

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SIGRAY, INC.
Petitioner,

v.

CARL ZEISS X-RAY MICROSCOPY, INC.,
Patent Owner.

IPR2022-00218
Patent 7,400,704 B1

Before GRACE KARAFFA OBERMANN, GEORGIANNA W. BRADEN,
and AMBER L. HAGY, *Administrative Patent Judges*.

OBERMANN, *Administrative Patent Judge*.

JUDGMENT

Final Written Decision on Remand

Determining Challenged Claims 2, 5, and 6 Unpatentable;

Denying Patent Owner's Revised Contingent Motion to Amend as to
Proposed Substitute Claims 16–21; and Dismissing Patent Owner's Revised
Contingent Motion to Amend as to Proposed Substitute Claims 22 and 23

35 U.S.C. § 318(a)

I. INTRODUCTION

Petitioner¹ filed a Petition (Paper 2, “Pet.”) seeking an *inter partes* review of claims 1–15 (the “challenged claims”) of U.S. Patent No. 7,400,704 (Ex. 1001, “the ’704 Patent”). Patent Owner² filed a Preliminary Response. Paper 6. Based on the information presented, we instituted an *inter partes* review. Paper 7 (“Institution Decision” or “Inst. Dec.”).

In timely sequence after institution, Patent Owner filed a Patent Owner Response (Paper 12, “PO Resp.”), Petitioner filed a Reply (Paper 19, “Reply”), and Patent Owner filed a Sur-reply (Paper 23, “Sur-reply”). In addition, Patent Owner filed a Contingent Motion to Amend (Paper 11) and, following the Board’s issuance of Preliminary Guidance (Paper 20), a Revised Contingent Motion to Amend (Paper 24). We held an oral hearing on March 28, 2023, and a transcript is in the record. Paper 34.

On May 22, 2023, the Board entered a Final Written Decision. Paper 35. We held that no challenged claims were proven unpatentable and, on that basis, we dismissed the Revised Contingent Motion to Amend. *Id.* at 2–3. On July 23, 2025, the Federal Circuit reversed, held claims 1, 3, and 4 invalid as anticipated by Jorgensen³, and remanded to the Board to determine whether Petitioner had established that claims 2, 5, and 6 are unpatentable as obvious. Paper 38, 1. For reasons that follow, we determine

¹ “Sigray, Inc. is the real party-in-interest.” Pet. 89.

² “Carl Zeiss X-Ray Microscopy, Inc. is the” real party-in-interest. Paper 4, 2.

³ Ex. 1007, S. Jorgensen, et al., *Three-Dimensional Imaging of Vasculature and Parenchyma in Intact Rodent Organs with X-ray Micro-CT*, Am. J. Physiol. (Sept. 1998) (“Jorgensen”).

that Petitioner demonstrates by a preponderance of the evidence that claims 2, 5, and 6 are unpatentable as obvious.

In view of the above circumstances, we consider Patent Owner's Revised Contingent Motion to Amend, which advances proposed substitute claims 16–21 (which correspond, respectively, to original claims 1–6) and proposed claims 22 and 23 (which correspond, respectively, to original claims 7 and 8). Paper 24, 3–9.

For reasons explained below in our analysis of the Revised Contingent Motion to Amend, we deny the motion as to proposed substitute claims 16–21, which correspond, respectively, to original claims 1–6, because those proposed substitute claims introduce new matter. We dismiss the Revised Contingent Motion to Amend as to proposed substitute claims 22 and 23, because those proposed substitute claims correspond, respectively, to original claims 7 and 8, which were held not proven unpatentable in our original Final Written Decision, and were not a subject of Petitioner's appeal to the Federal Circuit (Paper 35 at 63–64 (original Final Written Decision); Paper 38 at 2 (Federal Circuit's decision on appeal)).

II. BACKGROUND

A. Related Matters

The parties identify the following district court litigation as a related matter: *Carl Zeiss X-Ray Microscopy, Inc. v. Sigray, Inc.*, No. 5-21-cv-01129 (N.D. Cal.). Pet. 89; Paper 4, 1 (Patent Owner's mandatory notices).

B. The '704 Patent

The '704 Patent is directed to an X-ray imaging system that combines projection magnification and optical magnification. Ex. 1001, code (57), 2:47–51. An embodiment is shown in Figure 1, which is reproduced below.

