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Filed on behalf of Giesecke+Devrient *GmbH*, et al.

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

Case No. IPR2024-00838

**Petition for *Inter Partes* Review of
U.S. Patent No. 10,901,191**

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Ex. 1002	File History of U.S. Patent No. 10,901,191 FH
Ex. 1003	Declaration of Lambertus Hesselink, Ph.D.
Ex. 1004	U.S. Patent No. 62262767 Provisional
Ex. 1005	DE102010048262A1
Ex. 1006	DE102010048262A1 Official Translation into English (“Fuhse262”)
Ex. 1007	DE102010048262A1 Certificate of translation
Ex. 1008	U.S. Patent No. 10,639,925 to Fuhse (“Fuhse925”)
Ex. 1009	Reserved
Ex. 1010	U.S. Patent Application Publication No. 2012/0319395 (“Fuhse395”)
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Ex. 1015	Reserved
Ex. 1016	Reserved
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Ex. 1024	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); https://doi.org/10.1117/12.643164 (“Morford”)
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Ex. 1048	<i>Lumenco, LLC v. Giesecke+Devrient GmbH et al.</i> , Civil Action No. 2:23-cv-00100, Dkt. No. 29 (Aug. 9, 2003) (“Docket Control Order”)
Ex. 1049	U.S. Patent Application Publication No 2010/0208036 (“Kaule”)

I. INTRODUCTION

Giesecke+Devrient GmbH, Giesecke+Devrient Currency Technology GmbH, and Papierfabrik Louisenthal GmbH (collectively, “G+D” or “Petitioners”) requests review under 35 U.S.C. § 311 and cancellation of claims 1-12 of U.S. Patent No 10,901,191 (EX1001, “the ’191 Patent”) as unpatentable.

Optically variable devices (“OVDs”) for document anti-counterfeiting were introduced in the 1980s. Broadly applicable to many applications that require anti-counterfeiting, including currency (e.g., banknotes), passports, ID cards, and product labels, these solutions use optical features to verify the authenticity of documents.

OVD technology has advanced rapidly over the years in order to “stay ahead” of rapidly advancing counterfeiting technology, including the proliferation of low-cost digital scanners and high resolution color copiers. The first commercial OVDs were diffraction-based solutions that used groove microstructures to create diffraction patterns. The Australian ten-dollar banknote issued in January, 1988 first implemented the solution. By the early 2000s, micro-mirrors replaced diffraction patterns on currency.

The challenged claims recite known systems that use arrays of micro-mirrors to reflect light to produce images above the micro-mirrors. The claimed systems orient the micro-mirrors to pixels, such that for each pixel there is a set of micro-mirrors reflecting light for the pixel, and images are formed from the pixels.

Petitioners already pioneered this micro-mirror solution well before the '191 Patent's earliest possible priority date. As detailed in this Petition, Petitioners invented and publicly disclosed the subject matter of the challenged claims years before Patent Owner ("PO"). In particular, Christian Fuhse, the first named inventor for the primary reference relied on in this Petition, is the head of the Optical Effects and Data Processing team at Papierfabrik Louisenenthal (one of Petitioners). Wittich Kaule, the second named inventor, is a prolific and pioneering inventor in the field of optical security devices, with over 100 issued US and foreign patents in the field dating back to the 1970s.

Because the challenged claims cover known techniques published years before the earliest priority date, the Board should claim 1-12 as unpatentable.

II. BACKGROUND

By December 2015 (earliest priority date), micro-mirror arrays for document security already had been known for decades, including the approach pioneered by Petitioners and described in the primary reference relied on in this Petition. EX1003, ¶¶24-61.

A. Optically Variable Devices for Document Anti-Counterfeiting

During the 1990's, diffraction-based OVDs became widespread, and were adopted on a number of national currencies and other documents. To produce the

desired images, these OVDs generally used 30 x 30 μm or 60 x 60 μm pixel elements with picture information encoded by varying the individual groove angles and/or spacing (typically, 0.7-1.3 μm) continuously along the diffraction grooves. EX1003, ¶¶24-29.

In the early 2000s, micro-mirror OVDs were introduced, which replaced diffraction gratings with arrays of micro-mirrors. Micro-mirror OVD technology advanced rapidly in the period from the early 2000s, with significant efforts from industry, most prominently Petitioners – a preeminent innovator in the field for over 170 years, and governmental organizations, most prominently the Commonwealth Scientific and Industrial Research Organisation (“CSIRO”), an Australian Government agency. EX1003, ¶¶30-34.

B. Micro-mirror Arrays

Each micro-mirror in an array are on the order of 25-50 microns and reflects incident light in a certain direction determined by the orientation of the micro-mirror surface. The reflected incident light creates an image floating in space from the perspective of an observer. EX1003, ¶30.

Micro-mirrors OVD have been used on banknotes as anti-counterfitting measures because they are low cost. Specifically, by the early 2000s, micro-mirror OVD had become well-known and replaced diffraction gratings with arrays of

micro-mirrors. Through work of Petitioners, micro-mirror OVD technology advanced rapidly in the period from the early 2000s. EX1003, ¶¶31-34.

III. THE '191 PATENT

The '191 Patent is a Divisional of U.S. Patent No. 10,189,294 and claims priority to U.S. Provisional Patent Application No. 62/262,767 filed December 3, 2015. The '191 Patent claims recites the method variant of the '294 Patent.

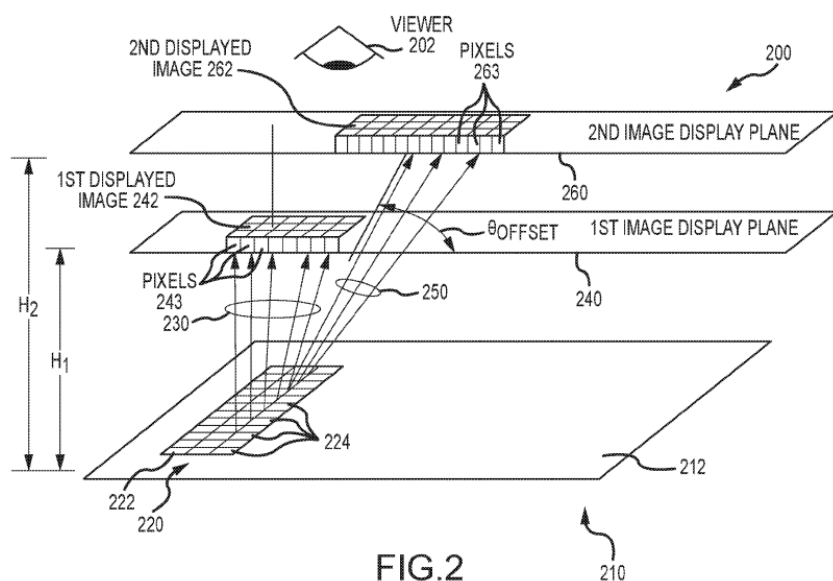
A. Specification

The '191 Patent frames its purported invention as designing and fabricating anti-counterfeiting security elements which are more difficult to replicate. EX1001, 1:30-2:34. The purported invention of the '191 Patent displays “images that float above and/or below a focal plane.” EX1001, 2:38-41; EX1003, ¶¶64-69.

Specifically, the '191 Patent describes a security element provided on, for example a currency or product label, which generates images with light in one or more “spatial planes above and below the surface of an array of micro mirrors.” EX1001, 2:38-41, 3:14-19; EX1003, ¶¶64-69. The micro-mirrors are small mirrors, such as rectangular mirrors made of metal with a side length of around 50 μm . EX1001, 4:7-13; EX1003, ¶66.

The '191 Patent groups the micro-mirrors in an array into sets, with the micro-mirrors of each set orientated to reflect ambient light towards a point corresponding

to a “pixel.” EX1001, 2:38-52. These pixels together form an image in an “image display plane,” and multiple images may be produced in different image display planes. *Id.* As shown in Figure 2, the result is to create “floating image(s)” “a height or distance above (or below in some cases) the place of the supporting surface containing the array of micro mirrors.” EX1001, 5:14-6:14; EX1003, ¶¶67-69.



Additionally, the angle at which one image (such as image 242) is viewed may be offset from the angle at which another image (such as image 262) is viewed by a viewing angle offset, θ_{Offset} (e.g., 10 to 30 degrees), such the viewer 202 typically only views one of the floating images 242, 262 at a time. EX1001, 8:8-11; EX1003, ¶¶69, 72.

B. Prosecution History

The '191 Patent was filed on Nov. 28, 2018, as U.S. Patent Application No.

16/203,128 (“the ’128 application”), claiming priority to provisional application No. 62/262,767, filed on Dec. 3, 2015.

During prosecution, the Examiner twice rejected some claims over prior art and once for indefiniteness. EX1002, pp. 359-68, 414-28. Both times in response, the applicant amended some claims and argued that the combination failed in relation to casting the micro mirrors with a nickel or polymer tool in contact with the surface of the substrate. EX1002, pp. 397-407, 437-47. The Examiner maintained the rejections (*see* pp. 464-76), and the applicant cancelled the rejected claims and accepted the allowed claims. EX1002, pp. 485-91.

In allowing the claims, the Examiner recited the language of claims 1 and 6. EX1002, pp. 493-501.

However, the Examiner apparently overlooked the importance of Fuhse262 (combination of its embodiments), as it was not applied during prosecution, and which discloses the claimed features that the applicant argued distinguished the prior art during prosecution and that the Examiner referenced in allowing the claims. Further, the Examiner did not have the benefit of Fuhse925, Fuhse395, Sauvage-Vincent, and Morford and therefore has not considered the combination of references presented herein.

IV. STATEMENT OF RELIEF REQUESTED

A. Grounds

No.	Claims	Ground Statements
1	1, 6	Fuhse262 (embodiment of Fig. 2) in view of Fuhse262 (embodiment of Figs. 8, 9, 10)
2	1, 6	Fuhse262 (Ground 1) in view of Fuhse925
3	2-4, 7-11	Fuhse262 (Ground 1) in view of Fuhse395
4	2-4, 7-11	Fuhse262 (Ground 1) in view of Sauvage-Vincent
5	5, 12	Fuhse262 (Ground 1) in view of Morford
6	2-4, 7-11	Fuhse262, Fuhse925 (Ground 2) and in further view of Fuhse395 (Ground 3)
7	2-4, 7-11	Fuhse262, Fuhse925 (Ground 2) and in further view of Sauvage-Vincent (Ground 4)
8	5, 12	Fuhse262, Fuhse925 (Ground 2) and in further view of Morford (Ground 5)

B. Priority Date

The earliest application to which the '191 Patent claims priority is U.S. provisional application 62/262,767, filed December 3, 2015, which is therefore the earliest possible priority date for all challenged claims. Petitioners do not concede that the claims are entitled to that priority date. EX1003, ¶63.

C. The References Are Prior Art

All references relied on in the Grounds are prior art under (AIA) 35 U.S.C. §102(a)(1) because they were patented or described in a printed publication before December 3, 2015, or §102(a)(2) because they were effectively filed before that date:

- (1) German Patent Application Publication No. 102010048262A1¹ (Fuhse262), published April 12, 2012 (EX1006²);
- (2) U.S. Patent No. 10,639,925 (“Fuhse925”) with priority to an application filed on May 8, 2015 (EX1008³);
- (3) U.S. Pub. No. 2012/0319395 (“Fuhse395”) filed December 3, 2010, published December 20, 2012 (EX1010);

¹ PCT Publication No. WO 2012/048847 (Fuhse847), published on April 19, 2012 with priority to October 12, 2010, claims priority to Fuhse262. (EX1040). EX1041 is a verified, official translation of the native language Fuhse847 Native at EX1040. See EX1043 (certificate of translation).

² EX1006 is a verified, official translation of the native language Fuhse262 at EX1005. See EX1007 (certificate of translation).

³ EX1044 is a verified, official translation of the native language DE-Fuhse969 at EX1018. See EX1045 (certificate of translation).

- (4) U.S. Pub. No. 2014/0285892 (“Sauvage-Vincent”) filed Oct. 12, 2012, published September 25, 2014 (EX1035); and
- (5) 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), (“Morford”) (EX1024⁴).

D. Overview of the Prior Art

1. Fuhse262 (EX1006)

Fuhse262 discloses a security element created from an array of reflective micro-mirrors that reflect light to “light spots” or “pixels,” which together form two- or three-dimensional images (i.e., “light-spot images”) that appear to “float” at “floating heights above or below” the surface of the substrate. EX1006, ¶0013-15. The images can be “visible from the same or different viewing angles.” EX1006, ¶0118; EX1003, ¶¶91-94.

⁴ Morford was publicly available as of at least 2006 as evidenced by the Library of Congress date stamp of May 16, 2006 (EX1024, 3) and the Library of Record (EX1041).

In one embodiment, Figure 2 shows concave mirrors 24 on the surface of substrate 22 that reflect light from distant light source 34 to “produce the specified image points as light spots 32.” EX1006, ¶0056-57; EX1003, ¶95.

