

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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WIRTGEN AMERICA, INC.,  
Petitioner,

v.

CATERPILLAR INC.,  
Patent Owner.

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IPR2022-01397  
Patent 9,975,538 B2

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Before BARRY L. GROSSMAN, JAMES J. MAYBERRY, and  
MATTHEW S. MEYERS, *Administrative Patent Judges*.

MEYERS, *Administrative Patent Judge*.

DECISION  
Final Written Decision  
Determining Some Challenged Claims Unpatentable  
*35 U.S.C. § 318(a)*

## I. INTRODUCTION

### *A. Background and Summary*

Wirtgen America, Inc. (“Petitioner”) filed a Petition to institute *inter partes* review of claims 1–13 (the “challenged claims”) of U.S. Patent No. 9,975,538 B2 (Ex. 1001, “the ’538 patent”). Paper 1 (“Pet.”). Caterpillar Inc. (“Patent Owner”) filed a Preliminary Response. Paper 6 (“Prelim. Resp.”). On March 14, 2023, we instituted an *inter partes* review of the challenged claims on all grounds raised in the Petition. Paper 7 (“Institution Decision” or “Inst. Dec.”), 40.

Subsequent to institution, Patent Owner filed a Patent Owner Response (Paper 12, “PO Resp.”), Petitioner filed a Reply to the Patent Owner Response (Paper 17, “Pet. Reply”), and Patent Owner filed a Sur-reply to Petitioner’s Reply (Paper 22, “PO Sur-reply”). An oral hearing was held on December 11, 2023. A transcript of the hearing is included in the record. Paper 26 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) as to the patentability of the claims on which we instituted trial. Based on the complete record, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 1–12 are unpatentable. We determine that Petitioner has not shown, by a preponderance of the evidence, that claim 13 is unpatentable.

### *B. Real Parties in Interest*

Wirtgen America, Inc. identifies itself and Wirtgen GmbH as the real parties-in-interest. Pet. 80. Patent Owner indicates that Caterpillar Inc. is the real party-in-interest. Paper 3, 1.

*C. Related Matters*

Petitioner and Patent Owner state that the '538 patent is involved in *Wirtgen America, Inc. v. Caterpillar Inc.*, Case No. 1:17-cv-00770 (D. Del.). Pet. 81; Paper 3, 1. Patent Owner also identifies three related *inter partes* review proceedings, IPR2022-01394 (U.S. Patent No. 7,525,995), IPR2022-01395 (U.S. Patent No. 7,523,995), and IPR2022-01396 (U.S. Patent No. 9,371,618). Paper 3, 1.

*D. The '538 patent*

The '538 patent, titled “MILLING MACHINE FUEL EFFICIENCY CONTROL SYSTEM,” issued on May 22, 2018. Ex. 1001, codes (54), (45). The '538 patent “relates to . . . methods and systems for controlling the rotor speeds of cold planers and rotary mixers with optimized performance and fuel efficiency.” *Id.* at 1:6–9. According to the '538 patent, “changes in engine speed and engine load throughout the operation can cause unwanted variations in the rotor speed” and existing milling machines “provide variable transmissions which allow for variations in the engine speed without affecting rotor speed.” *Id.* at 1:32–37. However, “these conventional systems do not further address fuel efficiency, which . . . can be adversely affected by variations in engine speed and engine load.” *Id.* at 1:37–40. Thus, the '538 patent purports to provide “solutions for controlling and maintaining a desired rotor speed of a milling machine, which also takes fuel consumption or efficiency into consideration.” *Id.* at 1:41–44.

Figure 1, reproduced below, shows a side view of an exemplary milling machine. Ex. 1001, 2:22.

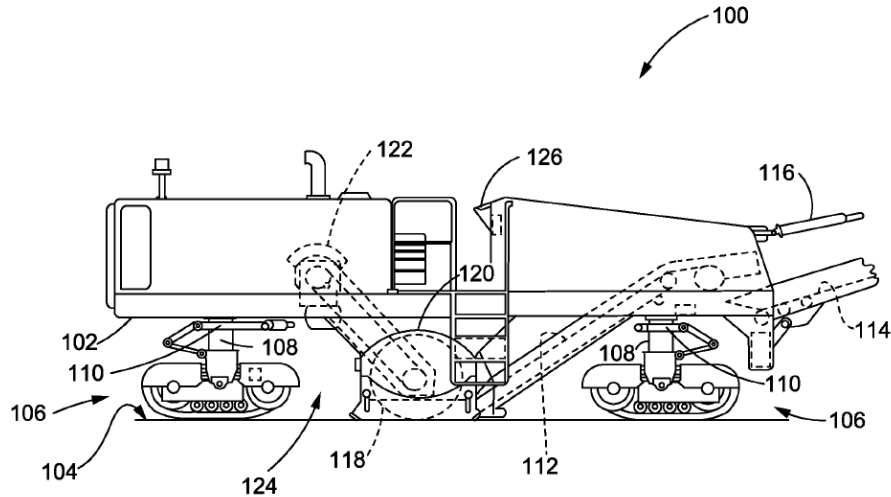


Figure 1 above shows milling machine 100 including rotor engine 122 as a power source that drives rotor 118 “via a hydrostatic, mechanical, or hydromechanical drive arrangement, such as a continuously variable transmission (CVT) 124.” *Id.* at 2:63–67.

Figure 2, reproduced below, shows a diagrammatic view of an exemplary control system. Ex. 1001, 2:24–25.

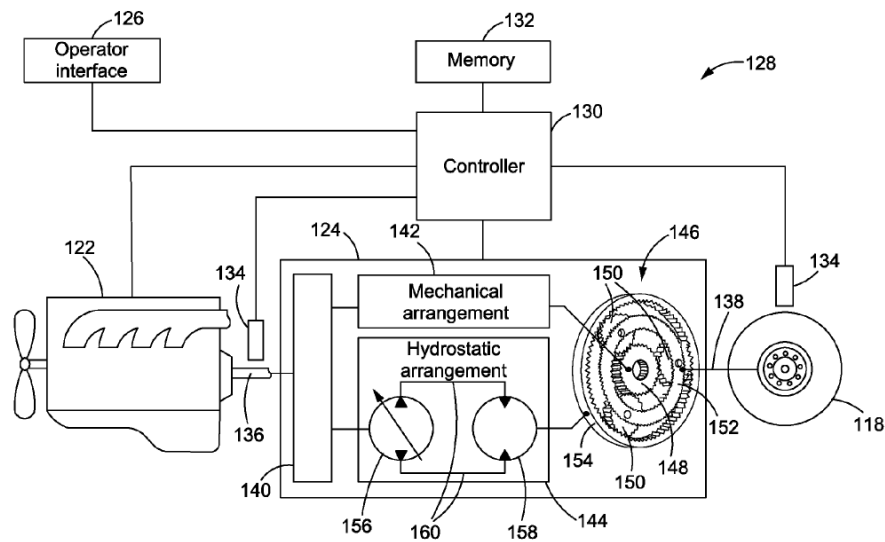


FIG.2

Figure 2 above shows control system 128 that may be integrated with milling machine 100 of Figure 1, to control rotor 118 in response of input received via operator interface 126. *Id.* at 3:8–12. Control system 128 includes controller 130 in communication with memory 132, operator interface 126, engine 122, rotor 118, and CVT 124. *Id.* at 3:12–15. Controller 130 communicates with sensors 134 for determining engine speed via engine output 136 and for determining rotor speed via CVT output 138. *Id.* at 3:15–20. Predetermined algorithms or instructions stored in memory 132 are used to operate controller 130. *Id.* at 3:27–29. CVT 124 includes clutch 140, mechanical arrangement 142, hydrostatic arrangement 144, and planetary gear set 146. *Id.* at 3:30–37.

CVT output 138 provides communication between rotor 118a and carrier 152 of planetary gear set 146. Ex. 1001, 3:48–50. CVT 124 and planetary gear set 146 “may be operated to continuously adjust the gear ratio, for instance, between the engine output 136 and the CVT output 138, in a manner which substantially maintains the rotor speed at the desired rotor speed specified by the operator irrespective of changes in the engine speed.” *Id.* at 3:51–57. Memory 132 is associated with controller 130 “in the form of lookup tables, maps, mathematical formulations, or any other suitable format” that enables controller 130 to automatically adjust one of, engine 122 and hydraulic motor 158 of hydrostatic arrangement 144, to output a desired rotor speed. *Id.* at 3:65–4:3.

Figure 4, reproduced below, “is a tabular illustration of fuel consumption rates and the associated efficiency points that may be referenced by” the disclosure of the ’538 patent. *Id.* at 2:30–32.

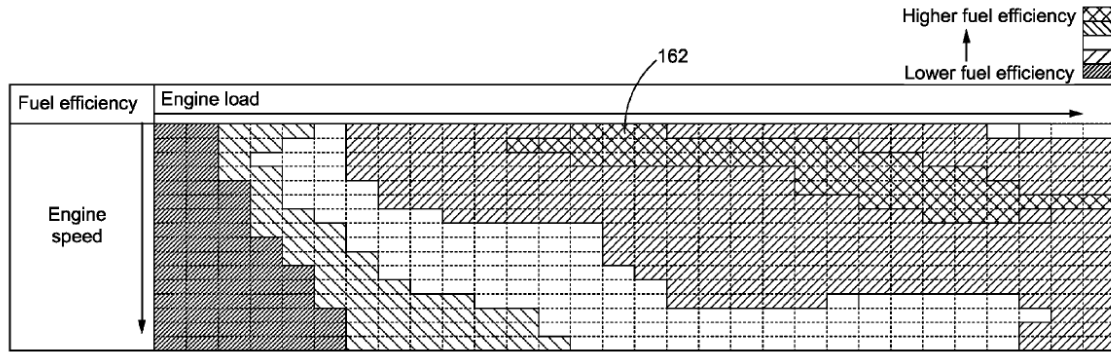


FIG.4

Figure 4 above is a graphical representation of the relative fuel consumption rates that may be used to predefine efficiency points 162, or combinations of engine speed and engine load expected to provide relatively better fuel economy. *Id.* at 4:14–18. According to the '538 patent

[i]nformation pertaining to these relationships between fuel consumption rate, engine speed and engine load, or at least the efficiency points 162 associated therewith, may be preprogrammed within the memory 132 and available to the controller 130, such as in the form of lookup tables, maps, mathematical formulations, or the like.

*Id.* at 4:18–23. Using efficiency points 162 as reference, controller 130 may control engine 122 to output an engine speed that is not only appropriate for the determined engine load, but also fuel efficient. *Id.* at 4:24–27. In particular, controller 130 communicates with engine 122 “to adjust engine speed based on changes in the engine load and predefined efficiency points 162 for better fuel economy.” *Id.* at 4:31–34.

Figure 5, reproduced below, is a flow diagram of a method for controlling a milling machine. *Id.* at 2:33–34.

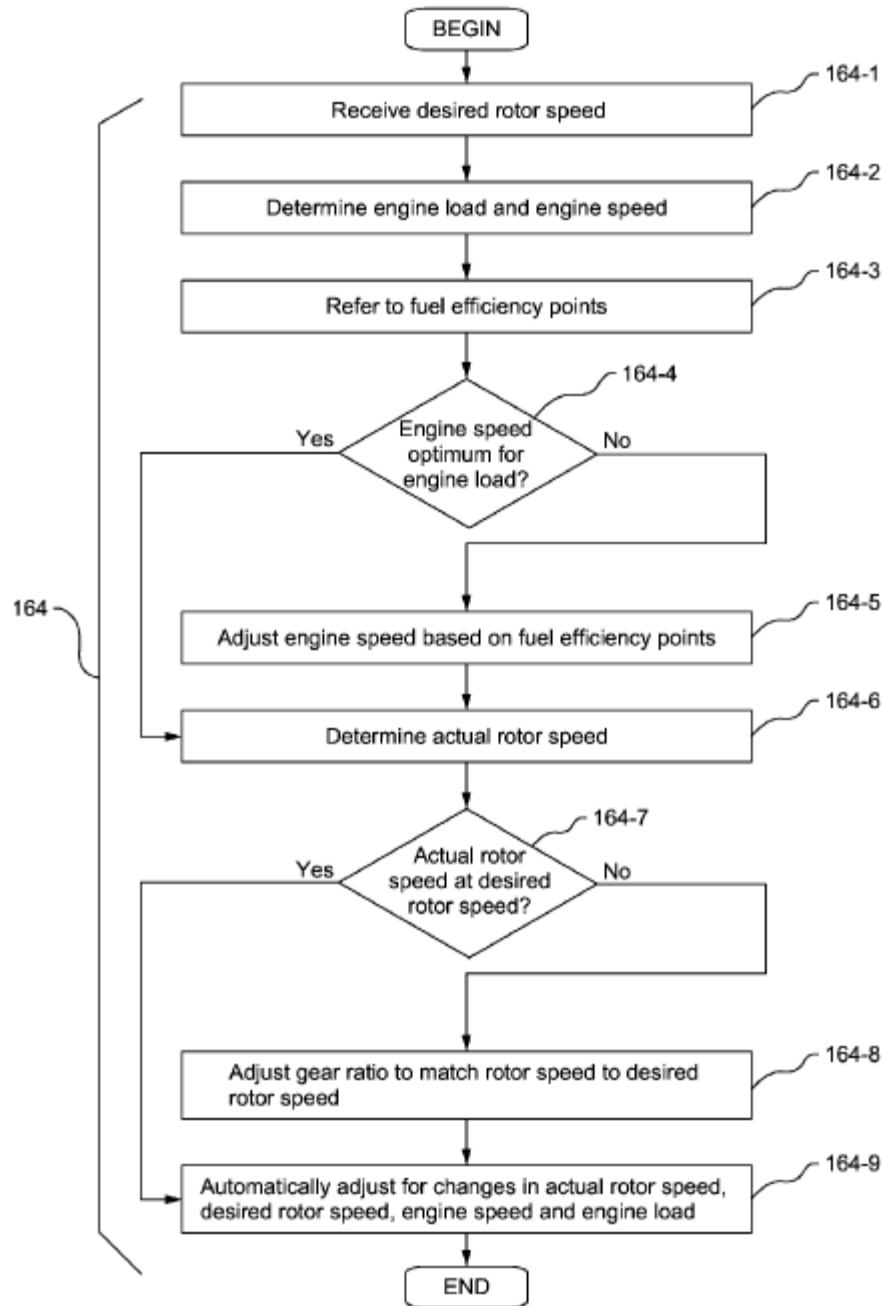


FIG.5

Figure 5 above shows method 164 for controlling milling machine 100 that has rotor 118 coupled to engine 122 through CVT 124, from the previous figures. *Id.* at 4:64–67. Starting in block 164-1, controller 130 receives a desired rotor speed from operator interface 126 of milling machine 100. *Id.*

at 4:67–5:3. In block 164-2, controller 130 determines the current engine load and speed via sensor 134 at engine output 136. *Id.* at 5:3–7. In block 164-3, controller 130 retrieves predefined fuel efficiency points 162 from memory 132 to determine an optimum engine speed for the given engine load. *Id.* at 5:7–12. Then, at block 164-4, controller 130 compares the actual speed to the optimum engine speed. *Id.* at 5:15–17. If the actual speed is not at the optimum engine speed, controller 130 adjusts the engine speed at block 164-5, whereas if the actual speed is at the optimum engine speed, controller 130 then determines the actual rotor speed at block 164-6. *Id.* at 5:18–26. Thereafter, at block 164-7, the actual rotor speed is determined whether it is the desired speed such that: (1) if it is not, the gear ratio is adjusted at block 164-8, and (2) if it is, controller 130 monitors “for any changes necessitating further gear ratio adjustments” including actual rotor speed, desired rotor speed, engine speed, and engine load, at block 164-9. *Id.* at 5:26–64.

