

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CATERPILLAR INC.,
Petitioner,

v.

WIRTGEN AMERICA, INC.,
Patent Owner.

IPR2022-01264
Patent 9,879,390 B2

Before BARRY L. GROSSMAN, JAMES J. MAYBERRY, and
RICHARD H. MARSCHALL, *Administrative Patent Judges*.

MAYBERRY, *Administrative Patent Judge*.

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

I. INTRODUCTION

Caterpillar Inc. (“Petitioner”) filed a Petition for *inter partes* review of claims 1–22 of U.S. Patent No. 9,879,390 B2 (Ex. 1001, the “’390 patent”). Paper 2¹ (“Pet.”). The ’390 patent is owned by Wirtgen America, Inc. Paper 6, 1.

For the reasons provided below, we conclude that Petitioner has proven, by a preponderance of the evidence, that claims 1–22 of the ’390 patent are unpatentable.

A. Procedural History

Upon review of the Petition, Preliminary Patent Owner Response (Paper 8), and evidence in the record, we instituted an *inter partes* review proceeding on all challenges in the Petition. Paper 9 (“Inst. Dec.”); *see* 37 C.F.R. § 42.108(a) (“When instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim.”).

Patent Owner filed a Response to the Petition. Paper 14 (“PO Resp.”). Petitioner filed a Reply to the Patent Owner Response. Paper 18 (Pet. Reply”). Patent Owner filed a Sur-reply to the Reply. Paper 21² (“PO Sur-reply”).

An oral hearing was held on October 30, 2023, and a transcript is included in the record. Paper 30 (“Tr.”).

¹ We refer to the public version of the Petition. Petitioner filed a confidential version of the Petition under seal as Paper 1.

² We refer to the public version of the Sur-reply. Patent Owner filed a confidential version of the Sur-reply under seal as Paper 23.

B. Real Parties-in-Interest

Caterpillar identifies itself as well as its subsidiaries Caterpillar Paving Products, Inc. and Caterpillar Prodotti Stradali S.r.L. as real parties-in-interest. Pet. 80. Wirtgen identifies itself and Wirtgen GmbH as real parties-in-interest. Paper 6, 1.

C. Related Matters

Petitioner and Patent Owner each identify the following district court proceeding as a related matter: *Wirtgen Am., Inc. v. Caterpillar, Inc.*, Case No. 17-770-RGA (D. Del.). Pet. 81; Paper 6, 2.

Petitioner and Patent Owner also each identify the following pending *inter partes* review proceeding as a related matter: IPR2022-01277 challenging claims in U.S. Patent 9,879,391, which matured from a continuation application of the '390 patent. Pet. 81; Paper 6, 2; *see* IPR2022-01277, Ex. 1001, code (60).

D. The '390 Patent

The '390 patent, titled “Road Milling Machine and Method for Measuring the Milling Depth,” issued January 30, 2018, from an application filed December 12, 2016. Ex. 1001, codes (22), (45), (54). The '390 patent ultimately claims priority to a U.S. application filed December 20, 2007, and a German application filed December 22, 2006. *Id.* at codes (30), (60).

The '390 patent relates to “a self-propelled road milling machine, especially a cold milling machine, as well as [] methods for measuring the milling depth.” Ex. 1001, 1:21–23. The '390 patent explains that “a problem with known road milling machines [is] that the milling depth can not be controlled accurately enough” so that measuring “an adjustment of side plates, for example, with respect to the machine frame is not sufficiently

accurate.” *Id.* at 1:45–56. The ’390 patent purports to address this problem, in one embodiment, by using side plates having sensors “spaced apart in the travelling direction.” *Id.* at 3:31–39. Figure 1 of the ’390 patent is reproduced below.

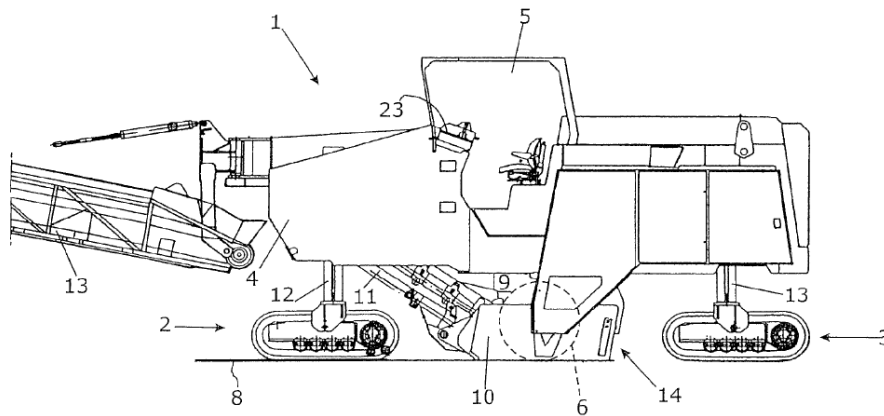


Fig.1

Figure 1 “shows a cold milling machine.” Ex. 1001, 3:55. The milling machine includes machine frame 4 supported by a track assembly having two front chain tracks 2 and at least one rear chain track 3 through lifting columns 12, 13. *Id.* at 4:7–11. Lifting columns 12, 13 allow machine frame 4 to be moved to a predetermined inclined position with respect to the ground or traffic surface 8. *Id.* at 4:13–15. Machine frame 4 supports milling roll 6, and arranged behind milling roll 6 is height-adjustable stripping means 14 which, in operation, has stripping plate 15 that engages milling track 17 formed by milling roll 6. *Id.* at 4:16–26. Side plates 10 are arranged on either side near the front end of milling roll 6. *Id.* at 4:35–36. Position sensors measure the displacements of side plates 10 or stripping plate 15 with respect to machine frame 4 or relative to each other. *Id.* at 4:45–53.

Figure 7a of the '390 patent, reproduced below, illustrates an embodiment of position sensors of the side plates.

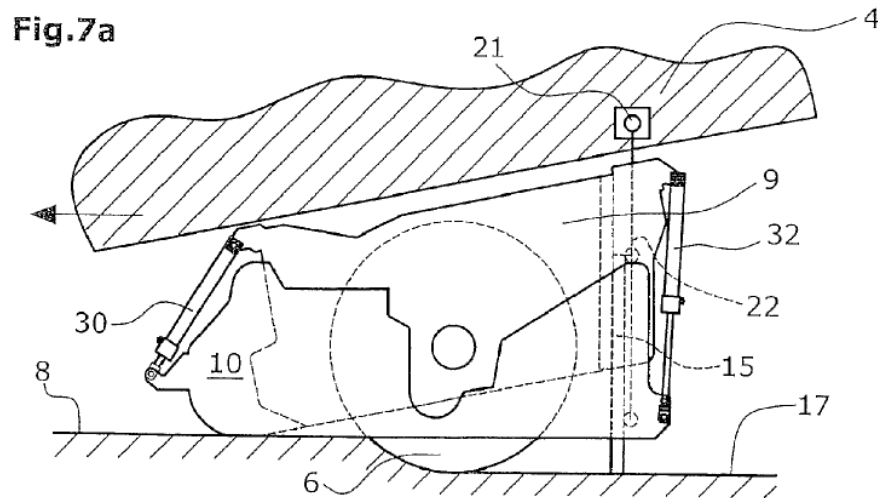


Figure 7a depicts a schematic illustration of the measurement error occurring at the stripping plate of the stripping means in the absence of parallelism between the machine frame and the ground or traffic surface. Ex. 1001, 3:67–4:2. Figure 7a illustrates the extent to which side plates 10 are pivotable with respect to machine frame 4. *Id.* at 6:18–20. Piston/cylinder units 30, 32 include position sensing systems, and their measuring signals may be used to determine the distance of side plates 10 from machine frame 4. *Id.* at 6:20–24.

Should two measuring means be used, one in front of the side plates 10 and one behind the same, seen in the travelling direction, it is also possible to determine the longitudinal inclination of the machine frame 4 with respect to the ground or traffic surface 8 or to also determine the transverse inclination of the machine frame 4 by a comparison of the measured values for both side plates 10 on both sides of the milling roll 6. *Id.* at 5:43–50.

E. Illustrative Claim

Among the challenged claims, claims 1 and 13 are independent claims. Independent claim 1 is illustrative and is reproduced below.

1. A self-propelled road milling machine, comprising:
 - [1a] a machine frame;
 - [1b] at least two front ground engaging supports, and at least one rear ground engaging support;
 - [1c] front and rear lifting columns supporting the frame from the ground engaging supports;
 - [1d] a milling roller supported from the frame for treatment of a ground surface;
 - [1e] a height adjustable stripping plate arranged behind the milling roller and operable to be lowered, during operation, into a milling track generated by the milling roller;
 - [1f] first and second height adjustable side plates arranged on opposite sides of the milling roller; and
 - [1g] a plurality of position sensors, each of the first and second side plates including at least two of the position sensors spaced apart in a traveling direction of the milling machine,
 - [1h] wherein each position sensor generates position signals representing changes in position for a respective side plate.

Ex. 1001, 6:53–7:4.³

³ We include labels for the limitations as used by Petitioner, with one exception. We separate out the “wherein” clause from limitation [1g] and assign it the label [1h]. Cf. Pet. 45 (providing, as limitation [1g], what we have labeled [1g] and [1h]).

F. Asserted Grounds

Petitioner asserts that the challenged claims are unpatentable on the following grounds:

Claims Challenged	35 U.S.C. § ⁴	References/Basis
1–6, 8–17, 19–22	103(a)	OMM ⁵ and Samuelson ⁶
7, 18	103(a)	OMM, Samuelson, and Zarniko ⁷

Pet. 5.

Petitioner relies on the declaration testimony of William Singhose, Ph.D., in support of its contentions. *See* Ex. 1006 (providing the Declaration); Ex. 1007 (providing Dr. Singhose’s curriculum vitae). Patent Owner relies on declaration testimony from Christopher Rahn, Ph.D., in response. Ex. 2003.

The following subsections provide brief descriptions of the asserted prior art references.⁸

⁴ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 296–07 (2011), took effect on September 16, 2011. The changes to 35 U.S.C. §§ 102 and 103 in the AIA do not apply to any patent application filed before March 16, 2013. Because neither party disputes that the application for the patent at issue in this proceeding has an effective filing date before March 16, 2013, we refer to the pre-AIA version of the statute.

⁵ Caterpillar, “PM-465 Cold Planer, Operation & Maintenance Manual” (Ex. 1002, hereinafter “OMM” for consistency with the Petition).

⁶ US 6,450,048 B1, issued Sept. 17, 2002 (Ex. 1004, “Samuelson”).

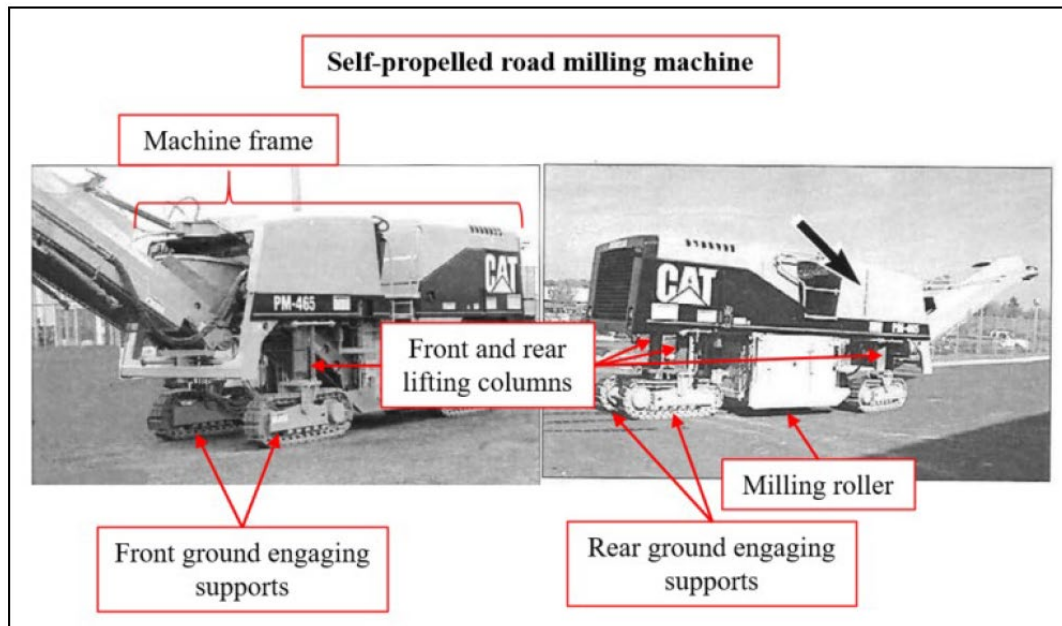
⁷ US 4,943,119, issued July 24, 1990 (Ex. 1005, “Zarniko”).

⁸ When discussing prior art references, Petitioner typically italicizes the name of the reference. When we quote the Petition, Petitioner’s Reply, and Dr. Singhose’s Declaration, we do not italicize the name.