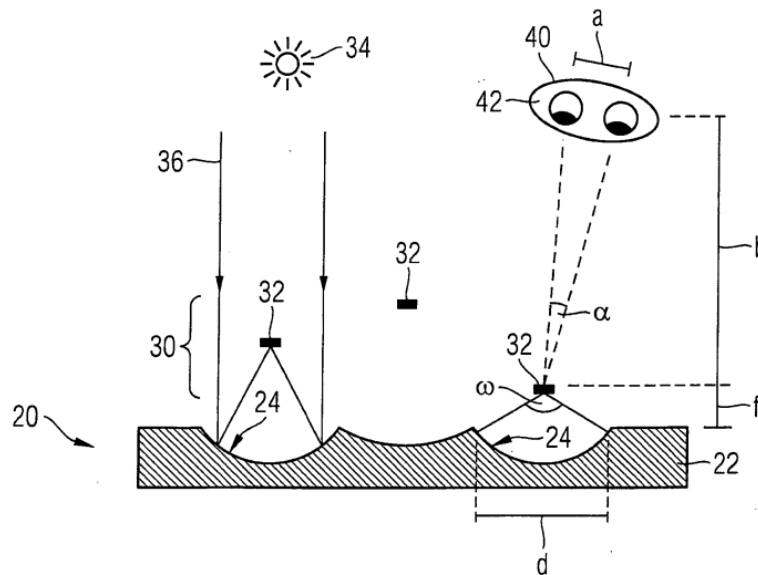
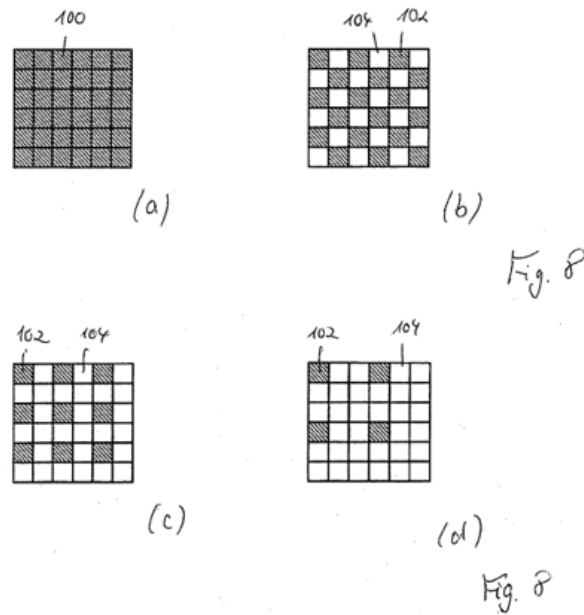


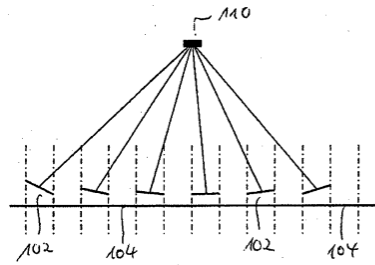
Fig. 2

In another embodiment with respect to Figures 8-10, Fuhse262 replaces the “curved concave mirror” of Figure 2 with a flat micro-mirrors array in order to obtain “higher resolution” images, and because “flat surfaces are easier to calculate and produce.” EX1006, ¶¶, 0048, 0083, 0086. Figures 8(a)-8(d) show micro-mirror array examples.

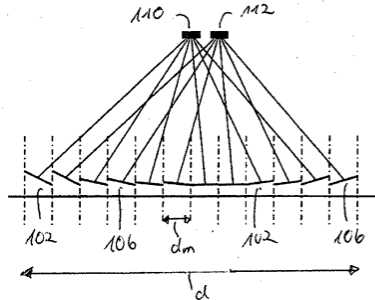


EX1006, ¶¶0087-90; EX1003, ¶96.

The micro-mirrors are an array of “n x n micromirrors” that each have “a flat mirror surface” with a “dimension of 50 μm x 50 μm .” EX1006, ¶0087. Further, a plurality of micro-mirrors may be “assigned to every light spot of the light-spot image,” as shown in Figure 9:



(a)



(b)

Fig. 9

EX1006, ¶¶0019; EX1003, ¶96.

The images may be a three-dimensional image, including any two-dimensional image “that floats at a certain height above or below the substrate surface.”

EX1006, ¶¶0068, 0054-56; EX1003, ¶92.

Fuhse262 discloses how to produce its images, which includes defining the image points for the image, and defining a cone for each image point such that a “sphere of influence” is defined on the substrate plane for assigning micro-mirrors to that image point. EX1006, ¶¶0036, 0125-31; EX1003, ¶97. Fuhse262’s Figure 10 and associated descriptions further teach how to orient each micro-mirror in the

array such that it reflects light to its assigned light spot. EX1006, ¶¶0096-99; EX1003, ¶¶98-102.

Fuhse262 discloses different images viewed at different angles (*see* ¶¶0111-15) and describes a “preferred procedure” to produce the structures of these combined teachings. EX1006, ¶¶0125-28, 0036; EX1003, ¶¶97, 92.

In the combined teachings of FIG. 2 and FIGs. 8-10, Fuhse262 teaches a substrate and ambient light source (as described in FIG. 2), as well as arrays of micro-mirrors that include assignments of sets of micromirrors to light spots that form light spot images. EX1003, ¶98.

2. Fuhse925 (EX1008)

Fuhse925 relates to an optical security element that shows different images (such as characters, numbers or shapes, referred to as curves in the patent) at different viewing/tilt angles, that “float alternatingly a few millimeters above or below the plane of the security thread.” EX1008, Abstract, 6:67-7:1; EX1003, ¶104.

These images are created using an array of micro mirrors orientated at different inclination angles on a substrate. EX1008, Abstract, 6:67-7:1; EX1003, ¶105.

3. Fuhse395 (EX1010)

Fuhse395 relates to manufacturing techniques of a reflective optical security element, such as would be applied to a banknote. EX1010, Abstract, ¶0087. Man-

ufacturing techniques include using an “an embossing tool” to “emboss[] in thermo-plastic foils or into foils coated with radiation-curing lacquers” to form reflective facets. EX1010, ¶¶59, 148-51; EX1003, ¶¶106-07.

4. Sauvage-Vincent (EX1033)

Like Fuhse395, Sauvage-Vincent relates to manufacturing techniques of a reflective optical security element, such as would be applied to a banknote. EX1033, ¶¶0002, Abstract. Sauvage-Vincent teaches a “die” or “master” that provides a “stamping operation” to produce the microstructure pattern of the desired optical elements. EX1033, ¶¶71, 73, 43, Abstract. This “stamping may be done by hot pressing of the dielectric material (‘hot embossing’) or by molding then cross-linking (‘UV casting’).” *Id*; EX1003, ¶108.

5. Morford (EX1024)

Morford relates to materials for use in optical components that have properties such as flexibility, high refractivity, and is curable with ultraviolet (UV) light. EX1024, Abstract; EX1003, ¶109.

E. The Prior Art is Analogous Art

Prior art is analogous if it is from the same field of endeavor, regardless of the problem addressed, or it is reasonably pertinent to the particular problem with which the inventor is involved. *Unwired Planet, LLC v. Google Inc.*, 841 F.3d 995, 1000 (Fed. Cir. 2016). Petitioners’ references are analogous because either they are from

the same field as the '191 Patent, *e.g.*, optical devices for document security.

EX1003, ¶¶214, 233, 274, 313 (while Morford isn't an optical device, it is a material for such devices); EX1001, Abstract, 1:15-23. Or, they are pertinent to a problem the inventor was focused on, *e.g.*, fabrication of security elements. *Id.*, *see also* ¶64; EX1001, 2:15-29.

V. LEVEL OF ORDINARY SKILL

Based on the relevant factors, *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995), a person of ordinary skill in the art ("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. EX1003, ¶¶82-87.

VI. CLAIM CONSTRUCTION

PO has sued Petitioners for infringement of the '191 Patent. *See, infra*, 0 Although the parties may propose constructions for certain terms in the litigation for purposes of determining infringement, no claim terms require express construction to resolve the challenges here.⁵ *Nidec Motor Corp. v. Zhongshan Broad Ocean*

⁵ In district court, the parties may dispute whether some claims are invalid under 35 U.S.C. § 112. For this proceeding only, Petitioners assumes the claims are not invalid under § 112.

Motor Co. Ltd., 868 F.3d 1013, 1017 (Fed. Cir. 2017); *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

VII. GROUNDS OF UNPATENTABILITY

A. Ground 1: Claims 1, 6 are rendered obvious under 35 U.S.C. §103 by Fuhse262 (combination of embodiments)

1. Motivation to Combine

Fuhse262 discloses “a depiction” element invention. EX1006, ¶¶0001, 0010-11, Abstract. Particularly, the Petition relies on a combination of Fuhse’s invention, including Figures 1-2, 8(a)-(d), and 9-10 and accompanying disclosures. EX1003, ¶¶112.

It would have been obvious to a POSITA to combine the multiple embodiments. EX1003, ¶¶112-16. It is well-established that “[c]ombining two embodiments disclosed adjacent to each other in a prior art patent does not require a leap of inventiveness.” *Boston Sci. Scimed, Inc. v. Cordis Corp.*, 554 F.3d 982, 991 (Fed. Cir. 2009).

Fuhse262 provides express motivation and direction to combine the features of its embodiments, and a POSITA would have been motivated to use micro-mirrors in lieu of concave mirrors, and calculate and orient them correctly, for benefits such as higher resolution and easier production. EX1003, ¶115.

Specifically, Figure 2 shows various aspects and elements “[t]o explain the principle of the invention.” EX1006, ¶¶0056-60. Figures 8(a)-(d) build on Figure 2 by replacing the “curved concave mirror” of Figure 2 “with micromirrors. EX1006, ¶0048. Fuhse262 explicitly refers back to the “previous exemplary embodiments” in building on those teachings. EX1006, ¶¶0083, 0087. Also, the Figures 8(a)-8(d) show different variations of the same teachings, such as different numbers of groupings of micro-mirrors. EX1003, ¶¶114, 116.

Fuhse262 provides explicit motivation to replace the curved mirrors of Figure 2 with micro-mirrors, including that “higher resolution” is obtained and that “flat surfaces are easier to calculate and produce.” EX1006, ¶¶0083, 0086-87; EX1003, ¶115.

Likewise, Figure 9 builds on the teachings of Figures 8(a)-8(d) by illustrating them “in a sectional view” and providing further explanation. EX1006, ¶¶0091-94, 0049; EX1003, ¶116. Finally, Figure 10 builds on the teachings of Figures 8(a)-8(d) and 9 by describing how to calculate and orient the surfaces of the micro-mirrors. EX1006, ¶¶0095-101, 0050 (“Fig. 10 illustrates the calculation of the flat mirror surfaces of the micromirrors of Figs. 8 and 9”). Fuhse262 also describes a “further development of the invention” regarding providing different images to the viewer

when viewed at different angles (*see* ¶¶0111-15), and describes a “preferred procedure” to produce the structures of these combined teachings. EX1006, ¶¶0125-28, 0036; EX1003, ¶116.

2. Reasonable Expectation of Success

A POSITA would have had a reasonable expectation of success combining the embodiments of Fuhse262. EX1003, ¶¶117-21.

As a POSITA would have recognized, the teachings of Fuhse262 relied on in this Ground (discussed in the Motivation) represent different aspects of the invention that all operate on the same principle, and work to disclose different aspects that rely on the same principles. EX1003, ¶118. The aspects of the Figure 2 descriptions relied on – such as the substrate and ambient light – would operate on the same principles, serve the same purpose, and maintain the same relevant characteristics when applied to the flat micromirrors of Figure 8-10. EX1003, ¶118. Fuhse262 teaches to “replace[]” the curved mirrors of Figure 2 with the micro-mirrors 100 (*see* EX1006, ¶¶0083-86), and a POSITA would have reasonably been able to adapt those teachings regarding Figure 2 to micro-mirrors. EX1003, ¶118.

Likewise, the different specific implementations, such as possible arrays sizes of 100 micro-mirrors (*see* EX1006, ¶0087) or 288 micro-mirrors (*see* EX1006,

¶¶0090-92), would have been routinely and predictably implemented by a POSITA. EX1003, ¶119.

As Petitioners’ expert explains, the art was relatively predictable in the relevant timeframe (2015). EX1003, ¶120. The predictable nature of the combination is confirmed by evidence showing that the operation of micro-mirror arrays—and their application to security elements—was well-understood at the time of the alleged priority date. EX1003, ¶120. Given that micro-mirror arrays of the type contemplated in the ’91 Patent were textbook knowledge at the time of the alleged invention, a POSITA would have no difficulty combining embodiments of Fuhse262. EX1003, ¶120.

Thus, a POSITA would have been able to implement the obviousness modifications in this ground without difficulty. *Id.*

3. Independent Claim 1

- a. [1Pre] “A method of fabricating a security element useful on paper and coin currency and product labels, comprising:”**

The preamble is not limiting. The preamble merely states what the invention is “useful as” (*see* EX1003, ¶124), and preambles that “only to state a purpose or intended use for the invention” are not limiting. *Catalina Mktg. Int’l, Inc. v. Coolsavings.com, Inc.*, 289 F.3d 801, 808 (Fed. Cir. 2002) (quoting *Rowe v. Dror*,

112 F.3d 473, 478 (Fed. Cir. 1997)) (“where a patentee ...uses the preamble only to state a purpose or intended use for the invention” is not limiting).

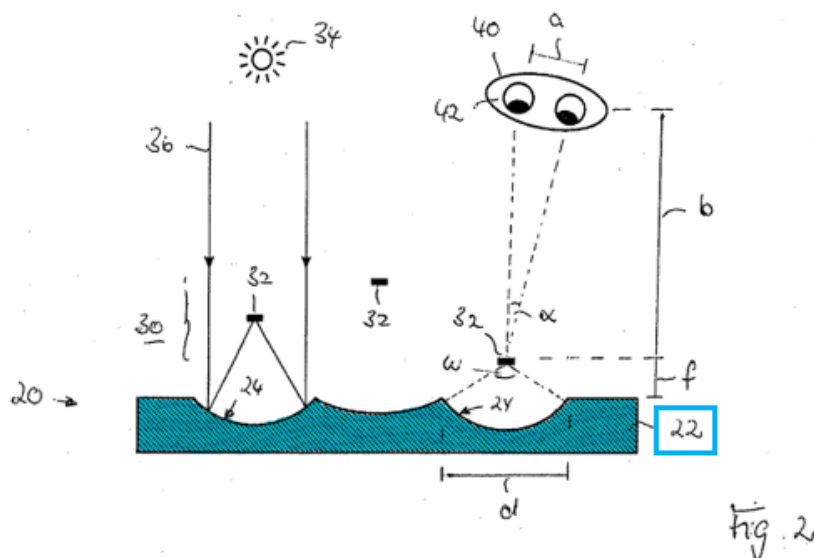
Further, no preamble term provides antecedent basis to terms in the claim body, so the preamble does not contribute to the structural completeness of the claim body. EX1003, ¶125.

