE+DEVRIENT CURRENCY
TECHNOLOGY GMBH, AND PAPIERFABRIK LOUISENTHAL GMBH,
Petitioners,
v.
LUMENCO, LLC,
Patent Owner

**PATENT OWNER'S RESPONSE TO THE PETITION
FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,189,294**

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TABLE OF AUTHORITIES

Cases

Par Pharm., Inc. v. TWi Pharms., Inc., 773 F.3d 1186 (Fed. Cir. 2014) 16

EXHIBIT LIST

Exhibit	Description
2001.	January 21, 2021 Letter*
2002.	Voxel Definition from Scientific Volume Imaging B.V. (Copyright 1992-2024)*
2003.	“Chapter XXXIII - 3-D Visualization on Mobile Devices” Sanna and Lamberti, from Handbook of Research on User Interface Design and Evaluation for Mobile Technology, 3-D Visualization on Mobile Devices, 2008, DOI: 10.4018/978/1/59904-871-0.ch033*
2004.	Declaration Of Dr. Mikael Lindstrand

* Previously submitted

I. INTRODUCTION

Petitioner fails to carry its burden of establishing, by a preponderance of the evidence, that any challenged claim of U.S. Patent No. 10,189,294 (the “’294 patent”) is unpatentable. Though Petitioner argues eight obviousness grounds, all eight grounds assert that Fuhse262 teaches or suggests independent claim elements [1b.5], [28b.5], [35b.4], and [35b.5]. Elements [1b.5], [28b.5], and [35b.4] recite similar limitations directed to the creation of voxels at the intersection of two or more beams of light. Element [35b.4] is directed to display of a second image in a second plane spaced a distance apart from the plane of a first image. As detailed herein, Fuhse262 does not teach or suggest either.

As to the “voxel” limitations, Fuhse262 does not use the term voxel or illustrate three-dimensional pixels and Petitioner’s expert, Dr. Hesselink, does not argue that Fuhse262 expressly discloses creation of voxels. Instead, Dr. Hesselink presents a modified version of a figure from Fuhse262 and asserts that a POSITA would simply understand that Fuhse262 discloses a voxel. Dr. Hesselink’s assertion should be rejected because he cannot plausibly establish the element is inherent in Fuhse262, and he otherwise ignores the significant technical challenges that must be overcome to obtain a visible voxel in the ambient light environment to which the claims are directed.

More specifically, Dr. Hesselink’s opinions are based on a fundamental

misunderstanding of the behavior of light rays in ambient light environments—he states in his analysis, for example, that all light rays are parallel to each other in ambient light environments. But as Patent Owner’s expert, Dr. Lindstrand explains, Dr. Hesselink’s understanding is categorically incorrect. As a result, Dr. Hesselink’s analysis does not consider the interference involved ambient light environments. This is unsurprising because Dr. Hesselink appears to have no experience working with optical security features in ambient light environments. Instead, all of his listed experience involves collimated light environments in which there is a single targeted light source and all rays are parallel. Dr. Hesselink’s opinions should be discarded or discounted for that reason. Without those opinions, there is no evidence to support the Petition’s argument that Fuhse262 teaches or suggests creation of a voxel.

Petitioner also fails to meet its burden as to the “second image” limitation. The Petition and Dr. Hesselink seize on one vague paragraph in Fuhse262 in support of their position. But, on closer inspection, that paragraph does not disclose or suggest a second image on a plane spaced apart from a first image. Instead, a POSITA would understand Fuhse262 to teach that a single image that includes two separate motifs, both of which are on the same or overlapping planes. None of the other references cited in the Petition remedy these deficiencies of Fuhse262, and neither the Petition nor Dr. Hesselink argue otherwise.

For at least these reasons, and as further explained below, all eight grounds

should be rejected.

II. THE PARTIES AND THE TECHNOLOGY

Petitioner Giesecke + Devrient GmbH is a Germany-based limited liability company that, among other business, manufactures optical security features for banknotes.¹

Patent Owner Lumenco is a Colorado-based research and development company founded in 2012. Lumenco's business focuses on micro-optic, micro mirror, lighting, and screen technologies. Over the past decade, Lumenco has provided a broad array of optical security products to governments and private companies around the world. For example, in 2015 Lumenco entered into a development agreement with the United States Bureau of Engraving and Printing ("BEP"). The collaboration lasted five years and involved micro-optical technologies for use on banknotes, which allowed the United States to test in its currency one of the most advanced micro-optic arrays available.

Beginning in the 2015 timeframe, Lumenco designed and developed a new micro mirror-based optical security feature. The optical security feature was designed for use in current and brand authentication. Lumenco's internal code name for this feature was Dycyfer™. Lumenco developed software that was used to

¹ <https://www.gi-de.com/en/currency-technology/banknote-solutions>

implement its novel design ideas and manufactured prototype micro mirror arrays to test and prove the operation of its ideas. Lumenco's work on Dycyfer™ led to the patent application that issued as the '294 patent. Lumenco's patented micro mirror technologies have a wide array of applications across diverse markets and industries including banknote security, brand protection, lighting and screen technologies, and solar technologies, among others.