1. *OMM (Ex. 1002)*

OMM is an operation and maintenance manual for the PM-465 cold planer that is used for cold milling pavement. Ex. 1002, Title, 2.⁹

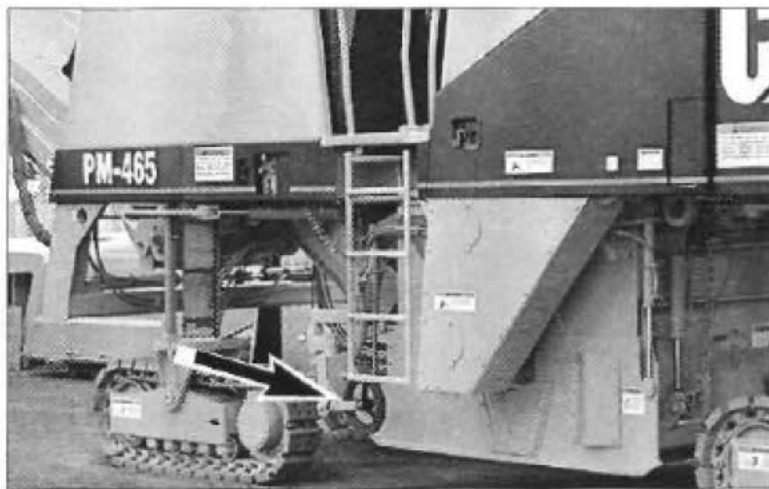
We reproduce below Petitioner’s annotated versions of the images depicted on pages 2 and 40 of OMM.



The images on pages 4 and 42 of OMM are annotated by Petitioner to denote uncontested components of the milling machine. Pet. 7. In particular, Petitioner adds the title, “Self-propelled road milling machine” placed inside a red rectangle. *Id.* Petitioner also denotes the “machine frame,” “milling roller,” “front and rear lifting columns,” “front ground engaging supports,” and “rear ground engaging support,” by placing these terms in red rectangles and using a lead arrow that extends from a rectangle

⁹ When referencing OMM, we use the pagination of the manual, rather than the exhibit, as this approach is consistent with how Petitioner references the manual.

to its respective component. *Id.* OMM's machine also includes Caterpillar's "Grade and Slope Electronic Control System," which includes, an "Electronic Control Module," "grade/slope controllers on the left and/or right side of the operator's console, the grade/slope controllers at ground level in front and/or behind the mandrel, a contacting or a non[-]contacting sensor on each side of the machine, [and] a slope sensor at the center of the machine." Ex. 1002, 32. According to OMM, the contacting sensor can include a grade slope wheel as depicted in the image on page 49 of OMM, reproduced below.



The image on page 49, on the left-hand side of the page, includes a black arrow denoting a grade slope wheel adjacent to the side plate of machine. Ex. 1002, 49. OMM explains that "[t]he grade slope wheel sends signals to the controller as the ground elevation varies." *Id.* According to OMM, "[i]f the machine uses the non-contacting method of measuring the grade, a sonic sensor is attached. The sonic grade sensor uses sound waves to monitor the distance from a fixed point on the machine to a grade reference point (such as: finished surface, curb, gutter, or stringline)." *Id.*

OMM notes that “[t]he sensors should be positioned on the centerline of the rotor to achieve an accurate cut. The further away from the center of the rotor, the less accurate the reading on the readout and the potential for less accurate cuts.” *Id.* at 48.

2. *Samuelson (Ex. 1004)*

Samuelson, titled “Hydraulic Cylinder Monitoring Apparatus,” issued September 17, 2002. Ex. 1004, codes (54), (45). Samuelson relates to “a hydraulic cylinder monitoring apparatus for a welded construction-type hydraulic cylinder.” *Id.* at 1:15–17. Samuelson discloses that hydraulic cylinders are used in various industries including “mobile equipment.” *Id.* at 1:35–40. Samuelson recognizes the importance of protecting the position measuring structure, e.g. transducer, of the cylinders, while being able to interchange “dumb” cylinders without transducers to “smart” cylinders. *Id.* at 1:45–60. Figures 5 and 6 of Samuelson are reproduced below.

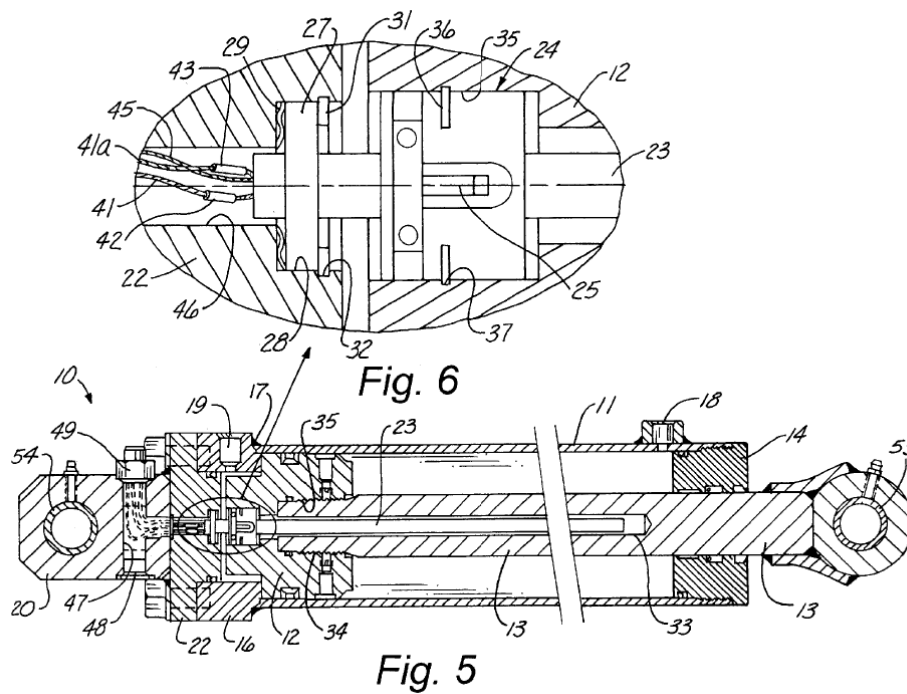


Figure 5 is a cross sectional view of a hydraulic cylinder having a monitoring apparatus disposed therein, and Figure 6 is an enlarged view of the circled portion shown in Figure 5. Ex. 1004, 2:53–57. Samuelson discloses that in operation, hydraulic cylinder 10 is connected at ends 53 and 54 to two objects that need to be selectively controlled by being separated and then moved back together while the relative spacing is monitored by the transducer structure 23 and 24. *Id.* at 4:17–21.

Samuelson explains that in Figure 5, a controller, not shown, is sensing the position of piston 12 with respect to cap 22 through reference supply and/or ground return wires 41 and 41a, which have fixed resistors. Ex. 1004, 4:22–26. Similarly, output wire 45 is connected to the controller. *Id.* at 4:27–28. According to Samuelson, when pressurized hydraulic oil is directed into port 19, cylinder 12 moves to the right and follower 24 will move with it, which will change the resistance. *Id.* at 4:29–33. “Consequently, the position of the piston (12) and/or rod (13) can readily be monitored as the piston (12) and rod (13) move from one position to another within the cylinder (11).” *Id.* at 4:41–44. Samuelson notes that “[b]ecause the fixed resistors (42) and (43) are disposed within the steel confines of the supplemental cap (22) and its flange (20), there is very little chance that they can be damaged during the use of the device.” *Id.* at 4:48–51.

3. *Zarniko (Ex. 1005)*

Zarniko, titled “Height Control Device and Method for a Fixture for Machining an Object Essentially Defined by a Single Plane,” issued July 24, 1990. Ex. 1005, codes (54), (45). Zarniko “relates to a height control device for . . . a milling fixture for stripping road surfacing.” *Id.* at 1:6–10. Zarniko discloses a height control device that “provides for two gauging devices, one

of which measures the distance to the unmachined plane, the other, the distance to the machined plane.” *Id.* at 2:32–34. We reproduce Zarniko’s Figure 1, below.

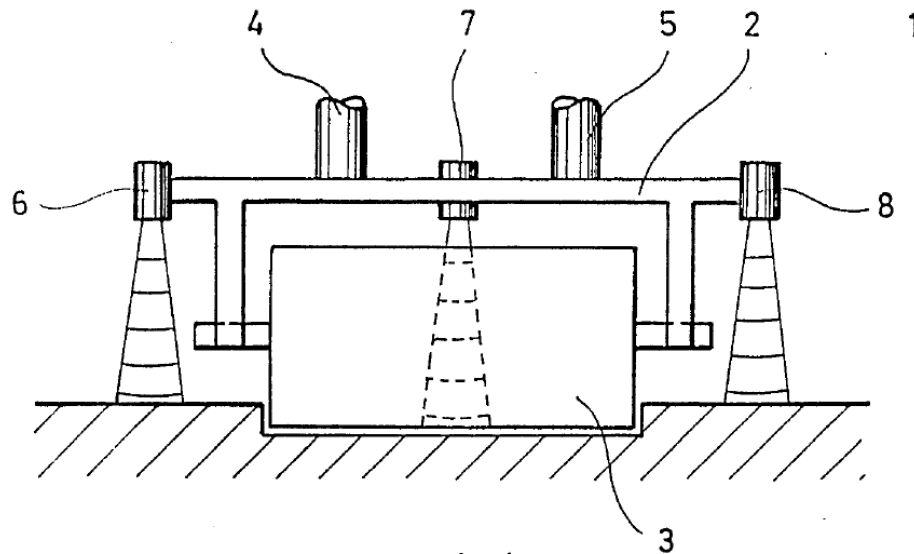


FIG. 1

Figure 1 depicts “a schematic front view of a milling fixture for stripping road surfacing and featuring a height control device in accordance with” Zarniko’s invention. Ex. 1005, 3:27–29. Milling fixture 1 includes bearing frame 2 and milling cutter 3. *Id.* at 3:36–38. Zarniko’s height control device includes first ultrasonic transceiver 6, second ultrasonic transceiver 7, and third ultrasonic transceiver 8 secured to bearing frame 2. *Id.* at 3:57–61. First and third ultrasonic transceivers 6, 8 are positioned outside the cutting width of milling cutter 3, so that these transceivers “can gauge the distance to the unmachined plane of the road surfacing by sensing the ultrasonic propagation time.” *Id.* at 3:62–66. Second ultrasonic transceiver 7 is configured to gauge the distance to the road surface after the surface is machined by milling cutter 3. *Id.* at 3:62–4:1.

II. ANALYSIS

A. Legal Standards

In *inter partes* reviews, a petitioner bears the burden of proving unpatentability of the challenged claims, and the burden of persuasion never shifts to the patent owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail in this proceeding, Petitioner must support its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d) (2023). Accordingly, all of our findings and conclusions are based on a preponderance of the evidence standard.

Petitioner’s asserted grounds of unpatentability are based on obviousness under 35 U.S.C. § 103(a). Section 103(a) forbids issuance of a patent when “the differences between the subject matter sought to be patented 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). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when available, evidence such as commercial success, long felt but unsolved needs, and failure of others.¹⁰ *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966); *see KSR Int’l Co.*, 550 U.S. at 407 (“While the sequence of these questions might be reordered in any particular case, the

¹⁰ The parties do not direct us to any objective evidence of non-obviousness.

[Graham] factors continue to define the inquiry that controls.”). The Court in *Graham* explained that these factual inquiries promote “uniformity and definiteness,” for “[w]hat is obvious is not a question upon which there is likely to be uniformity of thought in every given factual context.” 383 U.S. at 18.

The Supreme Court made clear that we apply “an expansive and flexible approach” to the question of obviousness. *KSR Int’l Co.*, 550 U.S. at 415. Whether a patent claiming the combination of prior art elements would have been obvious is determined by whether the improvement is more than the predictable use of prior art elements according to their established functions. *Id.* at 417. To support this conclusion, however, it is not enough to show merely that the prior art includes separate references covering each separate limitation in a challenged claim. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). Rather, obviousness additionally requires that a person of ordinary skill at the time of the invention “would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention.” *Id.*

“[O]bviousness must be determined in light of *all the facts*, and . . . a given course of action often has simultaneous advantages and disadvantages, and this does not necessarily obviate motivation to combine” teachings from multiple references. *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (emphasis added); *cf. Elekta Ltd. v. ZAP Surgical Sys., Inc.*, 81 F.4th 1368, 1374 (Fed. Cir. 2023) (“Whether a skilled artisan would have been motivated to combine references or would have had a reasonable expectation of success in combining references are questions of fact . . .”).

As a factfinder, we also must be aware “of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning.”

KSR Int’l Co., 550 U.S. at 421.

B. Level of Ordinary Skill in the Art

The level of skill in the art is “a prism or lens” through which we view the prior art and the claimed invention. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). “This reference point prevents . . . factfinders from using their own insight or, worse yet, hindsight, to gauge obviousness.” *Id.* Factors pertinent to a determination of the level of ordinary skill in the art include: (1) educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of workers active in the field. *Env’t Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 696–697 (Fed. Cir. 1983) (citing *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 1381–82 (Fed. Cir. 1983)). Not all such factors may be present in every case, and one or more of these or other factors may predominate in a particular case. *Id.* Moreover, these factors are not exhaustive but are merely a guide to determining the level of ordinary skill in the art. *Daiichi Sankyo Co. v. Apotex, Inc.*, 501 F.3d 1254, 1256 (Fed. Cir. 2007). In determining a level of ordinary skill, we also may look to the prior art, which may reflect an appropriate skill level. *Okajima*, 261 F.3d at 1355.