To the extent it is limiting, Fuhse262 teaches the preamble. Fuhse262’s invention relates to fabricating “a depiction element” “[f]or security applications” and with “an attractive visual appearance” (**fabricating a security element**). EX1006, ¶¶0008-12. The depiction element is **useful as a security element** for a “data carrier” and “[t]he data carrier can in particular be a value document,” such as a “paper banknote” (**paper... currency**). EX1006, ¶0037, FIG. 1. A POSITA would understand that “data carriers” includes **coin currency** and **product labels**. EX1003, ¶¶127-31.

Accordingly, Fuhse262 renders obvious [1Pre]. EX1003, ¶¶124-31.

b. [1a] “providing a substrate; and”

Fuhse262 teaches [1a]. EX1006, Abstract, ¶¶0001, 0010, 0035, 0056-65, 0110; EX1003, ¶¶132-35. Fuhse262 discloses **providing “a substrate 22”** shown below annotated in blue. *Id.*



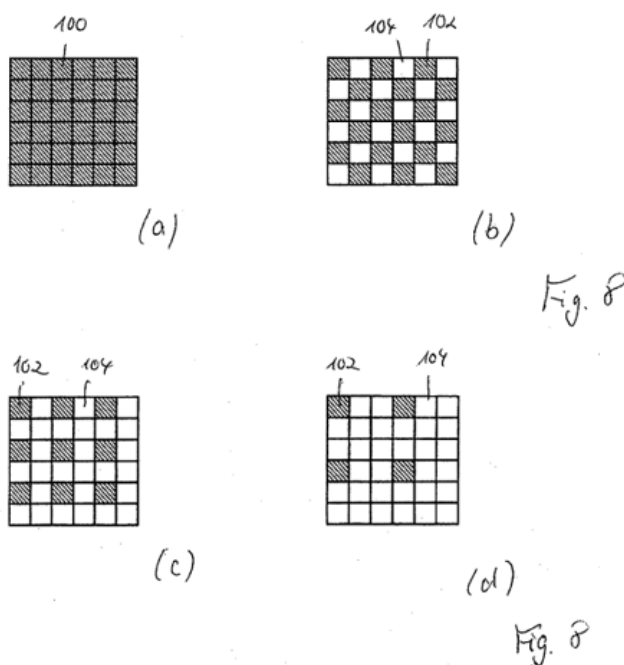
Accordingly, Fuhse262 renders obvious [1.a]. EX1003, ¶¶132-35.

- c. [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,”

Fuhse262 teaches [1b.1]. Fuhse262 arranges on “a surface region” of a substrate (**forming...on a surface of the substrate**) “a plurality of optical elements.” See EX1006, Abstract, ¶¶0010, 0001, 0035, 0056-65, 0110. The optical elements are a “plurality of micromirrors” (**an array of micro mirrors**) “distributed over a certain surface region of substrate 22” (**on a surface of the substrate**). EX1006, ¶¶0060, 0013, 0022, 0030, 0083, 0087-95.

Figures 8 8(a)-8(d) (below), and supporting disclosure, provides further detail of the **array of micro mirrors** as “an arrangement of $n \times n$ micromirrors 100, arranged next to one another without any distance between them.” EX1006, ¶¶0060,

0013, 0022, 0030, 0083, 0087-95. Specifically, the curved mirrors of Figure 2 are “replaced by” the plurality of micromirrors 100 because they are “easier to calculate and produce.” EX1006, ¶¶0083-86; EX1003, ¶139.



The micro-mirrors shown in Figure 8 **receiv[e] ambient light** because they are “illuminated” in the same manner as the lenses and mirrors disclosed in Fuhse262. EX1006, ¶¶0082-83, 0091. Fuhse262 discloses that the illumination is with **ambient light** such as “sunlight or a ceiling lamp.” EX1006, ¶0054. For example, Fuhse262 discloses illumination by “distant light source 34,” depicted in Figure 2 as sunlight:



EX1006, ¶¶0057-58, 0061, *see also* 0029 (distinguishing “normal illumination” “visible to the naked eye” with “directed illumination with laser light”). A POSITA would have understood that sunlight and light from a ceiling lamp are **ambient light** because they are understood to generally illuminate space. EX1003, ¶141.

Accordingly, Fuhse262 renders obvious [1b.1]. EX1003, ¶¶136-42.

- d. [1b.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,”

Fuhse262 teaches [1b.2]. Fuhse262 teaches that “upon illumination” (**in response**) “produce[d is]...a light-spot image composed of a plurality of light spots,” (**displaying an image...wherein the image comprises a plurality of pixels**) “that for a viewer appear floating above or below the surface region” (**in a plane spaced**

a distance apart from the surface of the substrate). EX1006, ¶¶0010-12, 0015, 0035-36, 0054-56, 0083-84, 0126-28. The production of a light-spot image composed of a plurality of light spots is **in response** to the illumination because the illumination causes the micro-mirrors to reflect light, which produces the light spots. EX1006, ¶0010; EX1003, ¶¶145-46.

Fuhse262 teaches that while “a truly three-dimensional” **image** can be formed by using light spots (**pixels**) of “different floating heights above and/or below the substrate surface,” alternatively, “all light spots [**a plurality of pixels**] in the light-spot **image** [may] have the same floating height,” (forming **a plane spaced a distance apart from the surface of the substrate**) which provides a two-dimensional image “that floats at a certain height above or below the substrate surface.” EX1006, ¶¶0068; EX1003, ¶¶149-53. Just as the pixels 243 in the ’191 Patent produce image 242 (*see* EX1001, 7:42-48, FIG. 2), the light spots produce the light spot image. EX1003, ¶¶147-48.

Fuhse262 teaches that any arbitrary “desired three-dimensional motif having image points P_j and height values Z_j above an xy plane” may be “specified,” meaning that providing image points P_j of all the same height values Z_j above the surface of the substrate results in **displaying an image in a plane spaced a distance apart from the surface of the substrate**. EX1006, ¶¶0036, 0125-28; EX1003, ¶¶149-53.

Accordingly, Fuhse262 renders obvious [1b.2]. EX1003, ¶¶143-53.

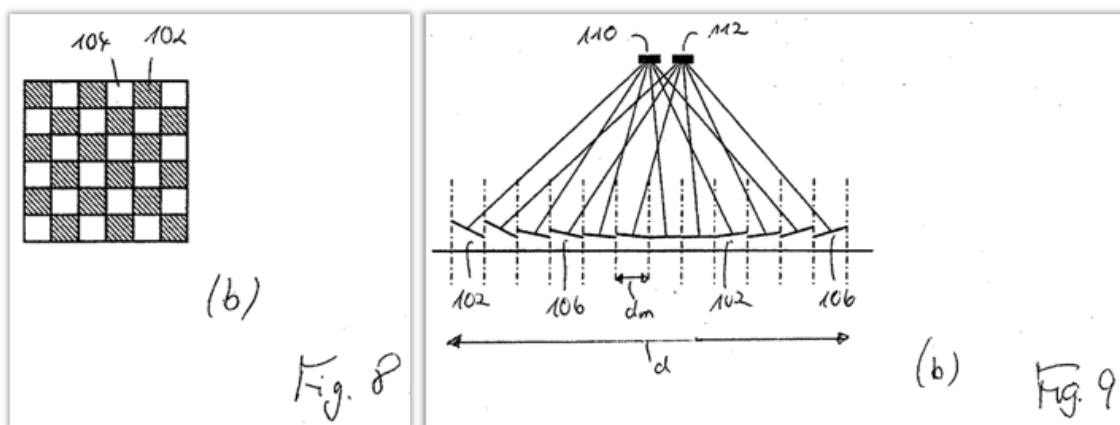
- e. [1b.3] “wherein the array of micro mirrors includes for each of the pixels a different set of the micro mirrors each having a reflective surface oriented, in a fixed manner, with a body of each of the micro mirrors rotated about at least one of first and second rotation axes extending through the body, to reflect the ambient light toward a point on the plane corresponding to one of the pixels,”

Fuhse262 teaches element [1b.3].

Fuhse262 discloses that **the array of micro mirrors includes for each of the pixels a different set of the micro mirrors**. EX1006, ¶¶0019-20, 0036, 0084, 0088, 0091-92. Fuhse262 explains that “a plurality of optical elements is assigned to *every* light spot” (**for each of the pixels a different set of the micro mirrors**), such that “groups of optical elements” “are each assigned to *different* light spots.” EX1006, ¶¶0019-20 (emphasis added). Fuhse262 does so by defining “a number of fine fields” “for every image point P_j ,” (**each of the pixels**), and providing that the optical elements in those fine fields (**a different set of the micro mirrors**) “contribute to producing the light spot that corresponds to image point P_j .” EX1006, ¶¶0036, 0126-28; EX1003, ¶¶154-55.

In the example of FIG. 8b, (shaded) micromirrors 102 form **a set of micro mirrors**, and (white) “fields 104 [] covered with micromirrors 106” form a second

set of micro mirrors, and the sets are different because they comprise different micromirrors. EX1006, ¶¶0091-92. As shown in Figure 9(b), “[m]icromirrors 102 form a group of micromirrors, which are all assigned to the same light spot 110 and produce it together when illuminated,” while micromirrors 106 “serve to produce a light spot 112,” meaning **a different set of the micro mirrors is assigned for each of the pixels**. *Id.* Fuhse262 states that in the “The number $n \times n$ of micromirrors is, for example, 10×10 ,” (totaling 100) meaning that in FIG. 8(b), each **set of micro mirrors** would have 50 micromirrors. EX1006, ¶0087; EX1003, ¶¶156-57.



Fuhse262 discloses that **the micro mirrors each having a reflective surface oriented... to reflect the ambient light toward a point on the plane corresponding to one of the pixels**. Fuhse262 discloses that its micro-mirrors may be “purely reflective” (**the micro mirrors each having a reflective surface**). Fuhse262,

¶¶0013, 0010-11, 0036, 0060. For each of the pixels, the micro-mirror surfaces reflect incident light (**reflect the ambient light**), such as light source 120, **towards** the point (x_0, y_0, z_0) , which “denotes the position of light spot 110” (**a point on the plane corresponding to one of the pixels**). EX1006, ¶¶0095-97; EX1003, ¶158.

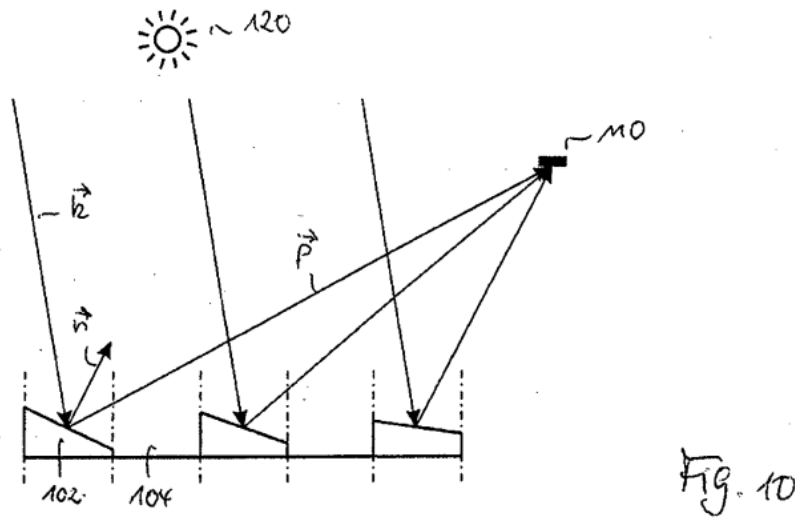
Fuhse262 discloses that such orientation is **in a fixed manner with a body of each of the micro mirrors rotated about at least one of first and second rotation axes extending through the body**. EX1006, ¶¶0095-0101. As an initial matter, Fuhse262’s orientation of all its mirrors is **in a fixed manner** because they have one permanent orientation (normal vector n , as discussed below). EX1003, ¶¶159-61. Micromirrors for security elements on, for example, currency, are generally manufactured with a particular orientation to produce a particular image, and generally are not variably-controlled. EX1003, ¶¶159-61.

Fuhse262 discloses how to calculate orientations of its flat micro-mirror surfaces with respect to Figure 10 and corresponding disclosures. *Id.* 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 $k \rightarrow$ is reflected onto the focal point (x_0, y_0, z_0) for all micromirrors 102 assigned to light spot 110,” the following equations are used to define the normal vector n , incident light k , and reflected light ray p :

$$\vec{n} = \frac{\vec{p} - \vec{k}}{|\vec{p} - \vec{k}|}, \quad \vec{p} = \begin{pmatrix} x_0 - x \\ y_0 - y \\ z_0 \end{pmatrix}, \quad |\vec{p}| = \sqrt{(x_0 - x)^2 + (y_0 - y)^2 + z_0^2}$$

EX1006, ¶¶0095-97; EX1003, ¶¶162.