### *E. Challenged Claims*

Petitioner challenges claims 1–13 of the ’538 patent. Pet. 1. Claims 1 and 6 are independent claims. Independent claim 1, reproduced below, is illustrative of the challenged claims.

1. A controller-implemented method of controlling a machine having a rotor coupled to an engine through a variable transmission, comprising:
  - receiving a desired rotor speed;
  - determining an engine load of the engine;
  - adjusting an engine speed of the engine based on the engine load and one or more predefined efficiency points at least partially based on predetermined fuel consumption rates and providing optimum engine speeds for different engine loads; and



adjusting a gear ratio of the variable transmission based on the engine speed and the desired rotor speed.

Ex. 1001, 6:20–32.

*F. Prior Art and Instituted Grounds of Unpatentability*

We instituted trial based on all asserted claims and grounds of unpatentability as follows:

<b>Claim(s) Challenged</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/Basis</b>
1–13	103 <sup>1</sup>	Willis <sup>2</sup> , Xing <sup>3</sup>
8, 13	103	Willis, Xing, Laux <sup>4</sup>

Pet. 3; Inst. Dec. 40.

Petitioner submits a declaration of Jeffrey L. Stein, Ph.D. (Ex. 1003) in support of its contentions. Patent Owner submits a declaration of Abid Kemal, Ph.D. (Ex. 2001) in support of its Response. Dr. Stein was cross-examined. *See* Ex. 2003 (deposition transcript of Dr. Stein). Dr. Kemal was also cross-examined. *See* Ex. 1028 (deposition transcript of Dr. Kemal).

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

*1. Overview of Willis (Ex. 1005)*

Willis “relates to road milling machines, and more particularly to systems for controlling milling machine operation.” Ex. 1005 ¶ 1. Figure 2,

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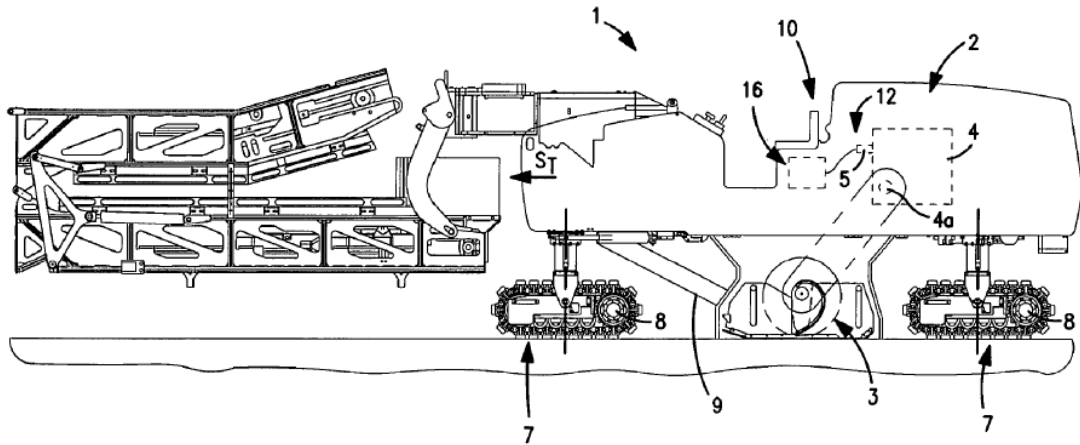
<sup>1</sup> The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, took effect on March 16, 2013. Because the application that issued as the ’538 patent was filed after March 16, 2013, we apply the AIA version of § 103. *See* Ex. 1001, code (22).

<sup>2</sup> U.S. Patent Application Pub. No. 2010/0014917 A1, published Jan. 21, 2010 (Ex. 1005, “Willis”).

<sup>3</sup> U.S. Patent No. 9,656,656 B2, issued May 23, 2017 (Ex. 1006, “Xing”).

<sup>4</sup> U.S. Patent No. 9,864,347 B2, issued Jan. 9, 2018 (Ex. 1012, “Laux”).

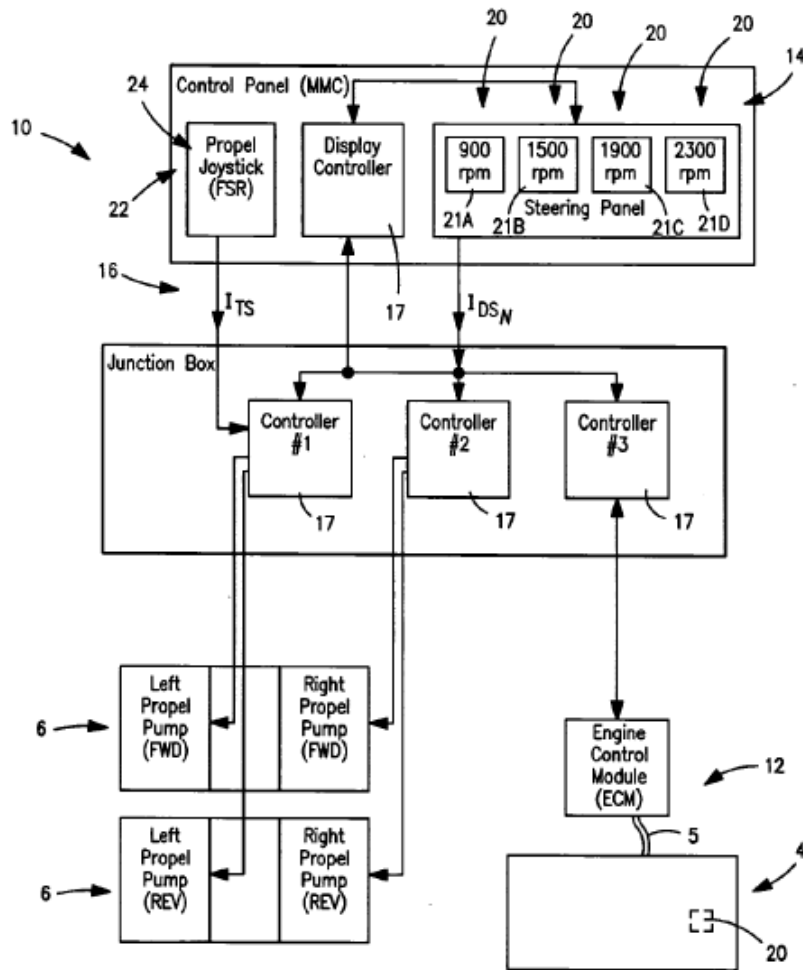
reproduced below, “is a side elevational view of a milling machine with a control system.” *Id.* ¶ 8.



**FIG. 2**

Figure 2 above shows milling machine 1 including cutter drum 3 coupled to engine 4. *Id.* ¶ 17. Milling machine 1 also includes control system 10 that comprises regulator 12 configured to adjust a speed of cutter drum 3. *Id.*

Figure 1, reproduced below, “is a schematic view of a control system for a milling machine.” Ex. 1005 ¶ 7.

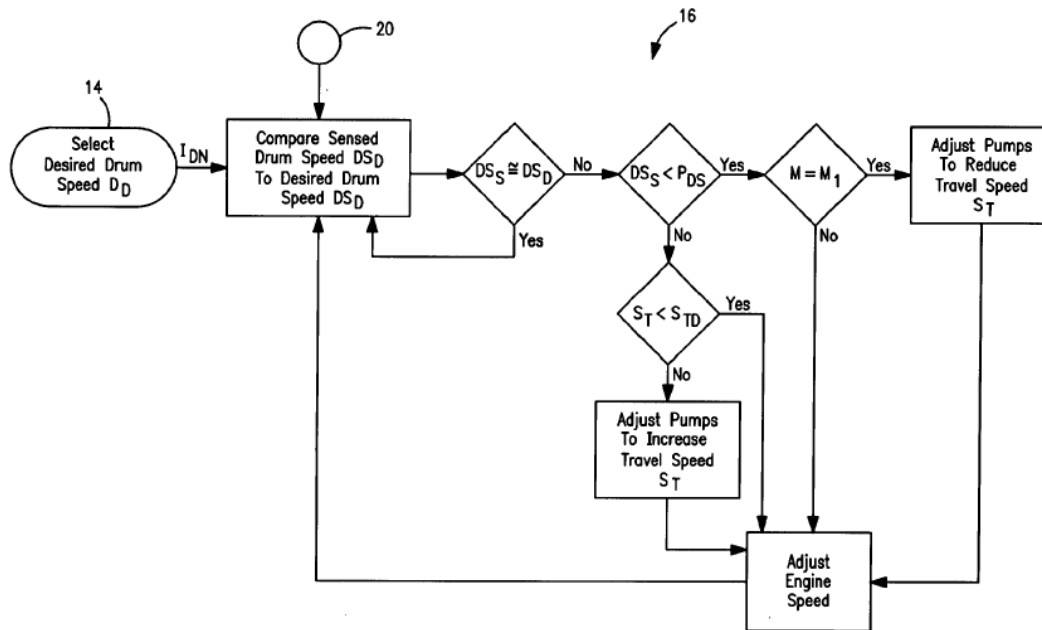


**FIG. 1**

Figure 1 above shows control system 10 having drum speed selector 14 “configured to generate an input  $I_{DS}$  corresponding to a desired drum cutting speed  $DS_D$ , and control 16.” *Id.* ¶ 17. Control 16 receives the input  $I_{DS}$  from selector 14 to operate regulator 12 “such that the actual drum speed  $DS$  at least generally corresponds to the desired speed  $DS_D$ .” *Id.* Drum speed selector 14 includes buttons 21A, 21B, 21C, and 21D as input members 20 to generate inputs that correspond to different desired drum speeds. *Id.* ¶ 18. Thus, each button or input member corresponds to a different desired

rotational speed  $DS_{DN}$  of cutter drum 3. *Id.* Control system 10 preferably further comprises sensor 20 “configured to sense the actual drum speed  $DS$  and to communicate with” control 16, “such as by transmitting a signal corresponding to drum speed  $DS$ .” *Id.* ¶ 21. Willis discloses that “[w]hen the engine 4 is configured to directly drive the cutter drum 3 as preferred, the regulator 12 is configured to adjust a speed of the engine 4 so that the sensed drum speed  $DS_S$  is generally equal to the desired drum speed  $DS_D$ .” *Id.* ¶ 22.

Figure 9, reproduced below, “is a logic flow chart depicting preferred operating features of a control.” Ex. 1005 ¶ 15.



**FIG. 9**

Figure 9 above shows control 16 for operating pumps and crawler assemblies of milling machine 1. *Id.* ¶ 24. Willis discloses that control 16 is “configured to compare the sensed drum speed  $DS_S$  with the desired speed  $DS_D$ , and to adjust” the pumps to reduce the speed of the crawler motors “when the sensed drum speed  $DS_S$  has a value lesser than a predetermined portion  $P_{DS}$  of the desired speed  $DS_D$ .” *Id.* Thus, control 16 “causes the

milling machine travel speed  $S_T$  to be reduced whenever the cutting drum 3 is rotating at less than a desired speed  $DS_D$ , which generally indicates that the load on the drum 3 is greater than desired (e.g., drum 3 begins cutting relatively harder material).” *Id.*

Willis further discloses control 16 is also configured to adjust the pumps so as to increase the speed of the crawler motors “when the value of the sensed drum speed  $DS_S$  increases from lesser than or about the predetermined portion  $P_{DS}$  of the desired speed to either greater than the desired speed predetermined portion  $P_{DS}$  or to about the desired speed  $DS_S$ .” Ex. 1005 ¶ 25. Thus, control 16

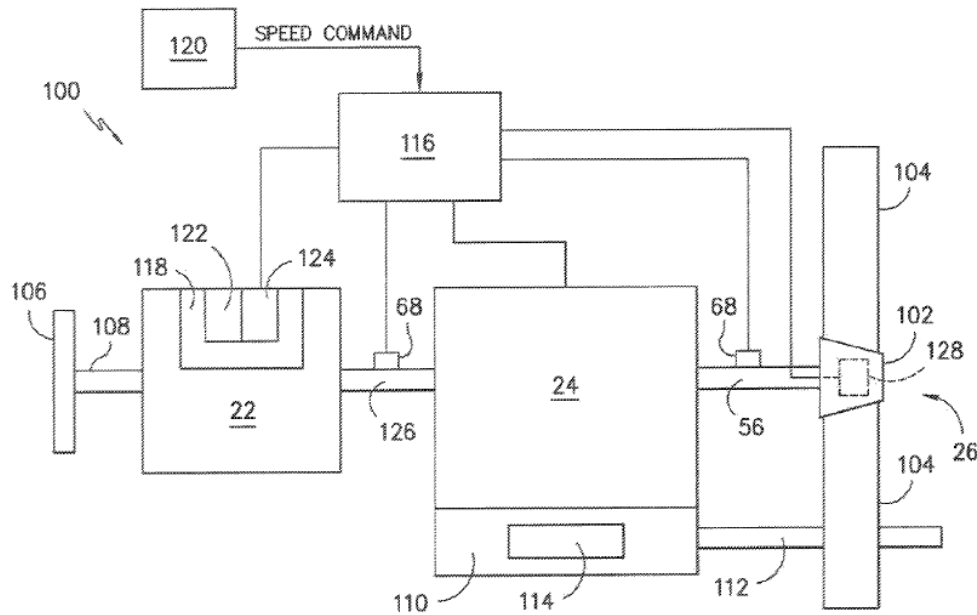
provides a ‘load control’ feature that decreases the machine travel speed  $S_T$  whenever the load on the drum 3 is sufficiently increased so as to lower the drum speed  $DS$  substantially below a desired speed, and returns the travel speed  $S_T$  to a desired value when the drum load is reduced.