In April 2016, Lumenco presented its Dycyfer™ technology to the BEP's Office of Technology Development as a potential technology for use in United States banknotes. Lumenco's proposal informed the BEP that Lumenco had filed a United States patent application related to the aforementioned technology.

In early 2017, Lumenco introduced its Dycyfer™ technology and its micro mirror patent application to Petitioner. During Lumenco's discussions with Petitioner, Petitioner requested information and a demonstration of those technologies. Mark Raymond and Hector Porras, founders of Lumenco and the named inventors of the '294 patent, discussed Lumenco's imminent launch of the Dycyfer™ technology with G+D and were promptly invited to meet with G+D executives in Germany. In May 2017, Messrs. Raymond and Porras flew to Gmund, Germany to meet with Petitioner's executives Alfred Kraxenberger, Manfred Heim, Michael Rahm, and Christian Fuhse. During that meeting, Messrs. Raymond and Porras presented Lumenco's Dycyfer™ technology and the patent application that

eventually issued as the '294 patent. Messrs. Raymond and Porras subsequently traded several emails with representatives of G+D before and after the May 2017 meeting regarding Lumenco's technology and inventions.

Petitioner eventually informed Lumenco that it was not interested in pursuing a license or partnership. Approximately one year later, Petitioner announced that it would be offering a new line of micro mirror optical security products. Those new products, marketed under the brand name Galaxy®, infringed and continue to infringe Lumenco's United States patents, including the '294 patent.

On January 21, 2021, Lumenco sent Petitioner a letter notifying Petitioner of its infringement of the '294 patent. **Exhibit 2001** [Ex. D to Amended ED TX Complaint]. The infringement did not cease. Patent Owner eventually learned that Petitioner was importing infringing products into the United States and selling those products in the United States. In 2023, Patent Owner initiated patent infringement litigation against Petitioner asserting four of its United States patents. *See* Petition, p. 1. Petitioner subsequently filed petitions for *inter partes* review of all four of those patents.

III. THE '294 PATENT

The '294 patent is directed towards sophisticated and robust optical security features using micro mirrors that generate multiplanar images (*i.e.*, the images appear to have optical depth) that are visible without specialized glasses or lighting

and without the use of holographic imagery. **Exhibit 1001**, 1:15-23; 2:1-29; 2:59-3:9. This results in security features for banknotes and brand authentication that are practically, if not literally, impossible to replicate and that are substantially better than any prior existing technologies. *Id.*

The '294 patent describes a special technique that enables images to be “written” into one or more spatial planes using a micro mirror array. *Id.*, 2:33-58. The images appear above and below the plane of the security element on which the micro mirrors are located. *Id.* The generated images consist of several pixels. *Id.* A pixel is created by several micro mirrors directing the light to a specific point. *Id.*, 3:9-59. The micro mirrors that generate a pixel are referred to as a “set.” *Id.*, 5:10-6:9.

A method of generating pixels by means of multiple micro mirrors is graphically illustrated in Figure 4 of the '294 patent. *Id.*, 8:56-9:18. In the example of Figure 4, the micro mirrors are located at the bottom of the security element. *Id.* As shown below, the light reflected by the mirrors is represented approximately by the arrows (423). *Id.* At their intersections, the reflected light creates the pixels (422) above the plane (420) of the security element. *Id.* Figure 4 also shows another plane (430) on which reflected light represented by the arrows (433) generates pixels (432). *Id.*

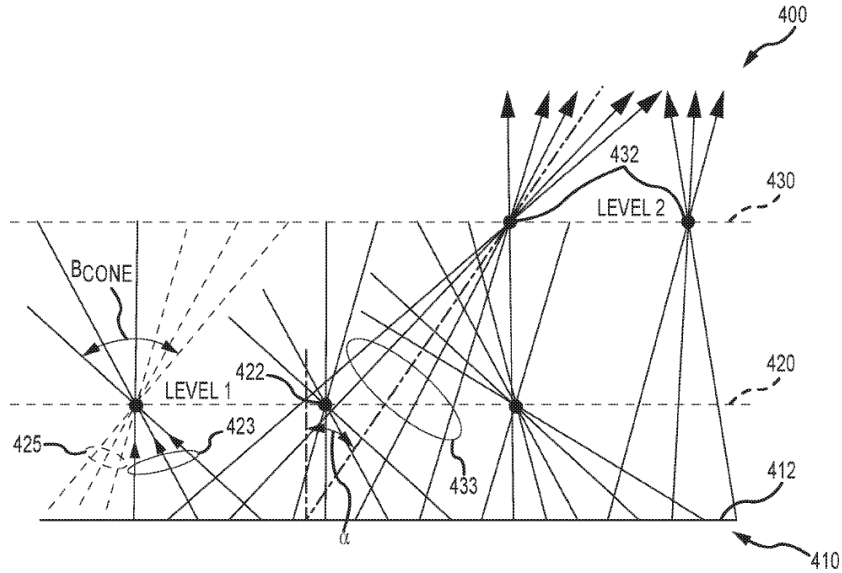


FIG. 4

Figure 2 of the '294 patent (reproduced below) shows an example of images generated by means of these pixels from a different perspective:

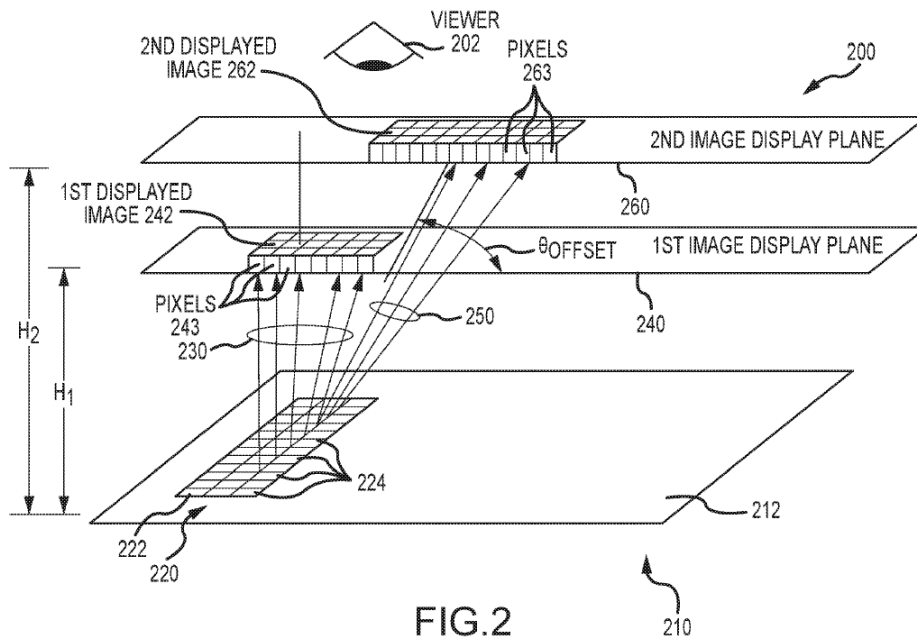


FIG. 2

See also Exhibit 1001, 7:23-8:19. Figure 2 of the '294 patent also shows an example of multiple micro mirrors (224) and two images, first displayed image 242 on plane

(240) and second displayed image 262 on plane (260) above the plane of the substrate (212) on which the micro mirrors are mounted. *Id.* The images consist of several pixels (243 and 263). *Id.*

The '294 patent illustrates three-dimensional pixels. Three-dimensional pixels are referred to in the art as “voxels.” For example, Figure 2 of the '294 patent illustrates a plurality of voxels 263, which are shown as three-dimensional cubes with depth, width, and height. Figure 1 of the '294 also illustrates a voxel with depth extending from the exemplary 3D display plane.

IV. A POSITA AND THE GROUNDS OF ALLEGED OBVIOUSNESS

A. LEVEL OF ORDINARY SKILL IN THE ART

In the opinion of Patent Owner’s declarant, Dr. Lindstrand, a person of ordinary skill in the art (a “POSITA”) in the relevant field, as of the date of alleged invention of the '294 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. *See Exhibit 2004*, ¶23.

Petitioner’s declarant, Dr. Hesselink, opines that a POSITA “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. 12 (citing *Exhibit. 1003*, ¶ 68).

The key differences in these two definitions are that, in Dr. Lindstrand's opinion, a POSITA would have had (1) an undergraduate degree *in a field similar to* electrical or mechanical engineering or physics is sufficient and (2) 2 years of experience with *diffusive light* micro-optic security features.

As to the first difference, an undergraduate degree in a field similar to the electrical or mechanical engineering or physics, which would include at least computer science degrees with engineering coursework, more accurately reflects the level of ordinary skill in the art in the '294 patent. *See Exhibit 2004*, ¶25. Dr. Hesselink's proposal is overly restrictive and fails to account for the fact that university degree programs vary and that degrees other than those specifically identified by Dr. Hesselink would provide appropriate subject matter training that, when combined with at least two years of relevant experience, would establish a person as a POSITA for the '294 patent. *Id.*

As to the second difference, Dr. Lindstrand explains that targeted light systems using lasers or other focused light sources are fundamentally different from security features like those described in the '294 patent, which operate by reflecting diffuse ambient light. *Id.* at ¶27. The challenges and considerations in designing diffusive light systems differ greatly from those involved in designing systems that operate with focused, collimated light sources such as lasers. *Id.*