These vectors are shown in Figure 10:

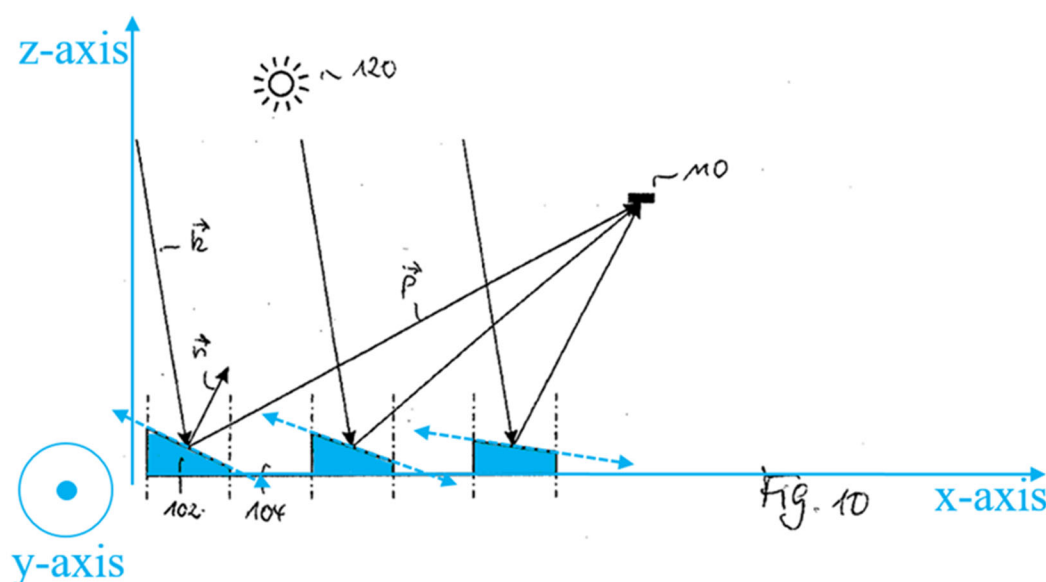


The x and y axes are **first and second rotation axes**, such that **a body of each of the micro mirrors rotated about at least one of first and second rotation axes extending through the body** in order to align the normal vector n of the micro-mirrors such that reflected light ray p is directed towards the point (x₀, y₀, z₀) corresponding to one of the pixels. EX1003, ¶¶163-66. In the '191 Patent, the **first and second rotation axes** are likewise the x and y axes. See '191 Patent, FIG. 1 ("1ST

ROTATION AXIS (Y-AXIS)” and “2ND ROTATION AXIS (X-AXIS).”);

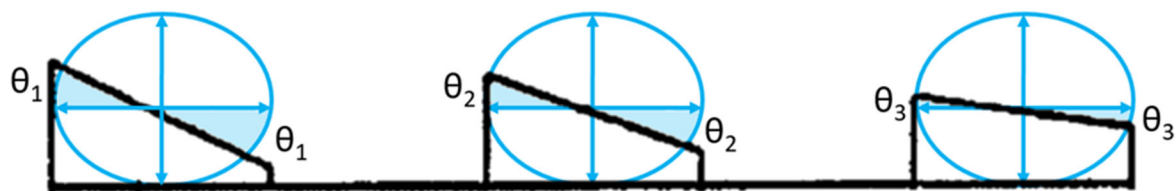
EX1003, ¶¶163-66.

As shown in annotated Figure 10 below, **a body of each of the micro mirrors** has been **rotated about at least one of first and second rotation axes extending through the body**. EX1003, ¶¶163-66. Assuming the axes shown in annotated Figure 10 below, with the x axis extending along the horizontal, the z axis extending along the vertical, and the y axis extending perpendicular to the page, the below micro-mirrors have been rotated about the **y rotation axis**, which **extend[s]** through the y - length of the micro-mirror **body**. EX1003, ¶¶163-66.



The below annotated Figure 10 of Fuhse262 shows the angle of rotation (*i.e.*, θ_1 , θ_2 , θ_3) about the y-axis for each of the three micro-mirrors. This angle represents the particular angle of rotation required in order for the micro-mirror to reflect light

to the coordinates of light spot 110. The angles θ_1 , θ_2 , and θ_3 are different because of the different positions of the mirrors require different angles of rotation to reflect light to the same point.



EX1003, ¶¶163-66.

Accordingly, Fuhse262 renders obvious element [1b.3]. EX1003, ¶¶154-66.

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

Fuhse262 teaches [1b.4]. Fuhse262’s **array of micro mirrors receiving ambient light** is an array of micro-mirrors arranged on, e.g., a banknote that receive the same **ambient light** that is the same for all micro-mirrors (e.g., sunlight in FIGs. 2, 10). *See, supra* Section VII.A.3.f. Fuhse262 relies on **ambient light** that is **concurrently** incident on all micro-mirrors, not focused light that is only incident on particular micromirrors at a given time. EX1003, ¶¶167-69. Fuhse262’s micro-mirrors are passive reflectors, and when illuminated with such concurrently incident ambient light, concurrently reflect the light, such that the micromirrors of **each of**

the different sets concurrently reflect the ambient light in the manner discussed in element [1.b3]. *See, supra*, Section VII.A.3.e ([1.b3]); EX1003, ¶170.

Further, each of the different sets **concurrently generate the plurality of pixels** in the manner discussed for [1.b3]. *See, supra*, Section VII.A.3.e ([1.b3]). As long as the micro-mirrors are properly oriented or aimed to generate their respective pixels, the concurrent reflections of ambient light will **concurrently generate the plurality of pixels**. EX1003, ¶171.

The '191 Patent does not use the term “concurrent” (or “simultaneous” or similar terms), and does not even discuss the concept of concurrent operation of sets of micro-mirrors.⁶ This limitation is trivially met by any array of passive micro-mirrors that operate based on reflecting ambient light. EX1003, ¶¶172-73.

Accordingly, Fuhse262 renders obvious [1b.4]. EX1003, ¶¶167-74.

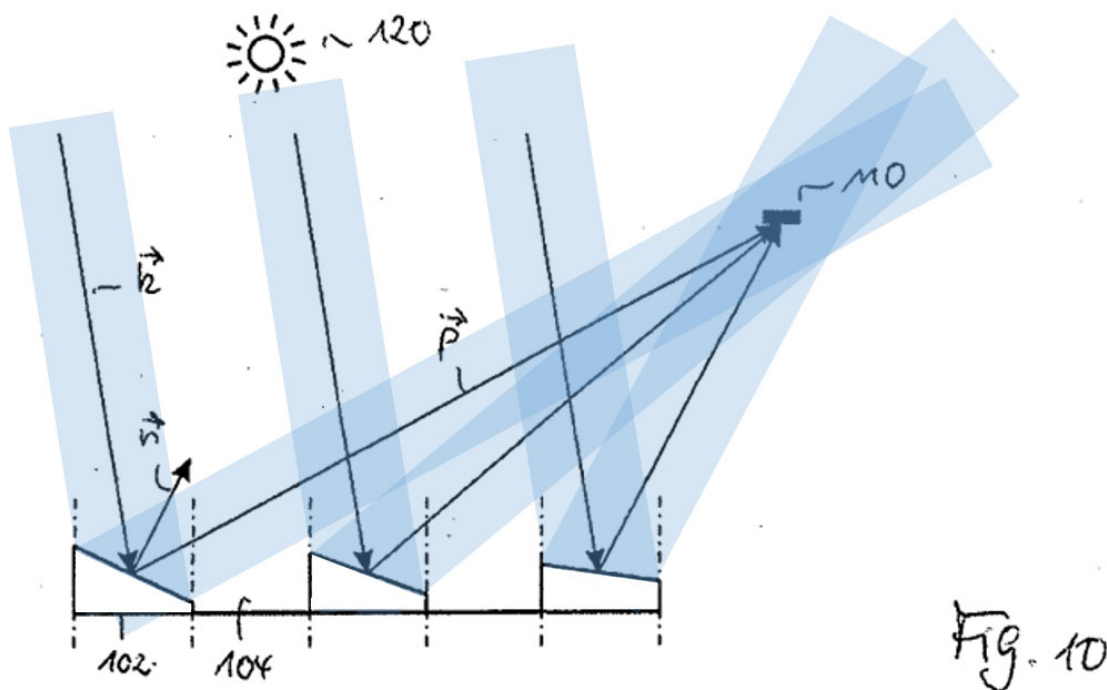
⁶ Any argument that “angular offset viewing” (*see* '191 Patent, 5:24-34) doesn't satisfy this limitation should be rejected because that involves whether an image is visible to a viewer from a certain angle, not whether the micromirrors are reflecting ambient light. Even in that case, ambient light would still be reflected by the micromirrors to create all the images, regardless if there is a viewer to view them.

- g. [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”

Fuhse262 teaches [1b.5].

For each of the pixels, a light spot at point (x_0, y_0, z_0) is **a point on the plane corresponding to one of the pixels**. *See supra*, Section VII.A.3.e ([1b.3]). In other words, each light spot is defined in three-dimensional space (i.e., x, y, z coordinates), which is the center-point of **a voxel is created at each of the points on the plane**. EX1003, ¶¶177-80.

Annotated Figure 10 below shows chief light rays for each optical element and converging on light spot 110. Ambient and reflected light form beams of light that reflect off the entire surface of the mirror, not just the center point, shown below. EX1003, ¶181.



The volume of the voxel corresponds to the intersection of beams from micro-mirror set, with the center of the voxel being the coordinates of the point (x_0, y_0, z_0) where all the beams intersect. As more micro-mirrors are added for a given pixel, the pixel or voxel becomes brighter and more defined. EX1003, ¶¶179-80.

As shown in Figure 10 above, Fuhse262 creates a voxel via intersection of two or **more beams of the reflected ambient light**. Each “reflected light ray” (i.e., the chief ray for each mirror) represents the center of each **beam[] of the reflected ambient light**. EX1003, ¶¶181-82. Because each pixel is required to be formed with a “set of micro mirrors” (as required by [1.b3]), the voxel would include **two or more beams**. EX1003, ¶182. As shown in Figure 10, each point (x_0, y_0, z_0) (a

point on the plane corresponding to one of the pixels) is the center-point of each voxel. EX1003, ¶183.

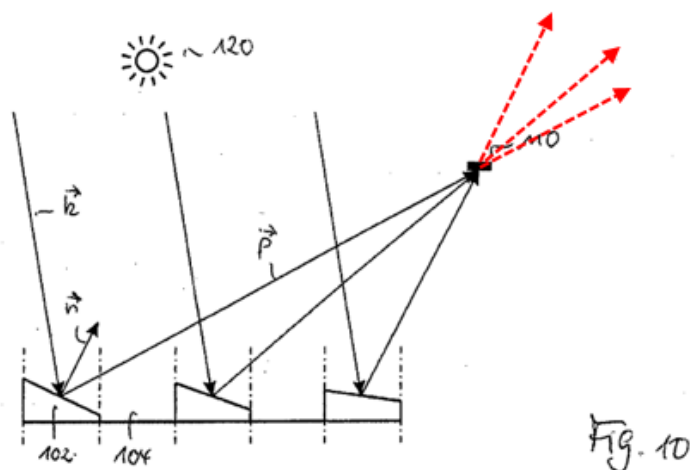
Accordingly, Fuhse262 renders obvious [1b.5]. EX1003, ¶¶175-83.

- h. [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.”**

Fuhse262 teaches element [1b.6].

Fuhse262 teaches that its “light-spot image composed of a plurality of light spots” (**each of the created voxels**) “for a viewer appear floating above... the surface region” in the form of a specified motif (**produces an effect of a point source of light floating above the surface of the substrate in the plane**). EX1006, ¶¶0010-11, 0015, 0035, 0058-59, 0063-69, 0083, 0089. The image in the plane “floats at a certain height above... the substrate surface” because “all light spots in the light-spot image have the same floating height.” EX1006, ¶¶0068; EX1003, ¶185.

The voxel’s **effect of a point source** is evident from Fuhse262’s Figures 9-10, as illustrated in the annotated Figure 10:



In other words, voxels produce[] an effect of a point source of light at least when a cone can be described in which the voxel is the cone's apex and the micro mirrors are within the base of the cone. Fuhse262 teaches a “cone” can be described “originating from the image point” and including all the micromirrors within the base of the cone (i.e., “sphere of influence E_j ”). EX1006, ¶¶0036, 0126; EX1003, ¶¶186-88.

Accordingly, Fuhse262 renders obvious element [1b.6]. EX1003, ¶¶184-90.

4. Independent Claim 6

Claim 6 is similar to independent claim 1, with a few exceptions which are mapped below. See the analysis for claim 1 in Section VII.A.3, which is incorporated herein. Only the differences are mapped below.

- a. **[6Pre] “A method of fabricating a security element useful on paper and coin currency and product labels, comprising:”**

Fuhse262 renders obvious the limitation. *See, supra*, Section VII.A.3.a ([1Pre]); EX1003, ¶191.

- b. **[6a] “providing a substrate; and”**

Fuhse262 renders obvious [28a]. *See, supra*, Section VII.A.3.b ([1a]); EX1003, ¶192.

- c. **[6b.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,”**

Fuhse262 renders obvious the limitation. *See, supra*, Section VII.A.3.c ([1b.1]); EX1003, ¶193.

- d. **[6b.2] “in response, displaying a first image and a second image in a plane spaced a distance apart from the surface of the substrate at first and second viewing angles, respectively, wherein the first and second images each comprises a plurality of pixels, and,”**

Fuhse262 teaches **in response, displaying a first image... in a plane spaced a distance apart from the surface of the substrate... wherein the first... image[] [] comprises a plurality of pixels.** *See, supra*, Section VII.A.3.d ([1b.2]); EX1003, ¶¶194-203.

Fuhse262 also teaches **a second image that comprises a plurality of pixels**, and is also **in a plane spaced a distance apart from the surface of the substrate** (*i.e.*, the same plane as the first image). Fuhse262 generates multiple images, including “a light-spot image A” (the **image**) and “a light-spot image B” (**a second image**). EX1006, ¶¶0111-20. Both images are produced in the same manner as previously discussed. *See, supra*, Section VII.A.3.d; EX1003, ¶¶196-97.

