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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. IPR-2024-00837

**Petition for *Inter Partes* Review of
U.S. Patent No. 10,317,691**

TABLE OF CONTENTS

I.	INTRODUCTION.....	1
II.	BACKGROUND	2
	A. Optically Variable Devices for Document Anti-Counterfeiting	3
	B. Micro-mirror Arrays.....	3
III.	THE '691 PATENT.....	4
	A. Specification.....	4
	B. Prosecution History	7
IV.	STATEMENT OF RELIEF REQUESTED	8
	A. Grounds	8
	B. Priority Date	8
	C. The References Are Prior Art.....	9
	D. Overview of the Prior Art.....	10
	1. Fuhse262 (EX1006)	10
	2. Fuhse925 (EX1008)	13
	3. Jordan (EX1009)	13
	4. Fuhse172 (EX1035)	14
	E. The Prior Art is Analogous Art.....	14
V.	LEVEL OF ORDINARY SKILL	14
VI.	CLAIM CONSTRUCTION	15
VII.	GROUND OF UNPATENTABILITY	15

A.	Ground 1: Claims 1, 4-7 and 10-12 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925.....	15
1.	Motivation to Combine	15
a.	Fuhse262 (Combination of Embodiments)	15
b.	Fuhse262 in view of Fuhse925	17
2.	Reasonable Expectation of Success	20
a.	Fuhse262	20
b.	Fuhse262 in view of Fuhse925	21
3.	Independent Claim 1	22
a.	[1Pre] “A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:”	22
b.	[1a] “a substrate; and on a surface of the substrate, an array of micro mirrors receiving ambient light and,”	23
c.	[1b] “in response, displaying a plurality of images in a plane spaced a distance apart from the surface of the substrate, wherein each of the images comprises a plurality of pixels,”	26
d.	[1c] “wherein the array of micro mirrors includes, for each of the pixels of each of the images, a set of 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,”	31
e.	[1d] “wherein each of the sets of the micro mirrors providing the pixels for each of the differing ones of the images has a differing cone angle offset,	

	wherein the cone angle offset is defined based upon a relative position of a cone axis for a cone of rays projected by the sets of the micro mirrors through each of the pixels,”	34
f.	[1e] “wherein the cone has a cone angle in the range of 10 to 45 degrees,”	42
g.	[1f] “wherein the cone angle offsets are selected whereby the cones do not overlap at a predefined height above the substrate, whereby only one of the images is observable at a time by a viewer,”	43
h.	[1g] “wherein each of the sets of the micro mirrors includes at least two of the micro mirrors,”	46
i.	[1h] “wherein the reflected ambient light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,”	46
j.	[1i] “wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate, and”	47
k.	[1j] “wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.”	48
4.	Independent Claim 6	52
a.	[6Pre] “A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:”	52

- b. [6a] “a substrate; and on a surface of the substrate, a plurality of micro mirrors receiving light and,” 52
- c. [6b] “in response, displaying a plurality of images in a plane a distance away from the surface of the substrate,” 52
- d. [6c] “wherein the plurality of micro mirrors includes, for each of displayed pixel of each of the images, a number of the micro mirrors each having a reflective surface oriented, in a rigid manner, to reflect the ambient light toward a point on the plane corresponding to one of the pixels,” 53
- e. [6d] “wherein each of the sets of the micro mirrors providing the pixels for each of the differing ones of the images has a differing cone angle offset, wherein the cone angle offset is defined based upon a relative position of a cone axis for a cone of rays projected through each of the pixels,” 53
- f. [6e] “wherein each of the numbers of the micro mirrors includes at least two of the micro mirrors,” 53
- g. [6f] “wherein the reflected ambient light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,” 54
- h. [6g] “wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate, and” 54
- i. [6h] “wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.” 54

5.	Independent Claim 12	54
a.	[12Pre] “A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:”	55
b.	[12a] “on a surface of the substrate, an array of micro mirrors receiving light and,”	55
c.	[12b] “in response, displaying images; wherein each of the images comprises a plurality of pixels,”	55
d.	[12c] “wherein the array of micro mirrors includes, for each of the pixels of the images, a set of the micro mirrors each having a reflective surface oriented to reflect received light toward a point on a plane corresponding to one of the pixels,”	55
e.	[12d] “wherein each of the sets of the micro mirrors providing the pixels for each of the images has a differing cone angle offset,”	55
f.	[12e] “wherein each of the sets of the micro mirrors includes at least two of the micro mirrors,”	56
g.	[12f] “wherein the reflected received light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,”	56
h.	[12g] “wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate,”	56
i.	[12h] “wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames,”	56

j.	[12i] “wherein the animation is in both the X axis and in the Y axis, and”	56
k.	[12j] “wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.”	57
6.	Dependent Claims	57
a.	Claim 4: “The assembly of claim 1, wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames.”	57
b.	Claim 5: “The assembly of claim 4, wherein the animation is in both the X axis and in the Y axis.”	59
c.	Claim 7: “The assembly of claim 6, wherein the cone has a cone angle in the range of 10 to 45 degrees and wherein the cone angle offsets are selected whereby the cones do not overlap at a predefined height above the substrate.”	60
d.	Claim 10: “The assembly of claim 6, wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames.”	60
e.	Claim 11: “The assembly of claim 10, wherein the animation is in both the X axis and in the Y axis.”	60
B.	Ground 2: Claims 1, 4-7 and 10-12 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925 and Jordan	60

1.	Motivation and Combine	61
2.	Reasonable Expectations	61
3.	[1Pre]/[6Pre]/[12Pre]	61
C.	Grounds 3 and 4: Claims 3, 9, and 13 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925, and Fuhse172 (Ground 3); Fuhse262 in view of Fuhse925, Jordan, and Fuhse172 (Ground 4).....	62
1.	Motivation and Combine	62
2.	Reasonable Expectations	63
3.	Claim 3	64
a.	[3a]: “The assembly of claim 1, wherein the micro mirrors are configured to display the images in at least two colors and”	64
b.	[3b]: “wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure the micro mirrors to display the image with the colors.”	65
4.	Claim 9	66
a.	[9a]: “The assembly of claim 6, wherein the micro mirrors are configured to display the images in at least two colors and”	66
b.	[9b]: “wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure the micro mirrors to display the image with the colors.”	66
5.	Claim 13	66

a.	[13a]: “The assembly of claim 12, wherein the micro mirrors are configured to display the images in at least two colors and”	66
b.	[13b]: “wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure the micro mirrors to display the image with the colors.”	66
VIII. SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS		67
IX. INSTITUTION IS APPROPRIATE UNDER FINTECH		67
X. INSTITUTION IS APPROPRIATE UNDER §325(D)		69
XI. MANDATORY NOTICES.....		75
A.	Real Parties-in-Interest Under 37 C.F.R. § 42.8(b)(1).....	75
B.	Related Matters Under 37 C.F.R. § 42.8(b)(2)	75
C.	Lead and Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)	75
D.	Service Information Under 37 C.F.R. § 42.8(b)(4).....	76
XII. GROUNDS FOR STANDING		76
XIII. CONCLUSION		77

TABLE OF AUTHORITIES

	Page(s)
Cases	
<i>Abbot Vascular, Inc. v. Flexstent</i> , IPR2019-00882, Paper 48, 28-29 (Oct. 2, 2020).....	17
<i>Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH</i> , IPR2019-01469, Paper 6 (PTAB Feb. 13, 2020).....	69, 70, 72
<i>Apple v. Fintiv</i> , IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020).....	67, 69
<i>Black v. CE Soir Lingerie Co.</i> , No. 2:06-CV-544, 2008 WL 3852722 (E.D. Tex. Aug. 15, 2008).....	17
<i>Boston Sci. Scimed, Inc. v. Cordis Corp.</i> , 554 F.3d 982 (Fed. Cir. 2009)	16
<i>Catalina Mktg. Int’l, Inc. v. Coolsavings.com, Inc.</i> , 289 F.3d 801 (Fed. Cir. 2002)	23
<i>Cellco P’ship d/b/a Verizon Wireless v. Huawei Device Co., Ltd.</i> , IPR2020-01117, Paper 10 (PTAB Feb. 3, 2021).....	73
<i>Google LLC v. Jawbone Innovations, LLC</i> , IPR2022-00630, Paper 10, 16-17 (PTAB Sept. 13, 2022)	69
<i>In re GPAC Inc.</i> , 57 F.3d 1573 (Fed. Cir. 1995)	14
<i>Hulu LLC v. SITO Mobile R&D IP, LLC</i> , IPR2021-00298, Paper 11 (PTAB May 19, 2021)	67
<i>KSR Int’l Co. v. Teleflex, Inc.</i> , 550 U.S. 398 (2007).....	19, 20, 63
<i>Laird Techs., Inc. v. Garftech Int’l Holdings, Inc.</i> , IPR2014-00024, Paper 46, 30-31 (Mar. 25, 2015).....	17

<i>Leapfrog Enters. v. Fisher-Price, Inc.</i> , 485 F.3d 1157 (Fed. Cir. 2007)	67
<i>LG Elecs. Inc. v. Pantech Corp.</i> , IPR2023-01273, Paper 26 (PTAB Apr. 9, 2024)	73
<i>Lumenco, LLC v. Giesecke+Devrient GmbH</i> , No. 2:23-cv-00100 (E.D. Tex. 2023).....	74
<i>Lumenco, LLC v. United States, No. 24-139-T</i> (Fed Cl. 2024)	74
<i>Newell Cos. v. Kenney Mfg. Co.</i> , 864 F.2d 757 (Fed. Cir. 1988)	67
<i>Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.</i> , 868 F.3d 1013 (Fed. Cir. 2017)	15
<i>Samsung Elecs. Co. Ltd. v. Dynamics Inc.</i> , IPR2020-00505, Paper 11 (PTAB Aug. 12, 2020).....	69
<i>Sand Revolution II, LLC v. Cont’l Intermodal Grp.-Trucking LLC</i> , IPR2019-01393, Paper 24, 11-12 (PTAB Jun. 16, 2020).....	69
<i>Sony Grp. Corp. v. MZ Audio Scis., LLC</i> , IPR2022-01544, Paper 12 (PTAB Apr. 21, 2023)	71
<i>Sotera Wireless, Inc. v. Masimo Corp.</i> , IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020)	69
<i>Texas Instruments Inc. v. U.S. Int’l Trade Comm’n</i> , 988 F.2d 1165 (Fed. Cir. 1993)	<i>passim</i>
<i>Unwired Planet, LLC v. Google Inc.</i> , 841 F.3d 995 (Fed. Cir. 2016)	14
<i>Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.</i> , 200 F.3d 795 (Fed. Cir. 1999)	15

Other Authorities

28 U.S.C. § 1498	68
------------------------	----

35 U.S.C. §102(a)(1).....	9
35 U.S.C. §103.....	15, 60, 62
35 U.S.C. § 112.....	15
35 U.S.C. § 311.....	1
35 U.S.C. § 325(d)	69, 73
37 C.F.R. § 42.8(b)(1-4)	73, 74, 75
37 C.F.R. § 42.10(b)	75
37 C.F.R. §42.24(a).....	80
37 C.F.R. § 42.24(d)	80

TABLE OF EXHIBITS

Exhibit	Description
Ex. 1001	U.S. Patent No. 10,317,691 to Raymond (“the ’691 patent”)
Ex. 1002	File History of U.S. Patent No. 10,317,691
Ex. 1003	Declaration of Lambertus Hesselink, Ph.D.
Ex. 1004	U.S. Provisional Application No. 62/262,767
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	U.S. Patent Application Publication No 2014/0367957 (“Jordan”)
Ex. 1010	Reserved
Ex. 1011	Reserved
Ex. 1012	Reserved
Ex. 1013	Reserved
Ex. 1014	Reserved
Ex. 1015	Reserved
Ex. 1016	Reserved
Ex. 1017	Reserved

Exhibit	Description
Ex. 1018	Reserved
Ex. 1019	Reserved
Ex. 1020	Reserved
Ex. 1021	Reserved
Ex. 1022	WO2012048847A1_English (“Fuhse847”)
Ex. 1023	Reserved
Ex. 1024	Reserved
Ex. 1025	Reserved
Ex. 1026	Lee R.A., Leech P.W., “Development of Optically Variable Devices for Document Security in CSIRO Journal of the Coatings Association of Australia,” Vol. 42(8), August 2005, p. 22-27.
Ex. 1027	<i>Optics</i> , Hecht, 4th Edition (2002)
Ex. 1028	Saleh and Teich. Fundamentals of Photonics (1st Edn. 1991), Ch. 1
Ex. 1029	Reserved
Ex. 1030	Franssila, S. Introduction to Microfabrication (1st ed. 2004)
Ex. 1031	Finale coin in the Australian Centenary of Federation Program Featuring an Optically Variable Device
Ex. 1032	New method of producing OVD coins
Ex. 1033	Reserved
Ex. 1034	Reserved
Ex. 1035	U.S. Pat. App. Pub. No. 2013/0093172 (“Fuhse172”)
Ex. 1036	Curriculum Vitae of Lambertus Hesselink
Ex. 1037	Reserved

Exhibit	Description
Ex. 1038	Reserved
Ex. 1039	Reserved
Ex. 1040	WO2012048847A1 (“Fuhse847 Native”)
Ex. 1041	Reserved
Ex. 1042	Reserved
Ex. 1043	WO2012048847A1 – Certificate of Translation
Ex. 1044	Reserved
Ex. 1045	Reserved
Ex. 1046	Reserved
Ex. 1047	Reserved
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	Reserved
Ex. 1050	Reserved

I. INTRODUCTION

Giesecke+Devrient GmbH, Giesecke+Devrient Currency Technology GmbH, and Papierfabrik Louisenenthal GmbH (collectively, “G+D” or “Petitioners”) request review under 35 U.S.C. § 311 and cancellation of claims 1, 3-7, and 9-13 of U.S. Patent No. 10,317,691 (EX1001, “the ’691 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 '691 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, 3-7, and 9-13 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, ¶¶22-33.