Lasers are high intensity collimated light sources. *Id.* In collimated light

source systems, rays of light are parallel to each other and the direction and angle of those rays of light are controlled and predictable. *Id.* Such systems are ideal for well-defined problems in highly controlled environments with small and well-characterized sources of disturbance. *Id.* Rays of light from lasers are high-intensity and efficient, making their behavior more predictable than light in diffusive systems. *Id.* In collimated light source systems, the designer knows exactly where the light is coming from and can manipulate and control variables like intensity, beam size, etc. *Id.*

Diffusive light systems like those disclosed in the '294 patent, in contrast, are designed to work with ambient light, such as ambient outdoor light or light from indoor diffuse light sources, e.g., overhead lights or lamps. *Id.* at ¶28. The light rays from these sources are not collimated and present technical challenges not present with collimated light source systems. *Id.* Diffusive light scattering causes unintended light rays in positions and directions not desired. This presents a number of challenges, e.g. positions that should appear deeply black appear instead be grayish. *Id.* Achieving high intensity and high contrast images in diffusive light systems is much more difficult than in collimated light source systems due to interference, diffraction, and scattering effects from untargeted light rays. *Id.*

For at least these reasons, a person who had experience mainly with focused, collimated light systems would not necessarily understand the principles and

challenges in diffusive light systems like those disclosed in the '294 patent. For that reason, a POSITA as to the '294 patent would have had at least 2 years of experience specifically with *diffusive light* micro-optic security features.

B. DR. HESSELINK IS NOT A POSITA

There is no evidence that Dr. Hesselink has any experience working with diffusive light systems like those disclosed by the '294 patent, much less the 2 or more years of experience that would be necessary to qualify as a POSITA for the '294 patent. Dr. Hesselink states: “My expertise is in ultra-high density optical data storage, and optical information systems generally, as well as optical communication components, nano photonics, optics and optical systems, and optical interconnects.” Exhibit. 1003, ¶ 6. This high-level summary of experience does not include any specific mention of experience with diffusive or ambient light features and does not mention optical security features. It is true that diffusive light micro mirror features are, broadly speaking, “optical systems.” But so are collimated light systems and a variety of other technologies. A POSITA would not understand a disclosure of general experience in “optics” to necessarily include experience with diffusive light systems. *See* Exhibit 2004, ¶32.

Dr. Hesselink provides several more specific examples of his experience with optical systems. He states that he has experience with “3-D displays, including autostereoscopic holographic displays, 3-D up conversion display, 3-D displays for

security applications, grating-based displays, as well as data analysis of complex 3-D flow visualizations using scanning laser systems, tomography, and mathematical topology,” as well as “3-D display and storage devices” and the use of “interferometry to determine the 3-shape of objects using optical and X-ray scanners.” Exhibit. 1003, ¶ 7. None of the specific technologies detailed by Dr. Hesselink are diffusive light systems. *See* Exhibit 2004, at ¶33. For example, autostereoscopic holographic, 3-D up conversion, and grating-based display systems all use collimated light or other focused light sources, not ambient or diffusive light sources. *Id.*

Dr. Hesselink appears to acknowledge that he has no *specific* experience with diffusive light systems like those described in the '294 patent. Instead, he admits that he believes he is qualified in view of his “broad knowledge of optics.” Exhibit. 1003, ¶ 8. Elsewhere in his declaration, Dr. Hesselink. But a broad knowledge of optics does not qualify Dr. Hesselink as a POSITA as to the '294 patent. Specific knowledge of diffusive light micro-optic security features is required, and Dr. Hesselink does not describe any such experience.

Perhaps because of his lack of experience with diffusive light systems, Dr. Hesselink’s opinions are based on an incorrect understanding of the technology described in the '294 patent. Most notably, Dr. Hesselink opines that “[i]n the patent, ambient light refers to parallel light, i.e., all the rays coming from the source

are parallel to each other.” Exhibit. 1003, ¶ 46. That statement is categorically false. *See* Exhibit 2004, ¶35. A POSITA would understand that “ambient light” as used in the art and in the ’294 patent specifically refers to non-collimated light, i.e., an environment where light rays are scattered and diffused. *Id.* at ¶36. Ambient light environments often involve light rays from multiple sources and light from those sources is often intentionally diffused. *Id.* at ¶37. Ambient light refers to, for example, the lighting conditions in an indoor office environment with multiple overhead light sources, natural light entering through windows, etc. *Id.* In such systems light rays engage the security features from a variety of directions—the rays are most certainly **not** all parallel to each other. *Id.*

As discussed in the previous section, the design and implementation of security features for diffusive, ambient light environments involves unique considerations and challenges as compared with collimated light environments in which the light rays are parallel to each other. Dr. Hesselink’s declaration makes clear that he does not recognize any difference between those two fundamentally different environments. Dr. Hesselink’s misunderstanding about the nature of ambient light systems makes him unqualified to offer opinions regarding the ’294 patent.