*Id.*

## 2. Overview of Xing (Ex. 1006)

Xing is directed to “a system and method for reducing the fuel consumption of a work vehicle.” Ex. 1006, 1:19–21. Xing explains that typically, continuously variable transmissions (CVTs) “have a hydro-mechanical configuration such that power from the engine flows in parallel through both a hydrostatic branch and a mechanical branch.” *Id.* at 1:30–33. “While the efficiency characteristics of conventional engines are relatively straight forward, the efficiencies of a CVT are much more complicated.” *Id.* at 1:39–41. “Thus, selecting the optimal operational settings in order to achieve the desired productivity and minimize fuel consumption can be quite challenging” for vehicles with a CVT. *Id.* at 1:52–54. For example, existing “control algorithms fail to take into account the role that other vehicle



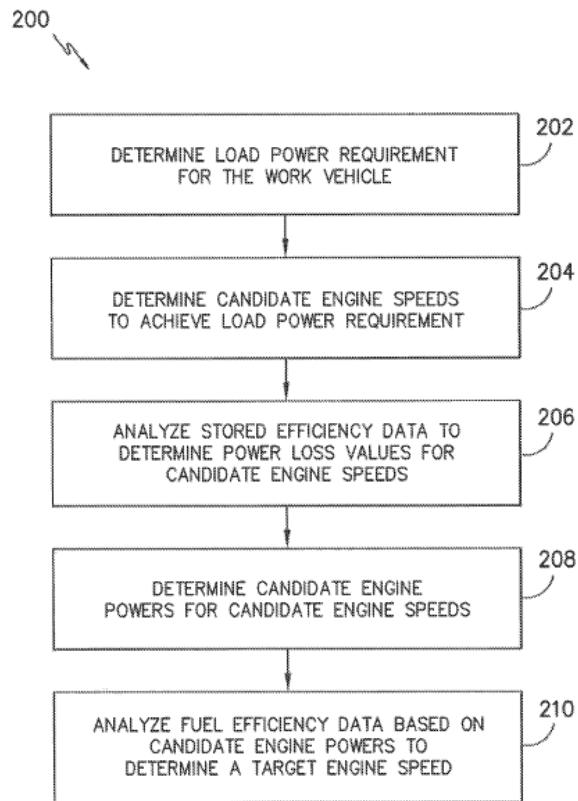


**FIG. -3-**

Figure 3 above shows system 100 including power take-off (PTO) 110 as part of transmission 24, configured to transfer power from engine 22 to one or more implements via PTO shaft 112. *Id.* at 6:64–7:3. Torque sensor 122 and speed sensor 124 may be mounted on engine 22 and coupled to controller 116 for monitoring engine speed. *Id.* at 8:17–28. Sensor 68 monitors rotational speeds of various shafts of transmission 24. *Id.* at 8:29–34. Xing discloses that the various drive train components and other power consuming components of the work vehicle “may generally operate at different efficiencies, with each component consuming varying amounts of power at differing vehicle operating parameters,” and “[a]s such, the most efficient operating conditions for one component may result in decreased efficiency for one or more other vehicle components.” *Id.* at 7:4–11. “For example, the efficiency of the transmission 24 may be relatively low when the engine settings (i.e., engine speed and engine torque) are selected to provide the most fuel efficient engine operation” and system 100 “may be

utilized to enhance fuel efficiency and achieve performance/productivity requirements by taking into account the individual component efficiencies of the various power consuming components of the work vehicle 10.” *Id.* at 7:11–21.

Figure 4, reproduced below, is a flow diagram of “a method for reducing the fuel consumption of a work vehicle.” Ex. 1006, 3:8–9.



*FIG. -4-*

Figure 4 above shows method 200 starting with step 202 in which “a load power requirement for the work vehicle 10 may be determined.” *Id.* at 9:18–19. According to Xing,

[t]he load power requirement generally corresponds to the amount of power required for the vehicle 10 to finish useful work, which may be a function of numerous factors, such as the weight of the work vehicle 10, the type of implement being hauled by the vehicle 10, field conditions and/or the like.



*Id.* at 9:19–24. Xing discloses that the relationship between the load power requirement ( $P_{load}$ ), the power produced by engine 22 of work vehicle 10 ( $P_{engine}$ ), and the vehicle's power loss due to system inefficiencies ( $P_{loss}$ ) is  $P_{engine} = P_{load} + P_{loss}$ . *Id.* at 9:27–36. At step 204, “a plurality of candidate engine speeds may be determined based on the load power requirement.” *Id.* at 10:16–18. At step 206, “suitable efficiency data for one or more of the components of the work vehicle 10 may be analyzed to determine a power loss value ( $P_{loss}$ ) for each candidate engine speed.” *Id.* at 10:43–46. At step 208, “a candidate engine power may be determined for each of the candidate engine speeds.” *Id.* at 11:65–67. Finally, at step 210, “fuel efficiency data may be analyzed to determine a target engine speed for the work vehicle 10 based on the candidate engine powers.” *Id.* at 12:26–28.

### 3. Overview of Laux (Ex. 1012)

Laux is directed to “a method for optimizing an operating function of a ground milling machine.” Ex. 1012, 1:15–16. According to Laux, “[t]he operation of such ground milling machines is comparatively costly, so that the demand always exists for the most optimum possible machine operation, for example, with respect to the lowest possible fuel consumption and, at the same time, the highest possible milling performance.” *Id.* at 1:33–37. Laux describes a milling machine powertrain that includes an engine that drives a rotor via a variable transmission and a controller that coordinates the operation of the engine and transmission to control rotor speed. *Id.* at 8:60–9:28. More particularly, Laux discloses

drive transmission 17 is implemented as a planetary transmission and acts as a summation transmission, wherein drive energy is fed via the input shafts 22 and 23 from the drive unit 4 and from the auxiliary drive 20 and is transmitted via the output shaft 21 from the planetary transmission 17 to the support tube 10.

*Id.* at 9:19–24.

## II. ANALYSIS

### A. *Principles of Law*

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). Petitioner bears the burden of persuasion to prove unpatentability of each challenged claim by a preponderance of the evidence. 35 U.S.C. § 316(e). This burden never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

#### 1. *Obviousness*

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, “would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). 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 skill in the art; and (4) when in evidence, any objective

evidence of obviousness or non-obviousness.<sup>5</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). “While the sequence of these questions might be reordered in any particular case” (*KSR*, 550 U.S. at 407), the Federal Circuit has explained that an obviousness determination can be made only after consideration of all of the *Graham* factors. *See, e.g., Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1360 (Fed. Cir. 2012).

The Supreme Court made clear that we apply “an expansive and flexible approach” to the question of obviousness. *KSR*, 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. “[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); *see also PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1196 (Fed. Cir. 2014) (“The presence or absence of a motivation to combine references in an obviousness determination is a pure question of fact.”).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

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<sup>5</sup> The parties do not present objective evidence of non-obviousness. *See* Pet. 80; *see generally* PO Resp.; PO Sur-reply.

*B. Level of Ordinary Skill in the Art*

The level of ordinary 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). The person of ordinary skill in the art is a hypothetical person presumed to have known the relevant art at the time of the invention. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). In determining the level of ordinary skill in the art, we may consider certain factors, including: “(1) the 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 active workers in the field.” *Best Med. Int’l, Inc. v. Elekta Inc.*, 46 F.4th 1346, 1353 (Fed. Cir. 2022) (citations omitted).

Petitioner asserts that one of ordinary skill in the art

would have had a bachelor’s degree in mechanical engineering or an equivalent degree and two to five years of experience working on designing or developing machine powertrains in which a controller controls a powertrain’s internal combustion engine and coupled transmission. Additional education may substitute for lesser work experience and vice versa.

Pet. 8 (citing Ex. 1003 ¶¶ 21–24).

In our Institution Decision, we applied Petitioner’s definition of the level of skill in the art, as reproduced above. At that time, we determined that this definition was consistent with the prior art of record and the skill reflected in the Specification of the ’538 patent. Inst. Dec. 19. In its Response, Patent Owner state that it “applies the level of ordinary skill in the art provided in the petition.” PO Resp. 7 (citing Pet. 8).

Based on the arguments presented and the cited references, we find Petitioner’s unopposed definition of the level of ordinary skill reasonable, supported by the prior art evidence, the Specification, and Dr. Stein’s Declaration testimony (Ex. 1003 ¶¶ 21–24), and, for purposes of this Decision, adopt it as our own.

### *C. Claim Construction*

In an *inter partes* review proceeding for a petition filed on or after November 13, 2018, a patent claim shall be construed 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).<sup>6</sup> This rule adopts the same claim construction standard used by Article III federal courts, which follow *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*), and its progeny. Under that standard, the words of a claim are generally given their “ordinary and customary meaning,” which is the meaning the term would have to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *See Phillips*, 415 F.3d at 1312–13. “[W]here a party believes that a specific term has meaning other than its plain meaning, the party should provide a statement identifying a proposed construction of the particular term and where the disclosure supports that meaning.” Patent Trial and Appeal Board Consolidated Trial Practice Guide 44 (Nov. 2019), available at <https://www.uspto.gov/TrialPracticeGuideConsolidated> (“CTPG”).

Petitioner asserts that “[i]n this Petition, all terms of the ’538 [p]atent claims have been given their ordinary and customary meaning as understood

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<sup>6</sup> The Petition in this case was filed August 10, 2022. *See* Paper 5, 1.

by one of ordinary skill in the art in light of the specification and the prosecution history pertaining to the patent” and that it “does not believe any specific constructions are required at this time.” Pet. 31. Patent Owner asserts that “[n]o constructions are required to reach a decision rejecting the merits of Petitioner’s grounds.” PO Resp. 7 (citing Ex. 2001 ¶¶ 36–37).

“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (alteration in original) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

Neither party presents arguments for the express construction of any term, instead interpreting the claim terms according to their ordinary and customary meaning. Pet. 31; PO Resp. 7.

For purposes of this Decision, and based on the complete record before us, we determine that no construction of any term is necessary.

#### *D. Obviousness over Willis and Xing (Ground 1: Claims 1–13)*

Petitioner asserts that claims 1–13 are unpatentable as obvious over Willis and Xing. Pet. 32–76. Petitioner also relies on the testimony of Dr. Stein to support its arguments. *Id.* (citing Ex. 1003). We have reviewed the Petition, Patent Owner Response, Petitioner Reply, Patent Owner Sur-reply, as well as the relevant evidence discussed in those papers and other record papers, and as discussed in greater detail below, we are persuaded that the record establishes by a preponderance of the evidence that Petitioner’s contentions that claims 1–12 would have been obvious over Willis and Xing, as Petitioner contends. We are not persuaded, however, that the record establishes by a preponderance of the evidence that Petitioner’s contentions

that claim 13 would have been obvious over Willis and Xing, as Petitioner contends. We adopt Petitioner’s contentions regarding claim 1–12 discussed below as our own.

*1. Petitioner’s Contentions for Claim 1<sup>7</sup>*

We use Petitioner’s notations to identify the claim elements. *See* Pet. 35–52.

- a) *[1[p]] A controller-implemented method of controlling a machine having a rotor coupled to an engine through a variable transmission, comprising:*<sup>8</sup>

Petitioner asserts that the combination of Willis and Xing teaches or suggests the subject matter of the preamble (1[p]). Pet. 35–41. More particularly, Petitioner annotates Figure 3 of Willis and asserts that Willis teaches “milling machine 1 with engine 4 coupled to rotor 3, under control of a drum speed control system.” *Id.* at 35–36 (citing Ex. 1005 ¶ 17). Petitioner also annotates Figure 3 of Xing, and asserts that Xing teaches “a work machine control system in which a controller controlled an output speed of a variable transmission’s output shaft by adjusting the variable transmission’s gear ratio as well as the speed of the machine’s coupled engine.” *Id.* at 37–38 (citing Ex. 1006, 4:8–54, Figs. 2, 3; Ex. 1003 ¶ 69); *see also id.* at 38–39 (citing Ex. 1006, 8:56–59 (“Using its CVT and control system, Xing practiced method 200, which allowed ‘for a work vehicle 10 to

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<sup>7</sup> Petitioner provides similar detailed analysis, supported by the testimony of Dr. Stein, for claim 6. *See* Pet. 59–66 (citing Ex. 1003).

<sup>8</sup> We need not decide whether the preamble of claim 1 is limiting because Petitioner has proven, by a preponderance of the evidence, that the cited art teaches the preamble.

be controlled in a manner that minimizes fuel consumption while maintaining the desired vehicle performance/productivity.”). Dr. Stein provides declaration testimony that one of ordinary skill in the art

would have been motivated to modify Willis to include a variable transmission and control system like that taught by Xing to improve fuel consumption and machine energy efficiency while maintaining desired machine performance. [Ex. 1003] ¶¶ 71–72. This would have involved coupling a CVT between Willis’s engine and rotor and configuring Willis’s controller with Xing’s algorithm, sensors, and control devices necessary to implement Xing’s algorithm.

*Id.* at 39 (citing Ex. 1006, 7:51–8:2).

*b) [1[a]] receiving a desired rotor speed;*

Petitioner asserts that the combination of Willis and Xing teaches or suggests the subject matter of limitation 1[a]. Pet. 41–44. More particularly, Petitioner asserts that “Willis’s milling machine, modified to include Xing’s algorithm and CVT, would have resulted in a controller that received a desired rotor speed.” *Id.* at 41 (citing Ex. 1005 ¶¶ 3, 5, 7). Petitioner further asserts that one of ordinary skill in the art “adapting Willis’s controller to run Xing’s algorithm would have expected to successfully modify Xing’s algorithm to utilize the desired drum speed  $DS_D$  (corresponding a desired rotor speed) input ( $I_{DS}$ ) received by Willis’s controller from Willis’s speed selector rather than the desired ground speed that Xing teaches.” *Id.* at 43 (citing Ex. 1003 ¶¶ 74–75).

*c) [1[b]] determining an engine load of the engine;*

Petitioner asserts that the combination of Willis and Xing teaches or suggests the subject matter of limitation 1[b]. Pet. 44–47. More particularly, Petitioner asserts that “Willis’s milling machine, modified to include Xing’s algorithm and CVT, would have resulted in a controller that



determined an engine load of the engine because Xing's algorithm was already configured to 'determine an engine load' during operation." *Id.* at 44. Petitioner asserts that Xing teaches "a conventional controller that stores algorithms for performing a method of optimizing fuel efficiency, as described, e.g., in Xing's Figure 4." *Id.* (citing Ex. 1006, 7:33–56).