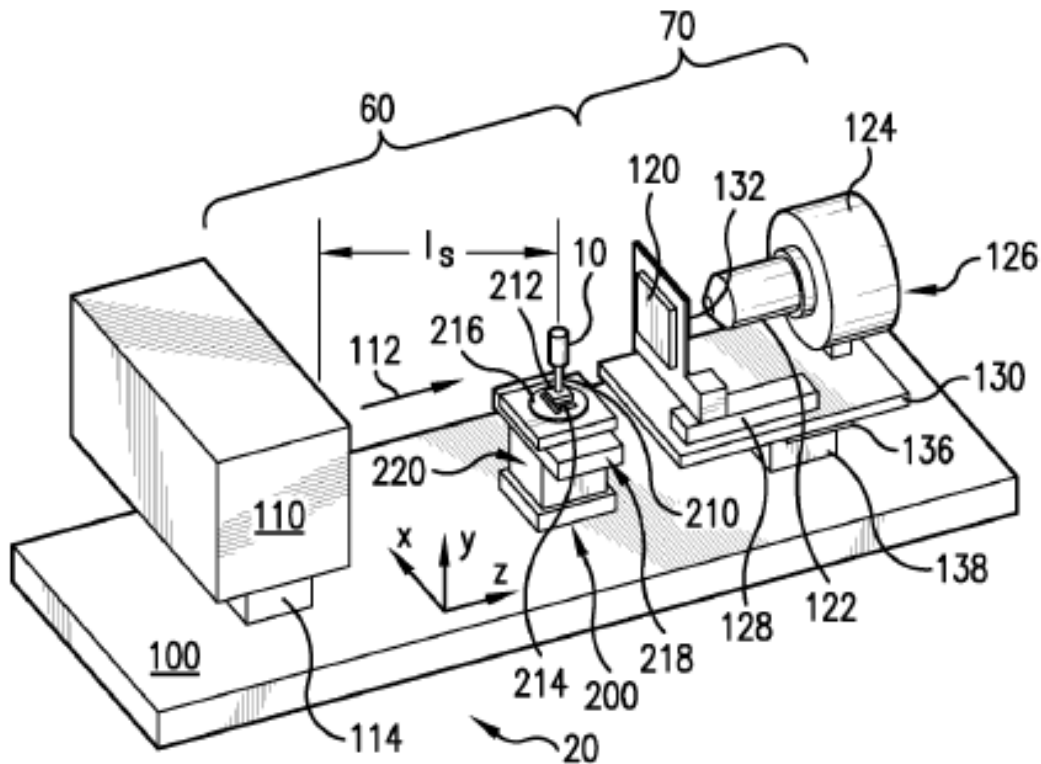


FIG. 1

Figure 1 is a diagram showing X-ray imaging system 20, including projection X-ray stage 60 and optical stage 70. Ex. 1001, 3:66–67, 4:19–23, 4:47–50, 5:13–16, Fig. 1.

The X-ray stage includes X-ray source 110 for generating X-ray beam 112, x-axis source motion stage 114 for adjusting the position of the X-ray source, and sample holder 200 for positioning sample 10 in the X-ray beam. *Id.* at 4:25–28, 4:35–40, 4:51–53, Fig. 1. The sample holder includes sample mount 210, mount base 212, x-z sample motion stage 214, sample rotation

stage 216, x-axis sample motion stage 218, and y-axis sample motion stage 220. *Id.* at 4:53–5:10. The X-ray stage also includes scintillator 120, which converts the X-ray beam, after interacting with a sample, into an optical signal. *Id.* at 5:11–13, 5:17–19.

The optical stage includes visible light magnification lens system 122, CCD detector 124,⁴ and z-axis scintillator motion stage 128 for adjusting the distance between the scintillation screen and the magnification lens system. *Id.* at 5:20–27. These optical stage components are secured to optical stage sub assembly bench 130, which can be aligned in the x- and y-directions using x-axis optical motion stage 136 and y-axis optical motion stage 138, respectively. *Id.* at 5:27–41.

C. Challenged Claims

Pursuant to the Federal Circuit’s mandate, we resolve only whether Petitioner has proven claims 2, 5, and 6 unpatentable as obvious under 35 U.S.C. § 103(a). Paper 38, 13. We reproduce below claim 1, from which claims 2, 5, and 6 depend.

1. An x ray imaging system, comprising:
 - a projection x ray stage including:
 - an x ray source generating a diverging x ray beam; and
 - a scintillator for converting the x ray beam, after interacting with a sample, into an optical signal;
 - an optical stage including:
 - a detector; and

⁴ “CCD” means “charge-coupled device.” Pet. 19; Ex. 1007, H1103.

a magnification lens for imaging the optical signal of the scintillator onto the detector;

wherein a magnification of the projection x ray stage is between 1 and 10 times and a magnification of the optical stage is 5 or greater.

Ex. 1001, 9:63–10:7.

We reproduce below claims 2, 5, and 6.

2. An x-ray imaging system as claimed in claim 1, wherein a spot size of the x-ray source is between 1 and 10 micrometers in diameter.

5. An x-ray imaging system as claimed in claim 1, wherein a distance between the sample and the scintillator is between 1 and 50 millimeters.

6. An x-ray imaging system as claimed in claim 1, wherein a distance between the sample and the scintillator is between 1 and 10 millimeters.

Id. at 10:8–18.

D. Challenges to Patentability

Pursuant to the Federal Circuit’s mandate (Paper 38 at 13), we limit our analysis to the following challenges stated in the Petition (Pet. 14).

Claim(s) Challenged	35 U.S.C. §⁵	Reference(s)/Basis
2, 5, 6	103(a)	Jorgensen ⁶

⁵ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the ’704 patent has an effective filing date before that date, we refer to the pre-AIA version of § 103. Ex. 1001, code (60).

⁶ *See supra* n.3.

Claim(s) Challenged	35 U.S.C. § ⁵	Reference(s)/Basis
2	103(a)	Jorgensen, Hayashi ⁷
5, 6	103(a)	Jorgensen, Deckman ⁸

Petitioner relies, *inter alia*, on declarations of Omid E. Kia, Ph.D. (Ex. 1005; Ex. 1023; Ex. 1025). Patent Owner opposes the challenges with evidence including a declaration of Julie Bentley, Ph.D. (Ex. 2005) and a declaration of Gonzalo Arce, Ph.D. (Ex. 2032). In addition, Patent Owner relies on a declaration of its employee, Mr. Bruce Johnson, for evidence of objective indicia of nonobviousness.

III. ANALYSIS

A. Legal Standard

A patent claim is unpatentable under 103(a) if the differences between the claimed subject matter and “the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007).

We resolve obviousness based on underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

⁷ Ex. 1012, US 6,249,566 B1, issued June 19, 2001 (“Hayashi”).

⁸ Ex. 1010, US 4,891,829, issued January 2, 1990 (“Deckman”).

B. Level of Ordinary Skill in the Art

The level of ordinary skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int'l Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citations omitted). In assessing the level of ordinary skill in the art, we consider various factors, which may include the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quotation omitted).