C. CLAIM CONSTRUCTION

Patent Owner and Petitioner agree that the terms do not require construction

for purposes of evaluating the Petition. *See* Pet. at p.13 and POPR at p.10.

**D. GROUND 1 – THE PETITION FAILED TO PROVE THAT FUHSE262
RENDERS OBVIOUS ANY OF CLAIMS 1, 6-13, 28, 32, 33, AND 35-38**

Petitioner failed to satisfy its burden of proving obviousness of independent claims 1, 28, and 35 because Fuhse262 does not teach or suggest all elements of any of those claims. The other claims challenged in Ground 1 depend from and add limitations to those independent claims, and Petitioner therefore also failed to meet its burden as to those dependent claims. The Board should therefore confirm the patentability of all challenged claims.

1. Independent Claim 1

Fuhse262 does not render obvious claim 1 at least because it does not teach or suggest claim elements [1b.5].

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

Fuhse262 fails to teach or suggest limitation [1b.5] at least because Fuhse262 fails to teach or suggest creating a “voxel . . . via the intersection of two or more beam of the reflected ambient light,” as required by element [1b.5].

Patent Owner agrees with the assertion of Petitioner and Dr. Hesselink that “[a] POSITA would understand[that] ‘voxels’ have a volume.” Petition, p. 31. Specifically, 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 a cluster of points in 2-D data.” **Exhibit 2002**, (Scientific Volume Imaging, Copyright, 1995-2024) at p. 1 (“Voxel is short for volume pixel, the smallest distinguishable box-shaped part of a 3D image. It is the 3D equivalent of the 2D pixel.”); **Exhibit 2003** (Handbook of Research on User Interface Design and Evaluation for Mobile Technology, 3-D Visualization on Mobile Devices, 2008, DOI: 10.4018/978/1/59904-871-0.ch033) at p. 575 (description of “voxel”).

Fuhse262 does not disclose voxels and does not teach or suggest the creation of pixels with volume. The Petition does not argue that Fuhse262 expressly discloses voxels. *See generally*, Petition, pp. 31-33. Fuhse262 does not use the term “voxel” and does not mention “pixels with volume,” “3D pixels,” or any similar term. *See generally*, Petition, pp. 31-33; **Exhibit 1006**. Instead, Fuhse262 consistently and unambiguously refers to the creation of “pixels P_j ,” which it also refers to as “image *points* P_j .” Exhibit 1006, ¶¶ [0036], [0126]-[0128] (emphasis added). Fuhse262 discloses that each pixel or image point P_j is formed at a specific *point* in space, *i.e.*, a specific point defined by its x, y, and x coordinates. *Id.* at ¶¶ [0095]-[0097]; Petition, p. 31. A POSITA would understand Fuhse262’s consistent description of a pixel as an “image *point*” as disclosure of a 2d pixel.

As best as it can be understood, the Petition appears to argue that Fuhse262 inherently discloses the creation of voxels. Petitioner must “meet a high standard in

order to rely on inherency to establish the existence of a claim limitation in the prior art in an obviousness analysis—the limitation at issue necessarily must be present, or the natural result of the combination of elements explicitly disclosed by the prior art.” *Par Pharm., Inc. v. TWi Pharms., Inc.*, 773 F.3d 1186, 1195-1196 (Fed. Cir. 2014). Here, Petitioner’s inherency argument should be rejected because Petitioner has not established that creation of a three-dimensional voxel is the “natural result” of the system of Fuhse262. *Id.* at 1195.

In place of a well-reasoned inherency argument, the Petition and supporting declaration merely present a marked-up version of FIG. 10 of Fuhse262 and then argue that the figure, as modified by Petitioner, allegedly shows voxels. Petition, p. 32; Exhibit. 1003, ¶¶ [178]-[179].² This falls far short of the substantial evidence that would be needed to show that Fuhse262 would *necessarily* produce voxels of any sort, much less voxels that “produce[] an effect of a point source of light floating above the surface of the substrate,” as required by the remainder of claim 1. *See Exhibit 1001*[‘294 patent], limitation [1b.6]. At best, Petitioner has shown that the micro mirror array of Fuhse262 *might* result in overlapping light beams if implemented in a real-world apparatus. Petitioner does not explain how or why light

² Dr. Hesselink’s declaration also cites to **Exhibit 1029**, p. 359 in support of Petitioner’s inherency argument. *See Exhibit 1003*, ¶ [180]. But that page is completely unrelated to the subject matter of the ’294 patent and does not mention mirrors, voxels, resolution. Instead, the cited page discusses plastic deformation and elastic-stress relations. Exhibit 1029, p. 359.

beams overlapping in an irregular shape would *necessarily* form a visible voxel for use in displaying an image. A haphazard and unintentional overlapping of random light beams does not magically create an image pixel or voxel, and Petitioner has not presented any evidence to the contrary.