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, ¶¶22-33.

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, ¶¶31-33.

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, ¶28.

Micro-mirrors OVD have been used on banknotes as anti-counterfeiting 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, ¶¶29-33.

III. THE '691 PATENT

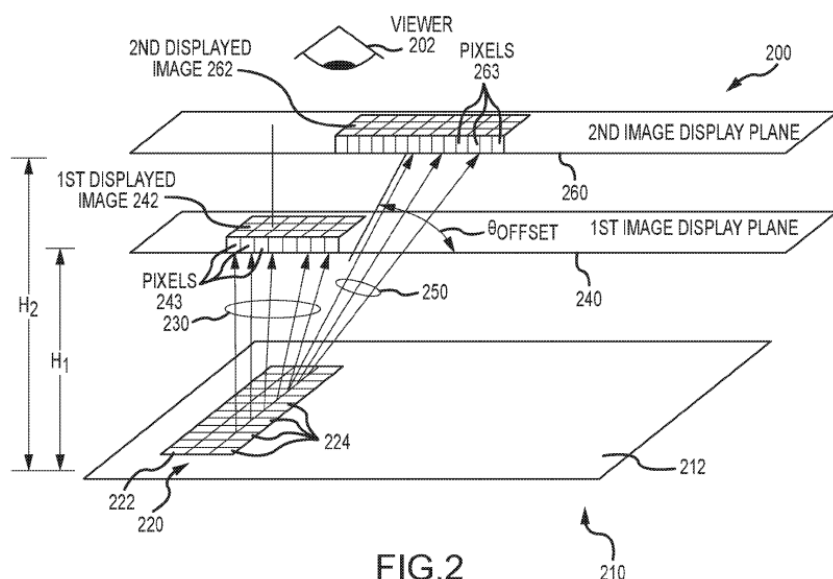
A. Specification

The '691 Patent is a continuation-in-part application that frames its purported invention as an advancement of currency anti-counterfeiting devices from prior art, such as “moiré patterns” and holograms. EX1001, 1:28-2:32. Instead of “merely laterally reflecting back light...or using reproducible holograms,” the purported invention of the '691 Patent displays “images that float above and/or below a focal plane.” EX1001, 2:26-32; EX1003, ¶¶49-53.

The '691 Patent describes a security element provided on a currency or product label, which generates images with light in “spatial planes above and below the surface of an array of micro mirrors.” EX1001, 2:36-39, 3:13-18; EX1003, ¶50.

The '691 Patent groups the micro-mirrors into sets, with the micro-mirrors of each set oriented to reflect ambient light towards a point corresponding to a “pixel.” EX1001, 2:36-51. Numerous pixels together form an image in an “image display plane,” and multiple images may be produced in different image display planes. *Id.*

Figure 2 depicts “floating image(s)” at “a height or distance above...the array of micro mirrors.” EX1001, 6:20-7:22; EX1003, ¶¶52-58.



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, such the viewer 202 typically only views one of the floating images 242, 262 at a time. EX1001, 9:15-21; EX1003, ¶54.

The continuation-in-part application added Figures 16-27 and associated description that purport to introduce 3D effects and animations. EX1001, 21:14-26. Fig. 19 (below) exemplifies an animation with the effect of a moving star in multiple axes where only one image is visible at any one time from a particular viewing angle. EX1001, 24:44-60; 26:6-37. Fig. 23 (below) shows a viewer seeing an image associated with a given voxel 2016, because rays/beams 2017 from the voxel (depicted

in a form of a cone, based on a viewing angle) are received by the viewer's eye 2002.

EX1001, 26:18-23; EX1003, ¶¶58-59.

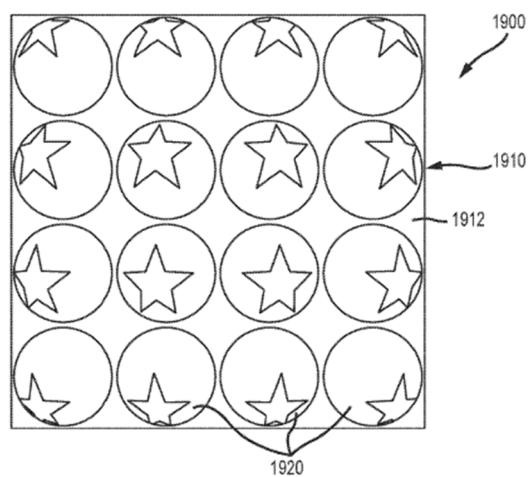
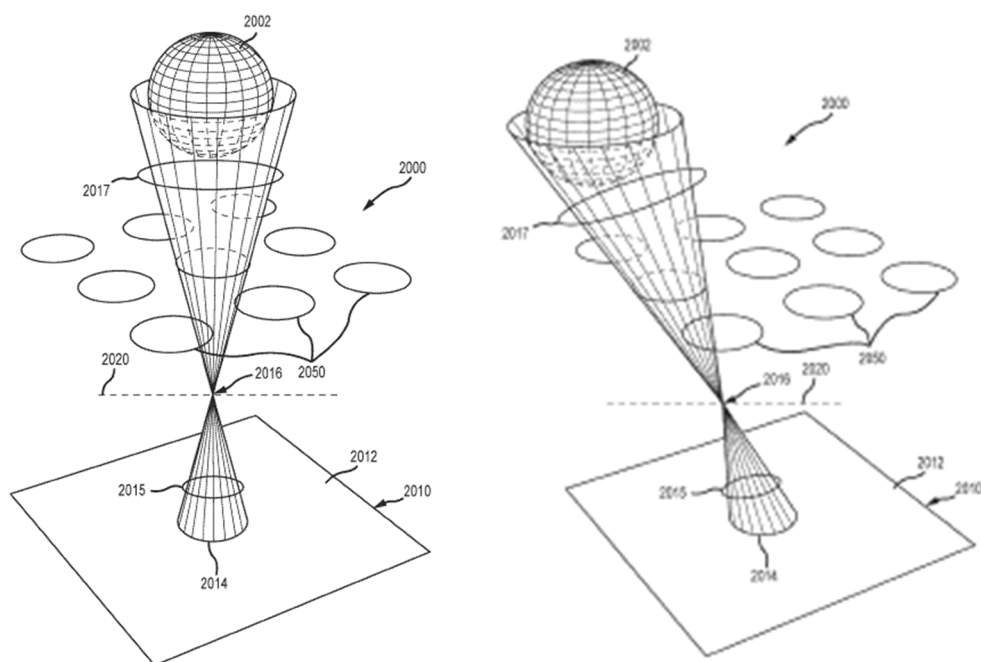


FIG. 19



EX1001, FIGs. 23 (left), 24 (right).

B. Prosecution History

The '691 Patent (Application No. 15/588,831) was filed on May 8, 2017, as a continuation-in-part of Application No. 15/162,113 (now US10,189,294), claiming priority to 62/262,767 (EX1004) (filed December 3, 2015). EX1001; EX1003, ¶48.

On January 23, 2019, the Office issued a non-final rejection rejecting claims 1-6, 41-45 and 49 as being anticipated by WO2010/048847 (“Kaule”) (p. 3); and claims 7, 46 and 50 as being unpatentable as obvious over Kaule in view of US2012/0098249 (“Rahm”) (p. 7). EX1002, pp. 107-17; EX1003, ¶¶60-61.

On January 29, 2019, Applicant amended claims 1 (issued claim 1), 41, 49 (issued claim 12), cancelled claims 2, 3, 10-40, 44 and 45, while other original claims remained, unamended, and added new claim 52. EX1002, pp. 94-98. Applicant premised its response by arguing that Kaule teaches light spots created by micromirrors with a single and not differing cones so there is no cone angle offset taught or suggested by this reference. *Id.*, p. 100; EX1003, ¶62.

On March 20, 2019, the Examiner again issued a series of prior art rejections against claims 41-43 based on Kaule, and against others claims based on Kaule in view of other references (pp. 3-12); and identified claim 52 as allowable (p. 12). EX1002, p. 66-80; EX1003, ¶63.

On the same day, Applicant amended each of claims 1 (issued claim 1), 41, and 49 (issued claim 12) with allowable subject matter from claim 52, and cancelled

claims 5, 6, 51 and 52, while other claims remained, unamended. EX1002, pp. 56-64; EX1003, ¶64.

On April 25, 2019, the Examiner allowed the claims (EX1002, pp. 31-38) and stated the “the prior art fails to teach or reasonably suggest” the claim language corresponding to elements [1g]-[1j]; [6e]-[6h]; and [12e]-[12g], [12j]. *Id.*, pp. 36-37; EX1003, ¶65.

IV. STATEMENT OF RELIEF REQUESTED

A. Grounds

No.	Claims Challenged	Ground Statements
1	1, 4-7, and 10-12	Fuhse262, Fuhse925
2	1, 4-7, and 10-12	Fuhse262, Fuhse925, Jordan
3	3, 9, 13	Fuhse262, Fuhse925, Fuhse172
4	3, 9, 13	Fuhse262, Fuhse925, Jordan, Fuhse172

B. Priority Date

The earliest application to which the '691 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, ¶48.

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) or §102(a)(2):

- (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 (EX1008);
- (3) U.S. Pub. No. 2014/0367957 (“Jordan”) filed June 13, 2014, published December 18, 2014 (EX1009); and
- (4) U.S. Pub. No. 2013/0093172 (“Fuhse172”) filed June 19, 2012 with priority to December 4, 2009, and published on April 18, 2013 (EX1035).

¹ PCT Publication No. WO 2012/048847 (“Fuhse847”), published on April 19, 2012 with priority to October 12, 2010, claims priority to Fuhse262. EX1022 is a verified, official translation of the native language Fuhse847 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).

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, ¶¶77-80.

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, ¶¶81, 96.

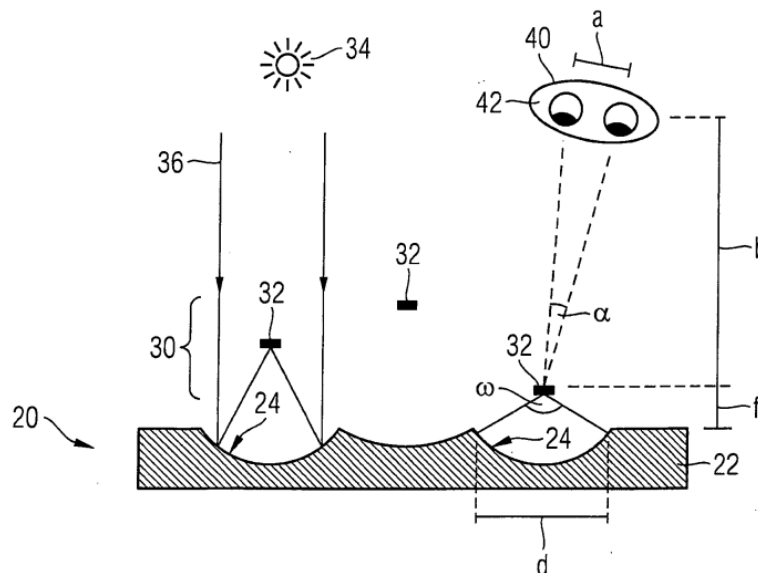
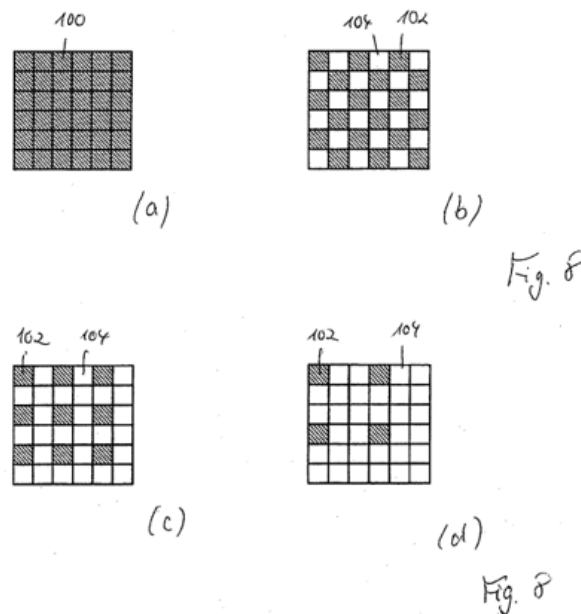


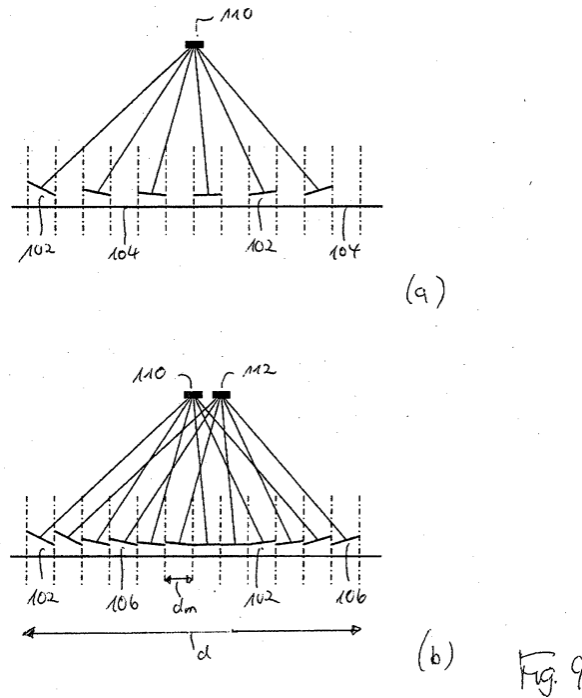
Fig. 2

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, ¶¶80-86, 97-98, 128.