Petitioner asserts that a person of ordinary skill in the art would have had “at least a four-year degree in mechanical engineering or a closely related field and at least two years of experience designing, developing, servicing or operating heavy machinery, including their components and

control systems.” Pet. 5 (referencing Ex. 1006 ¶ 23). Petitioner also states that “[a]dditional education could substitute for professional experience, and significant work experience—such as working with, servicing, or operating heavy machinery in the field—could substitute for formal education.” *Id.*

“Patent Owner does not dispute the Petition’s definition” of the level of ordinary skill. PO Resp. 24.

For purposes of this Decision, based on the prior art, the sophistication of the technology at issue, and Dr. Singhose’s Declaration testimony, we adopt Petitioner’s undisputed definition of the level of ordinary skill. *See* Ex. 1006 ¶ 23; *see, e.g.*, Exs. 1002, 1003 (providing information on the PM-465 Cold Planer); Ex. 1004; Ex. 1005; Ex. 1023 (providing US 4,186,968, which describes a roadway pavement planing machine); Ex. 1024 (providing US 4,270,801, which describes a paved roadway planning machine); Ex. 1050 (providing US 6,152,648, which describes an automatic control process for a roadway planar).

C. Claim Construction

We construe each claim “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 this standard, claim terms are generally given their ordinary and customary meaning as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc) (“We have frequently stated that the words of a claim ‘are generally given their ordinary and customary meaning.’” (citations omitted)).

Petitioner contends that “[t]he prior art renders all challenged claims unpatentable under the plain and ordinary meaning of the claims.” Pet. 6.¹¹ “Patent Owner does not believe that any claim terms need construction to resolve the prior art grounds raised in the Petition.” PO Resp. 24.

We determine that we need not expressly construe any claim terms to resolve the parties’ disputes on the record before us. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms that . . . are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)). To the extent that the scope of any particular claim term requires discussion, however, we provide it in our assessment of the challenges, which we turn to next.

D. Ground 1: Claims 1–6, 8–17, and 19–22 as unpatentable over OMM and Samuelson

Petitioner contends that the combination of OMM and Samuelson teaches or suggests each limitation of claims 1–6, 8–17, and 19–22. Pet. 5, 6–70. We first address Petitioner’s reasons for combining the teachings of OMM and Samuelson with respect to claim 1, and the reasonable expectation of success of the combination.

1. Petitioner’s proposed combination of OMM and Samuelson

We first present Petitioner’s reasoning for combining the teachings of OMM and Samuelson to arrive at the subject matter of the claims challenged

¹¹ Petitioner “notes that the parties exchanged preliminary claim constructions in the parallel litigation,” offering a construction for a single term, “controller,” “[b]ut . . . [t]hat construction is irrelevant to the outcome here and the Board thus need not address it.” Pet. 6.

under Ground 1. We then present Patent Owner’s counter arguments, and our analysis of the reasoning.

a) Petitioner’s reasoning

Petitioner contends that OMM and Samuelson are analogous art, as both references are in the same field of endeavor and reasonably pertinent to the problem that the ’390 patent attempts to solve. Pet. 17–18 (referencing Ex. 1002, 3, 32, 48–49; Ex. 1004, 1:35–63, 2:28–31, 4:17–47; Ex. 1006 ¶¶ 63–64); *cf. In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004) (“References . . . qualify as prior art for an obviousness determination only when analogous to the claimed invention.”). Patent Owner does not dispute that OMM and Samuelson are analogous art.

Petitioner contends that a person having ordinary skill in the art “would have been motivated to implement sensor-integrated cylinders like Samuelson’s on the PM-465 machine [disclosed in OMM] and use them to monitor and change the positions of components attached to those cylinders.” Pet. 18 (referencing Ex. 1006 ¶ 65), 48–49 (illustrating the proposed modification with Samuelson’s cylinders on the side plates). With respect to modifying the cylinders on OMM’s side plates, Petitioner contends that the hydraulic cylinders on the side plates, modified with Samuelson’s sensors, would “generate[] signals associated with the hydraulic cylinder’s position that are sent to and processed by a controller.” *Id.* at 19 (referencing Ex. 1004, 4:17–57). Petitioner explains that OMM describes that its “machine’s grade-and-slope system has controllers that receive signals from multiple sensors, and this information is used to control the drum’s milling depth by adjusting the ‘heights of the legs.’” *Id.* at 18–19 (referencing Ex. 1002, 32, 48–49). Petitioner adds that Samuelson discloses

that its sensors can be retrofitted into existing hydraulic cylinders, and that state-of-the-art evidence demonstrates that writing software for these sensors to work in the control system was within the level of ordinary skill. *Id.* at 19 (referencing Ex. 1004, 1:54–63, 4:58–62; Ex. 1050; Ex. 1006 ¶ 68). These contentions at least implicitly go to the likelihood of success of combining the teachings to arrive at the claimed invention. *Cf. Elekta*, 81 F.4th at 1376 (“Unlike a motivation to combine determination, which requires an explicit analysis, . . . a finding of reasonable expectation of success can be implicit.”).

Petitioner contends that one motivating factor expressly disclosed in Samuelson is that “because of improvements in controller technology, over time it became cost effective and easier to use sensor-integrated cylinders in mobile construction equipment.” Pet. 19–20 (referencing Ex. 1004, 1:35–45, Ex. 1006 ¶¶ 61, 81); *see also id.* at 25 (“A [person having ordinary skill in the art] would have known to consider the technological advances in the art and to look for ways to improve the PM-465 machine’s design by implementing those advances (e.g., by using sensor-integrated hydraulic cylinders on the machine).”).

Petitioner also contends that a person having ordinary skill in the art “would have been motivated to use Samuelson’s sensor-integrated cylinders (instead of the grade slope wheel) near the PM-465’s side plates to sense the ground and determine if the machine is milling at the intended depth.” Pet. 20. Petitioner explains that an artisan of ordinary skill would have understood that “side plates make excellent ground sensors on road-milling machines,” as they can move vertically relative to the milling drum. *Id.* Petitioner also describes that the side plates can operate in a “float mode,”

where the hydraulic cylinders do not apply any downward force on the side plates, so the plates are free to move up and down as they travel on the ground surface. *Id.* (referencing Ex. 1002, 39–40; Ex. 1006 ¶ 70); *see also id.* at 49 (contending that a person having ordinary skill in the art “would have been motivated to make this sensor-integrated cylinder modification because it provides for a *robust* ground sensing device that *directly contacts the ground*”).

Petitioner also contends that the side plates being near the centerline of the milling drum improves accuracy of sensing the difference between the cutting depth and ground surface. Pet. 20 (referencing Ex. 1002, 48–49); *see, e.g.*, Ex. 1002, 48 (“When using grade control[,] the position of the sensor is important if accuracy of the cut is vital. The sensors should be positioned on the centerline of the rotor to achieve an accurate cut.”). Petitioner explains that “[i]t was well known in the art to use components near the side plates as ground sensors.” Pet. 21–22, 47 (referencing Ex. 1002, 2, 48–49; Ex. 1003, 35–36; Ex. 1023, 9:48–61; Ex. 1024, 38:27–41:20; Ex. 1006 ¶ 71). Petitioner adds that “[t]he state-of-the-art even suggests that *the side plate itself* can be used as a grade sensing apparatus on a road-milling machine.” *Id.* at 22, 47 (referencing Ex. 1003, 15); *see also* Ex. 1003, 15 (“[T]he [grade position] sensor can be actuated by one of the following devices: wheel, ski, and side plate of the machine.”).

Petitioner concludes that a person having ordinary skill in the art “viewing the prior art would have been motivated to consider different ways to use side plates as ground sensors in milling machines.” Pet. 22–23 (referencing Ex. 1006 ¶ 76). Petitioner continues that, based on the disclosures in Samuelson, a person having ordinary skill in the art “would

have been further motivated to incorporate sensor-integrated cylinders into the side plates and to use those side plates as sensors by having the sensor-integrated cylinders monitor the extent to which the side plate [of the PM-465 machine described in OMM] moves up and down as it traverses the ground.” *Id.* at 23 (referencing Ex. 1006 ¶ 76).

Petitioner also contends that the PM-465’s grade slope wheel may be damaged by debris generated during milling, which further supports the proposed modification. Pet. 23 (referencing Ex. 1006 ¶ 77; Ex. 1020 ¶ 35; Ex. 1005, 1:23–45); *see also id.* at 46 (“The prior art explained that mechanical wheel sensors (like the grade slope wheel) were ‘easily . . . damaged under the rough conditions which normally exist in road repair work.’” (referencing Ex. 1005, 1:23–45) (alteration in original)). Petitioner adds that ultrasonic sensors, an alternative to mechanical sensors, can be “compromised ‘by the temperature, flow and humidity of the ambient air, by the operating voltage, [and] by the momentary atmospheric pressure.’” *Id.* at 23 (referencing Ex. 1005, 1:52–68; Ex. 1006 ¶ 77; Ex. 1020 ¶ 35); *see also id.* at 46–47 (discussing Zarniko’s disclosure on the problems with ultrasonic sensors). Petitioner contends that Samuelson solves the problem of damaged mechanical sensors by including the sensors in the hydraulic cylinder. *Id.* at 23–24, 47 (referencing Ex. 1004, 1:45–49, 4:48–52).

Petitioner also contends that its proposed modification that modify both hydraulic cylinders on a side plate “would allow the resultant design to accomplish grade-averaging, as known in the art, which would minimize the variation caused by readings taken by *a single sensor*.” Pet. 26 (referencing Ex. 1051, 10:22–38; Ex. 1006 ¶ 82); *see also* Ex. 1006 ¶ 83 (describing how using two sensors instead of one sensor improves the measurement).

Finally, Petitioner contends that using sensors in the hydraulic cylinders of a side plate eliminates possible error from an operator having to position the grade sensor manually, as required with the PM-425. Pet. 26–27 (referencing Ex. 1002, 48, 52; Ex. 1006 ¶ 84).

Petitioner also provides contentions directed to the motivation for placing Samuelson’s sensors in hydraulic cylinders on PM-425’s moldboard (stripping plate) and the lifting legs. Pet. 27–34. We will address this reasoning, as well as Patent Owner’s counter arguments, in connection with claims that recite these features.

b) Patent Owner’s responsive arguments

Patent Owner challenges Petitioner’s reasoning that the OMM’s grade wheel may be damaged from debris. PO Resp. 1–3, 27–29. Patent Owner argues that Dr. Singhose’s opinion directed to the motivating factor of damage to the grade wheel is based on declaration testimony from Mr. Netka that such sensors could be damaged. *Id.* at 3, 28. Patent Owner directs us to testimony from Mr. Netka that he was not aware of any instances where a grade position sensor such as the one disclosed in OMM was actually damaged. *Id.* at 3–4 (referencing Ex. 2004, 66:10–67:4), 30–31.

Patent Owner argues that Mr. Netka testified that the OMM’s grade wheel would not be exposed to milling debris, because the milling housing contains the debris, and the grade wheel is outside the milling housing. PO Resp. 31 (referencing Ex. 2004, 47:9–19; Ex. 1002, 16, 42; Ex. 1020 ¶ 36; Ex. 1006 ¶ 87; Ex. 2003 ¶ 46). Patent Owner notes that OMM discloses that the side plates—the structure that Petitioner contends would serve as the sensing mechanism—can be damaged from debris from the milling process,

“suggest[ing that] the side plates may not be a reliable sensing mechanism.” *Id.* at 31–32 (referencing Ex. 1002, 53; Ex. 2003 ¶¶ 45–46).

Patent Owner also argues that Samuelson is limited to protecting an exposed sensor transducer by moving the transducer into a protective housing, and that OMM’s grade wheel’s transducer is already in a protective housing. PO Resp. 28–29 (referencing testimony from Mr. Netka, Ex. 2004, 55:7–57:18); *see also id.* at 29 (“Samuelson’s teachings, however, only apply to a sensor’s transducer and provide no teachings for improving the robustness of the sensing mechanism.” (referencing Ex. 2003 ¶¶ 36–37)). In contrast, Mr. Netka’s declaration testimony and Zarniko’s statement upon which Petitioner relies address damage to the sensing mechanism, not the sensor’s transducer. *Id.* at 29.

With respect to Zarniko’s teaching, Patent Owner further argues that Zarniko’s statement about mechanical sensors is prior to November of 1988, well before OMM’s publication date. PO Resp. 29. Patent Owner adds that Zarniko’s teachings are about mechanical sensors generally, not the grade wheel disclosed in OMM. *Id.* at 30.

Patent Owner also criticizes Petitioner’s reasoning that the ability to use the side plates for grade averaging supports the proposed combination. PO Resp. 33–42. First, Patent Owner argues that Petitioner misunderstands the disclosure in Exhibit 1051 (US 4,130,420, “Swisher ’420”). *Id.* at 34. Patent Owner argues that Swisher ’420 does not rely on multiple sensors as Petitioner contends, but instead multiple contact points that provide a mechanical average for a single sensor. *Id.* at 35–36. Patent Owner argues that Petitioner’s reasoning for using a mathematical average rather than a mechanical average is not supported by evidence. *Id.* at 37.