Petitioner contends that a person of ordinary skill in the art (“POSITA”) would have had a Ph.D. in physics, electrical engineering, or a similar field, with course work or industry experience in control theory, x-ray optics, laboratory experience, and applied mathematics; or a master’s degree with a subset of that course work and 3–4 years of x-ray and computing imaging experience. Pet. 16 (citing Ex. 1005 ¶¶ 36–40).

Patent Owner counterargues that a POSITA “would have had a master’s degree in physics, optics, electrical engineering or a similar field and 3–4 years of x-ray microtomography experience.” PO Resp. 5 (citing Ex. 2005 ¶ 33). The parties agree that additional industry experience may compensate for less formal educational experience, and Patent Owner contends that the reverse also is true. Pet. 16; PO Resp. 5.

The level of ordinary skill in the art, as articulated by Patent Owner, more accurately reflects the subject matter of the ’704 Patent and the asserted prior art than does Petitioner’s articulation. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (“the prior art itself reflects an

appropriate level” as evidence of the ordinary level of skill in the art) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985)). Petitioner does not explain how “control theory” and “applied mathematics” (Pet. 16) relate to the subject matter of the ’704 Patent or the asserted prior art, and Petitioner’s reference to “laboratory experience” (*id.*) is too general to be useful in defining the level of skill.

Furthermore, whereas Petitioner requires a POSITA to have “x-ray and computing imaging experience” (*id.*), Patent Owner more particularly specifies “x-ray microtomography experience” (PO Resp. 5), which is the field of art for the ’704 Patent, as well as many of the asserted prior art references. Ex. 1001, code (54) (“High resolution direct-projection type x-ray microtomography system using synchrotron or laboratory-based x-ray source”); Ex. 1007 (discussing X-ray microcomputed tomography); Ex. 1008 (discussing X-ray nanotomography and microtomography); Ex. 1010, code (54) (“Method and apparatus for utilizing an electro-optic detector in a microtomography system”); Ex. 1011 (title: “Three-Dimensional X-ray Microtomography”).

For those reasons, we apply Patent Owner’s definition of a POSITA. Even if we were to apply instead Petitioner’s definition of a POSITA, however, the outcome would be the same because the controversy is not shown, on this record, to turn on the differences between the parties’ contentions about level of ordinary skill in the art. Neither party asserts that the outcome of this proceeding would differ based on the minor differences between the two parties’ definitions of an ordinarily skilled artisan. Nor does either party question whether the opposing party’s declarant is a person of ordinary skill in the art under either proposed definition.

C. Claim Construction

We construe claim terms in an *inter partes* review “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b).” 37 C.F.R. § 42.100(b). Under that standard, the words of a claim are generally given their “ordinary and customary meaning,” which is the meaning the term would have had to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

Neither party proposes any express claim constructions. *See* Pet. 17 (“all claim terms should receive their plain and ordinary meaning”); PO Resp. 5 (applying the same constructions as Petitioner). In accordance with the Federal Circuit’s mandate, however, we adopt and apply herein “[t]he plain meaning of the term ‘between 1 and 10,’” which “includes tiny, and even undetectable, magnification” and, moreover, we take account that Jorgensen anticipates claim 1, including that limitation. Paper 38, 11–12.

We determine that no other claim term requires express construction for purposes of resolving any controversy between the parties. *Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Asserted Obviousness of Claims 2, 5, and 6

Claims 2, 5, and 6 depend from claim 1. Ex. 1001, 10:8–18. We begin our discussion by acknowledging, per the Federal Circuit’s mandate, that

claim 1 is anticipated by Jorgensen, which “contains a beam diverging at the sample” that “necessarily produces projection magnification over 1” and, thereby, “inherently contains projection magnification” as required by claim 1. Paper 38, 12.

Against that backdrop, and consistent with the Federal Circuit’s mandate, we limit our discussion to whether Petitioner has proven that claims 2, 5, and 6 are unpatentable as obvious. Paper 38 at 13. For reasons that follow, we determine that Petitioner has carried its burden as to all three of those challenged claims.

1. Obviousness Challenge Based on Jorgensen Alone

Petitioner asserts that claims 2, 5, and 6 would have been obvious over Jorgensen alone. Pet. 14. We address each patent claim in turn.

a) Claim 2

Claim 2 specifies the x-ray imaging system of “claim 1, wherein a spot size of the x-ray source is between 1 and 10 micrometers in diameter.” Ex. 1001, 10:8–10. Petitioner argues that the subject matter of claim 2 would have been obvious from the disclosure of Jorgensen. Pet. 34.

Petitioner begins by pointing out that Jorgensen discloses that “X-ray microscope 3-D imaging depends importantly on the characteristics of the X-ray source” and that “Jorgensen uses an x-ray tube with ‘an effective spot size of 0.8×0.4 mm.’” Pet. 34 (quoting Ex. 1007, H1111, H1104). Furthermore, Jorgensen describes “blurring of the original X-ray projection image recorded by the CCD imaging array, due to the X-ray focal spot’s finite size.” *Id.* (quoting Ex. 1007, H1110). Petitioner and its declarant, Dr. Kia, submit that a POSITA would have been “motivated to reduce

blurring by decreasing spot size” and, on that basis, submit that the subject matter of claim 2 would have been obvious. Pet. 34 (citing Ex. 1005 ¶ 119). Patent Owner presents four counterarguments, which we address in turn.

i. Spot Size as a Result-Effective Variable

First, Patent Owner argues that Petitioner fails to “identify any prior art that discloses an x-ray source having the claimed spot size.” PO Resp. 45. We agree with Petitioner, however, that Patent Owner “fails to consider the advantages of a smaller spot size” — advantages that would have been known to a POSITA, given that they are discussed “in each of these references.” Reply 19. Petitioner further directs us to evidence that Patent Owner’s own witness, Dr. Bentley, “agreed that a POSITA would have been aware of tradeoffs between smaller and larger spot sizes.” *Id.* (citing Ex. 1024, 45:14–47:20).