Fuhse262 further teaches that two images may “lie next to each other and/or appear alternately in the same place when the viewing direction changes.” EX1006, ¶¶0027, 0118. Whether image A and B “lie next to each other” or are “in the same place,” they are in the same **plane spaced a distance apart from the surface of the substrate**. EX1003, ¶¶198-200. For example, when the two images are in the same place, their pixels have the same heights, and therefore are in the same plane. EX1003, ¶199. This is accomplished in the same way as discussed above. *See, supra*, Section VII.A.3.d; EX1006, ¶¶0036, 0125-28; EX1003, ¶¶197-99.

To the extent it could be argued that Fuhse262 only explicitly discloses a three-dimensional image in the same place or next to a two-dimensional image (*see* EX1006, ¶¶0027, 0118), it would have been obvious to provide two two-dimensional images. EX1003, ¶200. As discussed above (*see, supra*, Section VII.A.3.d ([1b.2])), by teaching any arbitrary three-dimensional image in space (*i.e.*, x, y, z

space) can be constructed of pixels, a POSITA would understand that a two-dimensional image can be constructed by fixing the height (z) values of the pixels. EX1003, ¶200. Based on Fuhse262’s teachings that multiple images may be created in the same place or next to each other, and that images may be two-dimensional, it would have been obvious to a POSITA to provide two two-dimensional images at the same height (*i.e.*, in the same plane). EX1003, ¶200.

Fuhse262 also teaches **first and second viewing angles** for the first and second images, respectively. Fuhse262 teaches that “different images become visible to the viewer from different directions.” EX1006, ¶0111, 0024; EX1003, ¶201.

In other words, light-spot image A (the **image**) is viewable from a certain angle (**a first viewing angle**), and an “image change” to light-spot image B (**the second image**) occurs when “tilted to the side” (**a second viewing**). These teachings are specifically taught to apply to the case where the two images “lie next to each other” or are “in the same place,” such that the images “appear alternately” “when the viewing direction changes.” EX1006, ¶¶0027, 0118; EX1003, ¶202.

Accordingly, Fuhse262 renders obvious [6b.2]. EX1003, ¶¶194-203.

- e. **[6b.3] “wherein the array of micro mirrors includes for each of the pixels a unique set of the micro mirrors each having a reflective surface rigidly oriented, by rotating a body of each of the micro mirrors about at least one of two rotation axes extending through the body, to reflect the ambient**

light away from the substrate toward a point on the plane corresponding to one of the pixels,”

Fuhse262 teaches [6b.3].

The sets of micro mirrors for each pixel are **unique** for the same reasons the sets are **different**. *See, supra*, Section VII.A.3.e; EX1003, ¶205.

The micro mirrors are oriented **rigidly** for the same reasons the micro mirrors are oriented **in a fixed manner**. *See, supra*, Section VII.A.3.e; EX1003, ¶206.

The reflected light **is away from the substrate** for the same reasons it is directed **toward a point on the plane corresponding to one of the pixels**. *See, supra*, Section VII.A.3.e; EX1003, ¶207.

Accordingly, Fuhse262 renders obvious [6b.3]. EX1003, ¶¶204-07.

f. **[6b.4] “wherein each of the unique sets of the micro mirrors includes a number of the micro mirrors in the range of 2 to 40, and”**

Fuhse262 teaches [6b.4]. The total number of micromirrors may be “for example a few tens, a few hundred or even several thousand.” EX1006, ¶0087. “The number $n \times n$ of micromirrors is, for example, 10×10 ,” (totaling 100) (see ¶0087) or 288 ($12 \times 12 = 144$ plus $12 \times 12 = 144$) (see ¶¶0090-92). EX1006, ¶0087. In Figure 8(c), Fuhse262 teaches that “every fourth field can be covered with micromirrors 102 that are assigned to a specific light spot,” while the other fields “are assigned to up to three other light spots.” EX1006, ¶0094. For the 100 micro-mirror example, if

“three other light spots” are utilized, that means the 100 micro-mirrors would serve four light spots, meaning **each of the unique sets of the micro mirrors includes** twenty five micromirrors (**a number of the micro mirrors in the range of 2 to 40**). EX1003, ¶209.

[6b.4] is also satisfied by Figure 8(d), where the “every ninth field is covered by micromirrors 102 assigned to a specific light spot,” and the remaining “micro-mirrors [] are assigned to *up to eight other light spots*.” EX1006, ¶0094 (emphasis added). If all “eight other light spots” are utilized, the 100 micro-mirrors would serve nine light spots, meaning **each of the unique sets of the micro mirrors includes** eleven micromirrors (**a number of the micro mirrors in the range of 2 to 40**). Similarly, for the 288 micro-mirror example, **each of the unique sets** would have 32 (i.e., 288 divided by nine) micromirrors (**a number of the micro mirrors in the range of 2 to 40**). EX1003, ¶210.

Accordingly, Fuhse262 renders obvious [6b.4].

- g. [6b.5] “wherein the reflected ambient light from the **number of the micro mirrors intersects at the point corresponding to the one of the pixels to create a voxel,**”

Fuhse262 renders obvious [6b.5]. *See, supra*, Section VII.A.3.g ([1b.5]); EX1003, ¶211.

- h. [6b.6] “whereby the voxel acts like a point light source positioned in the plane at the point corresponding to the one of the pixels.”**

Fuhse262 renders obvious [6b.6]. *See, supra*, Section VII.A.3.h ([1b.6]); EX1003, ¶212.

The voxel is created **at the point corresponding to the one of the pixels**. *See supra*, Sections VII.A.3.g ([1b.5]), VII.A.3.e ([1b.3]). EX1003, ¶213.

B. Ground 2: Claims 1, 6 are rendered obvious under §103 by Fuhse262 (Ground 1) in view of Fuhse925

This ground is the same as Ground 1, but additionally relies on Fuhse925’s teachings of product labels and orientation of its micro-mirrors, as teaching limitation [1Pre]/[6Pre] and [1b.3]/[6b.3]. EX1003, ¶¶214-20.

1. Motivation and Combine

Fuhse262 and Fuhse925 share the same inventor and assignee, which weighs strongly in favor of finding a motivation to combine the two references. *See, e.g., Abbot Vascular, Inc. v. Flexstent*, IPR2019-00882, Paper 48, 28-29 (Oct. 2, 2020); *Laird Techs., Inc. v. Garftech Int’l Holdings, Inc.*, IPR2014-00024, Paper 46, 30-31 (Mar. 25, 2015); *Black v. CE Soir Lingerie Co.*, No. 2:06-CV-544, 2008 WL 3852722, at *14 (E.D. Tex. Aug. 15, 2008) (“strong motivation to combine” prior art “patented by the same inventor”).

A POSITA would have found it obvious to apply the teachings of Fuhse925 to Fuhse262. Fuhse262 and Fuhse925 both relate to security elements for data carriers (e.g., banknotes, etc.) with arrays of optical elements that are arranged to produce, upon illumination, three-dimensional motifs, and thus are in the same field. EX1006, Abstract; EX1008, Abstract; EX1003, ¶214.

A POSITA would have looked to Fuhse925 when reviewing Fuhse262. Fuhse262 describes the proper orientation (*i.e.*, to produce the light spot in the correct location in three-dimensional space) of its micro-mirrors in the surface plane (*i.e.*, x-y axes) by a normal vector n of its reflective surface. EX1006, ¶¶95-99; EX1003, ¶¶215-17. While a POSITA would understand how much to rotate the mirror surface in the x and y axes to achieve the normal vector n (as is shown in Fuhse262 (FIGs. 9-10), it is not expressed in explicit detail. EX1003, ¶¶215-16. Fuhse925, however, *does* provide that explicit detail. Fuhse925 further teaches that the normal surface N can be broken down into two “inclination components” that represent the inclination angle (*i.e.*, how much the mirror surface should be rotated or tilted) of the mirror in each respective axis. EX1008, 7:33-63. It would therefore have been obvious for a POSITA to examine how mirror surface orientations are achieved when reviewing Fuhse262 to implement it. EX1003, ¶¶214-17.

Fuhse925 provides explicit detail for implementing what Fuhse262 teaches, namely a micro-mirror with a desired surface normal n . As Fuhse925 explains, $N_{\parallel}$ and $N_{\perp}$ are the “mirror slope” in each of the x and y axes (the claimed first and second rotation axes), such that the body of each of the micro mirrors [is] rotated about the x-axis extending through the body by an amount of $N_{\parallel}$, and the body of each of the micro mirrors [is] rotated about the y-axis extending through the body by an amount of $N_{\perp}$ to achieve the proper orientation of the micromirrors. EX1008, 7:33-63. Whereas Fuhse262 discloses a desired surface normal for each micromirror and shows the properly angled mirrors (see FIGs. 9-10), Fuhse925 provides further explicit detail for how to implement the properly oriented mirrors using “inclination components,” thus, it would have been obvious for a POSITA to combine Fuhse262 and Fuhse925. EX1003, ¶216.

Additionally, using Fuhse925’s teachings regarding inclination components in Fuhse262’s system would have involved using a known technique to improve Fuhse262 in a known way, without unpredictable results, and would thus also have been obvious under *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 416-18 (2007). EX1003, ¶217.

2. Reasonable Expectations

A POSITA would have had a reasonable expectation of success in implementing the combination of Fuhse262 and Fuhse925. As a POSITA would have recognized, the structures of Fuhse262 and Fuhse925 are similar and compatible. EX1003, ¶218.

For example, Fuhse262 teaches that its micromirrors may “for example, have a dimension of $50\text{ }\mu\text{m} \times 50\text{ }\mu\text{m}$ and can be formed with a flat mirror surface.” EX1006, ¶¶95-99. Fuhse925’s facets are “micromirrors” with “the dimensions... between $20\text{ }\mu\text{m}$ and $300\text{ }\mu\text{m}$, preferably between $50\text{ }\mu\text{m}$ and $200\text{ }\mu\text{m}$.” EX1006, 5:36-38, 7:43-48; EX1003, ¶219. The Fuhse references provide almost identical teachings regarding how the micro-mirrors in Fuhse262 and Fuhse925 should be made, further showing the compatibility in their teachings. *Compare* EX1006, ¶0032 *with* EX1008, 5:4-8; EX1003, ¶219. Thus, the teachings in Fuhse925 regarding proper orientation of micro-mirrors would have been incorporated into Fuhse262 with no difficulty. EX1003, ¶219.

As discussed in Ground 1 (see VII.A.2), the art was relatively predictable in the relevant timeframe (2015). *Id.*; EX1003, ¶220, 120. Thus, a POSITA would have been able to implement the obviousness modifications in this ground without difficulty. *Id.*

3. [1Pre]/[6Pre]

To the extent not taught by Fuhse262, Fuhse262 in view of Fuhse925 renders this element obvious.

Fuhse925 additionally teaches that its invention is **useful as a security element on** not only banknotes, but also on “labels on goods and packaging” (**product labels**). EX1008, 6:55-58.

A POSITA would have been motivated to combine Fuhse262 with Fuhse925 in order to maximize the utility and applications of the invention. While Fuhse262 describes its invention may be applicable to any “data carrier,” it does not explicitly list all of its application. A POSITA would have been motivated to look at other references, including Fuhse925, to find additional data carriers for additional applications. EX1003, ¶¶222-24.

Accordingly, Fuhse262 in view of Fuhse925 renders obvious the preambles. EX1003, ¶¶222-24.

4. [1b.3]/[6.b3] “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,”

Fuhse262 in view of Fuhse925 renders obvious element [1b.3]/[6b.3] with respect to the phrase **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. Fuhse262 discloses that the micromirrors each have a normal vector n of its reflective surface defined in the x and y axes, and a POSITA would understand rotating the surface in the x and y axis to achieve that normal vector n . EX1003, ¶226. However, to the extent it would not, Fuhse925’s additional teachings would provide that teaching.

Like Fuhse262, Fuhse925 teaches a security element (for currency, for example) using arrays of reflective micromirrors to create three-dimensional images appearing to float above the security element. EX1008, 6:63-7:18, 7:33-48. Also like Fuhse262, each micromirror is taught to have a normal – defined by “slope N ” – that defines the overall surface orientation of the micromirror. EX1008, 7:55-58; EX1003, ¶227. Fuhse925 further teaches that the normal surface N can be broken down into two “inclination components” that represent the inclination angle of the mirror in each respective axis. EX1008, 7:33-63. Fuhse925 Figures 2 and 3, are reproduced below:

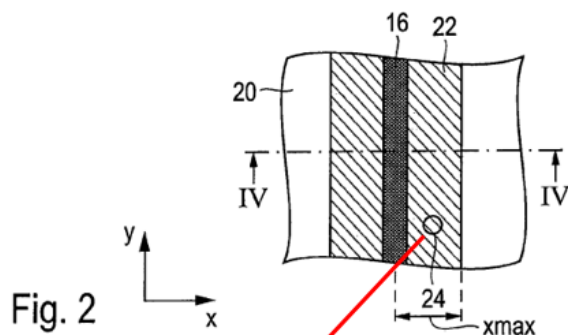


Fig. 2

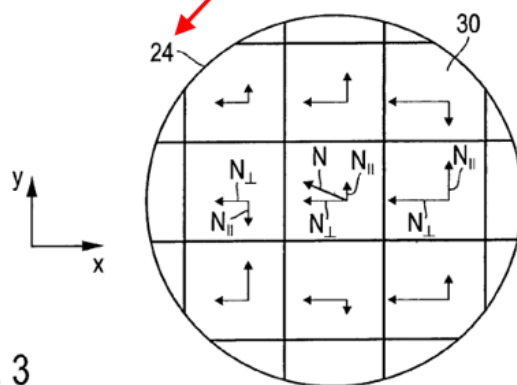


Fig. 3

EX1008, 7:33-58; EX1003, ¶¶228-29. As Fuhse925 explains, $N_{\parallel}$ and $N_{\perp}$ are the “mirror slope” in each of the x and y axes (**first and second rotation axes**), such that the **body of each of the micro mirrors [is] rotated about** the x-axis **extending through the body** by an amount of $N_{\parallel}$, and the **body of each of the micro mirrors [is] rotated about** the y-axis **extending through the body** by an amount of $N_{\perp}$ to achieve the proper orientation of the micromirrors. EX1008, 7:49-60; EX1003, ¶230.