Patent Owner also argues that Petitioner’s proposed modification determines the approximate height at the midpoint of the side plate, not the centerline of the milling drum as Petitioner contends. PO Resp. 38–41; *see also id.* at 40 (providing images of the machine corresponding to the machine disclosed in OMM). Patent Owner adds that, “at best, the proposed combination’s measurement would have the same accuracy as the previously existing mechanisms, including those already available for the PM-465.” *Id.* at 41 (referencing Ex. 1003, 16; Ex. 2003 ¶¶ 60–67). Patent Owner also argues that using two sensors incorporates errors from both sensors, rather than compensating for errors in one sensor. *Id.* at 41–42.

Patent Owner also argues that Petitioner fails to provide any evidence to support its contention that human error was a problem in aligning the grade wheel. PO Resp. 43–44.

With respect to reasonable expectation of success, Patent Owner argues that Samuelson does not provide any evidence to support how to implement its cylinder into OMM’s control system. PO Resp. 45–46. Patent Owner also argues that U.S. Patent No. 6,152,648 to Gfroerer (Exhibit 1050), upon which Petitioner relies, states that a person having ordinary skill in the art could write software to implement Gfroerer’s flowchart, not program any result. *Id.* at 47. Patent Owner also argues that the control system disclosed in OMM could not implement additional sensors. *Id.* at 48. Patent Owner argues that Dr. Singhose had no knowledge of the machine described in OMM ever being modified with sensor-integrated cylinders. *Id.* at 49.

Finally, Patent Owner argues that Samuelson does not support Petitioner’s reasoning of cost savings, as Samuelson’s statement applies to

controllers generally, and not controllers for sensor-integrated cylinders. PO Resp. 51.

c) Petitioner's reply arguments and Patent Owner's sur-reply arguments

Petitioner replies that the evidence of record supports a finding that the grade slope wheel was subject to damage. Pet. Reply 3 (referencing Ex. 2005, 32:13–34:12, 62:13–63:14; Ex. 1072, 28:14–29:8; Ex. 1071, 16:11–16, 34:1–11, 40:1–4; Ex. 1020 ¶ 35; Ex. 1006 ¶¶ 77, 80). Petitioner also states that OMM discloses that the operator must input the grade slope wheel's position, inviting operator error. *Id.* (referencing Ex. 1002, 64).

Petitioner replies that Zarniko recognizes weaknesses in mechanical sensors. Pet. Reply 4–5 (referencing Ex. 1005, 1:23–45); *see, e.g.*, Ex. 1005, 1:41–45 (“A further problem of said prior art height control device is that the mechanical sensor for sensing the road surfacing can easily be damaged under the rough conditions which normally exist in road repair work.”), 1:27–29 (describing the mechanical sensor as “a sensing wheel with height adjustment”). Petitioner argues that Zarniko's teachings are expressly directed to a sensing wheel. Pet. Reply 5. Petitioner also replies that Patent Owner's argument concerning Zarniko pre-dating OMM by nine years fails since OMM reflects a machine designed prior to its 1999 copyright date. *Id.*

Petitioner replies that Exhibit 1003, the *Systems Operation Testing and Adjusting Manual* for the machine disclosed in OMM supports using the side plates of the machine as the grade sensor actuator. Pet. Reply 6. Petitioner added that Mr. Netka testified that side plates were used as sensors in late 1999, or early 2000. *Id.* at 7.

Petitioner replies that Patent Owner's declarant testified that Samuelson's sensor-integrated cylinders can be used on road construction machines. Pet. Reply 9 (referencing Ex. 1072, 60:4–62:16; Ex. 1006 ¶ 63; Ex. 2005, 17:10–18). Petitioner adds that Samuelson provides a motivation for the modification. *Id.* at 9–10 (referencing Ex. 1004, 1:45–49, 1:58–63, 1:35–40, 4:48–52, 4:58–5:1; Ex. 1072, 60:4–63:13). Petitioner argues that this evidence demonstrates that Petitioner's motivation is not a product of hindsight reconstruction of the invention. Petitioner also directs us to deposition testimony from Dr. Singhose with respect to the robustness of Samuelson's sensor-integrated cylinder. *Id.* at 10 (referencing Ex. 2005, 32:13–35:13).

Petitioner also replies that Patent Owner fails to appreciate that Samuelson's teaching of lower controller costs means that such controllers were implemented routinely in construction machines, allowing implementing of the sensor-integrated cylinders. Pet. Reply 10–11.

Next, Petitioner replies that it correctly relies on grade slope averaging in support of its modification. Pet. Reply 14 (referencing Ex. 1006 ¶¶ 70–71, 83; Ex. 2005, 51:2–56:7). Petitioner argues that its declarant testifies that the side plates provide a distributed sensor that is less reactive to disturbances, and provides a natural mechanical averaging of the grade. *Id.* at 14–15 (referencing Ex. 1006 ¶ 74; Ex. 2005, 52:21–56:7).

Petitioner also replies that Dr. Singhose's testimony about sensor averaging using two sensors is supported by Patent Owner's declarant in parallel proceedings¹² before the Board. Pet. Reply 15–16 (referencing

¹² IPR2022-01278 and IPR2022-01310.

Ex. 1068 ¶ 73, which provides Dr. Lumkes’s declaration in the parallel proceedings). Petitioner also replies that Dr. Rahn, Patent Owner’s declarant in this proceeding, testified that a person having ordinary skill in the art would have been able to perform the necessary kinematic analysis to calculate milling drum depth even for an offset drum. *Id.* at 16–17 (referencing PO Resp. 40; Ex. 2003 ¶ 63; Ex. 1072, 104:21–105:5, 133:3–135:1). Petitioner added that this testimony also aligns with how Dr. Rahn testified about the ’390 patent. *Id.* at 17 (referencing Ex. 1072, 43:6–45:14).

Next, Petitioner replies that Patent Owner’s argument that the controller for the machine disclosed in OMM could not implement additional sensors improperly argues bodily incorporation of the teachings. Pet. Reply 18.

Petitioner replies that, consistent with Dr. Rahm’s testimony directed to the ’390 patent, a person having ordinary skill as defined here “would have easily known how to analyze the disclosures described in OMM and Samuelson and program the controller to first receive the signals from the sensor-integrated cylinders on the side plates and then move the legs to position the drum at the desired location.” Pet. Reply 21.

Patent Owner replies that Petitioner ignores that Samuelson is directed only to protecting the transducer, and the transducer in the grade wheel sensor of OMM is already protected. PO Sur-reply 13–14.

Patent Owner also replies that Petitioner fails to provide a reason to use the side plates as grade sensors. PO Sur-reply 15–16. Patent Owner then criticizes Petitioner’s reliance on Samuelson and Zarniko. *Id.* at 17–18. Patent Owner also repeats that Mr. Netka had no personal knowledge of a

damaged grade wheel transducer, and that OMM provides evidence that the side plates can be damaged and stick. *Id.*

Patent Owner also replies that Petitioner's argument about the exposed coiled cable of OMM's grade slope wheel represents a new argument. PO Sur-reply 18.

Next, Patent Owner replies that Dr. Singhose misunderstood Swisher '420's disclosure with respect to two sensors, and that this misunderstanding was the only support for having two sensors. PO Sur-reply 20–21. Also, as to Petitioner's reliance on Dr. Lumkes's testimony on the benefits of redundant sensors, Patent Owner replies that the Petition does not rely on redundant sensors, it relies on two sensors operating together. PO Sur-reply 22.

*d) Analysis of reasons to combine OMM and Samuelson
and reasonable expectation of success*

Based on our review of the complete record, we find that Petitioner has demonstrated, by a preponderance of the evidence, that a person having ordinary skill in the art would have been motivated to modify the teachings of OMM with Samuelson's teaching of smart cylinders to use OMM's side plates to monitor ground slope and to employ at least two smart cylinders attached to each side plate.

We agree with Petitioner that a person having ordinary skill in the art would have had reason to use the side plates as grade slope sensors. First, Exhibit 1003, the System Operation Testing and Adjusting Manual

(“SOTA”¹³) suggests using the side plates for grade monitoring. Pet. 22; Ex. 1003, 15 (“The method for measuring grade that contacts a reference surface uses a grade position sensor. The sensor can be actuated by one of the following devices: wheel, ski, and *side plate of the machine*.” (emphasis added)).

Second, we agree with Petitioner that a person having ordinary skill in the art would have looked to replace OMM’s grade slope wheel with the side plates “because it provides for a *robust* ground sensing device that *directly contacts the ground*.” Pet. 49. We find, on the complete trial record, that one motivating factor is that “OMM’s grade slope wheel is susceptible to damage and wear.” *Id.* at 24 (referencing Ex. 1006 ¶ 80). Zarniko discloses that a prior art “height control device has a mechanical sensor for sensing the level height of the bearing frame with respect to the unmachined road surfacing. This mechanical sensor in prior art height control devices constitutes, for example, a sensing wheel with height adjustment.” Ex. 1005, 1:24–29. That is, a grade slope wheel such as that disclosed in OMM. Zarniko continues that “[a] . . . problem of . . . [this] height control device is that the mechanical sensor for sensing the road surfacing can easily be damaged under the rough conditions which normally exist in road repair work.” *Id.* at 1:41–45. This evidence directly underpins Petitioner’s reasoning.

¹³ SOTA is a manual for the PM-465 Cold Planer Caterpillar Grade and Slope Electronic Control System, where the PM-465 Cold Planar is the machine disclosed in OMM. *See* Ex. 1003, cover; Ex. 1002, cover. When citing to SOTA, we follow Petitioner’s convention to cite to the page number of the manual, rather than the exhibit page number.

Also, we agree with Petitioner that employing the side panels as the mechanical grade slope sensors would provide for grade averaging, such that the machine would not perform overreactive height adjustments because of minor undulations in the ground surface experienced by the grade slope wheel. *See* Pet. 26 (referencing Ex. 1006 ¶ 83); *see, e.g.*, Ex. 2005, 52:21–56:7 (Dr. Singhose testifying that a grade slope wheel will “jump up” when hitting a rock and cause an overactive height adjustment, which would be experienced by a side plate “to a much lesser degree”).

We also agree with Petitioner that a person having ordinary skill in the art would have modified OMM’s side plate hydraulic cylinders with the smart (sensor-inclusive) hydraulic cylinders as taught by Samuelson. Pet. 19–20. Samuelson itself suggests this modification. As Petitioner argues, Samuelson teaches that, given that controller technology has gotten more cost effective, it became easier to employ smart cylinders on mobile construction equipment. *Id.* at 25 (referencing Ex. 1004, 1:19–49); *see also* Pet. Reply 9 (“Samuelson states that its sensors were protected ‘from damage and environmental degradation,’ easy to service and maintain, and meant to retrofit/upgrade’ old hydraulic cylinders on mobile equipment.” (internal citations omitted) (referencing Ex. 1004, 1:45–49, 1:58–63, 4:48–52, 4:58–5:1; Ex. 1072, 60:6–63:13)).

Petitioner also reasons that employing Samuelson’s sensor-integrated cylinders would eliminate the potential human error in positioning OMM’s sensor. Pet. 26 (referencing Ex. 1002, 48, 52). Petitioner contends that a person having ordinary skill in the art would have “recognize[d] that Samuelson’s sensor-integrated cylinders would replace the two standard cylinders on each side plate and would, therefore, reside at fixed locations

on each side plate,” which “would eliminate variability resulting from poor sensor placement—i.e., rather than relying on an operator to place a sensor, the PM-465’s control system would know the position of milling rotor’s centerline relative to the two sensor-integrated cylinders on the side plates (through simple geometry).” *Id.* at 26–27 (referencing Ex. 1006 ¶ 84).

We credit Dr. Singhose’s testimony¹⁴ concerning robustness, as it is consistent with the evidence of record. *See, e.g.*, Ex. 1006 ¶ 80 (“A [person having ordinary skill in the art] would have recognized that measuring the ground position using integrated sensors, like those disclosed in Samuelson, provides a significant advantage over the OMM’s grade slope wheel because the grade slope wheel is susceptible to damage and wear.”); Ex. 1005, 1:24–45 (Zarniko disclosing that mechanical sensors such as those like OMM’s grade slope wheel “for sensing the road surfacing can easily be damaged under the rough conditions which normally exist in road repair work.”); Ex. 1020 ¶ 35 (“The *contact* grade sensors . . . were exposed to the environment during milling and could be damaged by debris created by . . . obstacles encountered in the surrounding environment during milling machine operations.”).

¹⁴ Patent Owner characterizes Dr. Singhose’s testimony as “parroting the Petition” and cites to our precedential decision in *Xerox Corp. v. Bytemark, Inc.* To the extent Patent Owner is suggesting that Dr. Singhose’s testimony should be given little or no weight based on *Xerox*, we do not agree. Unlike the case in *Xerox*, Dr. Singhose provides evidence to support his opinions. *See Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 at 15 (PTAB Aug. 24, 2022) (precedential) (“Dr. Jones does not cite to any additional supporting evidence or provide any technical reasoning to support his statement.”); *cf.*, *e.g.*, Ex. 1006 ¶ 77 (discussing Zarniko).