The micro-mirrors are an array of “n x n micromirrors” that each have “a flat mirror surface” with a “dimension of 50 μ m x 50 μ m.” 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:



EX1006, ¶¶0019; EX1003, ¶¶80, 82.

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, ¶¶77, 139.

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. 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, ¶¶83-86, 98.

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, ¶¶78, 98, 145, 151.

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, ¶¶81-86, 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, ¶87.

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, ¶88.

3. Jordan (EX1009)

Jordan teaches methods of using arrays of reflective microstructures that produce images “as a security and anti-counterfeiting feature to identify and distinguish authentic products from counterfeit products,” such as “banknotes” or “coinage,” as well as “product marking and labeling” and “packaging.” EX1009, Abstract, ¶¶0013, 0002-04, 0113-14, 0124-25, 0154, 0159, 0174-77; EX1003, ¶89.

4. Fuhse172 (EX1035)

Fuhse172 discloses that in order “to apply a color-shifting coating, in particular a thin-film system, to the facets,” the thin-film system can use dielectric layers. EX1035, ¶¶0118, 0027-29; EX1003, ¶¶90-91.

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 they are from the same field as the ’691 Patent, *e.g.*, optical devices for document security. EX1003, ¶¶49-50, 77-91, 99, 243, 252; EX1001, Abstract, 1:19-26. They are also pertinent to a problem the inventor was focused on, *e.g.*, displaying images with document security devices. EX1003, ¶¶49-50, 77-91, 99, 243, 252; EX1001, 2:18-32.

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, ¶¶12-13.

VI. CLAIM CONSTRUCTION

PO has sued Petitioners for infringement of the '691 Patent. *See, infra*, XI.B. 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.³ *Nidec Motor Corp. v. Zhongshan Broad Ocean 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, 4-7 and 10-12 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925.

1. Motivation to Combine

a. Fuhse262 (Combination of Embodiments)

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, ¶94.

³ In district court, the parties may dispute whether some claims are invalid under 35 U.S.C. § 112. For this proceeding only, Petitioners assume the claims are not invalid under § 112.

It would have been obvious to a POSITA to combine the multiple embodiments. EX1003, ¶¶95-98. 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, ¶¶95-98.

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, ¶96.

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; EX1003, ¶97.

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, ¶98. 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, ¶98.

b. Fuhse262 in view of Fuhse925

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, ¶99.

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. 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. 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, ¶100.

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, ¶101.

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, ¶102.

2. Reasonable Expectation of Success

a. Fuhse262

A POSITA would have had a reasonable expectation of success combining the embodiments of Fuhse262. EX1003, ¶¶103-107.

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, ¶104. The aspects of the Figure 2 descriptions relied on – such as the substrate and ambient light (*see* ([1a])) – 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. 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, ¶104.

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, ¶105.

The art was relatively predictable in the relevant timeframe (2015). *Id.* 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, ¶106. Given that micro-mirror arrays of the type contemplated in the '691 Patent were textbook knowledge at the time of the alleged invention, a POSITA would have no difficulty combining embodiments of Fuhse262. EX1003, ¶106.

Thus, a POSITA would have been able to implement the obviousness modifications in this ground without difficulty. *Id.* EX1003, ¶107.

b. Fuhse262 in view of Fuhse925

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, ¶¶103, 108.

For example, Fuhse262 teaches that its micromirrors may “for example, have a dimension of $50\ \mu\text{m} \times 50\ \mu\text{m}$ and can be formed with a flat mirror surface.” EX1006, ¶¶95-99. Fuhse925’s facets are “micromirrors” with “the dimensions... between $20\ \mu\text{m}$ and $300\ \mu\text{m}$, preferably between $50\ \mu\text{m}$ and $200\ \mu\text{m}$.” EX1008, 5:36-38, 7:43-48; EX1003, ¶109. 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, ¶109. Thus, the teachings in Fuhse925 regarding proper orientation of micro-mirrors would have been incorporated into Fuhse262 with no difficulty. EX1003, ¶109.

As discussed above (*see* VII.A.2.a), the art was relatively predictable in the relevant timeframe (2015). *Id.* Thus, a POSITA would have been able to implement the obviousness modifications in this ground without difficulty. *Id.* As Petitioners' expert explains (*see* EX1003, Section V.A (Technology Background, Optical Security Feature)), the art of micro-mirror arrays was mature and known to work well before the time of the alleged invention. EX1003, ¶110.

The required mathematics regarding surface orientations (EX1003, Section V.C) would have been well within the skill of a POSITA because that knowledge is integral to OVD operation. Given the mature state of the art, it would have been routine and predictable for a POSITA to implement the system of Fuhse262's teachings according to the surface inclination teachings of Fuhse925 in 2015. EX1003, ¶111.

3. Independent Claim 1

- a. **[1Pre] "A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:"**

The preamble is not limiting. The preamble merely states what the invention is "useful as" (*see* EX1003, ¶114), 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).

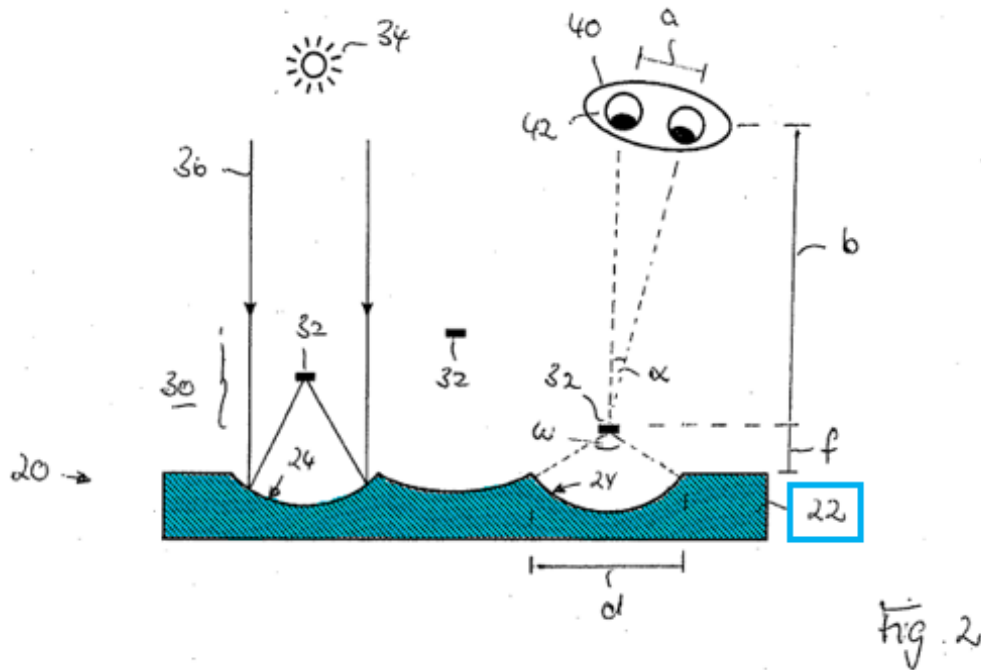
Further, no preamble term provides antecedent basis to terms in the claim body, so the preamble does not contribute to the structural completeness of the claim body. EX1003, ¶115.

To the extent it is limiting, Fuhse262 teaches the preamble. Fuhse262’s invention relates to “a depiction element” ([a] **visual display assembly**) “[f]or security applications” and with “an attractive visual appearance.” 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, ¶¶116-121.

Accordingly, Fuhse262 renders obvious [1Pre]. EX1003, ¶¶114-121.

b. [1a] “a substrate; and on a surface of the substrate, an array of micro mirrors receiving ambient light and,”

Fuhse262 teaches [1a]. EX1006, Abstract, ¶¶0001, 0010, 0035, 0056-65, 0110; EX1003, ¶¶122-123. Fuhse262 discloses “**a substrate 22**” shown below annotated in blue. *Id.*

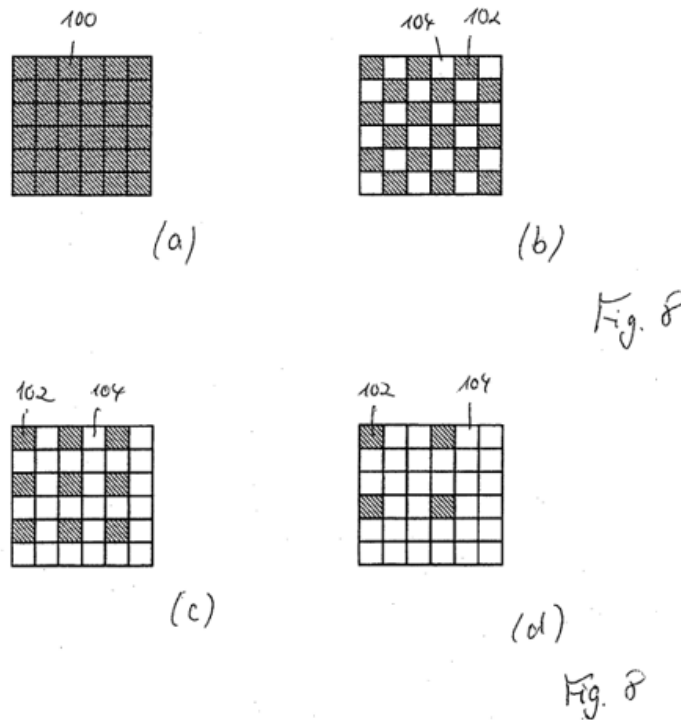


EX1006, FIG. 2 (annotated); EX1003, ¶123.

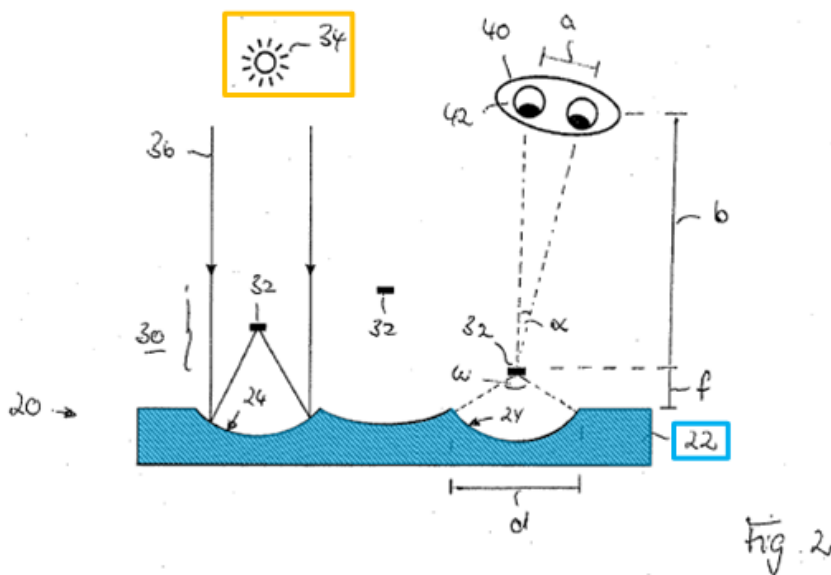
Fuhse262's substrate has "a surface region" (**on a surface of the substrate**) "in which a plurality of optical elements are arranged." See EX1006, Abstract, ¶¶0010, 0001, 0035, 0056-65, 0110. The optical elements may be "plurality of micromirrors" (**an array of micro mirrors**) "distributed over a certain surface region of substrate 22" (**on a surface of the substrate**). EX1006, ¶¶0060, 0013, 0022, 0030, 0083, 0087-95. The surface of the substrate defines a "xy plane" or "substrate plane." EX1006, ¶¶0126-27, 0110; EX1003, ¶¶124-127.

Figure 8, including Figures 8(a)-8(d), 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, ¶128.



A POSITA would have understood that this ordered arrangement of micro-mirrors 100 is **an array**. 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, FIG. 2 (annotated), ¶¶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, ¶¶123, 129-130.

Accordingly, Fuhse262 renders obvious [1a]. EX1003, ¶¶122-131.

- c. [1b] “in response, displaying a plurality of images in a plane spaced a distance apart from the surface of the substrate, wherein each of the images comprises a plurality of pixels,”**

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

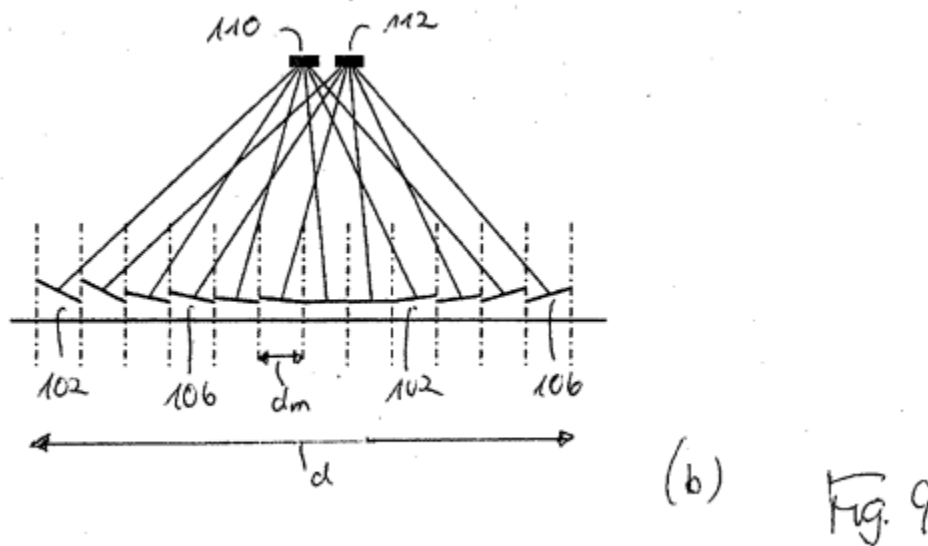
plane spaced a distance apart from the surface of the substrate). EX1006, ¶¶0010-12, 0015, 0026, 0035-36, 0054-56, 0083-84, 0126-28. The production of light-spot image composed of a plurality of light spots is **in response** to the illumination because the illumination causes the micro-mirrors to reflect light, which produces the light spots. EX1006, ¶0010; EX1003, ¶¶133-144.