In other words, the evidence supports that spot size would have been a result effective variable and, on this record, that optimizing that variable in view of various “tradeoffs,” recognized by Patent Owner’s own witness, would have been within the level of ordinary skill in the art. *Id.*; see *In re Boesch*, 617 F.2d 272, 276 (CCPA 1980) (“discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art”). Patent Owner does not counter Petitioner’s evidence on that point, but instead, refers us back to a related argument in the Response, pertaining to whether one would have undertaken that modification with a reasonable expectation of success, which we address below in connection with Patent Owner’s third argument. Sur-reply 18 (citing PO Resp. 47–49).

ii. Asserted “Teaching Away” from Smaller Spot Sizes

Second, Patent Owner submits that “Jorgensen teaches away from smaller spot sizes.” PO Resp. 45. We recognize that an obviousness challenge may be overcome “by showing that the prior art teaches away from the claimed invention in any material respect.” *In re Peterson*, 315 F.3d 1325, 1331 (Fed. Cir. 2003) (citing *In re Geisler*, 116 F.3d 1465, 1469 (Fed. Cir. 1997)). For a reference to teach away, however, it must state more than a general preference for an alternative invention. Specifically, it must “criticize, discredit, or otherwise discourage” investigation into the invention claimed. *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (quoting *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004)).

In Patent Owner’s view, “Jorgensen teaches away from smaller spot sizes” because smaller spot sizes “require significantly more power to generate the desired flux.” PO Resp. 45. Patent Owner directs us to evidence that, at best, illustrates that this disadvantage would have been among the “tradeoffs between smaller and larger spot sizes” that inform the selection. Ex. 1024, 45:14–47:20 (Dr. Bentley’s cross-examination testimony); see PO Resp. 45–46 (evidence of proposed disadvantage). This evidence does not “criticize, discredit, or otherwise discourage” investigation into the invention claimed. *Fulton*, 391 F.3d at 1201. At best, we find that it may indicate a preference for a different spot size depending on the desired application.

In any event, Petitioner argues that Patent Owner’s evidence does not, in fact, demonstrate that the disclosure in Jorgensen, upon which Patent Owner relies, would have discouraged a POSITA from investigating (and optimizing) smaller spot sizes. Reply 20. On that point, Petitioner directs us

to Jorgensen's disclosure that "the desired X-ray flux" is achieved by using "an angulated line source rather than a microfocus source" showing that Jorgensen is comparing the flux of different sources, not different spot sizes. Pet. 43 (citing Ex. 1007, H1104). Patent Owner's counterview that Jorgensen "expressly compares its 12×0.4 mm focal spot to a 0.8×0.4 [sic] mm focal spot" is not supported sufficiently by the cited evidence. Sur-reply 18 (citing Ex. 1007, H1104). Contrary to Patent Owner's view, the reference makes clear that it uses an x-ray tube that provides "an effective spot size of 0.8×0.4 mm." Ex. 1007, H1104. Thus, the 12×0.4 mm focal spot is not being compared directly to the 0.8×0.4 spot size, but rather, is being used as part of a comparison of an angulated line source to a microfocus source. *See* Reply 20.

In other words, Petitioner directs us to compelling evidence that Jorgensen "is not comparing different spot sizes" but, instead, "is comparing the flux of 'a line source' to that of a 'conventional focal spot' of the same size." Reply 20 (quoting Ex. 1007, H1104). Petitioner also identifies, within the four corners of the applied reference, evidence that a POSITA would have known how to compensate for any asserted disadvantage associated with flux when selecting a smaller spot size. *Id.* (citing Ex. 1007, H1113).

On this record, we determine that Jorgensen does not teach away from the proposed modification (and optimization) that would have led a POSITA to the smaller spot sizes specified in claim 2.

iii. Reasonable Expectation of Success

Third, Patent Owner submits that "a POSITA would not have been motivated to reduce the spot size in Jorgensen . . . with a reasonable

expectation of success.” PO Resp. 46; *see* Sur-reply 17 (same). This argument is tied directly to Patent Owner’s position that decreasing the spot size would have disadvantageously “generated significantly less flux.” Sur-reply 18; *see* PO Resp. 46–47 (same); *see also* Ex. 1008, 204 (“Reducing the size of the focal spot to submicron values dramatically reduces the corresponding x-ray flux.”). In Patent Owner’s view, reducing Jorgensen’s spot size would have frustrated Jorgensen’s stated “need[] to speed up the scan so as to minimize motion blurring.” PO Resp. 46 (quoting Ex. 1007, H1112).

Petitioner, for its part, acknowledges that a POSITA would have understood this tradeoff — namely, that reducing the size of the focal spot results in “an increased exposure time.” Reply 20. Petitioner points out, however, by citation to solid objective proof, that this was but one tradeoff that would have been taken into account by the POSITA. *Id.* (citing Ex. 1008, 201). We find significant, in that regard, that the same reference that Patent Owner touts as demonstrating that smaller spot size would have disadvantageously increased exposure time “describes an advantage of using a ‘source spot-size around and under one micron’ which ‘enhances the image of the object’s external and internal edges’ due to ‘small angle scattering.’” *Id.* at 21 (quoting Ex. 1008, 204) (citing Ex. 1008, Fig. 4).

Importantly, as Petitioner points out, this same reference “discloses a system that ‘employs an x-ray source with a 300–400 nm x-ray spot size,’ which is more than 20x smaller than the 10 μ m spot size required by claim 2.” *Id.* (quoting Ex. 1008, 201) (citing Ex. 1023 ¶ 14). That circumstance persuasively undercuts Patent Owner’s arguments against “the feasibility of even smaller spot sizes for use in x-ray microtomography.” *Id.*

Patent Owner raises additional arguments pertaining to the feasibility of that modification, but none on this record demonstrates a lack of feasibility. PO Resp. 46–49. Instead, each is a tradeoff (that is, a disadvantage) associated with particular applications. Critically, Patent Owner stops short of weighing the disadvantages against the corresponding advantages associated with decreased spot size. *Id.* We are not persuaded, based on the information advanced by Patent Owner, that those tradeoffs indicate that the modification would have been undertaken without a reasonable expectation of success. *Compare id.* and Sur-reply 17–18, with Pet. 34 and Reply 19, 20–21.