Put simply, a POSITA would not have understood Fuhse262 to disclose a system capable of creating a voxel. *See Exhibit 2004*, ¶43. Claim 1 of the '294 patent is directed to “an array of micro mirrors receiving ambient light and, in response, displaying an image.” *Exhibit 1001*, claim 1. The array uses voxels created by reflection of the ambient light on the micro mirrors to create the image, which is useful for security elements on paper and coin currently. *See Exhibit 2004*, at ¶44. Creation of a voxel in an ambient light environment using a micro mirror array is a highly technical endeavor, one cannot simply aim two mirrors towards each other and obtain a three-dimensional voxel that assists in creating an image for a security feature. *Id.* at ¶45.

More specifically, creation of a voxel involves technical challenges and considerations above and beyond those required to create a pixel. *Id.* at ¶46. Less information in the form of reflected light is necessary to create a pixel as compared with creation a 3-D voxel because a 3-D voxel adds another dimension. *Id.* In ambient light environments, where light rays hit a security feature from many angles at once instead of in parallel to each other, light rays reflected off of a micro mirror

encounters interference from incoming light rays and potentially from light rays reflected from other mirrors in the array. *Id.* at ¶47. That interference degrades the quality and shape of the light rays as they move toward an intersection point. *Id.* at ¶48. Because creating a pixel requires less information than creating a voxel, a security feature in which only pixels need to be produced requires less refinement and complexity. *Id.* A pixel can be displayed at the intersection of light rays even when there has been substantial degradation of those rays due to interference. *Id.* at ¶49.

In contrast, creating a voxel requires more focused and intense light rays that are less susceptible to degradation from interference in the ambient light environment *Id.* Creation of those more intense rays and the resulting voxel adds layers of complexity, as well as substantial additional design costs, to a system. *Id.* at ¶50. A POSITA would not expend the time and money to achieve the higher-level design required to produce a voxel if only pixels were necessary to achieve a desired image goal. *Id.* In certain applications the extra computational and storage pay-load of 3-D voxels is justified because creation of a 3-D voxel provides heightened benefits for security. *Id.* at ¶51. This is because, in the art of security features, the more difficult it is to replicate a feature the more valuable and secure that feature is. *Id.*

Dr. Hesselink does not acknowledge or address any of these concerns. This

may stem from Dr. Hesselink’s misunderstanding about the nature of ambient light environments. As explained in more detail above in Section IV.B. *supra*, Dr. Hesselink does not identify any specific experience with diffusive light systems like those described in the ’294 patent and his opinions are based on a fundamentally incorrect understanding of the technology described in the ’294 patent. Dr. Hesselink opines that “[i]n the patent, ambient light refers to parallel light, i.e., all the rays coming from the source are parallel to each other.” Exhibit. 1003, ¶ 46. That statement is categorically false. *See* Exhibit 2004, ¶52. In ambient light environments, light rays engage the security features from a variety of directions—the rays are most certainly **not** all parallel to each other and, as a result, there is much more interference in ambient light environments. *Id.* at ¶53. Viewed with this background, it is unsurprising that Dr. Hesselink, whose experience focuses on collimated light environments, fails to understand the complexities involved in creating a voxel and therefore opines, in essence, that any micro mirror array that creates a pixel would create a voxel that is usable in a security feature. *Id.* at ¶55.

For at least these reasons, and because Fuhse262 does not mention voxels or 3-D pixels, a POSITA would not understand Fuhse262 to teach or suggest the creation of voxels. *Id.* at ¶57. Nor would a POSITA be motivated to modify Fuhse262 to create a voxel instead of a pixel because doing so would only add unnecessary cost and complexity to the Fuhse262 system. *Id.*

Moreover, if three-dimensional voxels were *necessarily* the result of the Fuhse262 system, then that system would not be able to create the two-dimensional images disclosed by Fuhse262. Exhibit 1006, ¶¶ [0117], [0026]-[0027] (discussing creation of two-dimensional images, *i.e.*, images without a volume). If the Fuhse262 system created three-dimensional voxels instead of the two-dimensional pixels or image points expressly disclosed by Fuhse262, all of the images produced by Fuhse262 would also necessarily be three-dimensional because they would all have a volume. *See* Exhibit 2004, ¶58. Thus, the teachings of Fuhse262 itself confirm that creation of voxels is not the natural result of the Fuhse262 system. *Id.*

For at least these reasons, Fuhse262 does not teach or suggest the creation of “voxels” “via the intersection of two or more beam of the reflected ambient light,” as required by element [1b.5]. The Petition should therefore be denied.