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, 0015. Just as the pixels 243 in the ’691 Patent produce image 242 (*see* EX1001, 8:50-56, FIG. 2), the light spots produce the light spot image. EX1003, ¶¶138-139.

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. Fuhse262 interchangeably refers to image point P_j (**pixel**) and its corresponding light spot as “pixel P_j .” EX1006, ¶¶0126, 0128. The “xy plane” is understood to be **the surface of the substrate** because it is the plane that is divided into fields that are “covered with” the optical elements (micromirrors) which are **on a surface of the substrate**, as required by element [1a]. EX1006, ¶¶0036, 0125-28; EX1003, ¶140.

For example, Figure 9(b) shows “two closely adjacent light spots” 110 and 112 (two **pixels**) formed at the same height:



EX1006, ¶¶0049, 0091-92; EX1003, ¶144.

By teaching any arbitrary three-dimensional image in space (*i.e.*, x, y, z space) can be constructed of light points, a POSITA would understand that a two-dimen-

sional image can be constructed by fixing the height (z) values of the pixels. However, Fuhse262 goes further and explicitly teaches that a two dimensional image may be formed by fixing the height (z) values of the pixels: “*all light spots in the light-spot image have the same floating height.*” EX1006, ¶¶0068, 0015, 0026 (emphasis added). In fact, Fuhse262 refers to the resulting image as “a two-dimensional motif,” such as “a font or a logo.” EX1006, ¶¶ 0015, 0027, 0117. For the given fixed height of the two-dimensional motif (for example, $z = z_1$), the image is **in a plane** defined by (x, y, z_1). EX1003, ¶¶134-135, 141-144.

Fuhse262 also teaches **displaying a plurality of images**, such as “image A” and “image B,” which are “different images” that “become visible to the viewer from different directions.” EX1006, ¶¶0111-13. Each of these images is displayed in **a plane spaced a distance apart from the surface of the substrate** in the manner discussed above. EX1003, ¶145.

Moreover, Fuhse262 teaches “two-dimensional” images such as “a font or a logo” (EX1006, ¶¶0015, 0027, 0117), and teaches that “several” images may be produced. *Id.*, ¶¶0116-17; EX1003, ¶146.

Fuhse262 also 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**. For example, a POSITA would have understood that when the two images are in the same place, their pixels have the same heights, and therefore are in the same plane. This is accomplished as discussed above, by selecting all of the image points P_j of the **second image** with the same height values Z_j , the **first image**. EX1006, ¶¶0036, 0125-28, 0117 (“a two-dimensional motif” has “all image points are at the same height”). EX1003, ¶147.

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 (EX1006, ¶¶0027, 0118), a POSITA would understand that Fuhse262 teaches displaying two two-dimensional images in the claimed manner. As discussed above, based on Fuhse262’s teachings that 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. Thus, 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, a POSITA would understand that two two-dimensional images are displayed at the same height (i.e., in the same plane). EX1003, ¶148.

Accordingly, Fuhse262 renders obvious [1b]. EX1003, ¶¶132-149.

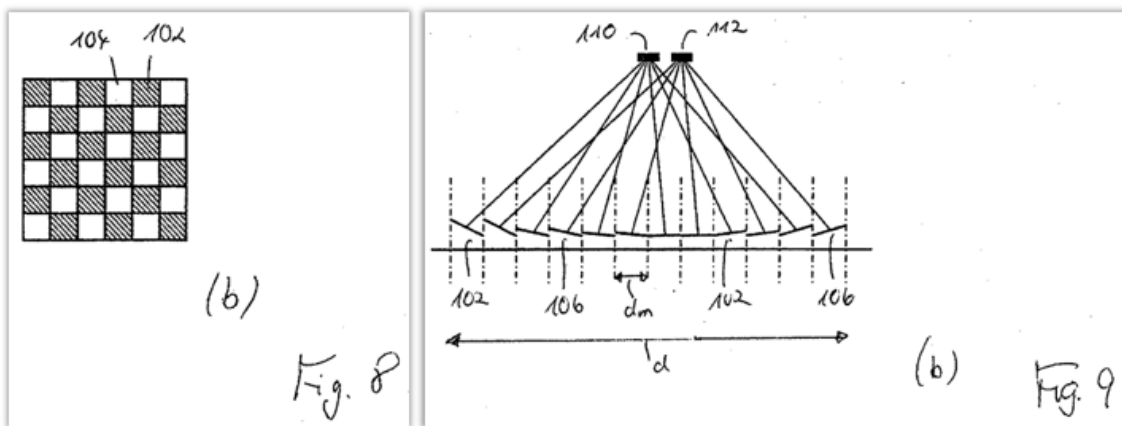
- d. [1c] **“wherein the array of micro mirrors includes, for each of the pixels of each of the images, a set of the micro mirrors each having a reflective surface oriented to reflect the ambient light toward a point on the plane corresponding to one of the pixels,”**

Fuhse262 teaches [1c]. Fuhse262 discloses that **the array of micro mirrors includes, for each of the pixels of each of the images, a 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 of each of the images, a 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 set of the micro mirrors**) “contribute to producing the light spot that corresponds to image point P_j .” EX1006, ¶¶0036, 0126-28; EX1003, ¶¶150-152.

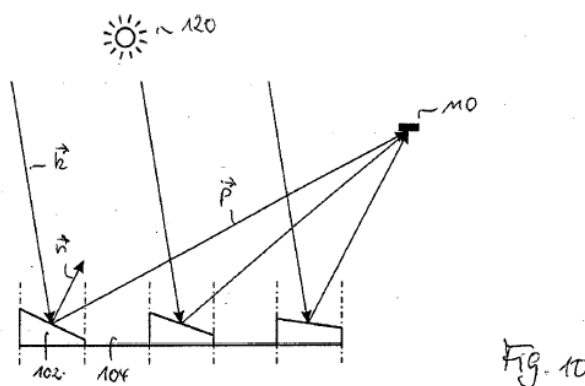
In the example of FIG. 8b, (shaded) micromirrors 102 form **a set of [] micro mirrors**, and (white) “fields 104 [] covered with micromirrors 106” form a second **set of [] micro mirrors**, and the sets are different because they comprise different micromirrors. EX1006, ¶¶0091-92. As shown in Figure 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 set of [] 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, ¶¶153-154.



Fuhse262 further describes an assignment system to assign micromirrors to light spots (**pixels**) in which each pixel is assigned a “group” of micromirrors, such that each micromirror is assigned to at most one pixel. Figure 10 and its descriptions teach how to properly orient each micromirror to reflect light to its assigned pixel. EX1003, ¶151.



Fuhse262 discloses that **a set of 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**. EX1003, ¶155. Fuhse262 discloses that its micro-mirrors may be “purely reflective.” EX1006, ¶¶0013, 0010-11, 0036, 0060. In particular, Fuhse262 discloses that “the flat mirror surfaces of the micromirrors” “reflect[]” incident light (**the micro mirrors each having a reflective surface**). EX1006, ¶¶0095-97. For each of the pixels, the micro-mirror surfaces reflect incident light (**reflect the ambient light**), such as light source 120, **toward a 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. Fuhse262 also discloses the light spots of an image all float “at the same floating height” (**a point on the plane corresponding to one of the pixels**) “above or below the surface region in order to form a backdrop motif” (**for each of the pixels of each of the images**). *Id.*, ¶¶0015; EX1003, ¶155.

Accordingly, Fuhse262 renders obvious [1c]. EX1003, ¶¶150-156.

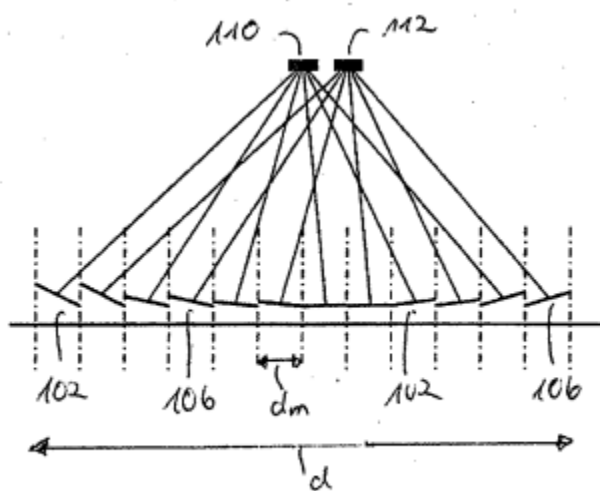
- e. [1d] **“wherein each of the sets of the micro mirrors providing the pixels for each of the differing ones of the images has a differing cone angle offset, wherein the cone angle offset is defined based upon a relative position of a cone axis for a cone of rays projected by the sets of the micro mirrors through each of the pixels,”**

Fuhse262 teaches [1d]. EX1006, ¶¶0015 0019-20, 0091-92, FIGS. 8(b), 9(b).
EX1003, ¶157.

Fuhse262 discloses that **each of the sets of micro mirrors providing the pixels for each of the differing ones of images has a differing cone angle offset**. As discussed in Section VII.A.3.d ([1c]), Fuhse262 discloses that “a plurality of optical elements is assigned to every light spot” (**for each of the pixels a set of the micro mirrors**), such that “groups of optical elements” “are each assigned to different light spots.” EX1006, ¶¶0019-20. In the example of FIG. 8(b), (shaded) micro-mirrors 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. *Id.*, ¶¶0091-92. Thus, in other words, each micromirror is assigned to a single light spot and no micromirrors are shared with multiple light spots. Therefore, a POSITA would understand that the set of micromirrors for each light spot contains a unique set of micromirrors. Fuhse262

also discloses the light spots of an image “all float at the same floating height above or below the surface region in order to form a backdrop motif” (**providing the pixels for each of the differing ones of the images**). *Id.*, ¶¶0015; EX1003, ¶158.

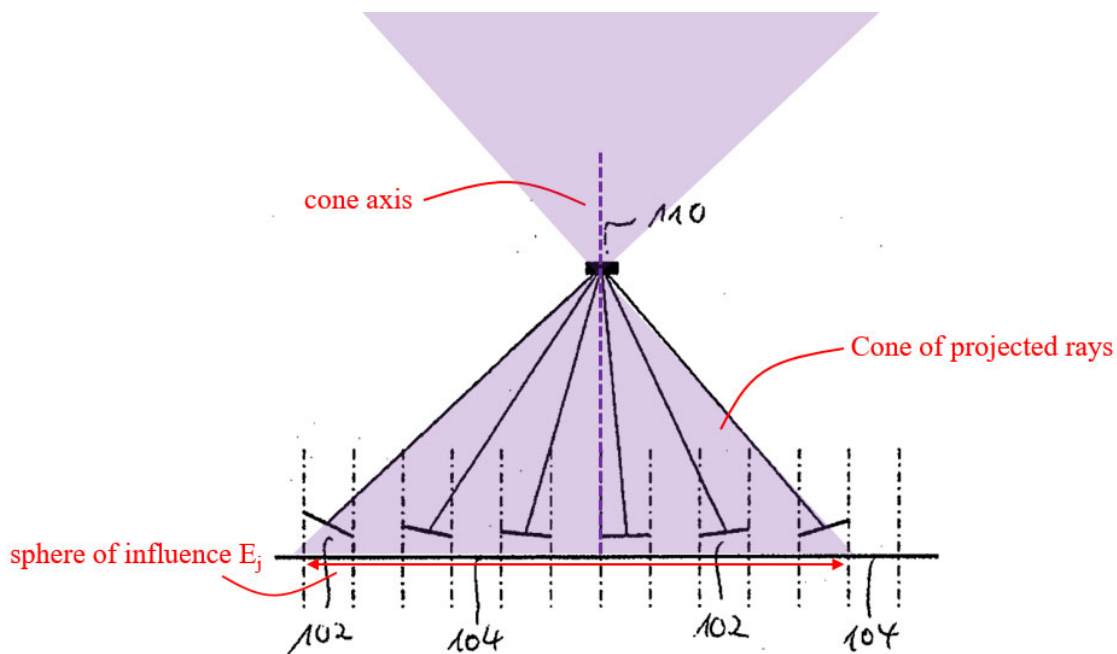
As shown in FIG. 9(b), “[m]icromirrors 102 form a group of micromirrors, which are all assigned to the same light spot 110 and produce it together when illuminated,” while micromirrors 106 “serve to produce a light spot 112,” meaning a **set of the micro mirrors is assigned for each of the pixels**. EX1006, ¶¶0091-92; EX1003, ¶159.



Fuhse262 teaches that for “every image point P_j ,” (every **pixel**), there is a “cone originating from” or “emanating from” the image point (an apex of a cone) (EX1006, ¶¶0036, 0126), and that “a sphere of influence E_j ” or “catchment area E_j ” (a base of the cone) “is determined by an intersection of the aperture cone originating

from the image point with the xy plane” (the surface of the substrate). *Id.*; EX1003, ¶160.