Petitioner contends that each side plate of the PM-425 machine, as unmodified, has two existing cylinders. Petitioner reasons that, in view of the modification to use the side panels as mechanical grade slope sensors, Samuelson suggests modifying both cylinders. Pet. 23–24. In the “float” mode that would be used, where the side panels float over the ground surface and move up and down with changing grade, the two cylinders would change position (that is, extend and retract), and Samuelson’s smart sensors would measure this movement. *See id.* at 20 (referencing Ex. 1006 ¶ 70, Ex. 1002, 39–40). As we have already discussed above, Samuelson teaches that, with improvements in controllers, modifying the cylinders to include sensors allows a controller to measure the movement in each cylinder.

Also, having measurements from two sensors provides a more accurate measurement than from one sensor. As Petitioner contends

replacing the existing side-plate cylinders on each PM-465 side plate with sensor-integrated cylinders would allow the resulting design to accomplish [sensor-based] grade-averaging, which is a method that uses multiple sensors to obtain an average measurement value for the grade. Such multi-sensor averaging minimizes the variations and noise effects caused by using only *a single sensor*.

Pet. 26 (referencing Ex. 1006 ¶ 82). Dr. Singhose explains that this increase in accuracy is realized because if one of the two sensors “starts to drift,” the measurement from the other sensor, when averaged with the drifting measurement, would provide a measurement closure to the actual value than provided just by the drifting sensor. *See* Ex. 2005, 33:22–34:8 (“The other part of this combination is that you’re going to put two of these Samuelson smart cylinders in the side plates, for example. So now I’m getting two

sensor measurements instead of one. Everyone knows that two sensor measurements increases the accuracy. You can take those two and you could average them, for example. So if one starts to drift or become out of calibration, the one that -- the other one is helping you compensate.”). We credit this testimony for at least the reason that it makes logical sense, since the averaging of multiple sensor readings reduces the effect of a single, inaccurate, sensor as compared to the effect if only that single, inaccurate, sensor is used. Also, we agree with Petitioner that OMM’s side plates are configured to include two sensor-integrated hydraulic cylinders, as the unmodified side plates each have two cylinders. *See* Pet. 24 (“Moreover, the PM-465 was already primed to receive Samuelson’s design—OMM shows that each side plate on the PM-465 has two existing side-plate cylinders that raise and lower the side plate.” (referencing Ex. 1002, 40, 49, 59)).

We also agree with Petitioner that modifying OMM’s control system, including providing any control logic and software would have been within the level of ordinary skill. *See* Ex. 1006 ¶ 67 (“Indeed, the state of the art recognizes that ‘[t]hose skilled in the art can readily write software for implementing’ controllers that use sensor signals to automatically raise and lower road-milling machines. [Gfroerer (Ex. 1050) Abstract, 4:14–23.]” (first alteration in original)). We credit this testimony, in part, because it is consistent with the level of ordinary skill, which includes “at least two years of experience designing, developing, servicing or operating heavy machinery, *including their* components and *control systems*.” *See supra*, Section II.B. This testimony is also consistent with Dr. Rahn’s deposition testimony, which states that a person having ordinary skill in the art could do the calculations for determining rotor depth. Ex. 1072, 133:12–17,

134:10–18. With these algorithms in hand, a person having ordinary skill in the art could write the requisite software. *Cf.* Ex. 1050 4:14–24 (indicating that those skilled in the art could write the requisite software for controlling a cold planar given the algorithms).

We have considered Patent Owner’s arguments and supporting evidence and determine, on the complete trial record, that the preponderance of the evidence support’s Petitioner’s reasoning with respect to combining OMM and Samuelson. With respect to Patent Owner’s arguments directed to the robustness of OMM’s unmodified sensors, we do not agree with Patent Owner that Zarniko’s filing date being nine years before OMM’s publication date weighs against its express statements concerning a grade slope wheel mechanical sensor and its tendency to be damaged. *See* PO Resp. 29–30. A person having ordinary skill in the art is presumed to be aware of the prior art and would understand that Zarniko is criticizing the type of grade slope wheel disclosed in OMM.

With respect to Mr. Netka’s testimony that he has no personal knowledge of any actual damage occurring to grade slope wheels, Mr. Netka does testify that “there’s multiple modes of failure for those sensors,” and recognizes that that road conditions could damage the sensor. *See* PO Resp. 30 (reproducing Mr. Netka’s testimony). Similarly, as Patent Owner recognizes, Dr. Singhose testifies that “as an engineer I can guarantee, because forces are applied to it, that it moves some amount.” *See id.* at 31 (reproducing Dr. Singhose’s testimony). The lack of any actual damage in the record is not sufficient to overcome the evidence that a person having ordinary skill in the art would have recognized that a wheel moving along the roadway and connected to the milling machine by a thin rod could be

damaged, motivating moving the entire sensing apparatus to a hydraulic cylinder. *See* Ex. 1002, 52 (providing an image of the grade slope wheel), 62 (same).

Also, the fact that OMM discloses that a side plate may be deformed and need replacing does not out-weigh Petitioner's reasoning. *See* PO Resp. 31–32; Ex. 1002, 51. The side plate provides functions other than a sensor and the fact that in its role of containing material it may be damaged, necessitating replacement, does not counter Petitioner's reasoning, including SOTA's express teaching to use the side plates as grade slope sensors. As such, Petitioner's proposed modification to use the side panels, in conjunction with smart cylinders, as grade slope sensors is nothing more than combining the teachings of known elements to yield predictable results. *Cf. KSR Int'l Co.*, 550 U.S. at 416 (“The Court recognized that when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result.”).

Also, the fact that Samuelson teaches that that the *transducer* is protected inside the cylinder is inapposite. *See* PO Resp. 32–33. Once Samuelson's teaching is applied to OMM as Petitioner proposes, the sensor configuration becomes OMM's hydraulic cylinders containing transducers and attached to a floating side panel. Samuelson provides a motivation for including the transducers inside the cylinders. Other motivations, including the express disclosures in SOTA and Zarniko and the advantages of mechanical grade-slope averaging and sensor averaging, underpins Petitioner's reasons for its overall modification.

Although we appreciate that Dr. Singhose does not understand that Swisher '420 uses only one sensor for its grade slope averaging, this misunderstanding does not outweigh his other testimony. *See* PO Resp. 34–36. As we discuss above, we agree with Dr. Singhose that the ground contact length of a side panel would provide mechanical averaging and using two sensors, one in each hydraulic cylinder attached to a side plate, would allow for averaging of sensor measurements.

Also, the fact that OMM also had the opportunity to use a ski to measure grade slope, which would provide mechanical grade averaging, does not demonstrate a deficiency in Petitioner's position. As we state above, the side plates are also identified as a possible mechanical grade slope sensor of the machine disclosed in OMM.

As for Patent Owner's argument that averaging the values from the two sensors would not account for the centerline of the milling drum (PO Resp. 38–41), we find that accounting for the centerline would represent "simple geometry" within the level of ordinary skill. We credit Dr. Singhose's testimony, which was confirmed by testimony from Dr. Rahn, Patent Owner's declarant, during his deposition. *See* Ex. 1006 ¶ 84 ("A [person having ordinary skill in the art] would have recognized that . . . the PM-465's control system would accurately know the position of the milling rotor's centerline relative to the two sensor-integrated cylinders on the side plates (through simple geometry), which means a grade-averaged value factoring in the centerline of the machine could be used."); Ex. 1072 133:12–17 ("So based on the assumptions you've given me, that they already have sensor-integrated cylinders, somehow they've figured out that's a good idea to have them, you have all the geometry and everything of the

side plates, then they could do that [rotor depth] calculation.”), 134:10–18 (“So in terms of doing the kinematic analysis, you can do it with an offset, you can do it where it’s centered. . . . I’m not sure which is going to be easier or harder in the end, but -- . . . One of ordinary skill could -- could do that analysis.”).

We also find that Patent Owner’s criticism of Petitioner’s use of sensor averaging does not demonstrate a deficiency in Petitioner’s reasoning. Patent Owner argues that “the proposed control scheme [of using the average of two measurements] at best incorporates the error of a second sensor rather than providing any way to compensate for errors from one sensor.” PO Resp. 42. This argument ignores the fact that a system that employs the average of a sensor value that is accurate and a second sensor value that is inaccurate, such an average result would be closer to the true grade than if you have a single sensor value that is inaccurate. In this way, the sensor averaging control scheme is more accurate than a single sensor.

We do not credit Dr. Rahn’s testimony concerning error, as it focuses on measurement error, that is, the error associated with any measurement taken when the sensor is operating properly. *See* Ex. 2003 ¶ 66. Instead, Petitioner and Dr. Singhose are accounting for the situation where one of the sensors is not operating properly, such that the error in that measurement exceeds the “ Δ ” considered by Dr. Rahn. *See* Ex. 2005, 32:13–35:6; Ex. 2003 ¶ 66.

We also find that Patent Owner’s argument that there is no evidence of actual human error in positioning OMM’s grade slope wheel does not demonstrate a deficiency in Petitioner’s position. We understand Petitioner’s position to be that an operator must position the grade slope

wheel and that, under Petitioner’s proposed modification, this manual operation would not be necessary. And, as such, a *potential* avenue for human error is eliminated. *See* Pet. 26 (“Further, using sensor-integrated cylinders as described eliminates the *potential* error caused by humans positioning grade sensors on the machine before milling” (emphasis added)); Ex. 1006 ¶ 84.

As we discuss above, we do not agree with Patent Owner that a person having ordinary skill in the art would not have been able to modify OMM’s teachings of a control system to allow for smart cylinders on the side plates providing grade slope sensors. *See* PO Resp. 44–45, 46–49.

We also find that Patent Owner’s criticism of Petitioner’s contentions concerning cost effectiveness does not demonstrate a deficiency in Petitioner’s position, as Patent Owner misunderstands Petitioner’s position. PO Resp. 50–52. Petitioner relies on Samuelson’s teaching that control systems have become more cost effective, allowing such controllers to be added to construction machines. *See* Pet. 19–20; Ex. 1004, 1:35–45. These cost-effective controllers provide a motivating factor in employing Samuelson’s smart cylinders, as the cylinders can be used with the controller technology to provide measurements during use of the machine. *See* Pet. 19–20; Ex. 1006 ¶¶ 66 (“Regarding Samuelson, its integrated sensors generate position signals associated with hydraulic cylinders that are sent to, and processed by, a controller.” (referencing Ex. 1004, 4:17–57)), 68 (“[B]ecause of improvements in controller technology, it became cost effective and more feasible to use sensor-integrated cylinders in mobile construction equipment.”).

In summary, we determine, on the complete trial record, that Petitioner has provided sufficient reasoning, supported by a preponderance of the evidence, that a person having ordinary skill in the art would have been motivated to modify OMM's hydraulic cylinders with Samuelson's smart cylinders, and use OMM's side plates as grade slope sensors. *Cf. KSR Int'l Co.*, 550 U.S. at 418 (stating that, to facilitate the analysis of an obviousness position, the proponent should provide "some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness").

We also find that Petitioner has proven, by a preponderance of the evidence, that a person having ordinary skill in the art would have had a reasonable expectation of success. First, as Petitioner contends, SOTA expressly discloses that the side panels can operate as mechanical grade slope sensors. Pet. 22 (referencing Ex. 1003, 15); *see also* Pet. 20 (discussing side plates operating in "float mode" (referencing Ex. 1002, 39–40; Ex. 1006 ¶ 70)). Second, Samuelson expressly teaches that transducers can be integrated into hydraulic cylinders. *See, e.g.*, Pet. 18 ("A [person having ordinary skill in the art] would have understood that OMM's Electronic Control Module ("ECM") . . . would be able to receive and process the position signals generated from a sensor-integrated cylinder like Samuelson's." (referencing Ex. 1002, 32; Ex. 1006 ¶ 64)), 19 ("Samuelson's built-in sensor generates signals associated with the hydraulic cylinder's position that are sent to and processed by a controller." (referencing Ex. 1004, 4:17–57)). Also, as discussed above, we find that a person having ordinary skill in the art would have been able to develop the requisite algorithms and write the corresponding software.

Patent Owner argues that OMM's control system would need hardware and software modification. PO Resp. 9. We have considered these arguments and find that they do not undermine a reasonable expectation of success in arriving at the claimed invention. As we state above, we find, on the complete trial record, that a person having ordinary skill in the art, including experience with controller systems, would have been able to make the required changes.

2. *Independent claim 1*

We turn our analysis now to the scope and content of the prior art and any differences between the prior art and the subject matter of independent claim 1, on a limitation-by-limitation basis. Patent Owner does not dispute any of Petitioner's contentions with respect to the prior art teaching or suggesting the subject matter of the limitations of claim 1.

a) *Preamble*

The preamble of claim 1 recites "[a] self-propelled road milling machine." Ex. 1001, 6:53. Petitioner contends that OMM discloses a self-propelled milling machine, the PM-425. Pet. 35 (referencing Ex. 1002, 2, 27; Ex. 1006 ¶ 102).

Upon review of the information in the Petition and corresponding evidence, we find that Petitioner has proved, by a preponderance of the evidence, that OMM teaches or suggests the subject matter of the preamble. In view of this determination, we need not resolve whether the preamble is limiting.

b) *Limitation [1a]*

Claim 1 recites "a machine frame." Ex. 1001, 6:54 (limitation "[1a]"). Petitioner contends that OMM discloses a machine frame.