Fuhse925 also clarifies that the micro-mirrors are oriented **in a fixed manner** by explaining that its reflective planar facets 30 are “characterized by an inclination

angle.” EX1008, 7:37-42. The planar facets 30 are “characterized” by this single “inclination angle” because they are manufactured to provide that angle to achieve a desired reflection. EX1003, ¶231.

Accordingly, Fuhse262 in view of Fuhse925 renders obvious [1b.3] and [6b.3].

C. Ground 3: Claims 2-4, 7-11 are rendered obvious under 35 U.S.C. §103 by Fuhse262 (Ground 1) and further in view of Fuhse395.

Claims 2-4 and 7-11 are mapped below. The positions for claims 1 and 6 are the same as the inclusion of Fuhse395 does not affect those positions. EX1003, ¶¶232-42.

1. Motivation to Combine

Fuhse262 and Fuhse395 share the same inventor and assignee, which weighs strongly in favor of finding a motivation to combine the two references. *See, e.g., Abbot Vascular*, IPR2019-00882, Paper 48, 28-29; *Laird Techs*, IPR2014-00024, Paper 46, 30-31; *Black*, 2008 WL 3852722, at *14.

A POSITA would have found it obvious to apply the teachings of Fuhse395 to Fuhse262. Fuhse262 and Fuhse395 both relate to security elements for data carriers (*e.g.*, banknotes, etc.) with arrays of optical elements that are arranged to produce, upon illumination, three-dimensional motifs, and thus are in the same field. EX1006, Abstract; EX1010, Abstract; EX1003, ¶¶233-34.

A POSITA would have looked to Fuhse395 when reviewing Fuhse262. While Fuhse262 teaches that its “optical elements are designed as embossed structures in an embossing lacquer layer” (EX1006, ¶¶32-33, 67), it is not expressed in explicit detail how the embossing is performed. Fuhse395 teaches this, namely, that an “embossing tool” is used for “embossing in thermoplastic foils or into foils coated with radiation-curing lacquers.” EX1010, ¶59. Specifically, Fuhse395 explains that reflective facets (*i.e.*, micromirrors) are formed by embossing “embossing lacquer layer 22” using an “an embossing tool 36” with “an embossing area 37.” EX1010, ¶¶148-51. EX1003, ¶235.

Whereas Fuhse262 discloses micromirrors designed as embossed structures in a lacquer layer, Fuhse395 provides further explicit detail for how to do that, and thus, it would have been obvious for a POSITA to combine Fuhse262 and Fuhse395. EX1003, ¶¶236-38.

Additionally, using Fuhse395’s teachings regarding embossing tools in Fuhse262’s system would have involved using a known technique to improve Fuhse262 in a known way, without unpredictable results, and would thus also have been obvious under *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 416-18 (2007). EX1003, ¶239.

2. Reasonable Expectation of Success

A POSITA would have had a reasonable expectation of success in implementing the combination of Fuhse262 and Fuhse395. Here, the art was relatively predictable in the relevant timeframe (2015). EX1003, ¶¶240-42, 120.

The art related fabrication of OVDs, including techniques such as using “dies” or “masters” for embossing and casting polymer substrates had been highly developed and known to work for decades. In fact, it was well-known to fabricate arrays of optical elements, including micro mirror arrays, for use in OVDs. These techniques generally relied on the properties of polymers, such as thermoplastics, that has already been developed to a commercially mature stage decades earlier. EX1003, ¶241.

By the 1980’s there were numerous thermoplastics and fabrication techniques that would be suitable to fabricate the mirco-mirror arrays described in both Fuhse262 and the ’191 Patent. Although prior art to the ’191 Patent, the fabrication techniques discussed in Fuhse262 and Sauvage-Vincent were not new at the time of their filing, and nothing in the structures described by Fuhse262 require anything more than traditional fabrication techniques for optical micro-structures that were well-known and known to work by the 1980’s. EX1003, ¶242.

Accordingly, a POSITA would have been able to implement the obviousness modifications in this ground without difficulty. EX1003, ¶¶240-42.

3. **Claim 2: The method of claim 1, wherein the forming the array of micro mirrors comprises casting the micro mirrors with a mirror tool in contact with the surface of the substrate, wherein the substrate comprises a clear, energy-cured polymer.**

Fuhse262 in view of Fuhse395 renders obvious claim 2. EX1003, ¶¶243-52.

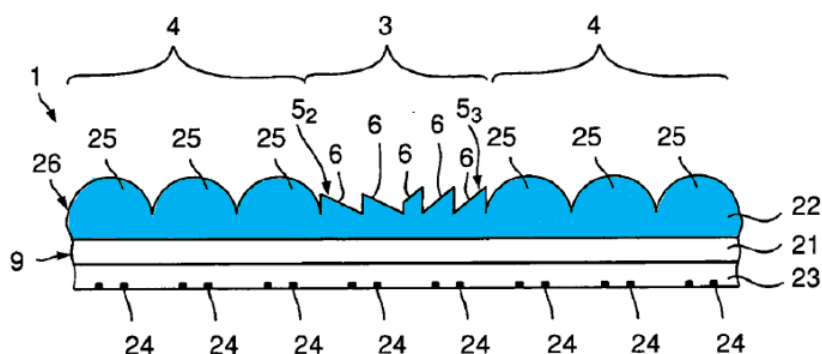
a. Casting – Fuhse262

Fuhse262 teaches that its “optical elements are designed [**the forming the array of micro mirrors comprises**] as embossed structures in an embossing lacquer layer.” EX1006, ¶¶32-33, 67. While a POSITA would understand that an embossing tool must have stamped the embossing lacquer layer (**casting the micro mirrors with a mirror tool in contact with the surface of the substrate**), this is not explicitly disclosed in Fuhse262. EX1003, ¶244.

b. Casting – Fuhse395

Fuhse395 teaches that “embossing tool” (**a mirror tool**) for “embossing in thermoplastic foils or into foils coated with radiation-curing lacquers” (**casting the micro mirrors**). EX1010, ¶¶59. Figures 11, reproduced and annotated below, teaches that reflective facets 6 (*i.e.*, micromirrors) are formed by embossing “embossing lacquer layer 22” (annotated in blue) to form part of the **substrate** (carrier 9) with carrier foil 21. EX1010, ¶¶0121, 0148. ; EX1003, ¶245.

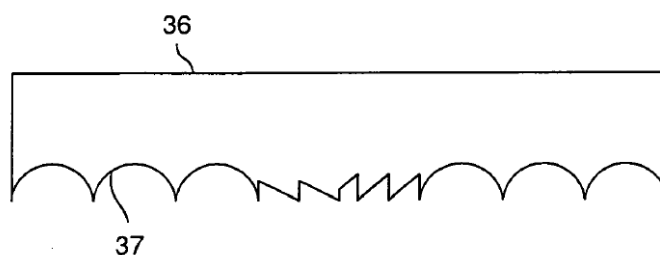
Fig. 11



Fuhse395, ¶¶119-24, 129-34.

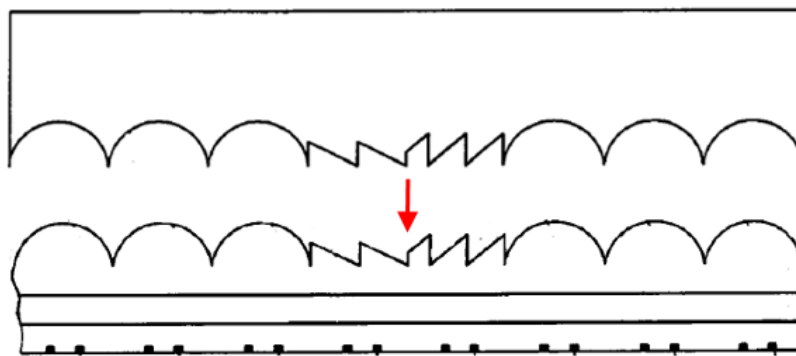
Figure 16 depicts the “embossing tool 36” with “embossing area 37.”

Fig. 16



Fuhse395, ¶¶148-51; EX1003, ¶246.

The embossing area 37 has “the inverted form of the surface structure to be embossed,” such that **casting the micro mirrors with embossing tool 36 (a mirror tool)** occurs when the embossing tool 36 is **in contact with the surface of the substrate**, as shown below:



EX1003, ¶247.

c. Clear, energy cured polymer

Fuhse395 teaches that **the substrate comprises a clear, energy-cured polymer**. The substrate (carrier 9) may be “a radiation-curing plastic (UV resin),” and is thus a “**polymer** substrate” (*i.e.*, a plastic) and **energy-cured** (*i.e.*, radiation-curing). Fuhse395, ¶¶93, 114, 121, 116; EX1003, ¶248-52.

A POSITA would have understood that such resins are clear for security elements on banknotes. For example, polyethylene terephthalate (PET), as Fuhse395 discloses, was a very common thermoplastic polymer resin of the polyester family and it was known to be “transparent” (**clear**). EX1003, ¶¶249-52.

Accordingly, Fuhse262 in view of Fuhse395 renders obvious claim 2. EX1003, ¶¶243-52.

4. **Claim 3: The method of claim 1, wherein the forming the array of micro mirrors includes metallization of surfaces of the micro mirrors and wherein the metallization applies a layer of aluminum, gold, or**

silver to form reflective surfaces.

Fuhse262 in view of Fuhse395 renders obvious claim 3. EX1003, ¶¶253-56.

a. Metallization of Surfaces – Fuhse262

Fuhse262 teaches that the forming the array of micro mirrors includes providing “the embossed structures ... a reflection-increasing coating[] [and] [i]n particular, **a full-surface or gridded metallization**” (**metallization of surfaces of the micro mirrors**). EX1006, ¶¶ 32-34; EX1003, ¶¶254-55. The “full-surface or gridded metallization” is “a reflection-increasing coating” of the micromirrors, meaning it is provided **to form reflective surfaces**. *Id.* However, Fuhse262 does not disclose the specific type of metal.

b. Aluminum, gold, or silver

Fuhse395 teaches that **the forming facets (the array of micro mirrors) includes** includes “metalliz[ation] in order that they act reflectively” (**metallization of surfaces of the micro mirrors**). Fuhse395, ¶¶129, 135, 129-31. Fuhse395 further explains that **the metallization applies a layer of aluminum, gold, or silver to form reflective surfaces**. Fuhse395, ¶0024; EX1003, ¶¶256.

Accordingly, Fuhse262 in view of Fuhse395 renders obvious claim 3. EX1003, ¶¶253-56.

- 5. Claim 4: The method of claim 3, wherein the forming the array of micro mirrors includes, prior to the metallization of the surfaces of the micro mirrors,**

embossing the surface of the substrate to form the surfaces of the micro mirrors and wherein the surface of the substrate includes an embossable coating or layer.

Fuhse262 in view of Fuhse395 renders obvious claim 4. EX1003, ¶¶257-61.

a. Fuhse262 teachings

The **embossing** is of **the surface of the substrate** because the “optical elements [array of micro mirrors] are designed as embossed structures in an embossing lacquer layer [an embossable ... layer].” EX1006, ¶0032. The embossing is **prior to the metallization of the surfaces of the micro mirrors** because the metallization is of “the embossed structures,” meaning the embossing occurred before the metallization. Fuhse262, ¶32; EX1003, ¶258.

b. Fuhse262 in view of Fuhse395 teachings

As discussed under claim 2 (VII.C.3), Fuhse395 teaches forming **the array of micro mirrors** by “embossing of the embossed layer 22” (**embossing the surface of the substrate**) **to form** “structures for the reflective facets 6” (**the surfaces of the micro mirrors**). Fuhse395, ¶¶129-31; EX1003, ¶259.

Fuhse395 teaches an “embossing tool” for “embossing in thermoplastic foils or into foils coated with radiation-curing lacquers.” Fuhse395, ¶¶59-60, 64-65, 114, 116, 121-24, 129-34, 148-51; EX1003, ¶260. For example, as shown in Figures 11 and 13, Fuhse395 teaches that reflective facets 6 (*i.e.*, micromirrors) are formed by

embossing “embossing lacquer layer 22” that forms part of the **substrate** (carrier 9) with carrier foil 21. As shown in Figure 11, the embossing lacquer layer 22 (which is **an embossable... layer**) is formed on **the surface of the substrate** (carrier 9). EX1003, ¶260.

The embossing is performed **prior to the metallization of the surfaces of the micro mirrors** because the “metalliz[ing],” is performed “[s]ubsequently” to the “embossing of the embossed layer 22,” meaning the embossing occurred before the metallization. Fuhse395, ¶0129; EX1003, ¶261.

6. **Claim 7: The method of claim 6, wherein the forming the array of micro mirrors comprises casting the micro mirrors with a mirror tool in contact with the surface of the substrate.**

Fuhse262 in view of Fuhse395 renders obvious claim 7. *See, supra*, Section VII.C.3 (claim 2); EX1003, ¶¶262-63.