Petitioner further asserts that Xing's "controller receive[s] signals from sensors communicatively coupled to the controller, such as torque sensor 122 and engine speed sensor 124." *Id.* at 45 (citing Ex. 1006, 8:16–40).

Petitioner explains that based on those signals, Xing's controller

evaluate[s] power losses from the transmission and other power consuming components at different candidate operating speeds, measure[s] engine load to determine the work output demanded of the machine, and independently set engine speeds and transmission ratios to minimize fuel consumption while achieving desired performance. . . .

The processor calculated a current load power requirement ( $P_{load}$ )—the amount of power for the machine to accomplish work—by measuring the current engine power ( $P_{engine}$ ) and estimating current power loss ( $P_{loss}$ ). . . . In block 202 of Figure 4, controller 116 calculated  $P_{engine}$ , based on signals indicating "the engine speed and the engine torque."

*Id.* at 46 (citing Ex. 1006, 8:67–9:3, 9:9–56). According to Petitioner, Xing's

processor calculated a current load power requirement ( $P_{load}$ )—the amount of power for the machine to accomplish work—by measuring the current engine power ( $P_{engine}$ ) and estimating current power loss ( $P_{loss}$ ). [Ex. 1006], 9:37–56. In block 202 of Figure 4, controller 116 calculated  $P_{engine}$ , based on signals indicating "the engine speed and the engine torque." [*Id.* at] 9:18–56. Using "component efficiency data stored within its memory," it calculated  $P_{loss}$  based on "the current vehicle operating parameters." *Id.* Then, controller 116 used this data to determine the current load power requirement ( $P_{load}$ ) based on the relationship of Equation 1: " $P_{engine} = P_{load} + P_{loss}$ ." *Id.*

*Id.* at 46–47.

- d) *[1[c]] adjusting an engine speed of the engine based on the engine load and one or more predefined efficiency points at least partially based on predetermined fuel consumption rates and providing optimum engine speeds for different engine loads;*

Petitioner asserts that the combination of Willis and Xing teaches or suggests the subject matter of limitation 1[c]. Pet. 47–49. More particularly, Petitioner asserts that “Willis’s milling machine, modified to include Xing’s algorithm and CVT, would have resulted in a controller that adjusted engine speed based on load and predefined efficiency points, as claimed.” *Id.* at 47 (citing Ex. 1006, 2:9–12, 3:50–67, 11:65–12:11). According to Petitioner, in order to determine “the machine’s power load requirement,” Xing’s controller- implemented method determined “the current engine load.” *Id.* (citing Ex. 1006, 9:37–56).

With reference to Figure 4 of Xing, Petitioner asserts that “controller 116 calculated a plurality of candidate engine settings (i.e., pairs of specific engine speeds and engine torques) based on the power load requirements and the estimated power loss due to the machine’s components.” Pet. 47 (citing Ex. 1006, 10:16–12:25, Fig. 4, elements 204–208). Petitioner then asserts that “[i]n block 210 of Figure 4, controller [1]16 determined which engine settings may be used for minimizing fuel consumption based on a fuel consumption maps (such as the one shown in Figure 11) or other suitable fuel efficiency data (such as that shown in Figure 5 above).” *Id.* at 48 (citing Ex. 1006, 3:58–63, 12:26–13:18, Fig. 4, element 210). Relying on the declaration testimony of Dr. Stein, Petitioner asserts that one of ordinary skill in the art “would have incorporated Xing’s engine map data and fuel efficiency data to determine an optimal engine speed for minimizing fuel

consumption,” and “would have had a reasonable expectation of success because storing such standard data structures for use by machine controllers was universally applicable to different machines, including milling machines.” *Id.* at 49 (citing Ex. 1003 ¶¶ 80–81; Ex, 1008, 5:12–6:59, 7:6–13).

e) *[1[d]] adjusting a gear ratio of the variable transmission based on the engine speed and the desired rotor speed.*

Petitioner asserts that the combination of Willis and Xing teaches or suggest the subject matter of limitation 1[d]. Pet. 50–52. More particularly, Petitioner asserts that “Willis’s milling machine, modified to include Xing’s algorithm and CVT, would have resulted in a controller that adjusted the CVT’s gear ratio based on engine speed and desired rotor speed as claimed. Xing’s variable transmission was operatively coupled to the engine.” *Id.* at 50 (citing Pet. 21–24). Relying on the declaration testimony of Dr. Stein, Petitioner asserts that one of ordinary skill in the art “would have been motivated to modify Willis to include a variable transmission and control system like that taught by Xing to ‘maintain a desired rotor speed.’” *Id.* at 51 (citing Ex. 1003 ¶¶ 85–87). According to Dr. Stein, one of ordinary skill in the art

would have utilized the desired rotor speed in place of the ground speed. Like Xing’s desired ground speed, Willis’s desired rotor speed is dictated by the rotary speed of Xing’s output shaft 56. Thus, to control the transmission gear ratio in the proposed combination, [one of ordinary skill in the art] would have used the desired rotor speed in place of the desired ground speed.

Ex. 1003 ¶ 85.

*f) Motivation to Combine<sup>9</sup>*

According to Petitioner, “[t]he ’538 [p]atent claims the combination of known milling machine components and powertrain systems with known controller-implemented methods for optimizing fuel efficiency while maintaining a desired rotor speed.” Pet. 32. In this context, Petitioner contends that one of ordinary skill in the art “would have been motivated to include a system and method like that taught by Xing in Willis’s milling machine.” *Id.* at 33. Petitioner further contends that one of ordinary skill in the art “would have known that milling machines were costly to operate and wanted to minimize fuel consumption to lower operating cost without sacrificing performance.” *Id.* at 33 (citing Ex. 1003 ¶¶ 63, 65; Ex. 1012, 1:33–45).

Petitioner asserts that “it was known that implementing a variable transmission in a milling machine could improve fuel efficiency” (*id.* at 33–34), and relying on the declaration testimony of Dr. Stein, reasons that one of ordinary skill in the art “would have recognized that using a hydromechanical CVT permitted controlling an engine to a speed that minimizes fuel consumption for a given load while controlling transmission gear ratios to achieve desired transmission output speeds that maximize machine performance.” *Id.* at 34 (citing Ex. 1003 ¶ 66). Petitioner further asserts that

Xing taught a method of controllably adjusting a CVT to further improve fuel efficiency without impacting machine performance. *Supra* [Pet. 18–24]. Thus, implementing a CVT and control method like that taught by Xing in Willis’s milling machine would have been a matter of combining prior art

elements according to known methods to yield predictable results.

*Id.* (citing Ex. 1003 ¶ 66).

Relying on the declaration testimony of Dr. Stein, Petitioner takes the position that one of ordinary skill in the art “would have expected to successfully incorporate Xing’s teachings, including those related to CVTs, engines, transmission control algorithms, and associated sensors, into Willis’s milling machine” because it would have been no more than the combination of “prior art elements according to known methods to yield predictable results.” Pet. 34 (citing Ex. 1003 ¶¶ 65–66); *see also id.* at 34–35 (“This combination would further apply a known technique and hardware to a known device that was ready for improvement, predictably yielding the result of the expected improvement.”). Petitioner concludes that one of ordinary skill in the art “would have expected that such a combination would improve the fuel consumption and energy efficiency of Willis’s milling machine, while maintaining desired rotor speed during operation.” *Id.* at 35.

We find, on the complete trial record, that a person having ordinary skill in the art would have been motivated to combine Willis and Xing, as Petitioner contends.<sup>10</sup>

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<sup>10</sup> In its Preliminary Response, Patent Owner argued that Petitioner failed to establish that one of ordinary skill in the art would have been motivated to combine Willis and Xing. *See* Prelim. Resp. 19–26. We addressed Patent Owner’s arguments in our Institution Decision. *See* Inst. Dec. 21–25. Patent Owner did not raise any arguments related to Petitioner’s motivation to combine Willis and Xing (Ground 1) or Willis and Xing in combination with Laux (Ground 2) in its Response. Thus, we find that Patent Owner has not preserved those arguments. *See* Paper 8, 8 (“Patent Owner is cautioned that any arguments not raised in the [Patent Owner Response] may be

2. *Patent Owner's Contentions for Claim 1*

Patent Owner contends that Petitioner's ground of unpatentability based on Willis and Xing is deficient.<sup>11</sup> PO Resp. 1–2, 8–24; PO Sur-reply 1–15. More particularly, Patent Owner argues that the Petition fails to show that Xing discloses “determining an engine load,” as recited by limitation 1[b], and as such, fails to show that Xing discloses “adjusting an engine speed based on the engine load,” as recited in part, by limitation 1[c]. PO Resp. 10–19. In addition, Patent Owner argues that the Petition fails to show that Xing discloses “adjusting an engine speed based on” “predetermined fuel efficiency points that provide optimum engine speeds for different engine loads,” as further required by limitation 1[c]. *Id.* at 20–24. We address each argument in turn.<sup>12</sup>

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deemed waived.”); *See also In re Nuvasive, Inc.*, 842 F.3d 1376, 1379–82 (Fed. Cir. 2016) (holding that patent owner waived arguments on an issue that were not raised in its response after institution).

<sup>11</sup> Patent Owner does not dispute Petitioner's contentions directed to the preamble and limitations 1[a] and 1[d]. We find, on the complete trial record, that Petitioner demonstrates, by a preponderance of the evidence, that the combination of Willis and Xing teaches or suggests the subject matter of these limitations.

<sup>12</sup> Patent Owner presents no specific argument or evidence directed to claim 6 other than noting its similarities to claim 1. *See, e.g.*, PO Resp. 10 (citing Ex. 2001 ¶ 41) (“Each of claims 1 and 6 require a controller to ‘determine an engine load’ and ‘adjust an engine speed based on the engine load.’”).

3. *Analysis of Claim 1*

- a) *“determining an engine load” and  
“adjusting an engine speed based on the engine load”*

Patent Owner contends that “Xing’s determination of a ‘load power requirement’ is not a determination of an ‘engine load,’” as required by limitation 1[b]. PO Resp. 10–19. More particularly, Patent Owner asserts that Xing’s “efficiency assessments and resulting engine speed adjustments are based on the load power requirement, not a determined engine load.” *Id.* at 14; *see also id.* at 17 (citing Ex. 2001 ¶ 51 (“the ultimate speed adjustments are based on the load power requirement, which is the only constant in Xing’s Figure 5”)). Patent Owner argues that during deposition, “Petitioner’s expert, Dr. Stein, confirmed that Xing’s load power requirement is ‘**not** the engine load,’ as it only represents ‘the power that’s going to . . . do useful work.’” *Id.* at 11 (citing Ex. 2003, 52:3–11).

Patent Owner takes the position that the Petition “relies on Xing’s disclosure where the load power requirement ( $P_{load}$ ) is calculated indirectly (rather than measured directly).” PO Resp. 13 (citing Pet. 46; Ex. 1003 ¶ 78; Ex. 2003, 47:18–49:6, 49:20–50:23). Patent Owner points out, however, that “Xing also teaches that, ‘[a]lternatively, the power load requirement may be determined directly by monitoring the output torque and the output speed of the work vehicle 10.’” *Id.* at 18 (citing Ex. 1006, 9:57–64). Thus, Patent Owner argues that because “any measurement of the load at the engine can be bypassed entirely by directly measuring the variable of interest,  $P_{load}$ , at the source—i.e., where the useful work is occurring,” Xing does not disclose “adjusting an engine speed” “based on the [determined] engine load.” *Id.* at 18–19 (citing Ex. 2001 ¶ 52).

Patent Owner also argues that Xing “teaches that a ‘future load power requirement’ may be used as the starting point to its method by forecasting the load power requirement based on previously calculated load power requirements.” PO Resp. 18 (citing Ex. 1006, 10:2–15). According to Patent Owner, “Xing shows that determining a current engine load is ultimately irrelevant to Xing’s fuel-efficiency method because the load power requirement forming the basis for the method can be calculated without making a determination as to the current engine load.” *Id.* (citing Ex. 2001 ¶ 53). Thus, Patent Owner asserts that “Xing’s adjustment of an engine speed for fuel-efficiency purposes is not ‘based on the [determined] engine load.’” *Id.* at 19.

Patent Owner further argues that Xing fails to teach or suggest “adjusting an engine speed” for fuel-efficiency purposes “based on the [determined] engine load” because

any candidate speed that Xing identifies as its target engine speed is not a speed that can achieve a given **measured** engine load (e.g., **measured** engine torque or engine power ( $P_{\text{engine}}$ )). Instead, Xing seeks to vary **both** engine speed and engine torque to identify the target candidate speed (which itself is paired with a candidate engine torque), which further evidences that the selection of target engine speed is made **independent** of any existing and measured engine load.

PO Resp. 19 (citing Ex. 2001 ¶ 55).

Petitioner responds that the challenged claims “only require adjusting an engine speed ‘based on the engine load and one or more predefined efficiency points at least partially based on predetermined fuel consumption rates and providing optimum engine speeds for different engine loads.’” Pet. Reply 5. Petitioner argues that Xing discloses “adjusting an engine speed”



“based on  $P_{load}$  calculated from  $P_{engine} - P_{loss}$ , where  $P_{engine}$  is the measured current engine load.” *Id.* at 4. According to Petitioner,

Dr. Kemal acknowledged that Xing discloses a machine that measures the current engine power, or load, and uses the measured engine load to estimate the useful work the machine currently outputs. Xing’s machine measures **current** engine power ( $P_{engine}$ ) and estimates the machine’s internal power losses ( $P_{loss}$ ) at the **current** engine speed to calculate the amount of useful work ( $P_{load}$ ) the machine currently outputs.

*Id.* at 3 (citing Ex. 1028, 84:17–87:7, 98:13–102:12). Petitioner contends that

Xing then estimates **candidate** power losses and **candidate** engine powers needed for the machine to output the same amount of useful work ( $P_{load}$ ) at different candidate engine speeds. [Ex. 1028], 105:15–106:15. The candidate engine power values are each calculated by adding the estimated system power losses at each candidate engine speed to the load power requirement ( $P_{load}$  or ( $P_{engine} - P_{loss}$ )).

*Id.* at 3–4. Petitioner adds that

Dr. Kemal admitted that Xing converts each candidate engine power into a candidate engine torque and uses Figure 11 to obtain the engine fuel consumption and engine efficiency corresponding to the candidate engine power and speed. [Ex. 1028], 106:16–108:20. He further admitted that Xing adjusts engine speed to the candidate engine speed and engine torque pair that is closest to the point at which the engine’s fuel efficiency is maximized. Kemal Decl. ¶ 50. Thus, irrespective of which candidate engine speed and engine torque Xing’s controller uses for engine speed adjustment, Xing discloses an adjusted speed based on  $P_{load}$  calculated from  $P_{engine} - P_{loss}$ , where  $P_{engine}$  is the measured current engine load. This is all that is required to meet the claim term.