Here again, it is worth emphasizing that the very same reference that Patent Owner touts, in support of its position that smaller spot sizes came with disadvantages, plainly discloses a system having a spot size “more than 20x smaller than the” spot size required by claim 2 — a circumstance that, we find, strongly supports that a POSITA would have been led to optimize, and would have known how to successfully optimize, spot sizes that fall within the scope of claim 2. Reply 21 (quoting Ex. 1008, 201) (citing Ex. 1023 ¶ 14). We agree with Petitioner that Patent Owner touts the disadvantages “but fails to consider the advantages of a smaller spot size.” *Id.* at 20.

For the above reasons, based on the record presented, we are not persuaded that a POSITA would have lacked a reasonable expectation of success in modifying Jorgensen, using the disclosures in Jorgensen and the POSITA’s own knowledge, in view of the various known advantages and tradeoffs, to attain a reduction in the spot size in a manner that would have met claim 2. *See* Sur-reply 17–18 (repeating arguments on point but

declining to counter effectively, if at all, Petitioner’s assessment of the issue in view of Exhibit 1008); Ex. 1008, 201, 204 (explaining the tradeoffs that enter the calculus when selecting spot size).

iv. Blurring as an Impetus for Spot Size Optimization

Fourth, and finally, Patent Owner argues that this challenge rests on an erroneous assumption “that the large size of Jorgensen’s x-ray focal spot is the primary cause of blurring.” PO Resp. 47. At the outset, we determine that Petitioner’s challenge does not require a showing that spot size is “the primary cause of blurring” in Jorgensen’s apparatus. *Id.* Petitioner raises evidence that a reduction in blurring would have provided a motivation for selecting a smaller spot size, but does not argue that spot size is the primary cause of blurring. Pet. 34 (citing Ex. 1007, H1110, H1111; Ex. 1005 ¶ 119).⁹

Patent Owner further argues that “reducing the size of the focal spot would not reduce blurring in any meaningful way” because, in Jorgensen’s apparatus, the x-ray source is placed “far away from the sample, which effectively reduces the focal spot size, and the beam is collimated.” PO Resp. 47–48 (citing Ex. 2005 ¶ 111). Patent Owner directs the Board to no objective support for that factual assertion, but relies on Dr. Bentley’s subjective opinion. *Id.*

Dr. Bentley, on that point, merely parrots the conclusory statements in the Response, without adding any further technical analysis or identifying

⁹ For that same reason, we find unpersuasive Patent Owner’s related argument that “Petitioner ignores various other factors that affect blurring.” PO Resp. 48.

any objective proof. *Compare* PO Resp. 47–48, with Ex. 2005 ¶ 111. We assign little weight to Dr. Bentley’s conclusory opinions. *See Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 at 15 (Aug. 24, 2022) (designated precedential Feb. 10, 2023) (assigning little weight to opinion testimony that “parrots” conclusory statements in a brief, without citing “any additional supporting evidence or” providing “any technical reasoning” in support of the opinion). Those conclusory opinions do not outweigh the intrinsic evidence, within the four corners of Jorgensen, which explicitly identifies focal spot size as a cause of blurring. Reply 21 (citing Ex. 1007, H1107, H1110, H1111).

Somewhat relatedly, Patent Owner submits that “reducing Jorgensen’s spot size would have reduced the flux, which would have reduced the amount of light generated by the crystal, which would have increased exposure time” and, therefore, “a POSITA would have understood that reducing Jorgensen’s spot size likely would have increased (not decreased) blurring.” PO Resp. 48. Dr. Bentley expands on that argument somewhat, opining that “a POSITA would have understood that reduced x-ray flux likely would have required a thicker crystal,” such “that reducing Jorgensen’s spot size likely would have increased (not decreased) blurring due, for example, to an increased time for motion and increased propagation within [a] thicker crystal.” Ex. 2005 ¶ 113.

We find too attenuated Dr. Bentley’s opinion that a POSITA “*likely* would have” used a thicker crystal, which “*likely* would have increased (not decreased) blurring” in the modified apparatus of Jorgensen — an opinion advanced without any persuasive objective support. *Id.* (Board’s emphasis). This opinion testimony is speculative, unsupported by citations to objective

proof, and less than clear or complete in its technical reasoning. *See Xerox Corp.*, Paper 9 at 15 (assigning little weight to opinion testimony presented without citing “any additional supporting evidence or” providing “any technical reasoning” in support of the opinion).

We find more persuasive the intrinsic disclosures in Jorgensen, which support that a POSITA would have understood that smaller focal spot size would advantageously improve problems associated with blurring. *See* Reply 21 (quoting Ex. 1007, H1107, H1110, H1111) (disclosures in Jorgensen indicating that spot size is a direct cause of blurring). We also find persuasive, in that regard, Petitioner’s argument that the very same background reference — which Patent Owner advances for its disclosure that reducing spot size causes “an increased exposure time” (PO Resp. 46–47 (quoting Ex. 1008, 204 (“the Sasov background reference”))) — “also teaches the advantages of using smaller spot sizes.” Reply 20–21 (citing Ex. 1008, 201, 204).