7. **Claim 8: The method of claim 7, wherein the substrate comprises a clear, energy-cured polymer.**

Fuhse262 in view of Fuhse395 renders obvious claim 8. *See, supra*, Section VII.C.3; EX1003, ¶¶264-65.

8. **Claim 9: The method of claim 6, wherein the forming the array of micro mirrors includes metallization of surfaces of the micro mirrors and wherein the metallization applies a layer of aluminum, gold, or silver to form reflective surfaces.**

Fuhse262 in view of Fuhse395 renders obvious claim 9. *See, supra*, Section VII.C.4 (claim 3); EX1003, ¶¶266-67.

- 9. Claim 10: The method of claim 9, wherein the forming the array of micro mirrors includes, prior to the metallization of the surfaces of the micro mirrors, embossing the surface of the substrate to form the surfaces of the micro mirrors**

Fuhse262 in view of Fuhse395 renders obvious claim 10. *See, supra*, Section VII.C.5 (claim 4); EX1003, ¶¶268-69.

- 10. Claim 11: The method of claim 10, wherein the surface of the substrate includes an embossable coating or layer.**

Fuhse262 in view of Fuhse395 renders obvious claim 11. *See, supra*, Section VII.C.5 (claim 4); EX1003, ¶¶270-71.

D. Grounds 4: Claims 2-4 and 7-11 are rendered obvious by Fuhse262 in view of Sauvage-Vincent

Claims 2-4 and 7-11 are mapped below. The positions for claims 1 and 6 are the same as the inclusion of Sauvage-Vincent does not affect those positions. EX1003, ¶¶273-82.

1. Motivation to Combine

A POSITA would have found it obvious to apply the teachings of Sauvage-Vincent to Fuhse262. Fuhse262 and Sauvage-Vincent both relate to security ele-

ments for documents such as banknotes w that are arranged to produce, upon illumination, motifs, and thus are in the same field. Fuhse262, Abstract; EX1033, Abstract; EX1003, ¶274.

A POSITA would have looked to Sauvage-Vincent when reviewing Fuhse262. While Fuhse262 teaches that its “optical elements are designed as embossed structures in an embossing lacquer layer” (EX1006, ¶¶32-33, 67), it is not expressed in explicit detail how the embossing is performed. Sauvage-Vincent teaches that a “die” or “master” may provide a “stamping operation” to produce the microstructure pattern of the desired optical elements. EX1033, ¶¶71, 73, 43, Abstract. It would therefore have been obvious for a POSITA to examine how embossed structures are produced when reviewing Fuhse262. That is, Sauvage-Vincent provides explicit detail for implementing what Fuhse262 teaches, namely a method for producing embossed structures for reflective micromirrors in security elements. EX1003, ¶¶275-78.

Additionally, using Sauvage-Vincent’s teachings regarding embossing tools in Fuhse262’s system would have involved using a known technique to improve Fuhse262 in a known way, without unpredictable results, and would thus also have been obvious. EX1003, ¶279.

2. Reasonable Expectation of Success

A POSITA would have had a reasonable expectation of success in implementing the combination of Fuhse262 and Sauvage-Vincent. Here, the art was relatively predictable in the relevant timeframe (2015). EX1003, ¶¶280, 120.

The art related fabrication of OVDs, including techniques such as using “dies” or “masters” for embossing and casting polymer substrates had been highly developed and known to work for decades. In fact, it was well-known to fabricate arrays of optical elements, including micro mirror arrays, for use in OVDs. These techniques generally relied on the properties of polymers, such as thermoplastics, that has already been developed to a commercially mature stage decades earlier. EX1003, ¶281.

By the 1980’s there were numerous thermoplastics and fabrication techniques that would be suitable to fabricate the mirco-mirror arrays described in both Fuhse262 and the ’191 Patent. Although prior art to the ’191 Patent, the fabrication techniques discussed in Fuhse262 and Sauvage-Vincent were not new at the time of their filing, and nothing in the structures described by Fuhse262 require anything more than traditional fabrication techniques for optical micro-structures that were well-known and known to work by the 1980’s. EX1003, ¶281.

Accordingly, a POSITA would have been able to implement the obviousness modifications in this ground without difficulty. EX1003, ¶¶280-82.

3. Claim 2

Fuhse262 in view of Sauvage-Vincent renders obvious claim 2. EX1003, ¶¶283-93.

a. Casting – Fuhse262

See, supra, Section VII.C.3.a. EX1003, ¶¶284, 244.

b. Casting – Sauvage-Vincent

Sauvage-Vincent teaches that a nickel “die” or “master” (**a mirror tool**) may to provide an “embossed layer” relief structure of the desired optical elements. EX1033, ¶¶71, 73, 43, Abstract. For example, as shown in Figure 1A (below), Sauvage-Vincent teaches that its “optical structures” are formed by the stamping operation as applied to dielectric material 101, “typically a stamping lacquer a few microns thick borne by a 12 µm to 50 µm film of polymer material, for example of PET (polyethylene terephthalate)” that forms part of the **substrate**. *Id.*; EX1003, ¶285.

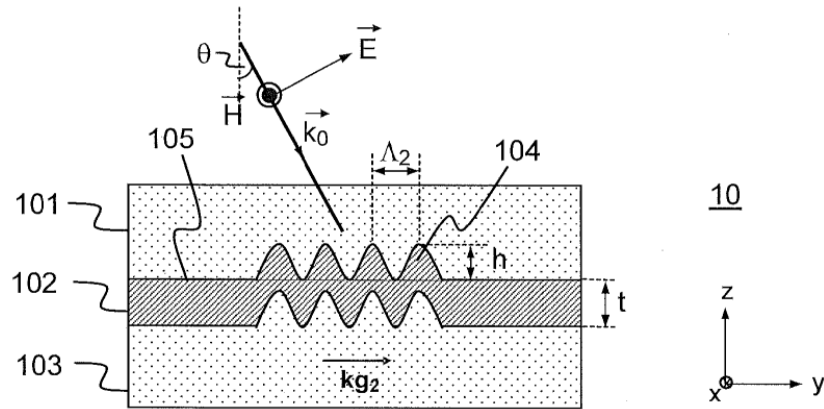


FIG.1A

The **casting the micro mirrors** occurs when “stamping operation is performed from the die to transfer the microstructure onto a film and structure the layer of dielectric material 101” (**casting the micro mirrors with a mirror tool in contact with the surface of the substrate**). EX1033, ¶¶71, FIG. 1A. In particular, this “stamping may be done ... by molding then cross-linking (‘UV **casting**’).” *Id.* (emphasis added). As another example, dielectric material 101 may be stamped by “hot pressing” or “hot embossing,” which is another form of **casting**. EX1003, ¶¶286-87.

c. Clear, energy cured polymer

1. Sauvage-Vincent’s substrate includes “dielectric material 101 (FIG. 1 A),” which is “typically a stamping lacquer a few microns thick borne by a 12 μm to 50 μm film of **polymer** material,” (**polymer**) “for example of PET (polyethylene

terephthalate),” which is a **clear, energy-cured polymer**. EX1033, ¶¶71, FIG. 1A; EX1003, ¶¶288, 292-93.

2. Layer 101 is **clear** because it is “transparent in said observation spectral band,” and is also referred to as a “transparent layer 101.” EX1033, Abstract, ¶¶0009, 0030, 0073, FIG. 1A; EX1003, ¶289.

3. The dielectric material 101 is an **energy-cured** polymer under two separate examples. First, the transparent dielectric material 101 may be “UV cast[ed]” that is formed when it is molded by the die, meaning that UV **energy cure[s] the** dielectric material. EX1033, ¶71; EX1003, ¶290.

Second, dielectric material 101 may be stamped by “hot pressing” or “hot embossing,” (i.e., the polymer structures are formed when the die presses against it at elevated temperature) which provides the **energy** for the layer to be **cured**. EX1033, ¶71; EX1003, ¶291.

4. Claim 3

Fuhse262 in view of Sauvage-Vincent renders obvious claim 3. EX1003, ¶¶294-97.

a. Metallization of Surfaces – Fuhse262

See, supra, Section VII.C.4.a (Ground 3, claim 3). EX1003, ¶¶ 254-55, 295-96.

b. Aluminum, gold, or silver

Sauvage-Vincent likewise teaches that the forming desired optical elements includes that a “metallization” (**metallization**). EX1033, ¶71. This “metallization is done in a vacuum, for example, one of the following metals: **silver, aluminum, gold**” (**a layer of aluminum, gold, or silver to form reflective surfaces**) *Id.*; EX1003, ¶297.

5. Claim 4

Fuhse262 in view of Sauvage-Vincent renders obvious claim 4. EX1003, ¶¶298-301.

See, supra, Section VII.C.5.a (Fuhse262 teachings). EX1003, ¶¶299, 258. Further, Sauvage-Vincent teaches a nickel “die” or “master” may create the micro-structures by “hot pressing of the dielectric material (‘hot embossing’)” (**embossing the surface of the substrate to form the surfaces of the micro mirrors**). EX1033, ¶71. This process results in an “embossed layer” (**an embossable... layer**). *Id.* As shown in FIGs. 1A and 7A, the dielectric material 101 is part of the **surface of the substrate**, and **the surface of the substrate includes** the dielectric material 101. EX1033, ¶73 (noting layers 71 and 73 in FIG. 7A are to be removed upon transfer); Figs. 1A, 7A; EX1003, ¶300.

The embossing is **prior to the metallization of the surfaces of the micro mirrors** because “[t]he duly embossed layer is **then** metalized,” meaning the embossing occurred before the metallization. EX1033, ¶71 (emphasis added); EX1003, ¶301.

6. Claim 7

Fuhse262 in view of Sauvage-Vincent renders obvious claim 7. *See, supra*, Section VII.D.3 (claim 2); EX1003, ¶¶302-03.

7. Claim 8

Fuhse262 in view of Sauvage-Vincent renders obvious claim 8. *See, supra*, Section VII.D.3 (claim 2); EX1003, ¶¶304-05.

8. Claim 9

Fuhse262 in view of Sauvage-Vincent renders obvious claim 9. *See, supra*, Section VII.D.4 (claim 3); EX1003, ¶¶306-07.

9. Claim 10

Fuhse262 in view of Sauvage-Vincent renders obvious claim 10. *See, supra*, Section VII.D.5 (claim 4); EX1003, ¶¶308-09.

10. Claim 11

Fuhse262 in view of Sauvage-Vincent renders obvious claim 11. *See, supra*, Section VII.D.5 (claim 4); EX1003, ¶¶310-11.

E. Ground 5: Claims 5 and 12 are rendered obvious by Fuhse262 in view of Morford

1. Motivation to Combine

A POSITA would have found it obvious to apply the teachings of Morford to Fuhse262. Fuhse262 relates to micro-optic components, and Morford relates to materials for use in micro-optics components, and thus are in the same field. EX1006, Abstract; EX1024, Abstract; EX1003, ¶¶313.

A POSITA would have looked to Morford when reviewing Fuhse262 for implementation details. While Fuhse262 teaches that its micro-mirrors are “embedded in a surrounding material or provided with a protective layer,” Fuhse262 does not specify what material to use. EX1006, ¶¶103-04, FIG. 12. However, Morford teaches that “a UV-curable high refractive index material” may be used as an optical material. EX124, p. 1; EX1003, ¶¶314-16. Morford teaches several advantages of using a high-index material, including “including minimal shrinkage during curing, the ability to cure at room temperature, no emission of by-products, and more efficient devices.” *Id.*

Additionally, using Morford’s teachings regarding UV-curable materials in Fuhse262’s system would have involved using a known technique to improve Fuhse262 in a known way, without unpredictable results, and would thus also have been obvious. EX1003, ¶¶317.

2. Reasonable Expectation of Success

A POSITA would have had a reasonable expectation of success in implementing the combination of Fuhse262 and Morford. Here, the art was relatively predictable in the relevant timeframe (2015). EX1003, ¶¶318-120.

Protective layers are relatively simple, and were well known and well-characterized well before the priority date. It would have been routine to apply the protective later described by Morford to the system of Fuhse262. A POSITA would have been familiar with protective layers and how to implement them. Fuhse262 is a system that is already adapted to use a protective layer, and little to no modification would be required to accommodate the particular protective layer described by Morford. EX1003, ¶319.

Protective layers provided by companies like Brewer Science (the provider of the varnish in Morford) are particularly developed for integration into optical micro-device fabrication, and Morford particularly explains the ease with which such materials may be adapted to such products. EX1003, ¶320.

Accordingly, a POSITA would have been able to implement the obviousness modifications in this ground without difficulty. EX1003, ¶¶318-20.

3. Claims 5/12: The method of claim[s] 1[/6], wherein the forming the array of micro mirrors comprises filling in recessed surfaces associated with the micro mirrors with a filler comprising at least one of an

ultraviolet (UV) varnish, an e-beam solvent, and a water-based varnish and wherein the filler has a refractive index of at least 1.55, whereby at least a portion of the received ambient light at extreme angles is reflected to sharpen the displayed image.

Fuhse262 in view of Morford renders obvious claim 5 and 12. EX1003, ¶¶321-27.

Fuhse262’s micromirrors are “embedded in a surrounding material or provided with a protective layer” (**a filler**). Fuhse262, ¶¶103-04. As discussed for claim 2 (*see, supra*, Section VII.C.3), the micromirrors are “embossed structures,” meaning that they include **recessed surfaces** as a result of the embossing. EX1006, ¶¶32-33, 67. A POSITA would have understood that by “surrounding” or “embedding” the micromirrors with the protective layer, the **recessed surfaces** would be **fill[ed] in**. EX1003, ¶322.

Fuhse262 teaches that the protective layer usually has “a refractive index of *approximately* $n = 1.5$.” EX1006, ¶104 (emphasis added). A POSITA would have understood that “approximately” 1.5 includes 1.55 (**the filler has a refractive index of at least 1.55**). EX1003, ¶323.