*Id.* at 4.

Petitioner further argues that Patent Owner’s arguments directed to Xing’s discussion of “alternative embodiments that directly measure[]  $P_{load}$

without relying on the determined engine load ( $P_{\text{engine}}$ )” fail to demonstrate any deficiency with the process performed by Xing’s controller. Pet. Reply 9–10. Petitioner argues that “although  $P_{\text{load}}$  can be measured directly, there is no dispute that Xing teaches that  $P_{\text{load}}$  is derived from engine load ( $P_{\text{engine}}$ ).” *Id.* at 10.

We have considered Petitioner’s arguments and evidence, and Patent Owner’s counterarguments and find, on the complete trial record, that Petitioner demonstrates, by a preponderance of the evidence, that the combination of Willis and Xing teaches or suggests “determining an engine load of the engine” and “adjusting an engine speed of the engine based on the engine load” as recited by limitation 1[b], and recited in part by limitation 1[c].

Petitioner explains that Xing’s controller 116 “receive[s] signals from sensors communicatively coupled to the controller, such as torque sensor 122 and engine speed sensor 124” (Pet. 45 (citing Ex. 1006, 8:16–40)), and

[b]ased on those signals, the controller in Xing evaluated power losses from the transmission and other power consuming components at different candidate operating speeds, measured engine load to determine the work output demanded of the machine, and independently set engine speeds and transmission ratios to minimize fuel consumption while achieving desired performance.

*Id.* at 46 (citing Ex. 1006, 8:67–9:3, 9:9–17). We find Petitioner’s explanation to be consistent with Xing’s disclosure that

the current load power requirement for the work vehicle may be determined indirectly by calculating the current engine power ( $P_{\text{engine}}$ ) and the current power loss ( $P_{\text{loss}}$ ) for the work vehicle 10. For example, as indicated above, the controller 116 may be configured to continuously monitor the engine speed and the engine torque (via sensors 122, 124), thereby allowing for the current engine power to be calculated by the controller 116.

Ex. 1006, 9:37–44; *see also id.* at 9:27–31 (“The relationship between the load power requirement and the power produced by the engine 22 of the work vehicle 10 is provided” by Equation 1: “ $P_{engine} = P_{load} + P_{loss}$ .”).

The ’538 patent discloses that “the engine load may include loads due to the rotor 118, the hydrostatic arrangement 144, and other parasitic loads.” Ex. 1001, 4:12–14. During deposition, when asked whether “the engine load referred to in line 12 of column 4 of the ’538 patent [is] equivalent to the engine power recited in Xing’s [Equation] 1” (Ex. 2003, 44:5–8), Dr. Stein responded that “the two are expressing the same idea that the engine must provide -- provide energy to -- to both the useful work and overcome the losses. And so the two concepts would be understood, by a person of ordinary skill in the art, to be equivalent” (*id.* at 45:8–14). To the extent Xing refers to engine torque, we credit Dr. Stein’s declaration testimony that one of ordinary skill in the art “would have understood that engine load measured in terms of torque can be converted to engine load in terms of power by multiplying measured torque by engine speed,” for at least the reason that this testimony is consistent with Xing’s teaching. *See* Ex. 1003 ¶ 65; *see also, e.g.*, Ex. 1006, 9:40–44 (“For example, as indicated above, the controller 116 may be configured to continuously monitor the engine speed and the engine torque (via sensors 122, 124), thereby allowing for the current engine power to be calculated by the controller 116.”). Therefore, we find Xing teaches or suggests “determining an engine load of the engine,” as recited by limitation 1[b].

We also understand Xing to teach or suggest “adjusting an engine speed of the engine based on the [determined] engine load,” as required in part by limitation 1[c]. Patent Owner argues that Xing’s “efficiency assessments and resulting engine speed adjustments are based on the load

power requirement, not a determined engine load.” PO Resp. 14. However, we agree with Petitioner that Xing’s controller adjusts its “engine to run at a speed that minimizes fuel consumption based on the current load on the engine.” Pet. 47 (citing Ex. 1006, 2:9–12, 3:50–67, 11:65–12:11). Although we agree with Patent Owner that Xing does determine a separate power load requirement ( $P_{load}$ ), we understand Xing to teach or suggest “adjusting an engine speed based on the engine load,” as required in part by limitation 1[c].

Patent Owner takes the position that “any current engine power ( $P_{engine}$ ) determined in Xing fails to satisfy the limitations of the claims because Xing’s method adjusts its engine speed based on the load power requirement ( $P_{load}$ ), not the current engine power ( $P_{engine}$ ). PO Sur-reply 2 (citing PO Resp. 14–19). Patent Owner asserts that “Petitioner’s theory that Xing discloses adjusting an engine speed based on the engine load is premised entirely on Xing’s Equation 1, where  $P_{engine} = P_{load} + P_{loss}$ .” *Id.* at 4 (citing Pet. Reply 2–4). Patent Owner argues, however, that Petitioner’s reasoning based on Xing’s Equation 1 “results in an illogical reading of the term ‘based on.’ For instance, the indirect determination of  $P_{load}$  involves calculating the difference between current  $P_{engine}$  (what Petitioner now maps to the determined engine load) and current  $P_{loss}$ .” *Id.* at 5. According to Patent Owner, Petitioner’s theory “adjusts the engine speed ‘based on’ all of these parameters,” but Patent Owner contends that “these parameters merely serve as a means to an end in Xing—the determination of  $P_{load}$ , which is the basis for which Xing adjusts its engine speed.” *Id.* at 6. We disagree.

At the outset, we note that limitation 1[c] does not exclude the presence of additional parameters from being considered by Xing’s controller when it “determine[s] which engine settings may be used as the

target engine settings for minimizing fuel consumption.” Ex. 1006, 3:62–63.

Rather, limitation 1[c] simply requires that the engine speed be adjusted “based on the engine load and one or more predefined efficiency points.”

Ex. 1001, 6:25–27. In this regard, Xing discloses that

[b]ased on the load power requirement and the calculated power consumption of such components, a plurality of candidate engine settings (e.g., pairs of specific engine speeds and engine torques) may be selected and analyzed to determine which engine settings may be used as the target engine settings for minimizing fuel consumption.

Ex. 1006, 3:57–63. When viewed in the context of Xing’s Equation 1, i.e., “ $P_{\text{engine}} = P_{\text{load}} + P_{\text{loss}}$ ,” we understand Xing to teach or suggest selecting a plurality of candidate engine settings based on the summation of  $P_{\text{load}} + P_{\text{loss}}$ , which would be  $P_{\text{engine}}$ , the parameter Petitioner relies on as “the measured current engine load. *See id.* at 12:3–6 (“[U]sing Equation 1, each candidate engine power may be equal to the summation of the load power requirement and the associated power loss value.”); *see also id.* at 12:26–28 (“fuel efficiency data may be analyzed to determine a target engine speed for the work vehicle 10 based on the candidate engine powers”).

That the language of limitation 1[c] does not preclude Xing’s use of other parameters is also consistent with the ’538 patent’s disclosure. For example, the ’538 patent’s Specification discloses that “controller 130 may retrieve, recall and/or refer to predefined fuel efficiency points 162, or any other predetermined information pertaining to the fuel consumption characteristics of the milling machine 100 stored in memory 132, to determine an optimum engine speed for the given engine load.” Ex. 1001, 5:7–12. Additionally, the ’538 patent discloses that “estimated fuel consumption rates for a given milling machine 100 and an associated engine

122 may be predetermined for different combinations of engine speed and engine load.” Ex. 1001, 4:9–18.

Thus, we find that Petitioner has proven, by a preponderance of the evidence, that Xing teaches or suggests “adjusting an engine speed of the engine based on the [determined] engine load,” as required in part by limitation 1[c].

b) *“adjusting an engine speed based on” “predetermined fuel efficiency points that provide optimum engine speeds for different engine loads”*

Patent Owner contends that “because of Xing’s different approach to efficiency assessment, Xing also does not adjust an engine speed based on predetermined fuel efficiency points that provide optimum engine speeds for different engine loads.” PO Resp. 20 (citing Ex. 2001 ¶ 56). Patent Owner argues first that Petitioner “fail[s] to expressly identify specifically what in Xing allegedly discloses the claimed ‘predetermined fuel efficiency points.’” *Id.* (citing Pet. 47–49). Patent Owner argues next that the ’538 patent uses

the determined engine load [to] serve[] as a reference point from which predetermined efficiency points are identified that provide optimum engine speeds for the determined engine load, which then becomes the adjusted speed for the given load. [Ex. 2001 ¶ 57]. In contrast, as described above with respect to Xing, Xing seeks to identify pairs of speed and torque combinations that can achieve a given load power requirement, and then determine which of these pairs is the most efficient. *Id.*

PO Resp. 21. According to Patent Owner, “Xing does not indicate that the candidate speeds associated with each of these pairings represent the *optimum* speed for the paired candidate engine torque; instead, Xing seeks to identify the most efficient combination of candidate engine speed-torque by comparing each of the pairings to an associated efficiency value.” *Id.*

(citing Ex. 2001 ¶ 58). Patent Owner explains that Xing fails to teach or suggest the claimed “predefined efficiency points” because

- (1) any “predefined efficiency points” that may be said to “provide optimum engine speeds for different engine loads” do not serve as a basis for adjusting the engine speed in Xing; and
- (2) conversely, any “predefined efficiency points” serving as a basis for adjusting the engine speed in Xing do not “provide optimum engine speeds for different engine loads.”

*Id.* at 22. Thus, Patent Owner contends that “Xing does not “‘adjust an engine speed’ based on such an optimal point because Xing instead adjusts the engine speed by selecting one of the engine speed-torque pairings based on its efficiency relative to the other pairs.” *Id.* at 23 (citing Ex. 2001 ¶ 59). Patent Owner argues last that “even if Xing’s candidate engine speed-torque pairings could be said to correspond to a “predetermined efficiency point” (e.g., on Xing’s FIG. 11 graph) that serves as the basis of an efficiency assessment and subsequent speed adjustment, those points do not constitute optimum engine speeds for different engine loads.” *Id.* at 24 (citing Ex. 2001 ¶ 61).

In response, Petitioner argues that Patent Owner’s arguments “import[] limitations into the [c]laims,” and fail to

identify any requirement that the engine speed be the most efficient engine speed or specify[] what the engine speed should be optimized for. The [c]laims only state that the engine speed is “based on . . . one or more predefined efficiency points at least partially based on predetermined fuel consumption rates and providing optimum engine speeds for different engine loads.”

Pet. Reply 16. According to Petitioner, Xing’s algorithm

determines the engine speed using the engine load and the efficiency points, and states that “the controller 116 may select the candidate engine speed/torque pair that maximizes fuel efficiency (i.e., the pair intersecting closest to the optimal fuel efficiency point 30) as the target engine speed and target engine

torque for producing the engine power necessary to achieve the lower power requirement.”

*Id.* at 17 (citing Ex. 1006, 12:58–63).

We have considered Petitioner’s arguments and evidence, and Patent Owner’s counterarguments and find, on the complete trial record, that Petitioner demonstrates, by a preponderance of the evidence, that the combination of Willis and Xing teaches or suggests “adjusting an engine speed of the engine based on the engine load and one or more predefined efficiency points at least partially based on predetermined fuel consumption rates and providing optimum engine speeds for different engine loads,” as recited by limitation 1[c].

Petitioner asserts that “Xing specifically states that the controller selects the engine speed/torque pair that *maximizes fuel efficiency*, and then clarifies which pair that would be—the one that intersects closest to the optimal fuel efficiency point 30.” Pet. Reply 17. To make this determination, Xing discloses that its controller relies on

suitable fuel efficiency data (e.g., in the form of fuel consumption maps, data tables, mathematical functions and/or the like) [that] may be stored within the controller 116 and may be utilized to determine the optimal engine settings based on the candidate engine speeds and associated candidate engine torques (derived from the candidate engine powers).

Ex. 1006, 12:48–54. And, “for each pair of candidate engine speeds and torques,” Xing discloses that “controller 116 may determine the fuel consumption of the engine 22 by referencing the fuel consumption map or other suitable fuel efficiency data.” *Id.* at 12:54–58. Following these steps, Xing then discloses that “controller 116 may select the candidate engine speed/torque pair that maximizes fuel efficiency (i.e., the pair intersecting closest to the optimal fuel efficiency point 30) as the target engine speed and



target engine torque for producing the engine power necessary to achieve the load power requirement.” *Id.* at 12:58–63. Given Xing’s disclosure, we credit Dr. Stein’s declaration testimony that, when “[c]onfigured with Xing’s algorithm, the machine’s controller adjusts the engine to run at one of the speeds at which the engine can produce sufficient power to meet the current load and at which the engine and the speed at which the engine minimizes fuel consumption.” Ex. 1003 ¶ 80 (citing Ex. 1006, 3:50–67, 9:37–40, 10:33–37, 11:65–12:11, 12:26–47).

Patent Owner argues that Petitioner “fail[s] to expressly identify specifically what in Xing allegedly discloses the claimed ‘predetermined fuel efficiency points.’” PO Resp. 20 (citing Pet. 47–49); PO Sur-reply 12. To support its argument, Patent Owner contends, that, “when asked to identify which aspect of Xing’s method mapped to the claimed ‘predetermined fuel efficiency points,’ Dr. Stein admitted to not having fully considered the claim language, instead relying on a visual comparison of FIG. 4 of the ’538 patent with Xing’s Figure 11 and corresponding disclosure.” *Id.* (citing Ex. 2003, 90:7–91:20).

We are not persuaded by Patent Owner’s argument at least because it mischaracterizes Dr. Stein’s deposition testimony when read in full context. For example, when asked “[w]hat aspect of Xing [Dr. Stein is] relying on as disclosing the predefined efficiency points recited in the claim,” (Ex. 2003, 87:13–15), Dr. Stein responded by stating that the data in Figure 5 of Xing,

along with the fuel map in [Xing’s] Figure 11, which has the fuel efficiency points that are claimed or the internal representation in the controller of how much fuel the engine uses, depending on what the engine speed and torque are.

So Xing goes through and says: I have some options here. I can move around in this space. I’m adjusting -- I can adjust the

engine speed, so what engine speed am I going to adjust to? I'm going to adjust to an engine speed that ends up giving me an operating point in this torque-speed space that is highly efficient as defined by these fuel-efficiency regions that -- or points that are talked about in the claim but are shown as regions in the Figure 11 in Xing.