Pet. 35–36 (referencing Ex. 1002, 2, 8); *see, e.g., id.* at 36 (providing an annotated image of the PM-425 machine identifying the machine frame).

Upon review of the information in the Petition and corresponding evidence, we find that Petitioner has proved, by a preponderance of the evidence, that OMM teaches or suggests the subject matter of limitation [1a] of claim 1.

c) Limitation [1b]

Claim 1 recites “at least two front ground engaging supports, and at least one rear ground engaging support.” Ex. 1001, 6:55–56 (limitation “[1b]”). Petitioner contends that OMM discloses a machine with at least two front ground engaging supports, and at least one rear ground engaging support—the machine’s front tracks and rear tracks. Pet. 36–37 (referencing Ex. 1002, 2, 29, 40; Ex. 1006 ¶ 104); *see, e.g., id.* at 37 (providing annotated images of the PM-425 machine identifying the front and rear engaging supports).

Upon review of the information in the Petition and corresponding evidence, we find that Petitioner has proved, by a preponderance of the evidence, that OMM teaches or suggests the subject matter of limitation [1b] of claim 1.

d) Limitation [1c]

Claim 1 recites “front and rear lifting columns supporting the frame from the ground engaging supports.” Ex. 1001, 6:57–58 (limitation “[1c]”). Petitioner contends that OMM discloses a machine with front and rear lifting columns as recited, “two that support the PM-465’s frame from the front tracks and two that support the frame from the rear tracks.” Pet. 37–38 (referencing Ex. 1002, 2, 14, 30–31, 40; Ex. 1006 ¶ 105); *see, e.g., id.* at 37

(providing annotated images of the PM-425 machine identifying the front and rear lifting columns), 38 (providing an annotated image of the PM-425 machine identifying a leg).

Upon review of the information in the Petition and corresponding evidence, we find that Petitioner has proved, by a preponderance of the evidence, that OMM teaches or suggests the subject matter of limitation [1c] of claim 1.

e) Limitation [1d]

Claim 1 recites “a milling roller supported from the frame for treatment of a ground surface.” Ex. 1001, 6:59–60 (limitation “[1d]”). Petitioner contends that OMM discloses a rotor drum supported from the frame as corresponding to the recited milling roller. Pet. 38–39 (referencing Ex. 1002, 12, 32, 51, 111, 117, 134; Ex. 1008 ¶¶ 107, 108); *see, e.g., id.* at 39 (providing an annotated image of the PM-425 machine “showing that ‘Support Bearing’ for ‘Rotor Drum’ is connected to machine frame”).

Upon review of the information in the Petition and corresponding evidence, we find that Petitioner has proved, by a preponderance of the evidence, that OMM teaches or suggests the subject matter of limitation [1d] of claim 1.

f) Limitation [1e]

Claim 1 recites “a height adjustable stripping plate arranged behind the milling roller and operable to be lowered, during operation, into a milling track generated by the milling roller.” Ex. 1001, 6:61–63 (limitation “[1e]”). Petitioner contends that OMM discloses a machine with a moldboard, corresponding to the recited height-adjustable stripping plate. Pet. 39–43 (referencing Ex. 1002, 14, 60, 118; Ex. 1006 ¶¶ 109–111).

Petitioner contends that the moldboard is the bottom portion of PM-465's rotor door. *Id.* at 39. Petitioner explains that "[a] primary purpose of the moldboard is to scrape away the milled material generated by the milling drum during milling operations." *Id.* at 43 (referencing Ex. 1020 ¶ 36); *see, e.g., id.* at 40 (providing an annotated image of the PM-425 machine and identifying the moldboard and rotor door), 41 (providing an annotated image of the PM-425 machine and identifying the moldboard), 42 (providing an annotated image of the PM-425 machine and identifying the milling roller, rotor door, and milling direction), 43 (providing an annotated image of the PM-425 machine and identifying the moldboard height-adjusting hydraulic cylinders).

Upon review of the information in the Petition and corresponding evidence, we find that Petitioner has proved, by a preponderance of the evidence, that OMM teaches or suggests the subject matter of limitation [1e] of claim 1.

g) Limitation [1f]

Claim 1 recites "first and second height adjustable side plates arranged on opposite sides of the milling roller." Ex. 1001, 6:64–65 (limitation "[1f]"). Petitioner contends that OMM discloses first and second height adjustable side plates arranged as recited. Pet. 43–45 (referencing Ex. 1002, 2, 40, 49, 50; Ex. 1006 ¶¶ 112–114). Petitioner explains that PM-465's side plates are height-adjustable using two hydraulic cylinders. *Id.* at 44–45; *see, e.g., id.* at 44 (providing an annotated image of the PM-425 machine and identifying the left and right side plates and the location of the milling roller, and an annotated image identifying the left side plate and two height-adjustment cylinders), 45 (providing an annotated

image of the PM-425 machine identifying the right side plate and two height-adjustment cylinders).

Upon review of the information in the Petition and corresponding evidence, we find that Petitioner has proved, by a preponderance of the evidence, that OMM teaches or suggests the subject matter of limitation [1f] of claim 1.

h) Limitation [1g]

Claim 1 recites “a plurality of position sensors, each of the first and second side plates including at least two of the position sensors spaced apart in a traveling direction of the milling machine.” Ex. 1001, 6:66–7:2 (limitation “[1g]”). Petitioner contends that OMM, as modified by Samuelson’s teachings of a sensor-integrated hydraulic cylinder, renders obvious the subject matter of limitation [1g]. Pet. 45–50. Petitioner explains that, unmodified, PM-465 includes a “‘grade slope wheel’ positioned near the side plate,” which “obtains information on ground elevation as it rolls along the ground.” *Id.* at 46 (referencing Ex. 1002, 2, 48–49, 62), *see also id.* (providing an image of the PM-465 machine with a black arrow pointing to the grade slope wheel). Petitioner adds that PM-465 also includes a sonic sensor, and “[t]he ground position information obtained by the PM-465’s grade sensors is used by the machine’s grade-and-slope system to ensure the milling roller is actually milling at the desired elevation.” *Id.* (referencing Ex. 1002, 32, 48–49).

Petitioner explains that the PM-465 machine disclosed in OMM includes side plates, each of which includes two hydraulic cylinders spaced apart in the traveling direction. Pet. 48–49 (providing annotated images of PM-465’s side plates as modified, with the in-cylinder sensors spaced above

in the traveling direction of the machine). Petitioner contends that a person having ordinary skill in the art would have been motivated to replace PM-465's existing sensors with Samuelson's sensors in the hydraulic cylinders of the side plates, for the reasons we present above in Section II.D.1.a.

Upon review of the information in the Petition and corresponding evidence, and our analysis of Petitioner's reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests limitation [1g] of claim 1.

i) Limitation [1h]

Finally, claim 1 recites "wherein each position sensor generates position signals representing changes in position for a respective side plate." Ex. 1001, 7:2–4 (limitation "[1h]"). Petitioner contends that, with its proposed modification, "the in-cylinder position sensors would continuously measure the side plates' changes in vertical position as the side plates float along the ground," such that "the sensor-integrated cylinders are 'position sensor[s]' that 'generate[] position signals representing changes in position for a respective side plate.'" Pet. 49–50 (referencing Ex. 1006 ¶ 120) (alterations in original). Petitioner contends that "[t]he grade-and-slope controllers already on the PM-465 would then process the side-plate position signals and ensure that the rotor drum is actually milling at the depth set by the operator." *Id.* at 50.

Upon review of the information in the Petition and corresponding evidence, and our analysis of Petitioner's reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance

of the evidence, that OMM, as modified by Samuelson, teaches or suggests limitation [1h] of claim 1.

j) Conclusion as to independent claim 1

Having reviewed the complete trial record, including Petitioner's showing as to how the combined teachings of OMM and Samuelson disclose each of the limitations of claim 1, and the reasons for combining the teachings of these references, we conclude that Petitioner has proved, by a preponderance of the evidence, that claim 1 is unpatentable under 35 U.S.C. § 103(a) over OMM and Samuelson.

3. Dependent claims 2–6 and 8–12

Claims 2–6 and 8–12 depend, directly or indirectly from claim 1. Petitioner contends that these claims are obvious over OMM and Samuelson. We address the parties' contentions with respect to these claims in the subsections below.

a) Claim 2

Claim 2 depends from claim 1 and further recites "a controller operably associated with the position sensors and configured to measure, based at least in part on the position signals from the position sensors, displacement of the side plates with respect to the machine frame." Ex. 1001, 7:5–10. Petitioner contends that "OMM discloses a grade-and-slope control system having a controller that continuously receives information on ground position from the PM-465's grade sensors." Pet. 50 (referencing Ex. 1002, 32, 48–49). Petitioner adds that, under its proposed combination of teachings from OMM and Samuelson, "the two sensor-integrated cylinders included on each of the two side plates measure the vertical displacement of the side plates relative to the machine frame as the

side plates traverse the ground in float mode and move up and down (relative to the machine frame).” *Id.* at 51 (referencing Ex. 1006 ¶ 122; cross referencing descriptions of OMM and the Petition’s combination from the Petition).

Patent Owner argues that Petitioner fails to demonstrate that a person having ordinary skill in the art would have had a reasonable expectation of success in modifying OMM’s controller to arrive at the claimed invention. PO. Resp. 9–10. As we discuss above, we find that Petitioner demonstrates, by a preponderance of the evidence, that OMM’s controller could receive signals from the sensor-integrated cylinders on the side plates to determine the side plates’ positions, and that a person having ordinary skill in the art could have developed the requisite algorithms and write the corresponding software. *See supra* Sec. II.D.1.d.

Upon review of the information in the Petition and corresponding evidence, and our analysis of claim 1 and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 2.

b) Claim 3

Claim 3 depends from claim 2 and further recites “wherein the plurality of position sensors are integrated with hydraulic piston/cylinder units for lifting or lowering the respective side plates.” Ex. 1001, 7:11–14. Petitioner contends that its proposed combination includes sensors in each of the four hydraulic cylinders of the two side plates that measure the extension and retraction of the cylinders, cylinders that lift and lower the side plates.

Pet. 51–52 (referencing Ex. 1006 ¶ 123; cross referencing descriptions in the Petitioner of Samuelson and the combination of Samuelson and OMM).

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1 and 2, and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 3.

Patent Owner does not dispute Petitioner’s contentions with respect to the subject matter of this claim.

c) Claim 4

Claim 4 depends from claim 2 and further recites “wherein the controller is configured to control the milling depth of the milling roller by generating control signals to vertically adjust one or more of the lifting columns.” Ex. 1001, 7:15–18. Petitioner contends that “OMM discloses a grade-and-slope system with a controller that receives information from various sensors, including the grade sensors that measure the ground, and then positions the rotor drum at the correct milling depth by sending signals that move the machine’s legs.” Pet. 52–53 (referencing Ex. 1002, 32, 48–49). Petitioner adds that OMM’s “control system would . . . process . . . signals (from the side plate sensors) and position the rotor drum in the correct location by moving the legs—just as it does now” using its grade slope sensor. *Id.* at 53 (cross referencing discussion in the Petition concerning motivation to combine Samuelson and OMM).

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1 and 2 and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner

proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 4.

Patent Owner does not dispute Petitioner's contentions with respect to the subject matter of this claim.

d) Claim 5

Claim 5 depends from claim 1 and further recites "wherein the stripping plate comprises one or more position sensors configured to generate position signals representing changes in position for the stripping plate." Ex. 1001, 7:19–22. Petitioner contends that OMM discloses a moldboard, the recited "stripping plate," with two height-adjustable cylinders that raise and lower the moldboard. Pet. 54 (cross referencing discussion in the Petition on reasons to modify OMM's moldboard cylinders with Samuelson's teachings of smart cylinders).

Petitioner contends that a person having ordinary skill in the art would have been motivated to employ Samuelson's sensor-integrated cylinders on OMM's moldboard as "a better way to hold the moldboard above the milled surface." Pet. 54. Petitioner adds that the modification "would have allowed [a person having ordinary skill in the art] to perform the 'In Place Milling' feature, but with more accuracy and less burden." *Id.* (referencing Ex. 1002, 58; Ex. 1006 ¶ 128); *see id.* at 28 (describing OMM's in-place milling (referencing Ex. 1002, 58)). Petitioner contends that

the sensor-integrated cylinders ("position sensors") would produce signals representing changes to the moldboard's vertical position ("position signals representing changes in position for the stripping plate"), and these signals would be sent to the controller. The controller would then process the signals, and the machine (or the operator) would measure the moldboard's vertical position relative to the machine frame and *automatically*

raise the moldboard to *varying* and precise heights desired by the operator, *and then keep it there*.

Id. at 54–55. Petitioner adds that this modification “would eliminate the need to perform the time-intensive and cumbersome step of manually affixing chains to the moldboard.” *Id.* at 55. Petitioner contends that a person having ordinary skill in the art “would also have been motivated to position the moldboard at precise heights because doing so would improve the ability of the moldboard to effectively grade the material being left in place during milling (i.e., the recycled road base).” *Id.*; *see id.* at 29 (“The operator would no longer be confined to setting the moldboard at a fixed position dictated by the chains and could grade the milled material accurately.” (referencing Ex. 1006 ¶ 89)).