When we weigh Dr. Bentley’s conclusory opinions against the intrinsic evidence contained within the four corners of Jorgensen and the Sasov background reference, we determine that a preponderance of the evidence supports Petitioner’s view that a desire to manage blurring would have provided an impetus for focal spot size optimization, leading to the range specified in claim 2. *See In re Aller*, 220 F.2d 454, 456-58 (CCPA 1955) (“where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation”).

b) Claim 5

Claim 5 specifies the system of claim 1 “wherein a distance between the sample and the scintillator is between 1 and 50 millimeters.” Ex. 1001, 10:16–18. Petitioner directs us to evidence that “Jorgensen discloses the sample in close proximity to the scintillator” and, further, that the reference indicates “that image quality increases as the sample-to-scintillator distance is reduced.” Pet. 35 (citing Ex. 1007, Fig. 2, H1104, H1111). Petitioner directs us to additional evidence that the distance between the sample and scintillator would have been a known, result-effective variable optimizable by a POSITA. *Id.* at 34–35 (citing Ex. 1007, H1104–H1106; Ex. 1005 ¶¶ 122–125); *see In re Boesch*, 617 F.2d 272, 276 (CCPA 1980) (“discovery of an optimum value of a result effective variable” generally falls within the level of ordinary skill in the art).

Patent Owner, for its part, does not oppose Petitioner’s evidence as to claim 5, except to argue that claim 1, from which claim 5 depends, is not proven unpatentable. *See, e.g.*, PO Resp. iii (Table of Contents, indexing no arguments specific to claim 5). The Federal Circuit’s decision disposes of those arguments as to claim 1. Paper 38 at 12 (holding “that claim 1 is anticipated”).

We find persuasive Petitioner’s unopposed arguments and evidence as to claim 5 and, therefore, we determine that a preponderance of the evidence supports that claim 5 is unpatentable as obvious over Jorgensen.

c) Claim 6

Similar to claim 5, claim 6 specifies the system of claim 1 “wherein a distance between the sample and the scintillator is between 1 and 10

millimeters.” Ex. 1001, 10:19–21. Petitioner refers the Board back to the same arguments and evidence that we find persuasive in connection with claim 5. Pet. 36. Here again, Patent Owner does not oppose those arguments and evidence, except to submit that claim 1, from which claim 6 depends, is not unpatentable over Jorgensen. *See, e.g.*, PO Resp. iii (Table of Contents, indexing no arguments specific to claim 6). The Federal Circuit’s decision disposes of those arguments as to claim 1. Paper 38 at 12 (holding “that claim 1 is anticipated”).

We find persuasive Petitioner’s unopposed arguments and evidence as to claim 6 and, therefore, we determine that a preponderance of the evidence supports that claim 6 is unpatentable as obvious over Jorgensen.

2. Obviousness Challenge Based on Jorgensen and Hayashi

Petitioner asserts that the subject matter of claim 2, which includes “a spot size of the x-ray source” that “is between 1 and 10 micrometers in diameter,” would have been obvious over the combined disclosures of Jorgensen and Hayashi. Pet. 45.

As it did in connection with the challenge based on Jorgensen alone, Petitioner begins by pointing out that Jorgensen discloses that “X-ray microscope 3-D imaging depends importantly on the characteristics of the X-ray source” and that “Jorgensen uses an x-ray tube with ‘an effective spot size of 0.8×0.4 mm.’” *Id.* (quoting Ex. 1007, H1111, H1104). Furthermore, Jorgensen describes “blurring of the original X-ray projection image recorded by the CCD imaging array, due to the X-ray focal spot’s finite size.” *Id.* (quoting Ex. 1007, H1110).

In this challenge, however, Petitioner further directs us to statements made by the Examiner during patent prosecution, in particular:

Hayashi teaches the micro-focus x-ray sources and means for decreasing size of the x-ray source's focal spot in range of about 2 micrometers or about 10 micrometers while increasing brightness and intensity of the x-ray source (column 9, lines 34–47). It would have been obvious to one of ordinary skill in the art at the time the invention was made to employ the micro-focus x-ray source as suggested Hayashi in the imaging system of Flannery, since such a modification would provide user with the capabilities to reduce the spot size of the x-ray source between 1 and 10 micrometers that would enhance imaging by increasing brightness and intensity of the x-ray source.

Pet. 45 (quoting Ex. 1002). Petitioner concludes by averring that the subject matter of claim 2 would have been obvious over Jorgensen and Hayashi. *Id.*

Patent Owner counters this by advancing the same arguments presented in the context of the challenge based on Jorgensen alone. PO Resp. 45–49. Patent Owner further argues that the Examiner's statement "is completely unsupported. It is also wrong." PO Resp. 49. By way of support, Patent Owner refers us to Dr. Bentley's opinion that "reducing Jorgensen's spot size would have reduced the x-ray flux, which would have degraded (not enhanced) imaging." *Id.* (citing Ex. 2005 ¶ 114).

To the extent Patent Owner's arguments as to this challenge mirror its arguments made in connection with the challenge based on Jorgensen alone (*see* PO. Resp. 45–49), our analysis above applies with equal force to this challenge based on the combined disclosures of Jorgensen and Hayashi.

We find unpersuasive, moreover, Patent Owner's argument and Dr. Bentley's parroting opinions about the statements made by the Examiner during patent prosecution. PO Resp. 49; Ex. 2005 ¶ 114. In particular,

Dr. Bentley refers back to her attenuated, speculative, and unsupported opinion that a POSITA “*likely*” would have increased (not decreased) blurring” by “*likely*” swapping in “a thicker crystal” in the modified apparatus of Jorgensen. Ex. 2005 ¶¶ 113, 114 (Board’s emphasis).

Petitioner, by contrast, directs us to the Examiner’s statements during prosecution, in addition to the intrinsic evidence of Jorgensen’s disclosure, to show persuasively why the combined teachings of Jorgensen and Hayashi would have suggested the subject matter of claim 2. Here again, therefore, we determine that a preponderance of the evidence supports Petitioner’s view that claim 2 is unpatentable as obvious over Jorgensen and Hayashi.