2. Independent Claim 28

As noted by the Petition, independent claim 28 is similar to independent claim 1. Petition, p. 34. As relevant to this response, element [28b.5] contains all the limitations recited in element [1b.5]. *Id.*, p. 39 (relying on arguments for element [1b.5]). And element [28b.6] recites limitations similar to those recited in element [1b.6]. *Id.*, p. 40 (relying on arguments for element [1b.6]). As discussed above in Section IV(D)(1), Fuhse262 does not teach or suggest limitations [1v.5] or [1b.6]. For the same reasons, Fuhse262 does not teach or suggest limitations [28b.5] or

[28b.6].

3. Independent Claim 35

As noted by the Petition, independent claim 35 is similar to independent claim 1. Petition, p. 40. As relevant to this response, elements [35b.4] and [35b.8] recite creation of voxels, similar to element [1b.5]. *Id.*, pp. 42 and 44 (relying, in relevant part, on arguments for element [1b.5]). As discussed above in Section IV(D)(1), Fuhse262 does not teach or suggest limitations [1b.5]. For the same reasons, Fuhse262 does not teach or suggest limitations [35b.4] or [35b.8].

Fuhse262 also fails to teach or suggest element [35b.5]. That element recites “further in response to the receiving of the ambient light, the array of micro mirrors *displays a second image in a second plane spaced a distance apart from the plane displaying the image.*” Claim 35 (emphasis added). Petitioner argues that Fuhse262 discloses displaying two images that “are in the ‘foreground’ and ‘background’ of each other.” Petition, p. 43 (citing Exhibit 1006, ¶¶ [0117]). The cited paragraph of Fuhse262 discloses a single light-spot image that contains both a 3-D motif and a 2-D motif. Exhibit 1006, ¶ [0117] (“It may also be advisable to *combine* a three-dimensional motif with a two-dimensional motif *in the light-spot image.*”) (emphasis added).

As relevant to this discussion, planes, like images, can be 2-D or they can be 3-D, i.e., they can have depth in addition to length and width. See Exhibit 2004, ¶63.

A POSITA describing the position of a 3-D image in terms of the plane on which that image is displayed would refer to the 3-D plane containing the full length, width, and depth of that 3-D image. *Id.* at ¶64. And when describing the position of a 2-D image in terms of the plane on which that image is displayed, a POSITA would refer to the 2-D plane containing the full length and width of that 2-D image. *Id.*

From Fuhse262’s disclosure of a *single light-spot image* that *combines* a 3-D motif and a 2-D motif, a POSITA would understand that the 3-D motif and the 2-D motif are both displayed *within the same three-dimensional plane*. See Exhibit 2004, ¶65; Exhibit 1006, ¶ [0117]. If the two motifs were truly in two separate, non-overlapping planes *spaced a distance apart* from one another, as required by element [35b.5], then they would not form part of the same light spot image—they would instead appear as two separate, distinct light-spot images. See Exhibit 2004, ¶65.

Indeed, the Petition admits that the “foreground” and “background” images are in the same plane. Petition, p. 42 (“Fuhse262 discloses displaying two images in the same plane **The** two images are in the “foreground” and “background” of each other.”). Yet the Petition still asserts that the two images are somehow “spaced a distance apart from each other.” *Id.* at p. 43³ This defies logic and

³ Dr. Hesselink’s declaration opines that a POSITA would understand that the two motifs are spaced apart from one another because Fuhse262 discusses that the 2-D motif can appear to be in the foreground of the 3-D motif. But this opinion does not appear in the Petition itself and Dr. Hesselink does not explain *why* the use of the terms “foreground” and “background” require that the two motifs be spaced apart.

conflicts with the teachings of Fuhse262.

Fuhse262 explains that “if a two-dimensional foreground motif is combined with a three-dimensional background motif, the light-spot image does not disappear completely, even in poor illumination conditions, but is simply *reduced* to the more robust two-dimensional foreground motif. An authenticity check is therefore still possible even in poor illumination conditions.” Exhibit 1006, ¶ [0117]. This disclosure teaches a POSITA that the 3-D motif portion of the disclosed light-spot image extends into the background of the 2-D motif but that the two motifs appear within the same 3-D plane, consistent with Fuhse262’s teaching that both motifs appear within the same light-spot image. See Exhibit 2004, ¶67. If the two motifs were indeed in entirely different, nonoverlapping planes, then the light spot image would not *reduce* into the 2-D motif in poor lighting conditions—the 3-D motif would simply disappear, leaving the separate 2-D image visible in a different location. *Id.*

For at least these additional reasons, a POSITA would understand that the 3-D motif and the 2-D motif of Fuhse62 are both displayed *within the same 3-D plane*. *Id.* at ¶68.

Moreover, even if a POSITA would have understood Fuhse262 to disclose a

He merely explains *how* a POSITA could design a system in which two images are spaced apart from one another. That logical leap depends entirely on improper hindsight bias.