Patent Owner argues that Petitioner’s “proposed combination ignores the technological shortcomings that require the chains—the PM-465 moldboard cylinders do not lock at intermediate heights—and therefore fails to solve the alleged problem.” PO Resp. 54 (referencing Ex. 2004, 68:4–69:6).

Petitioner replies that “PM-465’s original cylinders would be able to automatically keep the moldboard at the desired elevation during milling if they had sensors.” Pet. Reply 26 (emphasis omitted). Petitioner adds that “[k]eeping the moldboard at the desired elevation requires nothing more than ‘connecting pressurized fluid to either the upward or downward chambers in the cylinder,’ or ‘allow[ing] the moldboard to float,’ and Wirtgen’s expert admitted the PM-465 could do all of these things.” *Id.* (referencing Ex. 2003 ¶ 74) (second alteration in original); *see also id.*

(explaining how pressurized fluid would allow the cylinders to raise and lower the moldboard).

Patent Owner replies that Petitioner’s argument is a new argument, not supported by evidence. PO Sur-reply 2. Patent Owner adds that Petitioner’s new theory would result in a wavy road surface. *Id.* Patent Owner explains that “[t]he moldboard is used at times to grade the debris left in place during ‘In Place Milling,’ [and] the control scheme would produce a wavy milled surface, defeating the purpose of milling the surface recognized by Dr. Singhose.” *Id.* at 4. Patent Owner adds that Petitioner’s “proposed system, which relies on raising the moldboard, letting it float, and then raising it when the moldboard floats down, would not grade the milled material effectively or accurately.” *Id.* at 5.

We agree with Petitioner that a person having ordinary skill in the art would have had reason to modify OMM’s teaching of a moldboard with Samuelson’s teachings of smart cylinders to “eliminate the need to perform the time-intensive and cumbersome step of manually affixing chains to the moldboard.” *See* Pet. 54–55; Ex. 1006 ¶¶ 126–128. As with Petitioner’s modification of the cylinders of the side plates, the proposed modification amounts to nothing more than combining the teachings of known elements to yield predictable results. *Cf. KSR Int’l Co.*, 550 U.S. at 416 (“The Court recognized that when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result.”).

We have reviewed Patent Owner’s arguments and determine, on the complete trial record, that Petitioner provides sufficient reasoning, with rational underpinnings, for modifying OMM’s moldboard with Samuelson’s

smart sensors. Petitioner’s rational is based on facilitating in-place milling by using sensor-integrated hydraulic cylinders. *See* Pet. 27–29, 54–55; Pet. Reply 25–26. We understand that Petitioner argues that these hydraulic cylinders would automatically, that is, through use of the sensors and control system, maintain the moldboard in place.

Patent Owner’s reliance on Mr. Netka testimony is misplaced. Mr. Netka testifies that moldboard “would not be in a hold position.” Ex. 2004, 68:14–19. Mr. Netka further testifies that the solenoids would not allow the moldboard to be locked—the moldboard would float and gravity would cause it to drop without the chains. *Id.* at 69:3–6. But this testimony is based on how OMM works unmodified. Indeed, it is this precise problem that Petitioner’s modification seeks to improve. *See* Pet. 28 (“A [person having ordinary skill in the art would have further recognized that OMM’s chain design has limitations in that the moldboard could only be held by the chains at fixed positions, making it more difficult to accurately grade the ‘in place’ milled material.” (referencing Ex. 1006 ¶ 88)).

We also do not agree with Patent Owner that Petitioner’s Reply argument is an improper new argument. Petitioner specifically explains, for the first time in its Reply, that the moldboard cylinders would have hydraulic fluid and the control system would establish a feedback loop that would prevent the moldboard from moving too high or too low by using the fluid to extend and retract the cylinders. We determine that this argument is a proper argument in reply. In determining whether an argument is a proper argument in reply, we look to see if the Reply argument is responsive to an argument from Patent Owner and expands on a position in the Petition. *See Rembrandt Diagnostics, LP v. Alere, Inc.*, 76 F.4th 1376, 1384 (Fed. Cir.

2023) (“[W]e have held that a reply may be proper if it is responsive and simply expands on previously raised arguments.”). Or, if Petitioner relies on previously unidentified disclosure “to make a meaningfully distinct contention.” *Id.* at 1383 (“[W]e held that a petitioner who asserted in its reply previously unidentified prior-art disclosures ‘to make a meaningfully distinct contention’ was impermissibly raising a new theory of unpatentability.”). We find that Petitioner’s argument in reply is closer to the former situation.

Here, Petitioner expands its explanation to expressly argue that the moldboard cylinders could use hydraulic fluid and a control scheme to keep the moldboard in place. *See* Pet. Reply 26. We find that this argument responds to Patent Owner’s argument about the cylinders not locking, and is a natural expansion of Petitioner’s position. As even Dr. Rahn acknowledges, the moldboard uses hydraulic cylinders. *See* Ex. 2003 ¶ 74 (“The PM-465 hydraulics can raise and lower the moldboard.”). Petitioner’s proposed modification includes sensors that measure the extension and retraction of these cylinders. Petitioner’s explanation of the control system in place given these sensors is a logical extension of its proposed modification—hydraulic cylinders would be controlled to keep the moldboard in the desired position. *See* Ex. 1006 ¶ 89 (“Doing so would have allowed the operator to automatically raise the moldboard to any height within the range of motion. Furthermore, the control system could *automatically* keep the moldboard at the desired elevation during milling, eliminating the time-intensive and cumbersome step of manually affixing chains to the moldboard.” (emphasis omitted)).

We do not agree with Patent Owner’s argument directed to the modification producing a “wavy” roadway. This argument presumes a certain tolerance in the control system. That is, it presumes that the control system would not be able to adjust the height of the moldboard with minimal fluctuation.

Upon review of the information in the Petition and corresponding evidence, and our analysis of claim 1 and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 5.

e) Claim 6

Claim 6 depends from claim 5 and further recites “wherein the stripping plate further comprises one or more piston/cylinder units integrating the one or more position sensors.” Ex. 1001, 7:23–26. Petitioner contends that “the two sensor-integrated hydraulic cylinders being used on the PM- 465’s moldboard in the proposed OMM/Samuelson combination have internal ‘position sensors’ that measure the extension and retraction of the hydraulic cylinders (and thus the vertical elevation of the moldboard).” Pet. 55.

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1 and 5 and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 6.

Patent Owner does not dispute Petitioner’s contentions with respect to the subject matter of this claim.

f) Claim 8

Claim 8 depends from claim 1 and further recites “wherein each of the lifting columns includes an integrated position sensor configured to directly detect a lifted condition of its associated lifting column.” Ex. 1001, 7:32–35. Petitioner contends that “OMM discloses four legs (i.e., ‘lifting columns’)—two in the front and two in the rear,” and “each leg has an internal hydraulic cylinder that controls the extension and retraction of the leg.” Pet. 56 (referencing Ex. 1002, 32; Ex. 1006 ¶ 130). Petitioner contends that a person having ordinary skill in the art “would have been motivated to use sensor-integrated cylinders like Samuelson’s inside all four of the PM-465’s legs instead of the existing leg cylinders.” *Id.* Petitioner explains that “[t]his modification would have allowed the PM-465 to measure the extension and retraction of the hydraulic cylinders in each leg, which would have allowed the machine to measure the extension and retraction of the legs themselves . . . since the legs are fixed to and driven by the internal cylinders.” *Id.* at 56–57 (referencing Ex. 1006 ¶ 131).

Petitioner adds that a person having ordinary skill in the art would have had a reasonable expectation of success, as OMM includes sensors that determine whether the rear legs are in service height position, so OMM can process these signals. Pet. 57; *see also id.* at 29–34 (providing reasons for modifying OMM with Samuelson’s teachings of smart cylinders to include the smart cylinders in each of the four legs).

Petitioner contends that the existing sensors can be compromised by debris and need routine cleaning. Pet. 57 (referencing Ex. 1002, 112 (“There are sensors at the right-rear corner of the engine compartment. These sensors are used to sense the elevation of the rear legs. The face of

these sensors may require cleaning for proper operation. Use a mild soap and water with a soft cloth to remove any debris that prevents proper operation.”). Petitioner contends that Samuelson provides a configuration where the sensor is contained within a hydraulic cylinder, with “very little chance of damage.” *Id.* (referencing Ex. 1004, 4:48–57, 1:45–49).

Petitioner contends that the proposed “modification would have been simple—the PM-465 already had hydraulic cylinders that raise and lower the legs, and it would have been obvious for a [person having ordinary skill in the art] to replace them with sensor-integrated cylinders like Samuelson’s. Doing so would have made the PM-465’s service height feature more accurate and robust.” Pet. 57 (referencing Ex. 1006 ¶ 133).

Petitioner adds that such a configuration was known in the art, referencing the Roadtec RX-500 machine, which implemented sensor-integrated cylinders in all four legs in 2003. Pet. 58.

As another reason, Petitioner contends that the proposed modification would keep the machine level and parallel to the ground or a given horizontal plane. Pet. 58 (referencing Ex. 1006 ¶ 135; Ex. 1037, 3:45–65). Petitioner contends that this configuration would make the machine stable and promote operator comfort. *Id.* at 58–59 (referencing Ex. 1006 ¶¶ 135–136; Ex. 1057 ¶¶ 22–25; Ex. 1058, 2:4–12, 3:1–9; Ex. 1002, 12).

Patent Owner argues that Petitioner does not provide any evidence that the modified sensors would provide a more robust system than that used in OMM. PO Resp. 56. Patent Owner argues that OMM merely states that the sensors may require cleaning. *Id.* Patent Owner adds that Petitioner fails to explain how eliminating the need for cleaning makes the sensor more

robust, that is, have very little chance of damage. *Id.* at 56–57. Patent Owner argues that Petitioner’s reasoning is conclusory.

Patent Owner also argues that Petitioner fails to explain adequately how OMM’s controller would have been modified to achieve parallelism. PO Resp. 57–66. Patent Owner argues that the Petition’s “lack of any detailed discussion as to how the PM-465 controller could do so cannot support a finding of a reasonable expectation of success of achieving the claimed invention.” *Id.* at 66.

Petitioner replies that Patent Owner ignores evidence from OMM, Samuelson, and the state of the art. Pet. Reply 21–25. Petitioner replies that Samuelson and OMM suggest the modification—combining teachings of sensor-integrated cylinders with OMM’s teaching of service-height sensors. *Id.* at 22. Also, OMM expressly indicates that its existing sensors could be compromised by dirt and debris. *Id.*

We agree with Petitioner that a person having ordinary skill in the art would have had reason to modify OMM’s teaching of lifting legs with Samuelson’s teachings of smart cylinders to place the sensors inside a hydraulic cylinder, thus providing additional protection of the sensor. *See* Pet. 29–31, 67. As with Petitioner’s modification of the cylinders of the side plates, the proposed modification amounts to nothing more than combining the teachings of known elements to yield predictable results. *Cf. KSR Int’l Co.*, 550 U.S. at 416 (“The Court recognized that when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result.”). Indeed, state-of-the art

evidence supports the modification, evidence that is unrebutted. *See* Pet. 31, 58.

We have reviewed Patent Owner’s arguments and determine, on the complete trial record, that Petitioner provides sufficient reasoning, with rational underpinnings, for its proposed modification. We do not agree with Patent Owner that Petitioner’s reasoning is conclusory. The reasoning is supported by evidence from OMM and state-of the art evidence. We also do not agree with Patent Owner that the lack of details of how OMM’s controller would implement the measurements from the four leg sensors to realize parallelism and stability indicates a lack of a reasonable expectation of success. “[A]n obviousness determination requires finding that a person of ordinary skill in the art would have had a reasonable expectation of success.” *Elektro*, 81 F.4th at 1375. “Reasonable expectation of success refers to the likelihood of success in combining references *to meet the limitations of the claimed invention*.” *Id.* (emphasis added).

Claim 8 requires that the lifting columns includes an integrated position sensor configured *to directly detect a lifted condition of its associated lifting column*. As such, all that is needed is for the sensor within the hydraulic cylinders to measure the extension or retraction of the cylinder. Samuelson teaches this subject matter.¹⁵

Upon review of the information in the Petition and corresponding evidence, and our analysis of claim 1 and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a

¹⁵ We address Patent Owner’s argument with respect to claims 9–12, below.

preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 8.

g) Claim 9

Claim 9 depends from claim 8 and further recites “a controller configured to automatically control the lifted condition of at least one of the lifting columns to establish a predetermined inclination front to rear of the machine frame.” Ex. 1001, 7:36–40. Petitioner argues that OMM has a controller that satisfies the subject matter of claim 9. Pet. 60 (referencing Ex. 1002, 32, 55; Ex. 1006 ¶ 137). Petitioner contends that “the PM-465 as disclosed in OMM was a sophisticated machine with controllers capable of both receiving information on leg position and using sensor information to position the legs.” *Id.* (referencing Ex. 1006 ¶ 137).