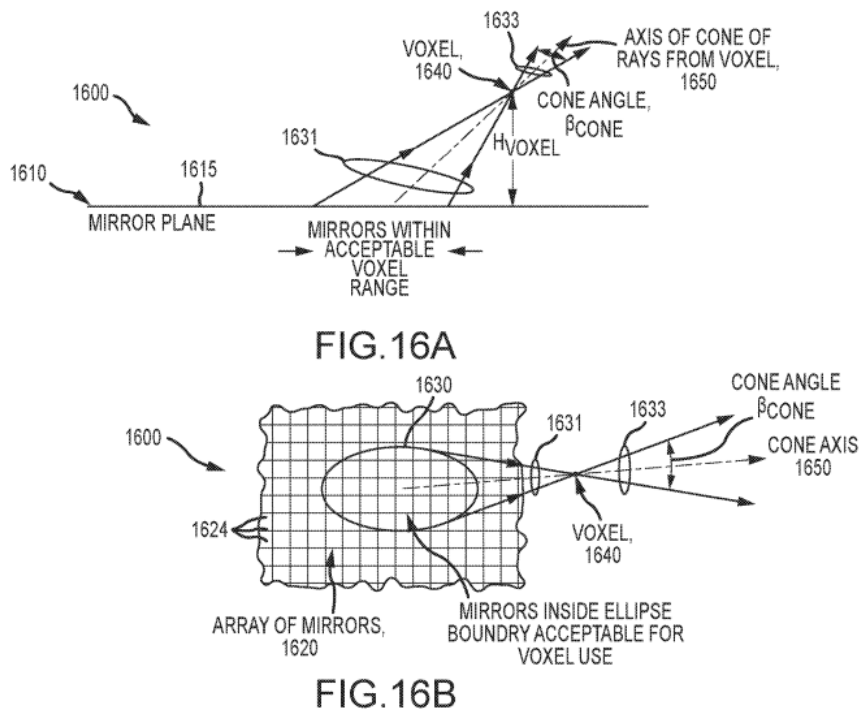
Fuhse262’s FIG. 9(a) (annotated, below) depicts a POSITA’s understanding of applying these teachings to light spot 110 (a pixel). As shown, as taught by Fuhse262, a cone is formed with the pixel as the apex and the base of the cone as the catchment area of the substrate surface, and **a cone of rays projected by the sets of the micro mirrors through each of the pixels** is formed. EX1006, ¶¶0036, 0126. As shown, the cone formed by the pixel (at the apex) and the catchment area (at the substrate surface) defines the **cone of rays**, and a **cone axis** is formed through the apex and center of the catchment area of each cone (i.e., the center point of the sphere of influence). EX1003, ¶161.



EX1006, FIG. 9(a) (annotated); EX1003, ¶161.

Accordingly, a POSITA would have recognized that the **axis** of that **cone** would be formed through the apex and center of the catchment area of each cone (i.e., the center point of the sphere of influence). EX1003, ¶162.

This is consistent with the '691 Patent, which states that cone axis 1650 “passes through the voxel 1640 and also through the center point of the cone base 1630.” EX1001, 22:34-60, FIGs. 16A-16B (below); EX1003, ¶163.

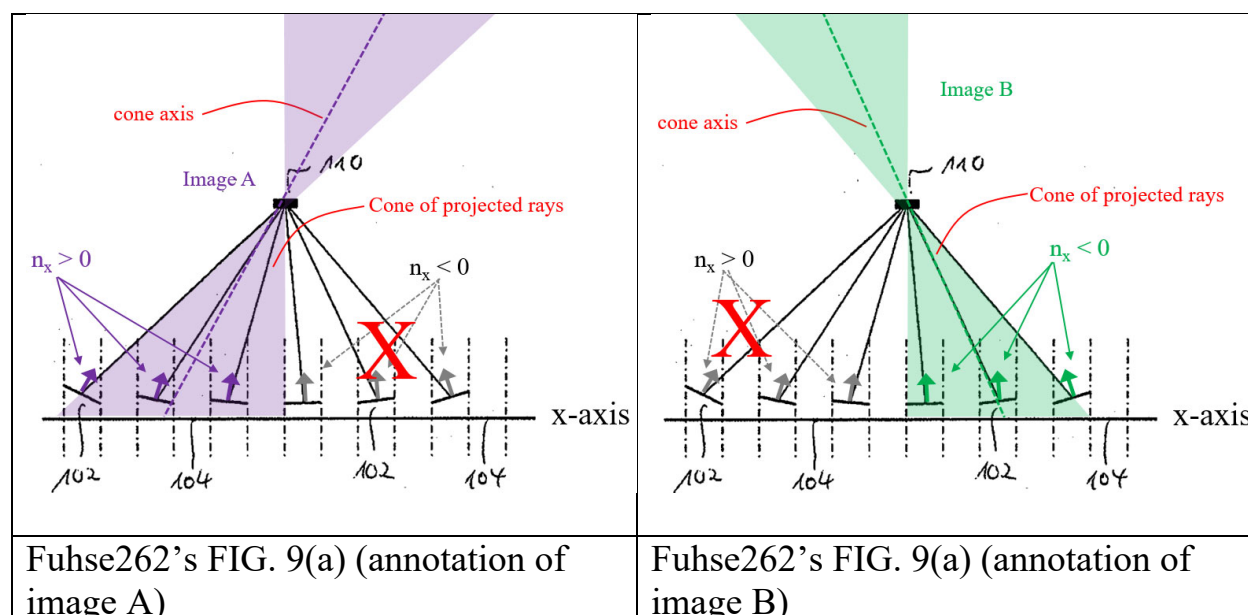


Fuhse262 also teaches producing two images that are visible at different viewing angles. EX1006, ¶0111 (“...different images become visible to the viewer from different directions. ... When tilted to the side, the security element should show an

image change from a light-spot image A to a light-spot image B....”), ¶0112 (“...those micromirrors in which the x component n_x of the normal vector is greater than zero are then omitted for the light-spot image A. This frees up half of the mirror space and the image is only visible in a limited angle range.”), ¶0113 (“For the light-spot image B, those micromirrors are omitted where the x component n_x of the normal vector is less than zero. With this reduced mirror arrangement, the freed-up mirror positions of the light-spot image A are covered. When the arrangement is tilted sideways, the light-spot image A and the light-spot image B alternately become visible.”) (emphasis added); EX1003, ¶164.

The two viewing angles are accomplished by omitting mirrors with certain x-components of the micro mirror normal. Vertical tilting is provided in the same way, but in the y-axis. EX1006, ¶0114; EX1003, ¶165.

Annotated figures of FIG. 9 below visually depict Fuhse262’s teachings. For image A, micromirrors in which the x component n_x of the normal vector is greater than zero (i.e., $n_x > 0$) have been omitted, meaning that all of image A’s rays (purple) will “point” from right to left. For image B, with the “free[d] up half of the mirror space,” micromirrors are omitted where $n_x < 0$, meaning that all of image B’s rays (green) will “point” from left to right. EX1003, ¶166.



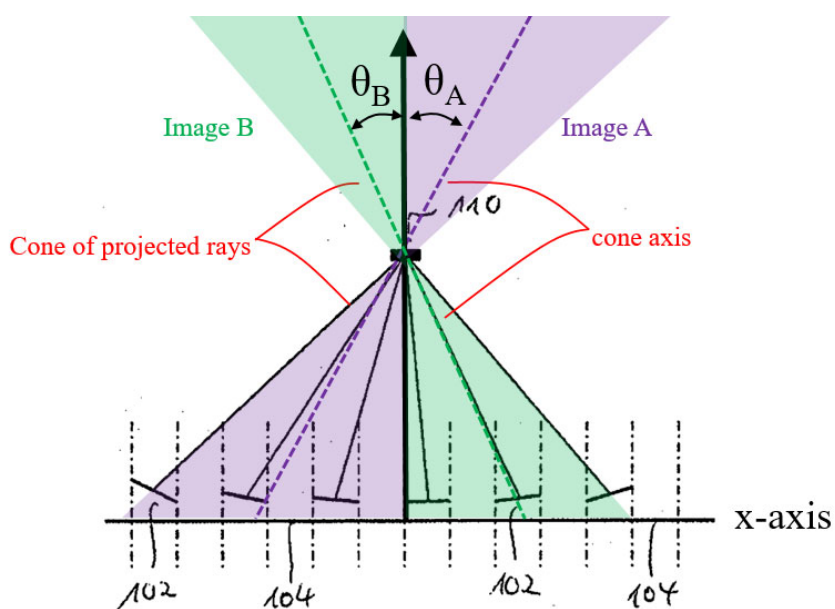
EX1006, FIG. 9(a) (annotated); EX1003, ¶166.

As shown above, for each image, there is a **cone of rays projected by the sets of the micro mirrors through each of the pixels**. While only a single pixel is shown for each image, Fuhse262 teaches that many pixels (or “light spots”) will form each image. The '691 Patent generally also shows one pixel and cone of projected rays per image “for ease of explanation” (e.g., FIG. 21) as it would be difficult to depict multiple images, each with many cones. EX1001, 25:53-66; EX1003, ¶167.

Fuhse262 flexibly allows different cones to be defined in different ways, explaining that “other criteria can of course also be used to separate the light-spot images of a changing image.” EX1006, ¶0115. For example, three images may be produced with the following conditions: “ $n_y > c_1$ for image A, $c_1 < n_y < c_2$ for image

B, $n_y < c_2$ for image C”. *Id.* When the “two numerical values” satisfy $c_1 < c_2$, this “allow[s] three light-spot images A, B, C to change when tilted vertically. By choosing the numerical values c_1 and c_2 , the size of the visibility range can be set as desired.” EX1006, ¶0115; EX1003, ¶¶168-169.

Fuhse262 teaches a **cone angle offset**, as shown by θ_A and θ_B in the annotated FIG. 9(a) below. The particular offset for each cone depends on the range of normal values of the micro mirrors for the given pixel, as taught by Fuhse262. EX1003, ¶170.



EX1006, FIG. 9(a) (annotated); EX1003, ¶170.

As shown in the annotated figures visualizing Fuhse262’s teaching, the **cone angle offset** is defined based upon a relative position of a cone axis for a cone of rays projected by the sets of the micro mirrors through each of the pixels. As

discussed, the cone axis passes through the apex and center of the catchment area of each cone (i.e., the center point of the sphere of influence), and the **cone angle offset is defined based upon a relative position of a cone axis** to the surface orthogonal. EX1003, ¶171.

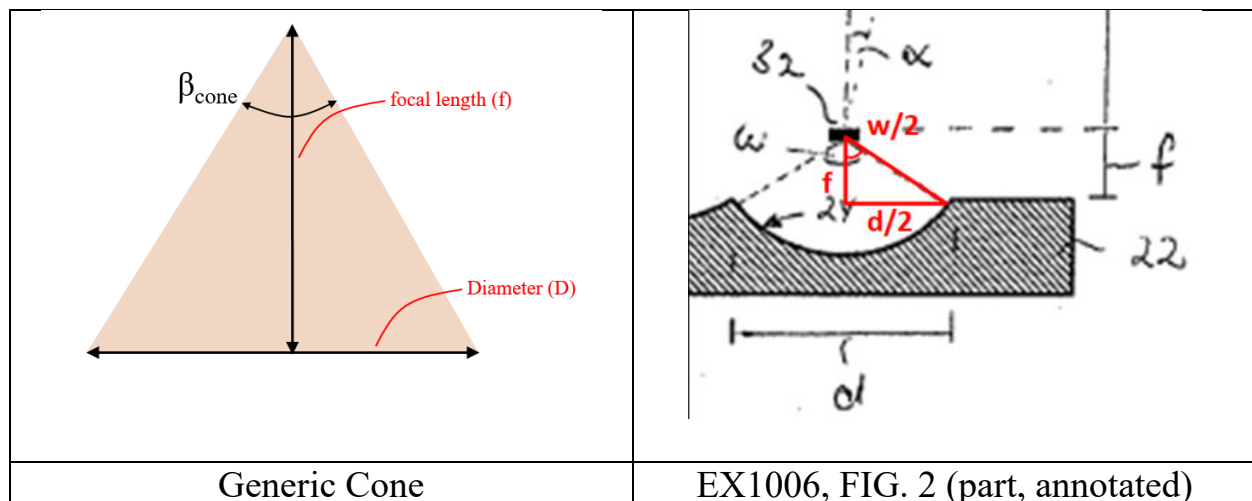
Because the normals of the micromirrors for each image pixel are exclusive of each other (i.e., each image has a distinct range of normal values to “separate” the images) (EX1006, ¶0115), **each of the sets of the micro mirrors providing the pixels for each of the differing ones of the images has a differing cone angle offset**. Thus, a POSITA would understand that there is a **differing cone angle offset** for each image because the surface normals of each image, which dictate the cone of reflected rays and cone axis, are required to be different. EX1003, ¶172.

Defining the **cone angle offset based upon a relative position of a cone axis to the surface orthogonal** is taught by the '691 Patent. EX1001, 24:63-25:2 (“a particular cone angle offset (e.g., a zero offset with the cone axis being orthogonal to the planar substrate containing the mirrors)"); 22:39-42 (“a particular offset value (defining a relative offset angle and direction relative to an orthogonal or ‘0’ offset of the cone axis 1650 such as with the DX, DY, and DZ values)"); 23:57-62 (“a first cone angle offset (such as with a ‘0’ offset)"); EX1003, ¶173.

Accordingly, Fuhse262 renders obvious [1d]. EX1003, ¶¶157-173.

f. [1e] “wherein the cone has a cone angle in the range of 10 to 45 degrees,”

Fuhse262 teaches [1e]. Fuhse262 teaches pixel “cones that have an aperture ratio > 0.2 , for example an aperture ratio of 0.4.” EX1006, ¶¶0126, 0036, 0059 (“The opening angle ω is given by the ratio of the mirror diameter d and the focal length f , $\omega = d/f$,” which may be about 5). A POSITA would understand that the cone angle β_{cone} relates to the focal length (pixel height) and diameter (of the sphere of influence) as follows. EX1003, ¶¶175-176.



EX1006, FIG. 2 (annotated); EX1003, ¶176.