3. Obviousness Challenge Based on Jorgensen and Deckman

Petitioner asserts that the subject matter of claims 5 and 6 would have been obvious over the combined disclosures of Jorgensen and Deckman. Pet. 61–62. As noted above, both claims depend from claim 1 and, further, specify “a distance between the sample and the scintillator” that “is between 1 and 50 millimeters” (claim 5) or “between 1 and 10 millimeters” (claim 6).

Petitioner asserts that “Deckman explicitly discloses” the limitations added by claims 5 and 6. Pet. 61; *see id.* at 62 (extending arguments about claim 5 to claim 6). We agree. “Deckman discloses a sample-to-scintillator distance of 2 mm.” *Id.* at 56 (citing Ex. 1010, 21:65–66 (“A phosphor conversion plate was located 2 mm behind the sample.”)). Patent Owner does not address that assertion effectively, if at all. *See* PO Resp. 25.

Petitioner, moreover, articulates adequate reasons why an ordinarily skilled artisan would have modified Jorgensen’s apparatus to include a sample-to-scintillator distance of 2 mm, as disclosed by Deckman, with a

reasonable expectation of success: “Jorgensen teaches that its system is derived from the system in Deckman and,” moreover, “specifically cites the work of” Deckman. Pet. 61–62 (citing Ex. 1007, H1103, H1104, H1113; Ex. 1005 ¶ 230).

Patent Owner does not oppose that reasoning for the combination. PO Resp. 25. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Based on the record presented, we find Petitioner’s reasoning persuasive; therefore, we determine that Petitioner shows adequately a reason to combine the references with a reasonable expectation of success, such that the subject matter of claims 5 and 6 would have been obvious over Jorgensen and Deckman.

E. Objective Indicia of Non-Obviousness

Objective indicia of non-obviousness, also known as secondary considerations, can be the most probative evidence of nonobviousness in the record, enabling a court to avert the trap of hindsight. *Crocs, Inc. v. Int’l Trade Comm’n*, 598 F.3d 1294, 1310 (Fed. Cir. 2010). Petitioner, in the Petition, states it “is aware of no evidence supporting a claim for secondary considerations” on non-obviousness. Pet. 86.

Patent Owner responds by advancing objective indicia of non-obviousness; namely, evidence that the claimed invention satisfied a long felt need and, in addition, enjoyed industry praise. PO Resp. 51–54. Patent Owner argues that the nexus requirement is met and, on that basis, submits that the objective evidence “here demonstrates that the claimed invention of the ’704 patent would not have been obvious.” *Id.* 64.

Petitioner comes forward in the Reply, however, with argument that Patent Owner's proffered evidence is probative only with respect to claims 1 and 7, and that Patent Owner's arguments pertaining to "supposed indicia of non-obviousness are irrelevant to the grounds against," *inter alia*, claims 2, 5, and 6. Reply 21–22.

Significantly, Patent Owner does not contest Petitioner's arguments in that regard, but contends, in essence, that because claims 1 and 7 are "nonobvious," it follows that any claim depending from claim 1 or 7 likewise "cannot be obvious." Sur-reply 21 (citing *Ormco Corp. v. Align Tech., Inc.*, 498 F.3d 1307, 1319 (Fed. Cir. 2007)).

Patent Owner's argument is unpersuasive because claim 1 (from which claims 2, 5, and 6 depend) is anticipated by Jorgensen. Paper 38, 1 (opinion of our reviewing court). Where Patent Owner admits that its objective evidence of nonobviousness relates solely to independent claim 1 (which is anticipated by the prior art) or independent claim 7 (from which none of claims 2, 5, or 6 depend), we are not persuaded that the proffered evidence bears any nexus to the additional limitations added by the dependent claims at hand. Accordingly, on this record, we find no probative objective indicia of nonobviousness of the subject matter of claim 2, 5, or 6.

F. Patent Owner's Revised Contingent Motion to Amend

In our original Final Written Decision, we dismissed Patent Owner's Revised Contingent Motion to Amend in view of the fact that we found no original claim unpatentable. Paper 35, 63–65. The Federal Circuit, however, determined that claims 1, 3, and 4 are anticipated by Jorgensen (Paper 38, 12–13) and we here determine that claims 2, 5, and 6 are invalid as obvious.

Accordingly, in this Final Written Decision on Remand, we consider the Revised Contingent Motion to Amend as to proposed substitute claims 16–21 (which correspond, respectively, to original claims 1–6, which are proven invalid on this record) and dismiss the motion only as to proposed claims 22 and 23 (which correspond, respectively, to original claims 7 and 8, which were held not proven unpatentable in our original Final Written Decision, and were not the subject of the Federal Circuit appeal (Paper 35 at 63–64; Paper 38 at 2)).

1. Legal Standard

Proposed amended claims must be supported by sufficient written description support. *Fleming v. Cirrus Design Corp.*, 28 F.4th 1214, 1217, 1224–26 (Fed. Cir. 2022) (affirming denial of motion to amend where the proposed amended claims were not supported by sufficient written description). The “application’s disclosure must ‘reasonably convey’” to a POSITA “that the inventor had possession of the claimed subject matter as of the filing date.” *Fleming*, 28 F.4th at 1225 (quoting *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1563 (Fed. Cir. 1991)).

Patent Owner bears the burden of persuasion to show, by a preponderance of the evidence, that amendments are supported in the disclosure(s) and do not introduce new subject matter. 37 C.F.R. §§ 42.121(a)(2)(ii), (b), (d)(1); *see Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 15 at 4, 7–8 (PTAB Feb. 25, 2019) (precedential).