Petitioner contends that a person having ordinary skill in the art would have known that the control system of OMM could work with the sensor-integrated cylinders of Samuelson in all four legs, explaining that “the controller would receive position signals from all four legs and been able to use that information to perform sensed leg-elevation adjustments to both the front and the rear of the machine.” Pet. 60–61 (referencing Ex. 1006 ¶¶ 100, 138). Petitioner adds that Exhibit 1037 “is a state-of-the-art reference that provides one example of the claimed ‘inclination’ position running ‘front to rear of the machine frame’—i.e., parallel-to-ground position.” *Id.* at 61 (referencing Ex. 1037, 3:45–65).

Petitioner argues that Patent Owner’s declarant testified that leg sensors could be used to detect where the ground relative to underneath the track is. Pet. Reply 23 (referencing Ex. 1071, 43:24–45:16). Petitioner adds that Roadtec’s RX-500 provides state-of the art evidence that leg sensors on

road machines keep the machine parallel to the ground. *Id.* Petitioner also argues that the claim does not limit when inclination is required, and that the claim would be satisfied during any operation, such as the “set-to-scratch” calibration.” *Id.* at 24.

Patent Owner replies that Petitioner did not demonstrate how to establish parallel-to-surface based on only leg sensor data, nor does Exhibit 1037 (“Sehr”) demonstrate how to use only leg-sensor data to automatically establish parallel-to-surface. PO Sur-reply 11. Patent Owner argues that Petitioner is wrong that the claims are satisfied during any operation. *Id.* at 11–12. Patent Owner adds that Exhibit 1037’s motivating support is related to parallelism during milling, and Petitioner has not demonstrated that its modification would work during milling. *Id.* at 12.

We determine that Petitioner has demonstrated, by a preponderance of the evidence, that a person having ordinary skill in the art would have been able to ensure that OMM’s controller is configured to automatically control the lifted condition of at least one of the lifting columns to establish a predetermined inclination front to rear of the machine frame, including parallelism. We agree with Petitioner and Dr. Singhose that “the PM-465, as disclosed in OMM, was a machine with sophisticated controllers capable of both receiving information on leg position and using sensor information to position the legs.” Pet. 60; Ex. 1006 ¶¶ 90–101, 130–142. We credit Dr. Singhose, in part, because it is consistent with OMM’s and SOTA’s disclosures. *See* Ex. 1002, 32 (describing grade/slope controls), 55 (describing grade/slope operations), 112 (identifying rear leg sensors); Ex. 1003, 7 (describing the Grade & Slope Electronic Control System (“The Grade & Slope Electronic Control System controls the extending of each

front leg in order to attain the desired surface profile.”) (“The system’s solenoids are components of the electrical proportional hydraulic valves. These valves are for extending and retracting of each leg (left front, right front and rear).”), 39–40 (describing solenoid valves for legs).

We have reviewed Patent Owner’s arguments and determine, on the complete trial record, that Petitioner provides sufficient reasoning, with rational underpinnings, for its proposed modification. We find, based on OMM’s unmodified controller’s capabilities as a starting point (to raise and lower the front legs and raise and lower (simultaneously) the rear legs and input from the slope sensor for the machine), and the proposed modification of including smart cylinders in each leg, that a person having ordinary skill in the art would have programmed the controller to maintain a certain inclination of the machine, including having the machine parallel to the ground. Also, state-of-the-art evidence such as that associated with the Roadtec-RX500, demonstrates that developing such a control system was within the level of ordinary skill. *See* Ex. 1054, 39:20–40:8, 77:11–82:10; *Ariosa Diagnostics v. Verinata Health, Inc.*, 805 F.3d 1359, 1365 (Fed. Cir. 2015) (“Art can legitimately serve to document the knowledge that skilled artisans would bring to bear in reading the prior art identified as producing obviousness.”).

We also do not agree with Patent Owner that the subject matter of claim 9 (and claims 10–12) must be satisfied during all operations or during milling operations. Patent Owner does not direct us to any language in the claims that would require such a construction.

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1 and 8 and Petitioner’s reasons to

combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 9.

h) Claim 10

Claim 10 depends from claim 9 and further recites “wherein the predetermined inclination comprises the machine frame being parallel to the ground surface or a milling track.” Ex. 1001, 7:41–44. Petitioner relies on its contentions for claim 9, and specifically, its contentions directed to a “parallel-to-the-ground” configuration. Pet. 62–63 (referencing Ex. 1006 ¶ 143; Ex. 1059, 2).

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1, 8, and 9 and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 10.

We address Patent Owner’s arguments above, in connection with our analysis of claims 8 and 9.

i) Claim 11

Claim 11 depends from claim 9 and further recites “wherein the predetermined inclination comprises the machine frame being parallel to a horizontal plane.” Ex. 1001, 7:45–47. Petitioner relies on its contentions for claim 9, and specifically, its contentions directed to a “parallel-to-a-horizontal-plane” configuration. Pet. 63 (referencing Ex. 1006 ¶ 144; Ex. 1060, 2).

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1, 8, and 9 and Petitioner’s reasons to

combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 11.

We address Patent Owner's arguments above, in connection with our analysis of claims 8 and 9.

j) Claim 12

Claim 12 depends from claim 8 and further recites "a controller configured to automatically control the lifted condition of at least one of the lifting columns." Ex. 1001, 7:48–51. Petitioner contends that "[t]he limitation added by claim 12 is included in its entirety in claim 9. Thus, claim 12 is obvious for the same reasons claim 9 is obvious."

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1, 8, and 9 and Petitioner's reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 12.

We address Patent Owner's arguments above, in connection with our analysis of claims 8 and 9.

k) Conclusions—dependent claims 2–6 and 8–12

Having reviewed the complete trial record, including Petitioner's showing as to how the combined teachings of OMM and Samuelson disclose each of the limitations of dependent claims 2–6 and 8–12 and the reasons for combining the teachings of these references, we conclude that Petitioner has proved, by a preponderance of the evidence, that claims 2–6 and 8–12 are unpatentable under 35 U.S.C. § 103(a) over OMM and Samuelson.

4. *Independent claim 13*

Independent claim 13 differs from independent claim 1 by additionally reciting “wherein each of the front and rear lifting columns comprise a hydraulic piston/cylinder unit having an integrated position sensor configured to generate position signals representing a lifted position of the respective lifting column.” *Compare* Ex. 1001, 6:53–7:4, *with id.* at 7:52–8:17. Additionally, instead of reciting “a plurality of position sensors” with “each of the first and second side plates including at least two of the position sensors spaced apart in a traveling direction of the milling machine,” claim 13 recites “wherein at least one of the side plates comprises first and second hydraulic piston/cylinder units spaced apart in a traveling direction of the milling machine, each piston/cylinder unit having an integrated position sensor configured to generate position signals representing changes in position for the respective at least one side plate.” *Compare id.* at 6:53–7:4, *with id.* at 7:52–8:17.

The limitations of claim 13 are captured in claims 1 and 8. *See* Pet. 64–67. Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1 and 8 and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claim 13.

We address Patent Owner’s arguments directed to this subject matter above, in connection with our analysis of claims 1 and 8.

Having reviewed the complete trial record, including Petitioner’s showing as to how the combined teachings of OMM and Samuelson disclose each of the limitations of independent claim 13 and the reasons for

combining the teachings of these references, we conclude that Petitioner has proved, by a preponderance of the evidence, that claim 13 is unpatentable under 35 U.S.C. § 103(a) over OMM and Samuelson.

5. *Dependent claims 14–17 and 19–22*

Dependent claims 14–17 and 19–22 depend, directly or indirectly from claim 13. Claim 14 recites the subject matter of claim 2; claim 15 recites the subject matter of claim 4; claim 16 recites the subject matter of claim 5; claim 17 recites the subject matter of claim 6; claim 19 recites the subject matter of claim 9; claim 20 recites the subject matter of claim 10; claim 21 recites the subject matter of claim 11; and claim 22 recites the subject matter of claim 12. *See* Pet. 67–70. Petitioner relies on its contentions for claims 2, 4–6, and 9–12 in arguing that claims 14–17 and 19–22 are unpatentable. *See id.*

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1, 2, 4–6, and 9–12 and Petitioner’s reasons to combine the teachings of OMM and Samuelson, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson, teaches or suggests the subject matter of claims 14–17 and 19–22.

Having reviewed the complete trial record, including Petitioner’s showing as to how the combined teachings of OMM and Samuelson disclose each of the limitations of dependent claims 14–17 and 19–22 and the reasons for combining the teachings of these references, we conclude that Petitioner has proved, by a preponderance of the evidence, that claims 14–17 and 19–22 are unpatentable under 35 U.S.C. § 103(a) over OMM and Samuelson.

E. Ground 2: Claims 7 and 18 as unpatentable over OMM, Samuelson, and Zarniko

Dependent claim 7 depends from claim 5, which in turns depends from independent claim 1, and further recites “controller configured to determine a relative displacement between one or more of the side plates and the stripping plate based on generated position signals from their respective position sensors.” Ex. 1001, 7:27–31. Similarly, dependent claim 18 depends from claim 16, which depends from independent claim 13, and further recites “controller configured to determine a relative displacement between one or more of the side plates and the stripping plate based on generated position signals from their respective position sensors.” *Id.* at 8:13–47. Petitioner contends, for Ground 2, that the subject matter of these claims are obvious over the combination of OMM, Samuelson, and Zarniko. Pet. 75–77.

Petitioner contends that “Zarniko describes the benefits of calculating vertical distances to the milled and unmilled surfaces and comparing those values to determine a milling depth.” Pet. 73 (referencing Ex. 1005, 2:10–59, 3:56–5:12). Petitioner contends that a person having ordinary skill in the art, based on this teaching from Zarniko “would have been motivated to use [Petitioner]’s proposed OMM/Samuelson sensing system instead of one that uses ultrasonic sensors to obtain the distances to the milled and unmilled surfaces (which are then compared by the control system as described in Zarniko).” *Id.* at 74 (referencing Ex. 1006 ¶ 170).

With respect to claim 7, Petitioner contends that a person having ordinary skill in the art, “viewing Zarniko would have looked for ways to measure a distance to the unmilled surface and a distance to the milled

surface and compare those values because, as Zarniko explains, doing so would have allowed the control system to compensate for the wearing down of the rotor bits.” Pet. 75 (referencing Ex. 1005, 2:39–45, 2:3–9; Ex. 1006 ¶ 171). Petitioner contends that OMM, as modified with Samuelson’s smart cylinders on the side plates and moldboard, would have been able to use Zarniko’s teachings “to track the position of side plates and moldboard relative to the machine frame as the side plates and moldboard ride along and monitor the ground.” *Id.* Petitioner continues that

It would have been obvious for a [person having ordinary skill in the art] to use the sensors in the sensor-integrated cylinders on the side plates to provide signals on side plate elevation that relate to a distance to the unmilled surface (“generated position signals”), to use the sensors in the sensor-integrated cylinders on the moldboard to provide signals on moldboard elevation that relate to a distance to the milled surface (“generated position signals”), and to use the PM-465’s sophisticated control system, including the ECM controller, to compare the relative positions between the distance measurements and ensure that the rotor drum is positioned at the depth set by the operator (“controller configured to determine a relative displacement between one or more of the side plates and the stripping plate”).

Id. at 75–76 (referencing Ex. 1006 ¶ 172). Petitioner relies on these same contentions for its unpatentability position for claim 18. *See id.* at 77.

Upon review of the information in the Petition and corresponding evidence, and our analysis of claims 1, 5, 13, and 16 and Petitioner’s reasons to combine the teachings of OMM, Samuelson, and Zarniko, we find that Petitioner proves, by a preponderance of the evidence, that OMM, as modified by Samuelson and Zarniko, teaches or suggests the subject matter of claims 7 and 18.

Patent Owner does not direct any specific arguments to Ground 2.

Having reviewed the complete trial record, including Petitioner's showing as to how the combined teachings of OMM and Samuelson disclose each of the limitations of dependent claims 7 and 18 and the reasons for combining the teachings of these references, we conclude that Petitioner has proved, by a preponderance of the evidence, that claims 7 and 18 are unpatentable under 35 U.S.C. § 103(a) over OMM, Samuelson, and Zarniko.

III. CONCLUSION

After considering all the evidence and arguments presently before us, we determine Petitioner has demonstrated, by a preponderance of the evidence, that the Challenged Claims are unpatentable.¹⁶

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

In summary:

Claims	35 U.S.C. §	Reference(s)/ Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–6, 8–17, 19–22	103(a)	OMM, Samuelson	1–6, 8–17, 19– 22	
7, 18	103(a)	OMM, Samuelson, Zarniko	7, 18	
Overall Outcome			1–22	

IV. ORDER

Accordingly, it is:

ORDERED that Petitioner has proven by a preponderance of the evidence that claims 1–6, 8–17, and 19–22 of U.S. Patent No. 9,879,390 B2 are unpatentable over OMM and Samuelson;

FURTHER ORDERED that Petitioner has proven by a preponderance of the evidence that claims 7 and 18 of U.S. Patent No. 9,879,390 B2 are unpatentable over OMM, Samuelson, and Zarniko;

FURTHER ORDERED that, pursuant to 35 U.S.C. § 318(b), upon expiration of the time for appeal of this decision, or the termination of any such appeal, a certificate shall issue canceling claims 1–22 of U.S. Patent No. 9,879,390 B2; 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.

IPR2022-01264
Patent 9,879,390 B2

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