*Id.* at 87:16–88:19.

Dr. Stein's response is similar to the answer provided by Dr. Kemal during cross-examination. When asked to explain "what predefined efficiency points are," Dr. Kemal answered that "predefined efficiency points can be at least partially based on the predetermined fuel consumption rates." Ex. 1028, 68:16–20. And, when asked to distinguish "predetermined fuel consumption rates" from "predefined efficiency points," Dr. Kemal responded that

predetermined fuel consumption rates are what we typically would refer to as an engine map. There's -- they are shown, for instance, in [the] '538 patent in Figure 4 where for different pairs of engine load and engine speed, you have -- you determine whether or not there is low fuel efficiency or high fuel efficiency. Predefined efficiency points are -- could be more than that. It could be -- you could look at engine efficiency in other ways; and so predetermined fuel efficiency points get you to the -- sorry. Predetermined fuel consumption rates -- sorry. Let me start again. The predetermined fuel consumption rates are engine maps, such as Figure 4 in the '538 patent shown in Page 9 of my declaration. What they do is they -- for a given engine load and engine speed, they are premapped to understand how fuel-efficient that particular operating point is for the engine. So you can go from low fuel efficiency to high fuel efficiency.

*Id.* at 124:2–125:4.

In light of Dr. Stein's and Dr. Kemal's deposition testimony, we credit Dr. Stein's declaration testimony that one of ordinary skill in the art "would have been motivated to incorporate Xing's engine map to utilize the engine

load data from the sensors such that the controller could execute the algorithm and select engine settings to achieve an optimized engine speed.”

Ex. 1003 ¶ 81. We find Dr. Stein’s declaration testimony, as well as his deposition testimony, to be supported by Xing’s disclosure. For example, Xing discloses that “for each pair of candidate engine speeds and torques, the controller 116 may determine the fuel consumption of the engine 22 by referencing the fuel consumption map or other suitable fuel efficiency data.” Ex. 1006, 12:54–58. Xing further discloses that, for each pair of candidate engine speeds and torques, its controller calculates “a bsfc value and/or a fuel consumption value” that “may then be analyzed and/or compared to determine the combination of engine settings that minimizes fuel consumption.”

Patent Owner argues that “the candidate engine speeds in Xing are not disclosed to be the optimum speed for the particular torque they are paired with.” PO Sur-reply 13 (citing PO Resp. 21–22, 24; *cf. id.*, 5–6 (citing Ex. 1001, 4:23–27, 5:7–12, Fig. 4)). Instead, according to Patent Owner “they are simply speed-torque combinations sufficient to achieve the load power requirement. *Id.* The distinction between this and the claimed invention is right in the claims: the claimed engine speeds provided via efficiency points are ‘optimum’ and they are optimized ‘for different engine loads.’” PO Sur-reply 13.

At least one difficulty with Patent Owner’s argument, however, is that it is premised on its mistaken contention that Xing’s engine speed-torque pairs are based only on satisfying the load power requirement. Here, Xing discloses that its

method 200 may allow for a work vehicle 10 to be controlled in a manner that minimizes fuel consumption while maintaining the

desired vehicle performance/productivity. Specifically, in several embodiments, the method 200 may allow for a candidate pool of engine settings (e.g., candidate engine speeds and/or torques) to be generated by analyzing both the load conditions of the work vehicle 10 and the individual efficiencies of various vehicle components. The candidate engine settings may then be analyzed to determine the specific engine settings at which the vehicle's fuel consumption is minimized. The engine operation may then be set to the specific engine settings and the transmission ratio may be adjusted such that the desired vehicle performance/productivity is maintained.

Ex. 1006, 8:56–9:3. During deposition, when asked whether Dr. Stein would “agree that Xing is concerned with figuring out the engine speed that will achieve the load power requirement while consuming the least amount of fuel” (Ex. 2003, 76:19–22), Dr. Stein disagreed, and replied

[i]t's not the load power requirement. It's the total engine power requirement that is important. And that's one of [Xing's] teachings, is that you can't just look at what the engine power is. You have to find out where the engine power is going and being able to forecast how much of that energy is going to be used by those different places, where it goes. And so the fuel -- the minimum fuel use is associated with the -- the engine operating the machine and accomplishing all of its -- all of its work.

*Id.* at 77:5–16. Thus, Patent Owner's arguments on this point are not persuasive.

Equally unpersuasive is Patent Owner's contention that “there is no evidence in Xing that the speed is an *optimum* speed for that torque, especially given that Xing's method calculates the candidate engine speed *before* any candidate engine torque.” PO Sur-reply 14 (citing PO Resp. 22–24 (citing Ex. 1006, 10:16–18, 12:28–33; Ex. 2001 ¶ 59)). According to Patent Owner “Petitioner does not explain how the simple fact that the speed-torque pair selected by Xing has the highest fuel efficiency relative to the other speed-torque pairs means that the speed of that selected pair is an

optimum speed “for different engine loads” (or even the torque it is associated with).” PO Sur-reply 15. However, we agree with Petitioner that

Xing discloses an algorithm that determines the engine speed using the engine load and the efficiency points, and states that “the controller 116 may select the candidate engine speed/torque pair that maximizes fuel efficiency (i.e., the pair intersecting closest to the optimal fuel efficiency point 30) as the target engine speed and target engine torque for producing the engine power necessary to achieve the lower power requirement.”

Pet. Reply 17 (citing Ex. 1006, 12:58–63). We credit the declaration testimony of Dr. Stein, who states with reference to Figure 11, that Xing’s controller refers to a fuel consumption map, “selects the candidate engine speed/torque pair that minimizes fuel consumption (i.e., the pair intersecting closest to the optimal fuel efficiency point) as the target engine speed and target engine torque,” and then “set[s] the engine to operate based on the target engine speed.” Ex. 1003 ¶ 80 (citing Ex. 1006, 3:58–67, 8:64–9:3, 12:58–63).

Thus, we find that Petitioner has proven, by a preponderance of the evidence, that Xing teaches or suggests “adjusting an engine speed of the engine based on the engine load and one or more predefined efficiency points at least partially based on predetermined fuel consumption rates and providing optimum engine speeds for different engine loads,” as recited by limitation 1[c]. Accordingly, upon review of the information in the Petition and corresponding evidence, and considering Patent Owner’s arguments, we find Petitioner has proven, by a preponderance of the evidence, on the complete trial record, that the combination of Willis and Laux teaches or suggests the subject matter of claim 1.

4. *Analysis of Claims 2–13*

a) *Claims 2–5*

Claims 2–5 depend from claim 1. *See* Ex. 1001, 6:32–49. Petitioner provides citations to evidence of record, including Willis, Xing, and Dr. Stein’s testimony on how the combination of Willis and Xing teaches or suggests the subject matter of claims 2–5. Pet. 52–58 (citing Ex. 1003).

Upon review of the information in the Petition and corresponding evidence, including Petitioner’s reasons for modifying Willis with Xing’s teachings, we find that Petitioner has proven, by a preponderance of the evidence, that the combination of Willis and Xing teaches or suggests the subject matter of claims 2–5. Patent Owner does not dispute Petitioner’s contentions with respect to these claims, other than the arguments made with respect to claim 1, which we address above. PO Resp. 24–25.

b) *Claim 6*

Claim 6 is similar to claim 1 in many respects, and Petitioner refers to its arguments with respect to claim 1 for these claims, with the exception of claim 6’s recitation of “a variable transmission operatively coupled to an output of the engine” and “a rotor operatively coupled to an output of the variable transmission.” *See* Pet. 59–66. Petitioner provides citations to evidence of record, including Willis, Xing, and Dr. Stein’s testimony on how the combination of Willis and Xing teaches or suggests the subject matter of claim 6. *Id.* (citing Ex. 1003).

Upon review of the information in the Petition and corresponding evidence, including Petitioner’s reasons for modifying Willis and Xing’s teachings, we find that Petitioner has proven, by a preponderance of the evidence, that the combination of Willis and Xing teaches or suggests the

subject matter of claim 6. Patent Owner does not dispute Petitioner's contentions with respect to this claim, other than the arguments made with respect to claim 1, which we address above. *See, e.g.*, PO Resp. 10 (citing Ex. 2001 ¶ 41) ("Each of claims 1 and 6 require a controller to 'determine an engine load' and 'adjust an engine speed based on the engine load.'").

*c) Claims 7–12*

Claims 7–12 depend from claim 6. *See* Ex. 1001, 6:65–7:20. Petitioner provides citations to evidence of record, including Willis, Xing, and Dr. Stein's testimony on how the combination of Willis and Xing teaches or suggests the subject matter of claims 7–12. Pet. 66–73 (citing Ex. 1003).

Upon review of the information in the Petition and corresponding evidence, including Petitioner's reasons for modifying Willis with Xing's teachings, we find that Petitioner has proven, by a preponderance of the evidence, that the combination of Willis and Xing teaches or suggests the subject matter of claims 7–12. Patent Owner does not dispute Petitioner's contentions with respect to these claims, other than the arguments made with respect to claims 1 and 6, which we address above. PO Resp. 24–25.

*d) Claim 13*

Claim 13 recites "[t]he machine of claim 6, further comprising a clutch disposed between the engine and the rotor, the controller being configured to selectively disengage the rotor from the engine through control of the clutch." Ex. 1001, 7:21–24.

Petitioner asserts that "Willis's milling machine, modified to include Xing's algorithm and CVT, would have resulted in a milling machine having directional clutches that the controller controlled to disengage a load

connected through transmission output, such as the milling drum, from the engine.” Pet. 73 (citing Ex. 1006, 5:11–17, 6:53–7:3). Petitioner explains that “Xing’s control algorithm used the controller to actuate directional clutches to disengage a load from the engine when the transmission output shaft 56 was connected to the load.” *Id.* at 73. Petitioner provides the following copy of Figure 2 of Xing, annotated to identify, among several items, forward directional clutch 52 and reverse directional clutch 54. *Id.* at 74 (citing Ex. 1006, Fig. 2).

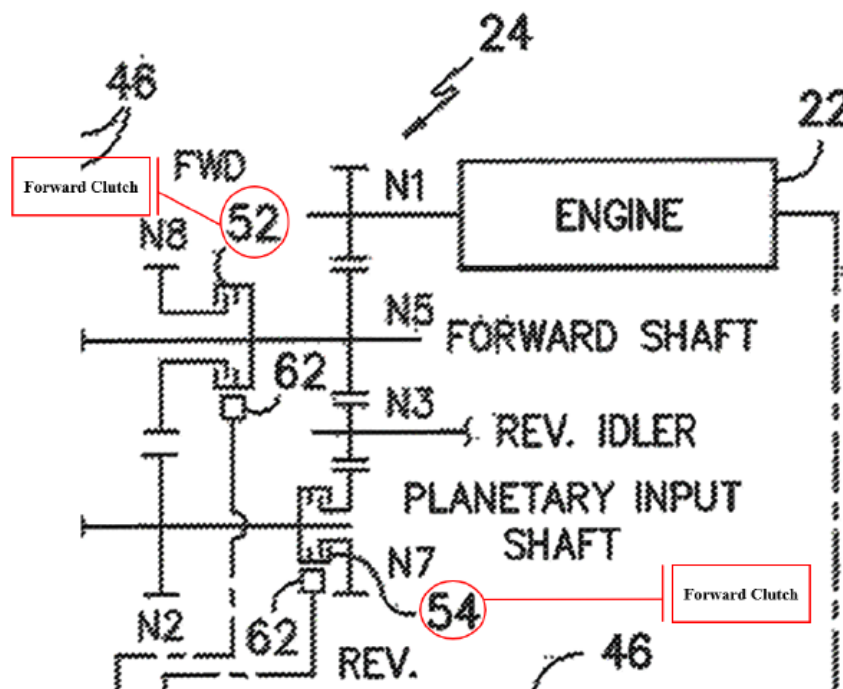


Figure 2 above shows transmission 24 including engine 22, forward directional clutch 52 and reverse directional clutch 54. Ex. 1006, 4:11–14. According to Petitioner, “Xing taught that forward directional clutch 52 and reverse directional clutch 54 selectively couple the engine to its planetary gear” and “[c]ontroller 116 could disengage both directional clutches 52, 54 from planetary unit 32.” Pet. 74 (citing Ex. 1006, 5:11–17, 6:3–6). Petitioner also contends that “[b]y actuating parking brake 70, output shaft



56 and its connected load remained mechanically isolated and disengaged from the engine.” *Id.* at 74–75 (citing Ex. 1006, 6:14–34; Ex. 1003 ¶ 150).

Alternatively, Petitioner argues that “Xing’s transmission could be configured so that the transmission output shaft 56 is connected indirectly (through PTO 110) to a load, such as a milling drum, via PTO shaft 112 and a third clutch set, PTO clutch 114, under control of controller 116.” Pet. 75 n.4 (citing 4:42–53, 5:38–55, 6:47–7:3, 7:21–23, Fig. 3). According to Petitioner, one of ordinary skill in the art

would have modified Willis’s milling machine so that the output of Willis’s engine was connected to the input shaft of Xing’s CVT, and PTO shaft 112 was connected to Willis’s milling drum. [Ex. 1003] ¶¶ 151–152. In this arrangement, PTO clutch 114 would have connected PTO shaft 112—and Willis’s milling drum—to transmission output shaft 56 and the engine.

*Id.* (citing Ex. 1005 ¶ 20; Ex. 1006, 4:33–37, 4:42–53, 6:47–7:3; Pet. 63–64 n.3).

According to Petitioner, in either arrangement, one of ordinary skill in the art

would have modified Willis’s milling machine so that the output of Willis’s engine was coupled to the input shaft of Xing’s CVT transmission and the transmission’s output was coupled (directly or indirectly) to Willis’s milling drum, because these are the methods Xing teaches for coupling its engine to a load via its CVT. [Ex. 1005 ¶ 20]; [Ex. 1006], 4:46–53, 6:53–7:3, Fig. 2 (showing load on shaft 56). The proposed combination includes two alternative ways selectively disengaging the engine from a load exerted by a rotor by disengaging the clutches in Xing’s transmission. [Ex. 1006,] 5:14–17, 5:32–37, 6:3–6.

Pet. 75–76. Petitioner also contends that one of ordinary skill in the art “would have been motivated to incorporate Xing’s CVT and control algorithm in Willis’s milling machine and would have had a reasonable expectation of success in doing so.” *Id.* at 76 (citing Pet. 33–52, 59–66).