While Fuhse262 does not explicitly disclose the material of the protective layer, but the use of **an ultraviolet (UV) varnish** was known in the art, for example, by Morford. Morford teaches that “a UV-curable high refractive index material”

(**an ultraviolet (UV) varnish**) may be used as an optical material. EX1024, p. 1. Further, Morford’s varnish has a refractive index of above 1.61 and highly transparent over the entire visible spectrum EX1024. EX1024, p. 4; EX1003, ¶324.

The ’191 Patent’s only teaching with respect to **whereby at least a portion of the received ambient light at extreme angles is reflected to sharpen the displayed image** is that it is a direct result of providing a material with an index of at least 1.55, meaning it is not-limiting. *See* ’191 Patent, 17:11-15; *Texas Instruments Inc. v. U.S. Int’l Trade Comm’n*, 988 F.2d 1165, 1172 (Fed. Cir. 1993) (“A ‘whereby’ clause that merely states the result of the limitations in the claim adds nothing to the patentability or substance of the claim.”). Thus, because Fuhse262 and Morford provide filler with an index of over 1.55, it would cause **at least a portion of the received ambient light at extreme angles is reflected to sharpen the displayed image**. EX1003, ¶325.

F. Ground 6: Claims 2-4, 7-11 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925 (Ground 2) and further in view of Fuhse395 (Ground 3)

Ground 6 corresponds to Ground 2 but with the addition of Fuhse395 (Ground 3) applied to Ground 2. Ground 2 addresses the independent claims and Ground 3 addresses certain dependent claims. Accordingly, Fuhse925 (secondary reference

for Ground 2) does not affect positions for Ground 3, and Fuhse395 (secondary reference for Ground 3) does not affect positions for Ground 2. The motivation for combination and reasonable expectation of success for Grounds 2 and 3 apply here. Grounds 2 and 3 are re-presented here as Ground 6 and the analysis is the same. To avoid duplication, Petitioners incorporates the analysis (*see, supra*, Sections VII.B and VII.C (Grounds 2 and 3)) and Claims 2-4, 7-11 are rendered obvious. EX1003, ¶328.

G. Ground 7: Claims 2-4, 7-11 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925 (Ground 2) and further in view of Sauvage-Vincent (Ground 4)

Ground 7 corresponds to Ground 2 but with the addition of Sauvage-Vincent (Ground 4) applied to Ground 2. Ground 2 addresses the independent claims and Ground 4 addresses certain dependent claims. Accordingly, Fuhse925 (secondary reference for Ground 2) does not affect positions for Ground 4, and Sauvage-Vincent (secondary reference for Ground 4) does not affect positions for Ground 2. The motivation for combination and reasonable expectation of success for Grounds 2 and 4 apply here. Grounds 2 and 4 are re-presented here as Ground 7 and the analysis is the same. To avoid duplication, Petitioners incorporates the analysis above (*see, supra*, Sections VII.B and VII.D (Grounds 2 and 4)) and Claims 2-4, 7-11 are rendered obvious. EX1003, ¶329.

H. Ground 8: Claims 5 and 12 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925 (Ground 2) and further in view of Morford (Ground 5)

Ground 8 corresponds to Ground 2 but with the addition of Morford (Ground 5) applied to Ground 2. Ground 2 addresses the independent claims and Ground 5 addresses certain dependent claims. Accordingly, Fuhse925 (secondary reference for Ground 2) does not affect positions for Ground 5, and Morford (secondary reference for Ground 5) does not affect positions for Ground 2. The motivation for combination and reasonable expectation of success for Grounds 2 and 5 apply here. Grounds 2 and 4 are re-presented here as Ground 8 and the analysis is the same. To avoid duplication, Petitioners incorporate the analysis above (*see, supra*, Sections VII.B and VII.E (Grounds 2 and 5)) and Claims 5 and 12 are rendered obvious. EX1003, ¶330.

VIII. INSTITUTION IS APPROPRIATE UNDER §314(A)

Efficiency, fairness, and merits support institution despite the existence of co-pending litigation. *Apple v. Fintiv*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”).

Factor 1 (stay) is favors institution, because Petitioners moved for a stay under seal (see Factor 2) based on issues unrelated to this proceeding. *See Hulu LLC*

v. SITO Mobile R&D IP, LLC, IPR2021-00298, Paper 11 at 10-11 (PTAB May 19, 2021).

Factor 2 (proximity to trial) favors institution. With this Petition filing, Final Written Decision may be expected by November 2025. While the trial is scheduled for November 18, 2024 (EX101048, p. 1), the case may be transferred to the Court of Federal Claims (CoFC). In a separate litigation before the CoFC concerning the same patents-at-issue and involving the US Government, PO expressly represented that 28 U.S.C. § 1498 covers the nucleus of operative facts concerning alleged infringing products and identifies Petitioners as product contractors to the defendant in that case. Separately, in the EDTX case, Petitioners filed a Motion for Protective Order (including a request for stay) under seal concerning technical information sought by PO in light of the sensitivity of the information and Petitioners' defense under §1498. Petitioners expect to have more information prior to institution and can share relevant information with the Board as applicable and with any appropriate protections in place.

Factor 3 (investment in parallel litigation) is neutral. Fact discovery has not closed and the parties have not engaged in expert discovery. EX1048, p. 3. And the *Markman* hearing has been scheduled for June 14, 2024, after the filing of this Petition.

Factor 4 (overlapping issues) is neutral. If the litigation is not transferred to the CoFC prior to institution, Petitioners will consider not pursuing the Petition’s grounds before the district court by stipulation. *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020); *Sand Revolution II, LLC v. Cont’l Intermodal Grp.-Trucking LLC*, IPR2019-01393, Paper 24, 11-12 (PTAB Jun. 16, 2020); *Google LLC v. Jawbone Innovations, LLC*, IPR2022-00630, Paper 10, 16-17 (PTAB Sept. 13, 2022). However, pending resolution of Factor 2, it is premature to submit a *Sotera* stipulation at this time.

Factor 5 (same parties) may weigh slightly in favor of denial, because Petitioners and PO are the same parties as in the district court. However, based on a “holistic view,” the factors favor institution. *Samsung Elecs. Co. Ltd. v. Dynamics Inc.*, IPR2020-00505, Paper 11 at 15 (PTAB Aug. 12, 2020).

Factor 6 (other considerations) favors institution. Because the challenged claims cover known techniques published years before the earliest priority date, as discussed above, the features of the challenged claims are disclosed/suggested in the prior art presented here. *See, supra*, Section VII. This Petition’s merits are compelling.

Accordingly, *Fintiv* favors institution.

IX. INSTITUTION IS APPROPRIATE UNDER §325(D).

The Board should not exercise discretion to deny institution of trial under 35 U.S.C. § 325(d). In performing an analysis under § 325(d), the Board uses the two-part *Advanced Bionics* framework: “(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).

Part One: The grounds/arguments presented in this Petition are not the same or substantially the same as the prior art combinations and arguments raised during prosecution. Indeed, the Examiner did not reject any of the challenged claims based on prior art disclosures/combinations. *See, supra*, Section III.B. Also, Fuhse925, Fuhse395, Sauvage-Vincent, and Morford were not cited during prosecution of the ’191 Patent and therefore were not substantively considered. *Id.* While Applicant cited Fuhse262 in an Information Disclosure Statement submitted during prosecution of the ’191 Patent (EX1002, pp. 154-55, 189-91), the Examiner neither cited nor applied it. Specifically, the Examiner did not substantively discuss or rely

at all on Fuhse262 in rejecting any claims, or consider its teachings in the combinations this Petition relies on. *See, supra*, Section III.B.

For Ground 1, Petitioners rely on a combination of different embodiments of Fuhse262 (an embodiment relating to Fig. 2 in view of embodiment(s) relating to Figs. 8-10). *See, supra*, Section VII.A. Such a combination was not considered by the Examiner. For Grounds 2-5, Petitioners rely on combinations of different Fuhse262 (Ground 1) in further view of Fuhse925, Fuhse395, Sauvage-Vincent, or Morford. *See, supra*, Sections VII.B- VII.E. For Grounds 6-8, Petitioners rely on combinations of different Fuhse262 in view of Fuhse925 (Ground 2) and in further view of Fuhse395, Sauvage-Vincent, or Morford. *See, supra*, Sections VII.F-H. Such combinations were not considered by the Examiner. *Sony Grp. Corp. v. MZ Audio Scis., LLC*, IPR2022-01544, Paper 12 at 7-8 (PTAB Apr. 21, 2023) (same or substantially the same art/argument was not presented to the Office where “the Examiner did not consider the specific combination of references asserted in the [] grounds”); *see also, supra*, Section III.B.

The prior art disclosures and combinations relied on in this Petition are not cumulative over prior art applied/relied on by the Examiner. For example, the Examiner did not reject any of the challenged claims based on prior art disclosures/combinations. *See, supra*, Section III.B. Moreover, the Examiner

identified certain claim features of the challenged claims that were believed to be missing in the prior art of record. EX1004, pp. 58-60, 109-11, 145-46; *see also, supra*, Section III.B. As discussed above in the analysis of the prior art and grounds (Section **Error! Reference source not found.**), such claim features identified by the Examiner and the challenged claims are obvious in view of the combination of different embodiments of Fuhse262 and/or such a combination in further view of other prior art references. *See, supra*, Section **Error! Reference source not found.** Thus, the prior art disclosures and combinations relied on in this Petition are not cumulative.

Part Two: Even if the prior art or arguments presented in this Petition are substantially the same as those raised or substantively considered during prosecution (they are not), the Examiner/Office erred in a manner material to the patentability of the claims. For this part, “if the record of the Office’s previous consideration of the art is not well developed or silent, then a petitioner may show the Office erred by overlooking something.” *Advanced Bionics*, Paper 6 at 10.

As discussed above (for Part One), the Examiner did not reject any of the challenged claims based on prior art disclosures/combinations. *See, supra*, Section III.B. The Examiner did not substantively discuss or rely on the prior art and the combinations that the Petition relies on. For example, the Examiner did not

substantively discuss or rely on Fuhse262 or consider the combinations presented for Grounds 2-8. Thus, the record is not well developed and is silent.

The Examiner overlooked relevant disclosures of prior art. For example, the Examiner identified certain claim features that were believed to be missing in the prior art of record. *See, supra*, Section III.B. However, as discussed above in the analysis of the prior art and grounds (Section **Error! Reference source not found.**), Petitioners have sufficiently shown a reasonable likelihood that such claim features identified by the Examiner and the challenged claims are obvious in view of the combination of different embodiments of Fuhse262 and/or such a combination in further view of other prior art references. *See, supra*, Section **Error! Reference source not found.** The Examiner clearly overlooked the relevant disclosures of Fuhse262 (*e.g.*, those pertaining to embodiments of Figs. 2, 8-10 and the combination of such embodiments) and those of other prior art references and the combinations relied on in the Petition. Thus, the Examiner/Office erred in a manner material to the patentability of the claims. *Cellco P'ship d/b/a Verizon Wireless v. Huawei Device Co., Ltd.*, IPR2020-01117, Paper 10 at 13-15 (PTAB Feb. 3, 2021) (declining to exercise discretion when an IDS and international search report identified prior art references, but the examiner did not address/apply them with

respect to the challenged claims); *LG Elecs. Inc. v. Pantech Corp.*, IPR2023-01273, Paper 26 at 15-18 (PTAB Apr. 9, 2024).

Accordingly, the Board should not exercise its §325(d) discretion to deny institution.

X. MANDATORY NOTICES

A. Real Parties-in-Interest Under 37 C.F.R. § 42.8(b)(1)

Petitioners are the real parties-in-interest.

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

To the best knowledge of Petitioners, the '191 Patent is involved in the following district court litigation: *Lumenco, LLC v. Giesecke+Devrient GmbH*, No. 2:23-cv-00100 (E.D. Tex. 2023) and *Lumenco, LLC v. United States*, No. 24-139-T (Fed. Cl. 2024).

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

Petitioners provides the following designation of counsel:

Lead Counsel	Backup Counsel
David M. Tennant (Reg. No. 48,362) davidtennant@paulhastings.com Postal & Hand-Delivery Address: Paul Hastings LLP 2050 M Street, NW Washington, DC 20036 Telephone: (202) 551-1997	Jacob Rothenberg (Reg. No. 77,891) jacobrothenberg@paulhastings.com Postal & Hand-Delivery Address: Paul Hastings LLP 2050 M Street, NW Washington, DC 20036 Telephone: (202) 551-1976

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Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this petition.

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

A Power of Attorney is being filed concurrently with this Petition in accordance with 37 C.F.R. § 42.10(b). Petitioner consents to electronic service by e-mail, using the email addresses identified above.

XI. GROUNDS FOR STANDING

Petitioners certifies that the '191 Patent is available for IPR; Petitioners is not barred or estopped from requesting IPR; and this petition is being filed within one year of service of the complaint in the co-pending district court litigation.

XII. CONCLUSION

Petitioners requests institution of this IPR and cancellation of the claims.

Dated: May 1, 2024

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that foregoing
**PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO.
10,901,191**, exclusive of the parts exempted as provided in 37 C.F.R. §42.24(a),
contains 13,910 words and therefore complies with the type-volume limitations of
37 C.F.R. §42.24(a).

Dated: May 1, 2024

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CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing **PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 10,901,191 AND EXHIBITS** are being served on May 1, 2024, via Federal Express overnight mail on counsel of record for U.S. Patent No. 10,901,191 as addressed below:

**McCarthy, Randall
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A courtesy copy is also being served on counsel for the patent holder in the pending litigation via electronic mail.

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Dated: May 1, 2024

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