3-D motif in a 3-D plane and a 2-D motif in a 2-D plane, it still would not teach or suggest that the 3-D plane and the 2-D plane are *spaced a distance apart* from one another as required by element [35b.5]. *Id.* at ¶69. As discussed above, Fuhse262’s use of the term “reduce” indicates to a POSITA that the 2-D motif is contained within the bounds of the 3-D motif. Thus, even if the 2-D motif were considered to be on its own 2-D plane, that 2-D plane would overlap or be contained within the 3-D plane on which the 3-D motif is displayed—the two planes would not be spaced a distance apart from one another. *Id.* at ¶70.

Thus, the Petition failed to meet its burden to establish that claim 35 is unpatentable.

E. GROUND 2 – THE PETITION FAILED TO PROVE THAT FUHSE262 AND FUHSE925 RENDER OBVIOUS ANY OF CLAIMS 1, 6-13, 28, 32, 33, AND 35-38

The combination of Fuhse262 and Fuhse925 (the “Ground 2 References”) does not render obvious any of claims 1, 6-13, 28, 32, 33, and 35-38. The only difference between Ground 1 and Ground 2 is Ground 2’s addition of Fuhse925. Fuhse925 is applied in Ground 2 only to limitations [1Pre], [28Pre], [35Pre], [1b.3], [28b.3], and [35b.3]. Petition, pp. 44-50. Fuhse925 does not remedy the deficiencies of Fuhse262 as to limitations [1b.5], [28b.5], [35b.4], and [35b.5], and the Petition does not so assert. Claims 1, 28, and 35 are therefore valid for at least the same reasons as those detailed with respect to Ground 1.

F. GROUNDS 3/4: THE PETITION FAILED TO PROVE THAT ANY OF CLAIMS 1, 6-13, 28, 32, 33, AND 35-38 ARE RENDERED OBVIOUS UNDER §103 BY FUHSE262 (GROUND 1) OR FUHSE262 IN VIEW OF FUHSE925 (GROUND 2), AND FURTHER IN VIEW OF JORDAN

The combination of Fuhse262, Fuhse925, and Jordan (the “Ground 3/4 References”) does not render obvious any of claims 1, 6-13, 28, 32, 33, and 35-38. The only difference between Grounds 3/4 and Grounds 1 and 2 is Ground 4’s addition of Jordan. Jordan is applied in Grounds 3/4 only to limitations [1Pre], [28Pre], and [35Pre]. Petition, pp. 50-52. Jordan does not remedy the deficiencies of Fuhse262 as to limitations [1b.5], [28b.5], [35b.4], and [35b.5], and the Petition does not so assert. Claims 1, 28, and 35 are therefore valid for at least the same reasons as those detailed with respect to Grounds 1 and 2.

G. DEPENDENT CLAIMS, GROUNDS 1-4: GROUND 1 (OBVIOUSNESS IN VIEW OF FUHSE262) OR GROUND 2 (FUHSE262 IN VIEW OF FUHSE925) IN VIEW OF JORDAN

Claims 6-13 depend from and add limitations to claim 1. Claims 32 and 33 depend from and add limitations to claim 28. Claims 36-38 depend from and add limitations to claim 35. Neither Fuhse262 or Fuhse925, taken alone or in combination, render obvious claims 1, 28, or 35 for at least the reasons discussed above with respect to Grounds 1 and 2. Jordan does not remedy the deficiencies of Fuhse262 and Fuhse925, and the Petition does not so assert. *See, generally*, Petition at pp. 52-64. Claims 6-13, 32, 33, and 36-38 are therefore patentable for at least the same reasons described above with respect to Grounds 1 and 2.

H. GROUNDS 5 - 8: GROUNDS 1, 2, 3, OR 4 IN VIEW OF FUHSE172

Claim 14 depends from and adds limitations to claim 1. Claim 34 depends from and adds limitations to claim 28. Claim 39 depends from and adds limitations to claim 35. Neither Fuhse262, Fuhse925, nor Jordan, taken alone or in combination, render obvious claims 1, 28, or 35 for at least the reasons discussed above with respect to Grounds 1-4. Fuhse172 does not remedy the deficiencies of Fuhse262, Fuhse925, and Jordan, and the Petition does not so assert. *See, generally*, Petition, pp. 64-68. Claims 614, 34, and 39 are therefore patentable for at least the same reasons described above with respect to Grounds 1-4.

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), I hereby certify that the foregoing Patent Owner's Response contains 5800 words as measured by the word processing software used to prepare the document, excluding the cover page, signature block, and portions exempted under 37 C.F.R. § 42.24(a) or (b).

DATED: February 18, 2025

Respectfully submitted,

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6, the undersigned certifies that February 18, 2025, the foregoing document was served on counsel of record for Petitioners by filing this document through the End-to-End System, as well as *via* electronic mail to counsel of record for Petitioners at the following address:

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