A POSITA would understand that, for an aperture (aperture ratio is given by $\left(\frac{d}{f}\right)$ or $\left(\frac{d}{2f}\right)$, as POSITAs define it differently) of 0.2, as taught in Fuhse262, $\beta_{\text{cone}} = 11.42^\circ$ or 43.6° , either of which is within the claimed range of 10° to 45° . For an

aperture ratio of 0.4, which is the example given by Fuhse262, this would result in $\beta_{\text{cone}} = 22.62^\circ$, which is within the claimed range of 10° to 45° . EX1003, ¶¶177-178.

Accordingly, Fuhse262 renders obvious [1e]. EX1003, ¶¶175-178.

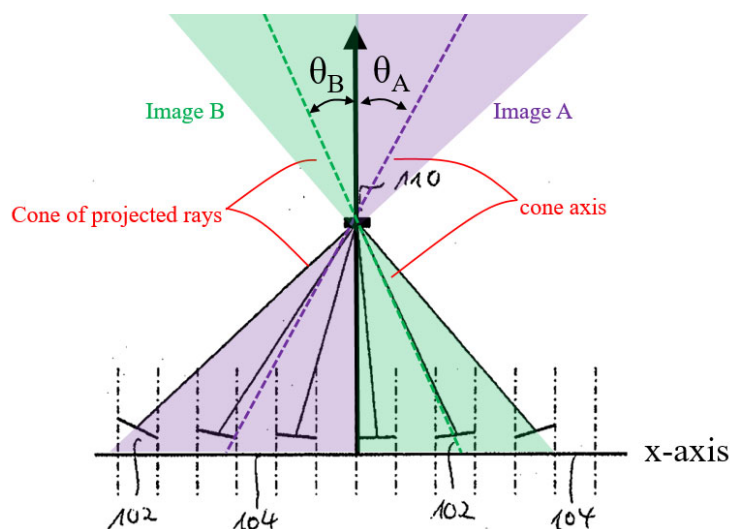
- g. [1f] “wherein the cone angle offsets are selected whereby the cones do not overlap at a predefined height above the substrate, whereby only one of the images is observable at a time by a viewer,”

Fuhse262 teaches [1f]. As discussed in Section VII.A.3.d ([1c]), Fuhse262 discloses that light spots of an image all float “at the same floating **height above** or below the **surface region** in order to form a backdrop motif” (pixels of each **image**). EX1006, ¶0015 (emphasis added). Fuhse262 also discloses a micro mirror array 102 arranged such that reflected rays generate light spot 110. *Id.*, ¶¶0091, 0095, FIGS. 9(a), 10; EX1003, ¶¶180-181.

A POSITA would understand that because **the cone angle offsets are selected** by defining the normals of the micro mirrors of each image to be exclusive of each other (i.e., each image has a distinct range of normal values to “separate” the images) (see ¶0115, as discussed for [1d]), **the cones do not overlap at a predefined height above the substrate**. EX1003, ¶182.

Reproduced below are annotated figure (of FIG. 9(a)) in Section VII.A.3.e ([1d]). As shown, as a result of selecting mutually exclusive mirror normal range for each image, and therefore differing cone angle offsets, **the cones do not overlap**

at a predefined height above the substrate (the height of the pixels). EX1003, ¶183.



EX1006, FIG. 9(a) (annotated); EX1003, ¶183.

Where the pixels of the different images are in the exact same plane, the cones do not overlap at the height of the pixels. Fuhse262 teaches this example (the two images may “appear alternately in the same place when the viewing direction is changed”). EX1006, ¶¶0118; EX1003, ¶184.

Fuhse262 also teaches that two images may “lie next to each other.” EX1006, ¶¶0118, 0027. In this case, at the common height of the two images (**a predefined height above the substrate**), all the cones of image A would reach their apex at the pixels of image A, and all the cones of image B would reach their apex at the pixels of image B, which are in different places because they are “next to each other.” Therefore, a POSITA would understand that when the two images lie next to each

other, the cones would also not **overlap at a predefined height above the substrate**. EX1003, ¶185.

Fuhse262 teaches that these “different images become visible to the viewer from different directions,” such that “[w]hen the arrangement is tilted sideways, the light-spot image A and the light-spot image B alternately become visible,” which a POSITA would understand to mean that **only one of the images is observable at a time by a viewer**. EX1006, ¶¶0111-18 (multiple images may “appear alternately in the same place when the viewing direction is changed”); EX1003, ¶186.

Further, the clauses “**whereby the cones do not overlap at a predefined height above the substrate**” and “**whereby only one of the images is observable at a time by a viewer**” are “whereby” clauses that only state the results of other element(s) of the claim (e.g., [1d], [1e], and “**wherein the cone angle offsets are selected**” of [1f]). Thus, these whereby clauses are non-limiting. *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.”).

Accordingly, Fuhse262 renders obvious [1f]. EX1003, ¶¶180-187.

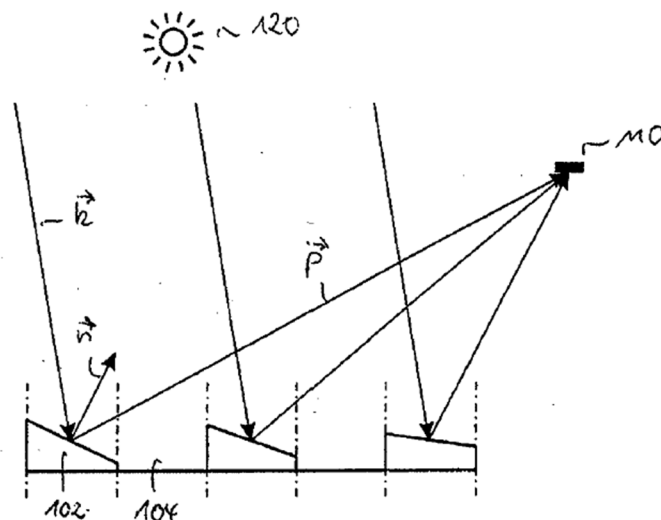
h. [1g] “wherein each of the sets of the micro mirrors includes at least two of the micro mirrors,”

Fuhse262 teaches [1g]. Fuhse262 discloses a plurality of micromirrors that generate a light spot 110 where micromirrors 102 form a group of micromirrors, which are all assigned to the same light spot 110 (“pixel”) and produce it together when illuminated. EX1006, ¶0091, FIGs 9(a), 9(b). As can be seen in FIGs. 9(a), 9(b) above, reflected chief rays from a plurality of micromirrors (**at least two micromirrors**) generate light spot 110. Fuhse262 also explains that the position of the mirror surfaces (the normal vector $\vec{n}$) are to be determined in such a way that the light incident from a specified direction $\vec{k}$ is reflected onto the focal point (x_0, y_0, z_0) for all micromirrors 102 (**at least two micromirrors**) assigned to light spot 110. *Id.*, ¶¶0096, FIG. 10; EX1003, ¶¶188-189.

Accordingly, Fuhse262 renders obvious [1g]. EX1003, ¶¶188-190.

i. [1h] “wherein the reflected ambient light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,”

Fuhse262 teaches [1h]. Fuhse262 discloses that the light 120 (**ambient light**) “incident from a specified direction $\vec{k}$ is reflected onto the focal point” (**intersects at the point**) “for all micromirrors 102” (**the at least two micromirrors**) “assigned to light spot 110” (**point corresponding to the one of the pixels**). *Id.*, ¶0097, FIG. 10 (below); EX1003, ¶¶191-192.



Accordingly, Fuhse262 renders obvious [1h]. EX1003, ¶¶191-193.

- j. [1i] “wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate, and”

Fuhse262 teaches [1i]. As discussed above, Fuhse262 discloses a group of micromirrors that generate a light spot 110 where “micromirrors 102 form a group of micromirrors, which are all assigned to the same light spot 110 and produce it together when illuminated.” EX1006, ¶0091, FIG. 8(b). Fuhse262 also discloses the light spots of an image all float “at the same floating height” (**a point on the plane**) “above or below the surface region in order to form a backdrop motif.” *Id.*, ¶0015; EX1003, ¶¶194-195.

Fuhse262 teaches that “every image point P_j ,” (**the point on the plane**) **corresponds to** a “cone originating from” or “emanating from” the image point (**an**

apex of a cone). EX1006, ¶¶0036, 0126. “[A] sphere of influence E_j [**a base of the cone**] is determined by an intersection of the aperture cone originating from the image point with the xy plane” (**coplanar with the surface of the substrate**). *Id.* As discussed in Section VII.A.3.c ([1b]), the “xy plane” is understood to be **the surface of the substrate** because it is the plane that is divided into fields that are “covered with” the optical elements (micromirrors) which are **on a surface of the substrate**, as required by [1a] (*see, supra*, [1a]). EX1006, ¶¶0036, 0125-28; EX1003, ¶196.

In Fuhse262, all of the micromirrors (in this case, the **at least two of the micro mirrors**) that “contribute to producing the light spot that corresponds to image point P_j ” are selected from fields in the xy plane that are “in the sphere of influence E_j of the image point P_j ” (**within a base of the cone**). EX1006, ¶¶0036, 0125-28; EX1003, ¶197.

Accordingly, Fuhse262 renders obvious [1i]. EX1003, ¶¶194-198.

- k. [1j] “wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.”

Fuhse262 in view of Fuhse925 renders obvious [1j]. EX1003, ¶199.

As discussed in the section above ([1i]), all of the micromirrors in Fuhse262 (including **each of the micro mirrors in each of the sets for the micro mirrors**) is

selected... from available micro mirrors in the base of the cone coplanar with the surface of the substrate. EX1003, ¶200.

Fuhse925 discloses a depiction region 22 “provided with a plurality of reflective, planar facets 30 that have, for example, a base area of $15\text{ }\mu\text{m}\times 15\text{ }\mu\text{m}$ and a maximum height of a few micrometers.” EX1008, 7:33-42. Fuhse925 discloses that “[e]ach of the planar facets 30 is especially characterized by an inclination angle against the plane of the areal motif region 20, which inclination angle has, as inclination components, a parallel component $N_{\parallel}$ parallel to the line 16 (y-direction in FIGS. 2 and 3) and a normal component $N_{\perp}$ perpendicular to the line 16 (x-direction in FIGS. 2 and 3).” EX1008, 7:37-42; EX1003, ¶201.

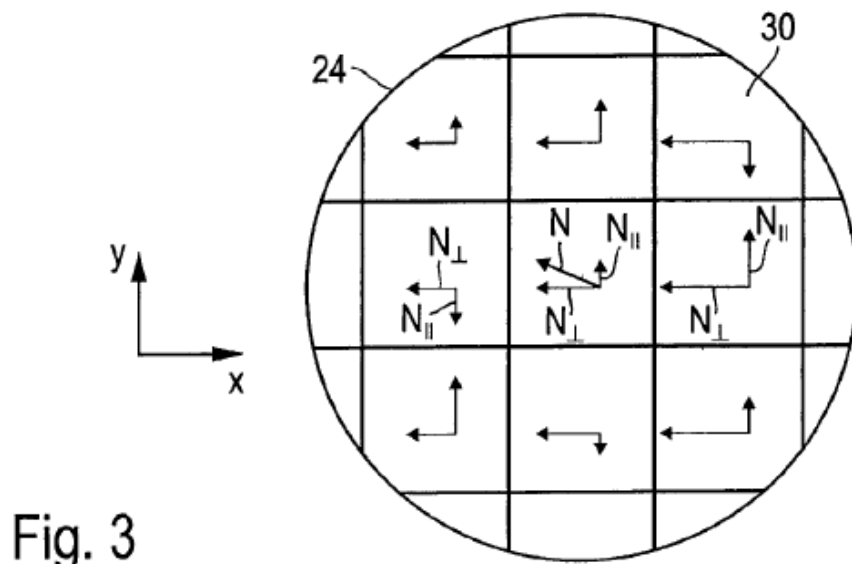


Fig. 3

EX1008, FIG. 3.

Fuhse925 teaches that the orientation vector N of each reflective facet 30 is defined by two inclination components – a normal component $N_{\perp}$ and a non-vanishing parallel component $N_{\parallel}$ – whereby the non-vanishing component $N_{\parallel}$ varies irregularly in the spreading range, especially according to a random distribution or a pseudorandom distribution. EX1008, 3:3-16, 9:1-31, 11:14-27. A POSITA would understand that because the non-vanishing component $N_{\parallel}$ is one inclination component of the orientation vector N of each reflective facet 30, the randomness of the non-vanishing component $N_{\parallel}$ would result in a randomness of the orientation vector N of each reflective facet 30 on the surface of the substrate. A POSITA would understand that it therefore follows that the randomness of the orientation vector N of each reflective facet 30 is the result of a random pattern of the reflective facets 30 (**the micro mirrors is arranged in a random pattern**). *Id.*; EX1003, ¶202.

Each facet 30 is coated with a reflective coating thereby forming **micro mirrors [] arranged in a random pattern**. EX1003, ¶203. Because the facets 30 are arranged according to a random distribution or a pseudorandom distribution, a POSITA would understand that making a selection of a subset of micromirrors from the plurality of micromirrors formed on the facets 30 would make for a **random selection**. *Id.*

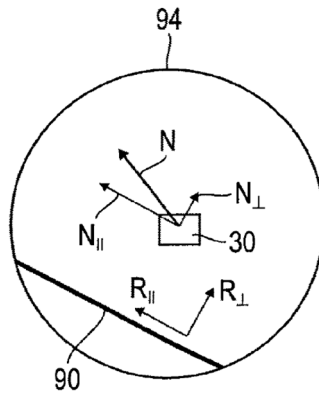


Fig. 7(b)

EX1008, FIG. 7(b).

Fuhse925 also discloses that “additional parallel component $N_{\parallel}$ ensures that a viewer still sees the line 16 floating at the depth T even if he tilts the security element upward or downward about the x-axis by a certain angle within the second angle range.” *Id.*, 9:27-31. A POSITA would understand that the random arrangement of facets 30 (**each of the sets of the micro mirrors arranged in a random pattern**) is such that an image of line 16 floating at depth T is visible to the observer. EX1003, ¶204.