In response, Patent Owner argues that “Petitioner fails to show that any of the components relied upon in the petition constitute a ‘clutch’ that is controlled to ‘selectively disengage the rotor from the engine.’” PO Resp. 25 (citing Ex. 2001 ¶ 64). Patent Owner argues first that Xing’s directional clutches 52, 54 do not “disengage the rotor from the engine.” *Id.* at 25–29. Patent Owner argues next that “Xing’s parking brake 70 is not a clutch controlled to disengage the rotor from the engine.” *Id.* at 29–31. Patent Owner last argues that “Petitioner’s reliance on Xing’s power take-off (PTO) component is insufficient.” *Id.* at 31–33. We address each argument in turn.

*i. directional clutches 52, 54*

Patent Owner argues that Petitioner “fails to show that by disengaging directional clutches 52, 54 ‘from planetary unit 32,’ the load (i.e., the milling drum in Petitioner’s combination) also would be disengaged from the engine.” PO Resp. 26. According to Patent Owner, the problem with Petitioner’s reliance on directional clutches 52, 54, is that

the load connected to the engine is still engaged with the engine even when directional clutches 52, 54 are disengaged because the directional clutches merely serve to direct engine power output through the hydrostatic branch of the transmission alone or both the hydrostatic and mechanical branches to drive the connected load.

*Id.* at 26 (citing Ex. 2001 ¶ 66). Patent Owner refers to Dr. Stein’s declaration testimony where Dr. Stein explains that

“[p]ower from the engine flows in parallel through both a hydrostatic branch and a mechanical branch and combines through a planetary unit or gear set 32.” [Ex. 1003] ¶ 55 (citing [Ex. ]1006, 4:42–53, 5:14–17, 5:65–6:3). “In the mechanical branch, the sun gear NS1 of the planetary unit 32 receives power from the engine 22 via planetary input shaft 50, which is

connected to engine 22, when either the forward or reverse directional clutch 52, 54 is engaged.” *Id.* (citing [Ex. ]1006, 5:9–14, 5:65–6:3).

*Id.* Patent Owner refers to Dr. Stein’s declaration testimony again where he explains, that in the hydrostatic branch of the transmission, “‘the ring gear NR of the planetary unit 32 receives power from the output gear N10 of hydrostatic unit 30 through gears N11, N12’” and “‘[p]ower flow from the engine is directed through both branches and then combined at the planetary unit 32, which is then applied to the load (i.e., milling drum) via an output shaft 56.’” *Id.* at 27 (quoting Ex. 1003 ¶¶ 55–56 (citing Ex. 1006, 1:25–38, 4:54–63, 6:34–45)).

Patent Owner adds that Xing’s “directional clutches 52, 54 direct whether the mechanical branch receives power output from the engine, while having no effect on the hydrostatic branch.” PO Resp. 28 (citing Ex. 2001 ¶ 69). Patent Owner also adds that alternatively, Xing discloses that its transmission “‘may be operated to have a pure hydrostatic power flow by disengaging both of the directional clutches 52, 54.’” *Id.* (citing Ex. 1006, 6:3–6). Patent Owner contends that

Xing therefore discloses two possible arrangements when directional clutches 52, 54 are controlled: (1) when either clutch is engaged, the transmission operates to provide “combined hydrostatic and mechanical power flow” from the engine to the transmission’s output; or (2) when both clutches are disengaged, the transmission operates to provide “pure hydrostatic power flow” from the engine to the transmission’s output.

*Id.* (citing Ex. 2001 ¶ 70; Ex. 1006, 4:54–63; Ex. 1003 ¶ 55). Consequently, Patent Owner argues that “[i]n either case, whether the clutches are engaged or disengaged, power from the engine can still flow to the planetary unit 32 and to the load (i.e., milling drum) via the output shaft 56.” *Id.* at 28–29 (citing Ex. 2001 ¶ 71).

In response, Petitioner argues that Patent Owner “improperly interprets [c]laim 13 to require the clutch to disengage all power, not just the power flowing through the clutches, from the engine.” Pet. Reply 19. According to Petitioner, there is nothing in claim 13, or claim 6 from which it depends, that would “exclude other methods of powering the rotor using the engine even after the drivetrain’s clutch disengages the engine from the rotor.” *Id.* at 19–20. Petitioner asserts

Xing teaches that the hydrostatic branch only transmits power from the engine at specific times through a hydrostatic unit transmitting power through a variable displacement hydraulic pump. The pump output is controlled by the angle of a swash plate in the pump, which is controlled by the controller to adjust the transmission ratio.

*Id.* at 20 (citing Ex. 1006, 4:54–5:8). Petitioner asserts further that Xing teaches “that the hydrostatic power flow can be adjusted to provide zero speed (zero transmission ratio) by adjusting the angle of the swash plate. At that swash plate angle, no power from the engine is transmitted through the hydrostatic branch.” *Id.* at 20–21. Based on Xing’s teachings, Petitioner concludes that

when the controller adjusts the hydrostatic unit’s swash plate for zero power flow, disengaging both of the directional clutches 52, 54 disengages all power from the engine to the output of Xing’s transmission. With the engine isolated from the transmission output and the load, Xing’s controller actuates parking brake 70 to hold the load in place.

*Id.* at 21 (citing Ex. 1006, 6:15–35).

In response, Patent Owner argues that “Petitioner’s arguments are unavailing because they rewrite the claim to require disengagement of the power flowing through the clutch, rather than disengagement of the rotor from the engine.” PO Sur-reply 17. According to Patent Owner,

[c]laim 13 does not recite that the claimed clutch disengages “power” flowing from the engine to the rotor through the clutch. Instead, the claim specifies that the clutch disengages one component (the rotor) from another component (the engine). Petitioner’s argument that claim 13 includes the limitations of claim 6, which is broad enough to encompass other methods of powering the rotor after the clutch is disengaged (Reply, 19), ignores the fact that claim 13 is a narrowing dependent claim. Claim 13 goes beyond a mere requirement that one flow of power from the engine to the rotor is cut off through disengagement of the clutch; it instead recites that specific components themselves are disengaged from one another: the rotor from the engine.

*Id.* at 17–18. And, to the extent Petitioner suggests “scenarios in which power flow via the hydrostatic branch may not occur” based on adjusting the angle of the swash plate to a zero transmission ratio (*id.* at 18 (citing Pet. Reply 20–21)), Patent Owner argues Petitioner’s argument is unpersuasive based on the deposition testimony of Dr. Kemal, who “testified that, even in view of Petitioner’s hypothetical configuration in which the swash plate angle is at zero, power could still be transmitted from the engine to the rotor.” *Id.* at 18–19 (citing Pet. Reply 21 n.4 (citing Ex. 1028, 81:19–82:1)).

We have considered Petitioner’s arguments and evidence, and Patent Owner’s counterarguments and find, on the complete trial record, that Patent Owner’s arguments supported by the testimony of Dr. Kemal outweigh Petitioner’s arguments and evidence. In making this determination, we agree with Patent Owner that claim 13 does not simply require “disengagement of the power flowing through the clutch,” as Petitioner contends. Pet. Reply 19–20.

Instead, we agree with Patent Owner that claim 13 requires a “clutch” that is “disposed between the engine and the rotor” to “selectively disengage the rotor from the engine.” Ex. 1001, 7:21–24; *see also* PO Sur-reply 17

(Claim 13 “specifies that the clutch disengages one component (the rotor) from another component (the engine).”).” We also agree with Patent Owner that “Xing’s directional clutches 52, 54 fail to ‘disengage the rotor from the engine’ because the rotor would remain engaged to the engine via the hydrostatic branch, as evidenced by its ability to still transmit power to the rotor.” PO Sur-reply 18 (citing PO Resp. 25–29).

We credit the declaration testimony of Dr. Kemal who states that “whether clutches 52, 54 are engaged or disengaged, power from the engine can still flow to the planetary unit 32 and to the load (i.e., milling drum) via the output shaft 56.” Ex. 2001 ¶ 71. We also credit the deposition testimony of Dr. Kemal, where he testified that “there is always some power going through the hydrostatic unit” regardless of the angle of the swashplate. Ex. 1028, 81:14–82:4. We note that Petitioner has not directed us to any portion of Dr. Stein’s testimony to rebut Dr. Kemal’s testimony.

Thus, we find that Petitioner has failed to provide sufficient evidence to establish that Xing’s directional clutches (*see* Pet. 73–76) teach or suggest the subject matter of claim 13.

*ii. parking brake 70*

Patent Owner argues that Petitioner “fails to show how Xing’s parking brake constitutes a clutch that can selectively disengage the rotor from the engine.” PO Resp. 29–30 (citing Ex. 2001 ¶ 72). More particularly, Patent Owner argues that “apart from stating that the parking brake 70 would ‘mechanically isolate[]’ the rotor from the engine, neither Petitioner nor its expert explain how this would be understood to be a configuration that would **disengage** the rotor from the engine.” *Id.* at 30 (citing Ex. 2001 ¶ 74). Petitioner does not respond to Patent Owner’s argument in its Reply.

We have considered Petitioner’s arguments and evidence, and Patent Owner’s counterarguments and find, on the complete trial record, that Patent Owner’s arguments supported by the testimony of Dr. Kemal outweigh Petitioner’s arguments and evidence. In making this determination, we credit the declaration testimony of Dr. Kemal who opines that

Xing’s parking brake 70 would not have been understood to be a “clutch” as conventionally known by those in the art. Those skilled in the art typically understood that a brake, such as a parking brake, is a device that inhibits or prevents motion of a moving load, while a clutch is a device that provides for engaging and disengaging energy transfer from a power input (e.g., engine) to an output (e.g., rotor).

Ex. 2001 ¶ 73 (citing Ex. 1006, 6:29–34).

Thus, we find that Petitioner has failed to provide sufficient evidence to establish that Xing’s parking brake (*see* Pet. 73–76) teaches or suggests the subject matter of claim 13.

*iii. power take-off (PTO)*

Patent Owner argues that Petitioner “does not explain (or even allege) that the third clutch set, PTO clutch 114, is a clutch controlled to selectively disengage the rotor from the engine as claimed.” PO Resp. 32 (citing Ex. 2001 ¶ 75). According to Patent Owner, “Petitioner’s proposed configuration requires additional, unaddressed modifications, and no motivation is provided as to why [one of ordinary skill in the art] would pursue such a configuration” and “raises inconsistencies with regard to Petitioner’s mapping of Xing to the challenged claims, as Xing treats the power associated with the PTO as a loss component, which is separate from the load power requirement Xing bases its method on.” *Id.* (citing Ex. 2001 ¶ 75; Ex. 1006, 9:27–36, 10:53–67, Fig. 8).

Petitioner responds that Patent Owner “wrongly argues that the Petition does not explain or even allege that clutch 114 is controlled to selectively disengage the rotor from the engine as claimed.” Pet. Reply 22. According to Petitioner, “Dr. Kemal does not address whether a controller controls clutch 114 or state that Wirtgen or Dr. Stein has incorrectly interpreted these teachings from Xing.” *Id.* (citing Ex. 2001 ¶¶ 75–76). Petitioner concludes that one of ordinary skill in the art “would have understood that Xing’s controller can be configured to selectively couple the planetary unit of the transmission to a load (such as a milling drum) connected via the PTO by automatically controlling PTO clutch 114.” *Id.* at 22–23 (citing Ex. 1003 ¶¶ 69, 71, 119 n.4, 151).

In response, Patent Owner argues that Petitioner still fails “to establish that its alternative reliance on Xing’s PTO clutch 114 discloses the claimed clutch that ‘disengage[s] the rotor from the engine.’” PO Sur-reply 19 (citing PO Resp. 31–33 (citing Pet. 75 n.4)). According to Patent Owner,

Petitioner does not even attempt to respond to [Patent Owner’s]’s observation that the evidence cited by Petitioner as illustrating Xing’s PTO clutch 114 arrangement—Dr. Stein’s testimony that Laux taught the same clutch arrangement—directly contradicts any conclusion that Xing’s PTO clutch meets the claimed limitations because Laux’s clutch arrangement fails to “disengage” a load (e.g., a milling drum from the engine). *Id.* at 19–20 (citing PO Resp. 32–33 (citing Ex. 2001 ¶ 76)).

We have considered Petitioner’s arguments and evidence, and Patent Owner’s counterarguments and find, on the complete trial record, that Patent Owner’s arguments supported by the testimony of Dr. Kemal outweigh Petitioner’s arguments and evidence.

Petitioner asserts that Xing teaches that its “PTO ‘may be coupled to any . . . suitable load L, such as . . . a power take-off’ and ‘form[s] part of



the transmission 22 and may be configured to be engaged via a PTO clutch 114.” Pet. Reply 22 (citing Ex. 1006, 4:49–53, 6:67–7:3). Petitioner adds that when “[c]onnected to Willis’s engine in this manner, as Xing describes, Willis’s milling drum acts as a load on Willis’s engine and is an implement that can be connected to the PTO output shaft 112.” *Id.* (citing Ex. 1006, 6:64–67). However, Xing discloses that “drive axle assembly 26 may include a differential 102 coupled to the transmission output shaft 56 and one or more axle shafts 104 coupled to the differential 102 for transferring power.” Ex. 1006, 6:53–58. Thus, we agree with Patent Owner that Petitioner fails to persuasively show that Xing’s PTO clutch 114 “disengage[s] the rotor from the engine” as recited by claim 13.

Thus, we find that Petitioner has failed to provide sufficient evidence to establish that Xing’s power take off (*see* Pet. 75 n.4) teaches or suggests the subject matter of claim 13.

#### *5. Conclusions for Ground 1*

Based on the analysis above, we conclude that Petitioner has proven, by a preponderance of the evidence, that claims 1–12 are unpatentable under 35 U.S.C. § 103 over the combination of Willis and Xing. We also conclude that Petitioner has not proven, by a preponderance of the evidence, that claim 13 is unpatentable under 35 U.S.C. § 103 over the combination of Willis and Xing.

#### *E. Alleged Obviousness over Willis, Xing, and Laux (Ground 2: Claims 8 and 13)*

Petitioner asserts that claims 8 and 13 are unpatentable as obvious over Willis, Xing, and Laux. Pet. 76–80. Petitioner also relies on the testimony of Dr. Stein to support its arguments. *Id.* (citing Ex. 1003). We

have reviewed the Petition, Patent Owner Response, Petitioner Reply, Patent Owner Sur-reply, as well as the relevant evidence discussed in those papers and other record papers, and as discussed in greater detail below, we are persuaded that the record establishes by a preponderance of the evidence that Petitioner's contentions that claim 8 would have been obvious over Willis, Xing, and Laux, as Petitioner contends. We are not persuaded, however, that the record establishes by a preponderance of the evidence that Petitioner's contentions that claim 13 would have been obvious over Willis, Xing, and Laux, as Petitioner contends. We adopt Petitioner's contentions regarding claim 8 discussed below as our own.