2. Parties’ Contentions

Patent Owner proposes substitute claims 16 to 21 as replacements for claims 1 to 6, respectively. Paper 24, 26–28. Substitute claim 16 is

independent and substitute claims 17 to 21 depend directly or indirectly from substitute claim 16. *Id.*

Substitute claim 16 recites “a second magnification of the projection x ray stage that is greater than or equal to 2 times and less than 10 times.” *Id.* at 26. Patent Owner contends that proposed substitute claim 16 does not add new subject matter, but rather, is directed to subject matter that is supported by the written description of the ’704 patent’s parent application; namely, U.S. App. 11/035,749 (“the ’749 application”). Paper 24, 3–8 (citing Exhibit 2028).

Petitioner counterargues that Patent Owner fails to direct the Board to adequate written description support for the recited second magnification of proposed substitute claim 16, because there is no disclosure in the ’749 application of a projection magnification range between 2 and 10 times. Paper 26 (Petitioner’s Opposition), 1–3; *see* Paper 32 (Petitioner’s Sur-Reply), 6 (“[n]or does the specification describe a range of 2 times to 10 times”).

3. Analysis

The portions of the ’749 application identified by Patent Owner as providing adequate written description, in fact, do not describe “a second magnification of the projection x ray stage that is greater than or equal to 2 times and less than 10 times.” Paper 24, 26–27 (proposed substitute claim 16). Specifically, in that regard, Patent Owner directs us to, *inter alia*, paragraphs 19 and 78, which describe that preferably the magnification of the projection of the x-ray stage is *less than or equal to 2*. Paper 24, 5. It is not clear on this record, and Patent Owner does not adequately explain, how

or why those portions support a second magnification that is *greater than or equal to 2 times* and less than 10 times as specified in proposed substitute claim 16. *Id.* The only mention of greater magnifications in the portions of the written description cited by Patent Owner is in paragraph 52, which describes magnifications of 5X and higher, but these are magnifications of the *optical stage*, not the *projection x-ray stage* as claimed. *Id.* (quoting Ex. 1001 ¶ 52). Presumably, this description is cited in support of the limitation reciting “a magnification of the optical stage is 5 times or greater.”

On this record, therefore, we determine that Patent Owner does not identify sufficient written description support for the magnitude of the second magnification of the projection x-ray stage as recited in proposed substitute claim 16. *See* Paper 24, 3–8; *see also* Paper 29 (Patent Owner’s Reply to Opposition), 1–2 (nowhere identifying adequate written description support for this subject matter). Proposed substitute claims 17 through 21 similarly lack adequate written description support, because each contains all of the limitations of substitute claim 16 by virtue of dependency from proposed substitute claim 16.

Patent Owner’s Revised Contingent Motion to Amend (Paper 24) fails to comply with the requirements of 35 U.S.C. § 316 because the amendment introduces new matter. 35 U.S.C. § 316(d)(3) (“[a]n amendment . . . may not . . . introduce new matter”). Furthermore, the Revised Contingent Motion to Amend runs afoul of 37 C.F.R. § 42.121 because the motion does not establish support in the relevant disclosure(s) for each proposed substitute claim and introduces new subject matter. *See* 37 C.F.R. §§ 42.121(a)(2)(ii) (motion to amend may be denied where the amendment introduces new subject matter), (b) (motion must set forth the support in the

relevant disclosure(s)), (d)(1) (patent owner's burdens); *see also* *Lectrosonics*, IPR2018-01128, Paper 15 at 4 (“the Board first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121”).

For these reasons, we deny Patent Owner's Revised Contingent Motion to Amend.

IV. CONCLUSION¹⁰

For the foregoing reasons, we determine that Petitioner demonstrates by a preponderance of the evidence that claims 2, 5, and 6 are unpatentable.

Proposed substitute claims 16–21 introduce new matter and, therefore, the Revised Contingent Motion to Amend is denied as to those claims.

Because proposed substitute claims 22 and 23 correspond to original claims 7 and 8, which are not proven unpatentable,¹¹ we dismiss the Revised Contingent Motion to Amend as to proposed substitute claims 22 and 23.

We summarize the Final Outcome After Remand from the U.S. Court of Appeals for the Federal Circuit as follows.

¹⁰ Should Patent Owner wish to pursue amendment of any of claims 1–7 in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

¹¹ See Final Written Decision, Paper 35 (finding Petitioner did not show by a preponderance of evidence that claims 7 and 8 are unpatentable).

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
2, 5, 6	103(a)	Jorgensen	2, 5, 6	
2	103(a)	Jorgensen, Hayashi	2	
5, 6	103(a)	Jorgensen, Deckman	5, 6	
Overall Outcome			2, 5, 6	

Revised Contingent Motion to Amend	Claims
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in Amendment	16–23
Substitute Claims: Motion to Amend Granted	
Substitute Claims: Motion to Amend Denied	16–21
Substitute Claims: Not Reached	22, 23

V. ORDER

It is

ORDERED that Petitioner demonstrates by a preponderance of the evidence that claims 2, 5, and 6 of the '704 patent are unpatentable;

ORDERED that Patent Owner's Revised Contingent Motion to Amend is *denied* as to proposed substitute claims 16–21, which introduce new matter;

ORDERED that Patent Owner's Revised Contingent Motion to Amend is *dismissed* as to proposed substitute claims 22 and 23, the patentability of which we do not reach; and

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

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PETITIONER:

Alan G. Laquer
Craig S. Summers
James E. Youngblood
KNOBBE, MARTENS, OLSON & BEAR, LLP
2agl@knobbe.com
2css@knobbe.com
2jey@knobbe.com

PATENT OWNER:

John C. Phillips
Ryan O'Connor
FISH & RICHARDSON P.C.
IPR47349-0001IP1@fr.com
PTABInbound@fr.com
phillips@fr.com
oconnor@fr.com