Further, the clause “**whereby each of the sets of the micro mirrors is arranged in a random pattern**” is a “whereby” clause that only states the result of other element(s) of the claim (e.g., “**wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate**” of

[1j]). Thus, this whereby clause is non-limiting. *Texas Instruments*, 988 F.2d at 1172.

Accordingly, Fuhse262 in view of Fuhse925 renders obvious [1j]. EX1003, ¶¶199-205.

4. Independent Claim 6

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

- a. [6Pre] “A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:”**

Fuhse262 renders obvious [6Pre]. *See, supra*, Section VII.A.3.a ([1Pre]); EX1003, ¶207.

- b. [6a] “a substrate; and on a surface of the substrate, a plurality of micro mirrors receiving light and,”**

Fuhse262 renders obvious [6a]. *See, supra*, Section VII.A.3.b ([1a]); EX1003, ¶208.

- c. [6b] “in response, displaying a plurality of images in a plane a distance away from the surface of the substrate,”**

Fuhse262 renders obvious [6b]. *See, supra*, Section VII.A.3.c ([1b]); EX1003, ¶209.

- d. [6c] “wherein the plurality of micro mirrors includes, for each of displayed pixel of each of the images, a number of the micro mirrors each having a reflective surface oriented, in a rigid manner, to reflect the ambient light toward a point on the plane corresponding to one of the pixels,”

Fuhse262 renders obvious [6c]. *See, supra*, Section VII.A.3.d ([1c]); EX1003, ¶¶210-211.

The micro mirrors are oriented **rigidly** for the same reasons the micro mirrors are oriented **in a fixed manner**. *Id.* A POSITA would understand that in this context, the terms rigid and fixed both describe micromirrors that have a permanently fabricated shape (e.g., from embossing) for reflecting light in a single orientation (e.g., to a single pixel). EX1003, ¶211.

- e. [6d] “wherein each of the sets of the micro mirrors providing the pixels for each of the differing ones of the images has a differing cone angle offset, wherein the cone angle offset is defined based upon a relative position of a cone axis for a cone of rays projected through each of the pixels,”

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

- f. [6e] “wherein each of the numbers of the micro mirrors includes at least two of the micro mirrors,”

Fuhse262 renders obvious [6e]. *See, supra*, Section VII.A.3.h ([1g]); EX1003, ¶213.

- g. [6f] “wherein the reflected ambient light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,”**

Fuhse262 renders obvious [6f]. *See, supra*, Section VII.A.3.i ([1h]); EX1003, ¶214.

- h. [6g] “wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate, and”**

Fuhse262 renders obvious [6g]. *See, supra*, Section VII.A.3.j ([1i]); EX1003, ¶215.

- i. [6h] “wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.”**

Fuhse262 in view of Fuhse925 renders obvious [6h]. *See, supra*, Section VII.A.3.k ([1j]); EX1003, ¶216.

5. Independent Claim 12

Claim 12 is similar to independent claim 1, with a few exceptions which are mapped below. *See* analysis for cl. 1 in Section VII.A.3, which is incorporated herein.

- a. **[12Pre] “A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:”**

Fuhse262 renders obvious [12Pre]. *See, supra*, Section VII.A.3.a ([1Pre]);
EX1003, ¶¶218.

- b. **[12a] “on a surface of the substrate, an array of micro mirrors receiving light and,”**

Fuhse262 renders obvious [12a]. *See, supra*, Section VII.A.3.b ([1a]);
EX1003, ¶¶219.

- c. **[12b] “in response, displaying images; wherein each of the images comprises a plurality of pixels,”**

Fuhse262 renders obvious [12b]. *See, supra*, Section VII.A.3.c ([1b]);
EX1003, ¶¶220.

- d. **[12c] “wherein the array of micro mirrors includes, for each of the pixels of the images, a set of the micro mirrors each having a reflective surface oriented to reflect received light toward a point on a plane corresponding to one of the pixels,”**

Fuhse262 renders obvious [12c]. *See, supra*, Section VII.A.3.d ([1c]);
EX1003, ¶¶221.

- e. **[12d] “wherein each of the sets of the micro mirrors providing the pixels for each of the images has a differing cone angle offset,”**

Fuhse262 renders obvious [12d]. *See, supra*, Section VII.A.3.e ([1d]);
EX1003, ¶¶222.

- f. [12e] “wherein each of the sets of the micro mirrors includes at least two of the micro mirrors,”**

Fuhse262 renders obvious [12e]. *See, supra*, Section VII.A.3.h ([1g]);
EX1003, ¶¶223.

- g. [12f] “wherein the reflected received light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,”**

Fuhse262 renders obvious [12f]. *See, supra*, Section VII.A.3.i ([1h]);
EX1003, ¶¶224.

- h. [12g] “wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate,”**

Fuhse262 renders obvious [12g]. *See, supra*, Section VII.A.3.j ([1i]);
EX1003, ¶¶225.

- i. [12h] “wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames,”**

Fuhse262 renders obvious [12h]. *See, infra*, Section VII.A.6.a (Claim 4);
EX1003, ¶¶226.

- j. [12i] “wherein the animation is in both the X axis and in the Y axis, and”**

Fuhse262 renders obvious [12i]. *See, infra*, Section VII.A.6.b (Claim 5);
EX1003, ¶¶227.

- k. [12j] “wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.”

Fuhse262 in view of Fuhse925 renders obvious [12j]. *See, supra*, Section VII.A.3.k ([1j]); EX1003, ¶¶228.

6. Dependent Claims

Fuhse262 in view of Fuhse925 renders obvious claims 4, 5, 7, 10-11. *See* analysis for independent claims 1/6 (in Sections VII.A.3/VII.A.4) from which claims 4, 5, 7, 10-11 depend, which is incorporated herein. EX1003, ¶¶229-242.

- a. **Claim 4: “The assembly of claim 1, wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames.”**

Fuhse262 teaches claim 4. As discussed above in Section VII.A.3.g (Ground 1, [1f]), Fuhse262 teaches that these “different images become visible to the viewer from different directions,” **(the images comprise two or more frames of an animated clip)** such that “[w]hen the arrangement is tilted sideways, the light-spot image A and the light-spot image B alternately become visible,” which a POSITA would understand to mean that **a viewer observes animation when viewing two or more of the images associated with the two or more frames.** EX1006, ¶¶0111-

18 (multiple images may “appear alternately in the same place when the viewing direction is changed”); EX1003, ¶¶229-230.

As shown in element [1.f], when an observer tilts the device, or moves across the plane of the device, the observer will see the images in rapid succession in the form of an animation. As discussed in ¶¶011-16 (EX1006), the normals for each images may be defined to be non-overlapping but in adjacent ranges, meaning that the images will appear in rapid succession of each other. EX1003, ¶231.

Each image is a distinct image that appears “alternatively,” so each image corresponds to a **frame**. This is consistent with the ’691 Patent, which consistently and almost exclusively, refers to an “image/frame.” EX1001, 22:34-28:11; EX1003, ¶232.

Thus, a POSITA would be able to **observe animation when viewing two or more images** by changing the viewing angle. EX1003, ¶233.

Further, the clause “**whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames**” is a “whereby” clause that only states the result of other element(s) of the claim (e.g., [1d]-[1f], and “**wherein the images comprise two or more frames of an animated clip**” of claim 4). Thus, this whereby clause is non-limiting. *Texas Instruments*, 988

F.2d at 1172 (“A ‘whereby’ clause that merely states the result of the limitations in the claim adds nothing to the patentability or substance of the claim.”).

Accordingly, Fuhse262 renders obvious claim 4. EX1003, ¶¶229-234.

b. Claim 5: “The assembly of claim 4, wherein the animation is in both the X axis and in the Y axis.”

Fuhse262 teaches claim 5. As discussed in the section immediately above for claim 4, Fuhse262 teaches that these “different images become visible to the viewer from different directions,” such that an animation is formed when tilting the device. EX1003, ¶¶235-236.

Fuhse262 teaches that **the animation is in both the X axis and in the Y axis**. Fuhse262 teaches an **animation is in the X axis** in which the “x component n_x ” of the micromirrors are controlled to display the multiple images “alternatively” “[w]hen the arrangement is tilted sideways” (EX1006, ¶¶0112-13), and also teaches an **animation is in the Y axis** in which the “the y-component of the normal vector n_y ” of the micromirrors are controlled to display the multiple images successively “when tilted vertically” (*id.*, ¶¶0114-15). EX1003, ¶¶237.

A POSITA would also understand that the tilting does not need to be strictly confined to a line along the z or y axis, but could be along other lines, such as $y=x$. In this case, **the animation is in both the X axis and in the Y axis**. EX1003, ¶238.

Accordingly, Fuhse262 renders obvious claim 5. EX1003, ¶¶235-239.

- c. **Claim 7: “The assembly of claim 6, wherein the cone has a cone angle in the range of 10 to 45 degrees and wherein the cone angle offsets are selected whereby the cones do not overlap at a predefined height above the substrate.”**

Fuhse262 renders obvious claim 7. *See, supra*, Sections VII.A.3.f ([1e]) and VII.A.3.g ([1f]); EX1003, ¶240.

- d. **Claim 10: “The assembly of claim 6, wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames.”**

Fuhse262 teaches renders obvious claim 10. *See, supra*, Section VII.A.6.a (Claim 4); EX1003, ¶241.

- e. **Claim 11: “The assembly of claim 10, wherein the animation is in both the X axis and in the Y axis.”**

Fuhse262 teaches renders obvious claim 11. *See, supra*, Section VII.A.6.b (Claim 5); EX1003, ¶242.

B. Ground 2: Claims 1, 4-7 and 10-12 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925 and Jordan

This ground is the same as Ground 1, but additionally relies on Jordan’s teachings regarding the useful applications of optical security elements, as relevant to the preamble. EX1003, ¶¶234-251.

1. Motivation and Combine

A POSITA would have been motivated to combine Fuhse262 and Fuhse925 in further view of Jordan, 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 Jordan, to find additional data carriers. EX1003, ¶243.

2. Reasonable Expectations

A POSITA would have had a reasonable expectation of success in implementing the combination of Fuhse262, Fuhse925, and Jordan. As Petitioners’ expert explains, The art was relatively predictable in the relevant timeframe (2015). A POSITA would have been able to implement the obviousness modifications in this ground without difficulty. EX1003, ¶244.

Because coin currency and product labels were known in the art as useful applications of OVD technology, a POSITA would have routinely recognized that Fuhse262 would be “useful as a security element” for those applications. EX1003, ¶245.

3. [1Pre]/[6Pre]/[12Pre]

To the extent not taught by Fuhse262 and Fuhse925, Fuhse262 in view of Fuhse925 and Jordan teaches this element. Jordan teaches methods of using arrays

of reflective microstructures that produce images “as a security and anti-counterfeiting feature to identify and distinguish authentic products from counterfeit products,” such as “banknotes” or “coinage,” as well as “product marking and labeling” and “packaging.” EX1009, Abstract, ¶¶0013, 0002-04, 0113-14, 0124-25, 0154, 0159, 0174-77; EX1003, ¶¶248-249.

Accordingly, Fuhse262 in view of Fuhse925 and Jordan renders obvious the preambles of claims 1, 28, and 35. *Id.*

C. Grounds 3 and 4: Claims 3, 9, and 13 are rendered obvious under 35 U.S.C. §103 by Fuhse262 in view of Fuhse925, and Fuhse172 (Ground 3); Fuhse262 in view of Fuhse925, Jordan, and Fuhse172 (Ground 4)

Fuhse262 (whether in Grounds 1 or 2) in view of Fuhse172 teaches claims 3, 9, and 13. *See, supra*, Section VII.A (for Ground 1 which applies to Ground 3) and Section VII.B (for Ground 2 which applies to Ground 4); EX1003, ¶¶252-274.

1. Motivation and Combine

It is obvious to apply the teachings of Fuhse172 to Fuhse262. Fuhse262 and Fuhse172 are in the same field. EX1006, Abstract; EX1008, Abstract; EX1003, ¶252.

One reviewing Fuhse262 would have looked to Fuhse172. EX1003, ¶253. Fuhse262 teaches that its micro-mirrors may be provided with “a thin-film element with a color-shifting effect” (EX1006, ¶0032), or are included with “layer systems

that show a color change when tilted.” EX1006, ¶0034. However, Fuhse262 does not provide explicit detail on how to implement those thin-films or layers, such as what materials to use, in order to provide color-shifting. Fuhse172, however, *does* provide that explicit detail. EX1003, ¶253.

Fuhse172 further teaches that dielectric materials may be used to provide color-shifting. *See* EX1035, ¶¶0118, 0027-29. It would therefore have been obvious to examine how thin-films or layers are implemented to achieve color-shifting when reviewing Fuhse262. EX1003, ¶254. Fuhse925 provides explicit detail for implementing what Fuhse262 teaches, namely that dielectric materials may be used to provide a thin-film color-shifting effect. EX1003, ¶255.

Additionally, using Fuhse172’s teachings regarding thin-film dielectrics 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, ¶256.

2. Reasonable Expectations

A POSITA would have had a reasonable expectation of success in implementing the combination of Fuhse262 and Fuhse172. EX1003, ¶257. As a POSITA would have recognized, the structures of Fuhse262 and Fuhse172 are similar and compatible. *Id.* Like Fuhse262, Fuhse172 provides reflective facets for security

elements that reflect light to produce images. EX1035, ¶¶97-98, Abstract. Like Fuhse262’s teaching to use “50µm x 50µm” size for the mirrors (EX1006, ¶0087), Fuhse172 teaches to use edge lengths of its facets “in the range between 20 and 100 µm.” EX1035, ¶98; EX1003, ¶257.