*1. Analysis of Claims 8 and 13*

*a) Claim 8*

Claim 8 recites “[t]he machine of claim 7, wherein the gear set is a planetary gear set having a sun gear coupled to the engine, a carrier coupled to the rotor, and a ring gear coupled to the hydraulic motor.” Ex. 1001, 7:1–4.

Petitioner asserts that, as discussed with respect to Ground 1, the combination of Willis and Xing teaches or suggests this arrangement. Pet. 76 (citing *id.* at 68–69). However, to the extent the combination Willis and Xing fails to teach or suggest the subject matter of claim 8, “Laux, by referencing and incorporating Schomaker, taught a solution that was commonly used in planetary transmissions.” *Id.* (citing Ex. 1003 ¶ 155). Petitioner explains that “Schomaker’s planetary gears were mounted on carrier 23, which coupled planetary gears 22 to output shaft 24” and “[c]arrier 23 transferred the orbital motion of planetary gears 22 around sun gear 21 to output shaft 24, thereby rotating output shaft 24.” *Id.* at 76–77

(citing Ex. 1016 ¶ 35, 37). According to Petitioner, one of ordinary skill in the art

would have been motivated to incorporate Laux's carrier into Xing's planetary unit 32 to harness the planetary gears' orbital motion and couple the planetary unit's output to the transmission's output shaft 56 either directly or via Xing's range gears. Indeed, Xing's CVT was designed to use a planetary gear to combine the power output from the CVT's mechanical and hydrostatic paths to rotate output shaft 56. Laux's planetary gear arrangement provided a known way to do so. [One of ordinary skill in the art] would have had a reasonable expectation of success in doing so because Xing's CVT already included the necessary components to provide such an arrangement.

*Id.* at 77–78.

Upon review of the information in the Petition and corresponding evidence, including Petitioner's reasons for modifying Willis, Xing, and Laux's teachings, we find that Petitioner has proven, by a preponderance of the evidence, that the combination of Willis, Xing, and Laux teaches or suggests the subject matter of claim 8. Patent Owner does not dispute Petitioner's contentions with respect to this claim, other than the arguments made with respect to claims 1 and 6 as they pertain to Ground 1, which we address above. PO Resp. 33.

*b) Claim 13*

Claim 13 recites “[t]he machine of claim 6, further comprising a clutch disposed between the engine and the rotor, the controller being configured to selectively disengage the rotor from the engine through control of the clutch.” Ex. 1001, 7:21–24.

Petitioner asserts that, as discussed with respect to Ground 1, the combination of Willis and Xing teaches or suggests this arrangement. Pet. 78 (citing *id.* at 73–76). However, to the extent the combination Willis and

Xing fails to teach or suggest the subject matter of claim 13, “Laux taught a milling machine powertrain in which clutch 15 was disposed between the engine and the rotor to selectively disengage the rotor from the engine.” *Id.* (citing Ex. 1003 ¶ 157; Pet. 14–18). Figure 3, of Laux, reproduced below, is an outline sketch of a drive train of Laux’s ground milling machine. Ex. 1012, 8:27–28.

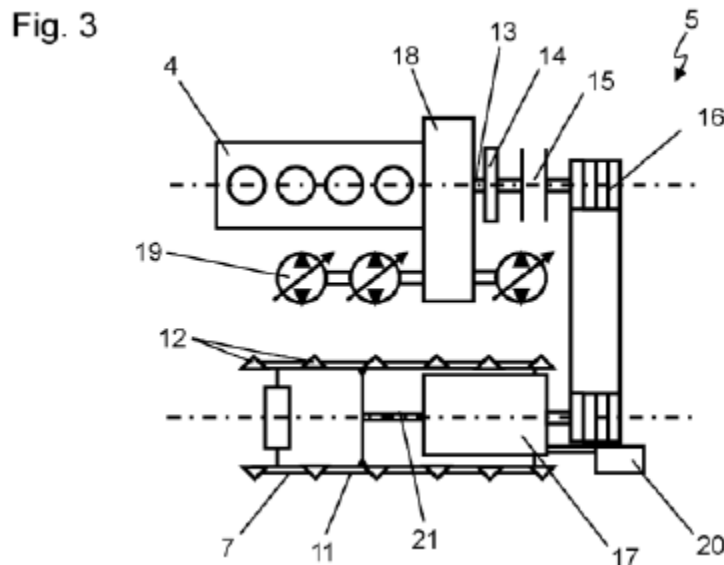


Figure 3 above shows shift clutch 15, belt drive 16, and a drive transmission 17 are connected to the output shaft 13 of internal combustion engine 4. Ex. 1012, 9:6–10.

Petitioner asserts that Laux discloses “[e]ngine 4 was coupled to belt drive 16 via output shaft 13 and shift clutch 15.” Pet. 79 (citing Ex. 1012, 9:3–10). Petitioner asserts further that “[c]lutch 15 could disengage engine 4 from belt drive 16, drive transmission 17, and rotor 7,” and as such, “teaches all the limitations of this claim.” *Id.* at 79 (citing Ex. 1012, 9:3–10).

According to Petitioner, one of ordinary skill in the art

would have been motivated to incorporate Laux’s clutch into Willis’s milling machine that has been modified to include

Xing's CVT and algorithm. Milling drum tools 12 frequently wear down during milling and, are typically replaced manually by machine operators. Conventionally, [one of ordinary skill in the art] would have understood that, for safety reasons, the milling drum needed to be disengaged from the engine to avoid unexpected startup and possible injury. *See, e.g.*, [Ex. ]1017 (US Patent No. 8,167,378 ("Busely")), 1:34–47. In such milling machines, this was conventionally achieved using a clutch between the rotor and the engine.

*Id.* (citing Ex. 1017, 3:66–67, Fig. 2). Petitioner explains that one of ordinary skill in the art "would have wanted to retain this safety feature from conventional milling machine" and "would have been motivated to incorporate Laux's clutch" with "a reasonable expectation of success in doing so because clutches were well-known and Laux taught a successful way to implement a clutch in a milling machine wherein the engine was coupled to the rotor via a CVT." *Id.* at 80.

In response, Patent Owner asserts that the addition of Laux to Willis and Xing fails to show "a clutch that is controlled 'to selectively disengage the rotor from the engine.'" PO Resp. 33. Patent Owner argues that similar to the deficiency identified in Xing, i.e., "whether the clutch component Petitioner identifies in Laux is engaged or disengaged, the rotor is still connected to the engine." *Id.* (citing Ex. 2001 ¶ 78). More particularly, Patent Owner argues that Laux "fails to disclose that clutch 15 'disengage[s]' rotor 7 from engine 4 because, even when clutch 15 is disengaged, rotor 7 would still be connected to engine 4 via a secondary drive 20 and hydraulic pumps 19." *Id.* at 34 (citing Ex. 2001 ¶ 79). Here, Patent Owner points out that

Laux describes two paths in which drive energy from the engine 4 is transmitted to the transmission 17 and thus to its output shaft 21 for rotating the milling drum. [Ex. 2001] ¶ 82. The first is a

mechanical path, in which power from the engine 4 is outputted via shaft 13 to the belt drive 16 and inputted into the transmission 17 via shaft 22. *Id.* The second is a hydrostatic path, in which power from the engine 4 is outputted to hydraulic motors 19, which drive hydraulic motor 20, the output of which is inputted into the transmission via shaft 23. *Id.*

*Id.* at 34–35.

Petitioner responds that Patent Owner improperly “focuses primarily on Laux as an independent reference rather than how it is used as part of the proposed combination.” Pet. Reply 23. Petitioner asserts that “Laux discloses that a shift clutch 15 in a milling machine drive train can be located as the last drive train element immediately adjacent the belt drive 16 in part of the drive train between engine 4 and belt drive 16.” *Id.* (citing Pet. 59–64, 78–79 (citing Ex. 1012, 9:3–10)). Petitioner takes the position that “[w]hen implemented in the proposed combination, Laux’s shift clutch 15 would have been located as the last drive train element between Xing’s transmission and adjacent Willis’s drive pulley ‘belt-and-pulley system’ at the output of Xing’s transmission.” *Id.* (citing Pet. 11; Ex. 1005 ¶ 20).

Petitioner asserts that Laux teaches that its “clutch 15 disengages engine 4 from belt drive 16 and the load imposed by its milling drum (rotor 7).” Pet. Reply 24 (citing Ex. 1012, 9:3–10). Petitioner further asserts that “Xing teaches that its transmission’s “planetary unit 32 may be configured to be selectively coupled to the load L . . . under automatic control of the controller 116.” *Id.* at 24–25 (citing Ex. 1006, 5:14–17; Pet. 73). Based on these teaching, Petitioner argues that “Xing teaches that the drive train element specifically designed to disengage its transmission and engine from the load should be controlled by Xing’s controller. Xing’s teaching would

therefore apply to Laux's clutch 15 implemented in Willis's machine modified by Xing." *Id.* at 25.

In response, Patent Owner contends that Petitioner's reply arguments "are unavailing because they . . . advance a modification that was not proposed in the petition." PO Sur-reply 21. According to Patent Owner, the Petition "rel[ies] on Laux's unmodified clutch 15 that 'could disengage engine 4 from belt drive 16, drive transmission 17, and rotor 7.'" *Id.* at 22 (citing Pet. 78–80). Patent Owner argues further that "Petitioner's new modification is insufficient to satisfy its burden in establishing obviousness because the clutch arrangement proposed by Petitioner is neither taught nor suggested by the applied references, i.e., "Laux's clutch is disposed between the engine 4 and transmission 17" and the Petition "does not allege that Willis or Xing teach such a configuration." *Id.* at 23 (citing Ex. 1012, Fig. 3; Pet. 78–79 (relying on clutch 15's placement between engine 4 and input of drive transmission 17). Patent Owner adds that the Petition fails to provide "evidence explaining why [one of ordinary skill in the art] would have been motivated to reposition Laux's clutch in this manner.

We have considered Petitioner's arguments and evidence, and Patent Owner's counterarguments and find, on the complete trial record, that Petitioner does not demonstrate, by a preponderance of the evidence, that the combination of Willis, Xing, and Laux teaches or suggests "a clutch disposed between the engine and the rotor, the controller being configured to selectively disengage the rotor from the engine through control of the clutch," as recited by claim 13.

In making this determination, we agree with Patent Owner that Laux "fails to disclose that clutch 15 'disengage[s]' rotor 7 from engine 4 because, even when clutch 15 is disengaged, rotor 7 would still be connected to

engine 4 via a secondary drive 20 and hydraulic pumps 19.” PO Resp. 34 (citing Ex. 2001 ¶ 79). We credit Dr. Kemal’s declaration testimony that, in Laux,

hydraulic pumps 19 are connected to the engine 4 before (or upstream) from the clutch 15, which is shown by the pumps’ connection to transfer case 18, as illustrated above in Laux’s FIG. 3. See [Ex. ]1012, 9:10–13. Due to this arrangement, a person of ordinary skill would have understood that, even with clutch 15 disengaged, the transmission 17 (and thus the rotor 7) would still be connected to the engine 4 via the hydrostatic path (i.e., auxiliary drive 20 and hydraulic pumps 19). Given this connection, a person of ordinary skill would have understood that control of clutch 15 would not “disengage the rotor from the engine” because the rotor would still be engaged with the engine through the hydrostatic path.

Ex. 2001 ¶ 83.

We also agree with Patent Owner that Petitioner’s contention regarding clutch 15 in the proposed combination of Willis, Xing, and Laux (Reply Br. 23), is an improper new argument. 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 later situation.



Here Petitioner does not expand on a position from the Petition that Patent Owner criticizes based on the merits of the contentions. Instead, Petitioner supplements its contentions in the Petition that one of ordinary skill in the art would have “incorporate[d] Laux’s clutch into Willis’s milling machine that has been modified to include Xing’s CVT and algorithm” (Pet. 78) by its new suggestion that “Laux’s shift clutch 15 would have been located as the last drive train element between Xing’s transmission and adjacent Willis’s drive pulley ‘belt-and-pulley system’ at the output of Xing’s transmission.” Reply Br. 23. Although Petitioner contends that this configuration was proposed in the Petition (*id.* (citing Pet. 11 (citing Ex. 1005 ¶ 20))), we agree with Patent Owner that this “newly asserted modification, which now relies on components of Willis’s direct drive train, is thus contrary to the petition.” PO Sur-reply 22 n.6. Petitioner’s response is the type of “meaningfully distinct contention[s]” that signal that Petitioner is augmenting deficient contentions in the Petition with new arguments.

Accordingly, upon review of the information in the Petition and corresponding evidence, including Petitioner’s reasons for modifying Willis and Xing with Laux’s teachings, and Patent Owner’s arguments, we find that Petitioner has not proven, by a preponderance of the evidence, that the combination of Willis, Xing, and Laux teaches or suggests the subject matter of claim 13.

## *2. Conclusions for Ground 2*

Based on the analysis above, we conclude that Petitioner has proven, by a preponderance of the evidence, that claim 8 is unpatentable under 35 U.S.C. § 103 over the combination of Willis, Xing, and Laux. We also conclude that Petitioner has not proven, by a preponderance of the evidence,

that claim 13 is unpatentable under 35 U.S.C. § 103 over the combination of Willis, Xing, and Laux.

### III. CONCLUSION

After considering all the evidence and arguments presently before us, we conclude Petitioner has proven, by a preponderance of the evidence, that claims 1–12 are unpatentable. We conclude Petitioner has not proven, by a preponderance of the evidence, that claim 13 is unpatentable.<sup>13</sup>

In summary:

<b>Claims</b>	<b>35 U.S.C. §</b>	<b>Reference(s)/Basis</b>	<b>Claims Shown Unpatentable</b>	<b>Claims Not shown Unpatentable</b>
1–13	103(a)	Willis, Xing	4–7	13
8, 13	102(a)	Willis, Xing, Laux	8	13
<b>Overall Outcome</b>			1–12	13

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<sup>13</sup> 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).

#### IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has proven by a preponderance of the evidence that claims 1–12 of U.S. Patent No. 9,975,538 B2 are unpatentable;

FURTHER ORDERED that Petitioner has not proven by a preponderance of the evidence that claim 13 of U.S. Patent No. 9,975,538 B2 is unpatentable;

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 1–12 of U.S. Patent No. 9,975,538 B2; and

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

IPR2022-01397  
Patent 9,975,538 B2

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