As discussed in Ground 1 (*see* VII.A), the art was relatively predictable in the relevant timeframe (2015). Thus, a POSITA would have been able to implement the obviousness modifications in this ground without difficulty. EX1003, ¶258.

3. Claim 3

a. [3a]: “The assembly of claim 1, wherein the micro mirrors are configured to display the images in at least two colors and”

Ground 1 references or Ground 2 references render this element obvious. EX1003, ¶261.

As an initial matter, **the micro mirrors are configured to** reflect visible light to **display the image**, which is visible and therefore is **with colors**. A POSITA would understand that all visible light has **colors**. See EX1003, ¶262.

To the extent it could be argued that this claim requires the image be displayed with particular colors, Fuhse262 satisfies this interpretation in two ways. EX1003, ¶263.

First, Fuhse262 teaches that its invention can be “combined with other security features,” such as “layer systems that show a color change when tilted.”

EX1006, ¶0034. As discussed, one of these tilting angles corresponds to **the image** (see claim 4) (Section VII.A.6.a), so in this case, the image would be shown with the “color change.” See EX1003, ¶264.

Second, Fuhse262 teaches that its mirco-mirrors may be “designed as embossed structures in an embossing lacquer layer,” such as “a thin-film element with a color-shifting effect.” EX1006, ¶0032. Because the thin film provides “color-shifting” of the reflected light of **the micro mirrors**, **the image is display[ed] with the colors** that the film shifted to. EX1003, ¶265.

Accordingly, Fuhse262 renders obvious [3a]. EX1003, ¶¶261-265.

- b. [3b]: “wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure the micro mirrors to display the image with the colors.”**

Ground 1 references or Ground 2 references and further in view of Fuhse172 render [3b] obvious. EX1035, ¶¶0118, 0027-29; EX1003, ¶266.

Fuhse172 discloses that in order “to apply a color-shifting coating, in particular a thin-film system, to the facets,” the thin-film system can have multiples “**dielectric layer[s]**” formed one on the other. EX1035, ¶¶0118, 0027-29. This “dielectric layer” is a **dielectric material** that is **used to configure the micro mirrors to display the image with the colors**. EX1003, ¶267.

Fuhse172 further discloses that instead of multiple dielectric layers, a combination of dielectric layers and metal layers may also be used, which also means a **dielectric material** is used. EX1035, ¶¶0027-29; EX1003, ¶¶268-270.

Accordingly, Fuhse262 renders obvious [3b]. EX1003, ¶¶266-270.

4. Claim 9

- a. [9a]: “The assembly of claim 6, wherein the micro mirrors are configured to display the images in at least two colors and”

Ground 1 references or Ground 2 references and in further view of Fuhse172 renders [9a] obvious. *See, supra*, Section VII.C.3.a ([3a]). EX1003, ¶271.

- b. [9b]: “wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure the micro mirrors to display the image with the colors.”

Ground 1 references or Ground 2 references and in further view of Fuhse172 renders [9b] obvious. *See, supra*, Section VII.C.3.b ([3b]). EX1003, ¶272.

5. Claim 13

- a. [13a]: “The assembly of claim 12, wherein the micro mirrors are configured to display the images in at least two colors and”

Ground 1 references or Ground 2 references and in further view of Fuhse172 renders [13a] obvious. *See, supra*, Section VII.C.3.a ([3a]). EX1003, ¶273.

- b. [13b]: “wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure

the micro mirrors to display the image with the colors.”

Ground 1 references or Ground 2 references and in further view of Fuhse renders [13b] obvious. *See, supra*, Section VII.C.3.b ([3b]). EX1003, ¶274.

VIII. SECONDARY CONSIDERATIONS OF NONOBVIOUSNESS

Secondary considerations should be considered but do not control the obviousness conclusion. *Newell Cos. v. Kenney Mfg. Co.*, 864 F.2d 757, 768 (Fed. Cir. 1988). Where, as here, a strong *prima facie* obviousness showing exists, even relevant secondary considerations supported by substantial evidence may not dislodge the obviousness conclusion. *Leapfrog Enters. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007). Petitioners is aware of no evidence supporting a claim for secondary considerations.

IX. INSTITUTION IS APPROPRIATE UNDER FINTIV

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 (EX1048, p. 1), the case may be transferred to the Court of Federal Claims (CoFC). In a separate litigation filed January 2024 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 against Petitioners, 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.

X. 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. For example, Fuhse925, Jordan, and Fuhse172 were not cited during prosecution of the ’691 Patent and therefore were not substantively considered. *See, supra*, Section III.B. For Ground 1, Petitioners rely on a combination of Fuhse262⁴ and Fuhse925. *See, supra*, Section VII.A. Such a combination was not considered

⁴ Applicant cited Fuhse262 and WO2012/048847 (“Fuhse847”), which claims priority to Fuhse262, during prosecution of the ’691 Patent. The Examiner referred to Fuhse847 as “Kaule” (based on the name of the co-inventor) and relied on it to reject claims during prosecution of the ’691 Patent. EX1002, 69-78, 110-116, 128, 301, 470; *see also, supra*, Section III.B.

by the Examiner. For Grounds 2-3, Petitioners rely on such a combination (of Fuhse262 and Fuhse925) in further view of Jordan and/or Fuhse172. *See, supra*, Sections VII.B-VII.C. 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.

Moreover, 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 determined the claim limitation, “wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern” ([1j], [6h], [12j]), to be missing in the prior art of record, and did not apply any prior art against this limitation to reject the claims containing the limitation. EX1002, pp. 36-37, 56-64, 78, 98; *see also, supra*, Section III.B. As discussed above in the analysis of the prior art and grounds (Section VII), this limitation is disclosed by Fuhse925 (which was not substantively considered by the Examiner), and the challenged claims are

obvious in view of the combination of Fuhse262 and Fuhse925 (which was not substantively considered by the Examiner) and/or such a combination in further view of other prior art references. *See, supra*, Sections III.B, VII. Thus, the prior art disclosures/combinations relied on in this Petition are not cumulative.

The Examiner’s non-final and final rejections were premised on a misapplication of “Kaule” (PCT version of Fuhse262). EX1022, 1. Whereas the Examiner mapped “a plurality of images” in element [1b] to light spots 110 and 112 in FIG. 9B (EX1002, 441-42, 508-11), Petitioners present an entirely different position which is not substantially the same argument. Specifically, Petitioners map “a plurality of pixels” to light spots, such as 110 and 112, and map “a plurality of images” to Fuhse262’s “image A” and “image B”, supported at EX1006, ¶¶0111-19, which appears to have been overlooked. *See, supra*, Pet VII.A.3.c ([Ground 1, element 1b]). To be clear, images A and B are “light-spot images” (*see* ¶0111), and “a light-spot image [is] composed of a plurality of light spots” (¶0010). The file history is completely silent on this mapping.

The Examiner’s lack of reliance on ¶¶0111-19 results in other new arguments by Petitioners. For example, the Examiner made a combination argument because Kaule/Fuhse262 purportedly “does not explicitly teach that only one of the images is observable at a time by a viewer.” EX1002, p. 511. However, with the proper

disclosures, Kaule/Fuhse262 makes clear that “different images become visible to the viewer from different directions,” such that “[w]hen the arrangement is tilted sideways, the light-spot image A and the light-spot image B *alternately* become visible.” EX1006, ¶¶0111-18 (multiple images may “appear alternately in the same place when the viewing direction is changed”) (emphasis added). *See, supra*, Pet VII.A.3.g ([Ground 1, element 1f]). It should be evident that these disclosures were overlooked.

Part Two: Even if the prior art or arguments presented in this Petition are substantially the same as those raised 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 substantively discuss or rely on the prior art combinations that the Petition relies on. For example, the Examiner did not substantively discuss or rely on the combination of Fuhse262 and Fuhse925 (Ground 1) or such a combination in further view of Jordan and/or Fuhse172 (for Grounds 2-3). Moreover, as discussed above, the Examiner did not apply any prior art against the above-discussed limitation ([1j], [6h], [12j]) to reject

the claims containing the limitation. *See, supra*, Section III.B. 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 (including the above-discussed limitation ([1j], [6h], [12j])). *See, supra*, Section III.B. However, as discussed above in the analysis of the prior art and grounds (Section VII), 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 Fuhse262 and Fuhse925 and/or such a combination in further view of other prior art references. *See, supra*, Section VII. The Examiner clearly overlooked the relevant disclosures of Fuhse925 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); *LG Elecs. Inc. v. Pantech Corp.*, IPR2023-01273, Paper 26 at 15-18 (PTAB Apr. 9, 2024).

Further, the Examiner's lack of reliance on ¶¶0111-19, which discloses a number of aspects of the claims, shows that the Examiner's previous consideration of

Kaule/Fuhse262 is not well developed, and that the Examiner erred by overlooking them.

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

XI. MANDATORY NOTICES

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

There are no real parties-in-interest other than Petitioners.

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

To the best knowledge of Petitioners, the '691 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:

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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

XII. GROUNDS FOR STANDING

Petitioners certifies that the '691 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.

XIII. CONCLUSION

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

Dated: May 2, 2024

Respectfully submitted,

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CLAIM LISTING APPENDIX

Claim 1	
1Pre	A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:
1a	a substrate; and on a surface of the substrate, an array of micro mirrors receiving ambient light and,
1b	in response, displaying a plurality of images in a plane spaced a distance apart from the surface of the substrate, wherein each of the images comprises a plurality of pixels,
1c	wherein the array of micro mirrors includes, for each of the pixels of each of the images, a set of 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,
1d	wherein each of the sets of the micro mirrors providing the pixels for each of the differing ones of the images has a differing cone angle offset, wherein the cone angle offset is defined based upon a relative position of a cone axis for a cone of rays projected by the sets of the micro mirrors through each of the pixels,
1e	wherein the cone has a cone angle in the range of 10 to 45 degrees,
1f	wherein the cone angle offsets are selected whereby the cones do not overlap at a predefined height above the substrate, whereby only one of the images is observable at a time by a viewer,
1g	wherein each of the sets of the micro mirrors includes at least two of the micro mirrors,
1h	wherein the reflected ambient light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,
1i	wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate, and
1j	wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.
Claim 3	

3	The assembly of claim 1, wherein the micro mirrors are configured to display the images in at least two colors and wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure the micro mirrors to display the image with the colors.
Claim 4	
4	The assembly of claim 1, wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames.
Claim 5	
5	The assembly of claim 4, wherein the animation is in both the X axis and in the Y axis.
Claim 6	
6Pre	A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:
6a	a substrate; and on a surface of the substrate, a plurality of micro mirrors receiving light and,
6b	in response, displaying a plurality of images in a plane a distance away from the surface of the substrate,
6c	wherein the plurality of micro mirrors includes, for each of displayed pixel of each of the images, a number of the micro mirrors each having a reflective surface oriented, in a rigid manner, to reflect the ambient light toward a point on the plane corresponding to one of the pixels,
6d	wherein each of the sets of the micro mirrors providing the pixels for each of the differing ones of the images has a differing cone angle offset, wherein the cone angle offset is defined based upon a relative position of a cone axis for a cone of rays projected through each of the pixels,
6e	wherein each of the numbers of the micro mirrors includes at least two of the micro mirrors,
6f	wherein the reflected ambient light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,
6g	wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate, and

6h	wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.
Claim 7	
7	The assembly of claim 6, wherein the cone has a cone angle in the range of 10 to 45 degrees and wherein the cone angle offsets are selected whereby the cones do not overlap at a predefined height above the substrate.
Claim 9	
9	The assembly of claim 6, wherein the micro mirrors are configured to display the images in at least two colors and wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure the micro mirrors to display the image with the colors.
Claim 10	
10	The assembly of claim 6, wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames.
Claim 11	
11	The assembly of claim 10, wherein the animation is in both the X axis and in the Y axis.
Claim 12	
12Pre	A visual display assembly useful as a security element on paper and coin currency and on product labels, comprising:
12a	a substrate; and on a surface of the substrate, an array of micro mirrors receiving light and,
12b	in response, displaying images; wherein each of the images comprises a plurality of pixels,
12c	wherein the array of micro mirrors includes, for each of the pixels of the images, a set of the micro mirrors each having a reflective surface oriented to reflect received light toward a point on a plane corresponding to one of the pixels,

12d	wherein each of the sets of the micro mirrors providing the pixels for each of the images has a differing cone angle offset,
12e	wherein each of the sets of the micro mirrors includes at least two of the micro mirrors,
12f	wherein the reflected received light from the at least two of the micro mirrors intersects at the point corresponding to the one of the pixels,
12g	wherein the point on the plane corresponds to an apex of a cone and the at least two of the micro mirrors are located within a base of the cone coplanar with the surface of the substrate,
12h	wherein the images comprise two or more frames of an animated clip, whereby a viewer observes animation when viewing two or more of the images associated with the two or more frames,
12i	wherein the animation is in both the X axis and in the Y axis, and
12j	wherein each of the micro mirrors in each of the sets for the micro mirrors is selected randomly from available micro mirrors in the base of the cone coplanar with the surface of the substrate, whereby each of the sets of the micro mirrors is arranged in a random pattern.
Claim 13	
13	The assembly of claim 12, wherein the micro mirrors are configured to display the images in at least two colors and wherein at least one of ink, plasmonic resonance, and dielectric coating is used to configure the micro mirrors to display the image with the colors.

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.
10,317,691**, exclusive of the parts exempted as provided in 37 C.F.R. §42.24(a),
contains 13,952 words and therefore complies with the type-volume limitations of
37 C.F.R. §42.24(a).

Dated: May 2, 2024

Respectfully submitted,

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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. 10,317,691 AND EXHIBITS** are being served on May 2, 2024, via Federal Express overnight mail on counsel of record for U.S. Patent No. 10,317,691 as addressed below:

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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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