

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUM INDUSTRIAL TECHNOLOGY, INC.,
Petitioner,

v.

AMSTED RAIL COMPANY, INC.,
Patent Owner.

IPR2023-00540
Patent 10,137,915 B2

Before JAMES P. CALVE, KEVIN W. CHERRY, and
MICHAEL L. WOODS, *Administrative Patent Judges*.

CHERRY, *Administrative Patent Judge*.

JUDGMENT

Final Written Decision

Determining All Challenged Claims Unpatentable

Denying Patent Owner's Motion to Amend

35 U.S.C. § 318(a)

ORDER

Dismissing Patent Owner's Motion to Exclude (Paper 32)

37 C.F.R. § 42.64(c)

I. INTRODUCTION

A. Background

Hum Industrial Technology, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting institution of *inter partes* review of claims 1, 21–30, 36, and 37 (“the Challenged Claims”) of U.S. Patent No. 10,137,915 B2 (Ex. 1001, “the ’915 patent”). Patent Owner filed a Preliminary Response (Paper 6, “Prelim. Resp.”). With our prior authorization, Petitioner filed a Reply to Patent Owner’s Preliminary Response (Paper 7), and Patent Owner filed a Sur-reply (Paper 9). Applying the standard set forth in 35 U.S.C. § 314(a), we instituted an *inter partes* review as to all claims and grounds set forth in the Petition. Paper 10 (“Inst. Dec.”).

After institution, Patent Owner filed a Patent Owner Response (Paper 15, “PO Resp.”), Petitioner filed a Reply (Paper 18, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 24, “Sur-reply”). Additionally, Patent Owner filed a Contingent Motion to Amend and a Request for Preliminary Guidance (Paper 16), and Petitioner filed an Opposition (Paper 19). We provided Preliminary Guidance on the Motion to Amend (Paper 22). Patent Owner filed a Revised Contingent Motion to Amend (Paper 23, “RM TA” or “Motion”), Petitioner filed an Opposition (Paper 27, “RM TA Opp.”), Patent Owner filed a Reply (Paper 31, “RM TA Reply”), and Petitioner filed a Sur-reply (Paper 38, “RM TA Sur-reply”). Patent Owner also filed a Motion to Exclude (Paper 32, “MTE”), Petitioner filed an Opposition (Paper 36, “MTE Opp.”), and Patent Owner filed a Reply (Paper 37, “MTE Reply”). An oral hearing was held for this proceeding on June 10, 2024, and the transcript is of record. Paper 42.

We have jurisdiction pursuant to 35 U.S.C. § 6. This Decision is a Final Written Decision under 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 as to the patentability of the Challenged Claims. Petitioner bears the burden of proving unpatentability of the Challenged Claims. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). To prevail, Petitioner must prove unpatentability by a preponderance of the evidence. *See* 35 U.S.C. § 316(e) (2018); 37 C.F.R. § 42.1(d) (2021). Having reviewed the arguments and the supporting evidence, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 1, 21–30, 36, and 37 of the '915 patent are unpatentable. We deny Patent Owner's Revised Motion to Amend. We dismiss Patent Owner's Motion to Exclude as moot.

B. Related Proceedings

The parties identify *Amsted Rail Company, Inc. v. Hum Industrial Technology, Inc. et al*, Case No. 4:22-cv-00445-AGF (E.D. Mo.), as a related matter. Pet. 2; Paper 5 (Patent Owner's Mandatory Notices), 1. Petitioner also states that it has filed petitions for *inter partes* review challenging claims of several patents related to the '915 patent in IPR2023-00538 (U.S. Patent No. 9,365,223 B2) and IPR2023-00539 (U.S. Patent No. 9,981,673 B2). *See* Pet. 2 (identifying the related patents).

C. Real Parties in Interest

Petitioner identifies its real parties in interest as Hum Industrial Technology, Inc. and Dr. Brent Wilson. Pet. 1.

Patent Owner identifies Amsted Rail Company, Inc., Amsted Digital Solutions, Inc., and IONX LLC as its real parties in interest. Paper 5, 1.

D. The Asserted Grounds of Unpatentability and Declaration Evidence

Petitioner challenges the patentability of claims 1, 21–30, 36, and 37 of the ’915 patent on the following grounds:

Claim(s) Challenged	35 U.S.C. §¹	Reference(s)/Basis
1, 22, 24, 25, 27–30, 36, 37	103	Armitage ² , Barone ³
21	103	Armitage, Barone, LeFebvre ⁴
23, 26	103	Armitage, Barone, Winfree ⁵
1, 21, 22, 25, 27–30, 36, 37	103	LeFebvre, Barone
24, 37	103	LeFebvre, Barone, Armitage,
23, 26	103	LeFebvre, Barone, Winfree

Pet. 6. Petitioner supports its challenge with a Declaration of Steven Ricca (Ex. 1003), and a Declaration of Steven Ricca in Support of Petitioner’s Reply (Ex. 1025). Petitioner also submits the Declaration of Steven Ricca in Support of Petitioner’s Opposition to Patent Owner’s Motion to Amend (Ex. 1028) and the Declaration of Steven Ricca in Support of Petitioner’s

¹ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. § 103. The ’915 patent claims benefit of a Dec. 24, 2013, filing date, which is after the effective date of the applicable AIA amendments. Ex. 1001, Code (60).

² U.S. Patent Publication No. 2011/0282540 A1, published Nov. 17, 2011, filed May 11, 2011) (Ex. 1006, “Armitage”).

³ U.S. Patent Publication 2007/0208841 A1, published Sept. 6, 2007, filed Jan. 19, 2007 (Ex. 1007, “Barone”)

⁴ U.S. Patent Publication No. 2007/0152107 A1, published July 5, 2007, filed Dec. 22, 2006 (Ex. 1005, “LeFebvre”).

⁵ U.S. Patent No. 7,706,213 B2, issued Apr. 27, 2010, filed Oct. 23, 2007 (Ex. 1008, “Winfree”).

Opposition to Patent Owner's Revised Motion to Amend (Ex. 1030). Patent Owner supports its arguments with an Expert Declaration of Dr. Michael Shamos (Ex. 2001), Expert Declaration of Dr. Michael Shamos in Support of Patent Owner's Response (Ex. 2006), Expert Declaration of Michael Shamos in Support of Patent Owner's Motion to Amend (Ex. 2008), Expert Declaration of Dr. Michael Shamos in Support of Patent Owner's Revised Motion to Amend (Ex. 2009), and Expert Declaration of Dr. Michael Shamos in Support of Patent Owner's Revised Motion to Amend Reply (Ex. 2010).

E. The '915 Patent

The '915 patent is titled "System and Method for Detecting Operational Anomalies in Train Consists and Railcars." Ex. 1001, code (54). The '915 patent issued from Application Serial No. 15/108,065, filed as a PCT on Dec. 24, 2014. *Id.* at codes (21), (22). The '915 patent claims priority to provisional application No. 61/920,700, filed Dec. 24, 2013. *Id.* at code (60).

The '915 patent relates to a system and method for the real-time, on-board monitoring of various operational parameters of railcar and train consists, and for analyzing the readings in real time to predict or timely detect anomalous operational conditions. *Id.* at 1:51–55. The system includes a hierarchical arrangement of components which provide a distributed data analysis capability for detecting operational anomalies at various levels of the hierarchy, and which provides for the flow of data, events and alerts to a central point. *Id.* at 1:61–65.

An illustrative embodiment of such a system is depicted in Figure 2, reproduced below.

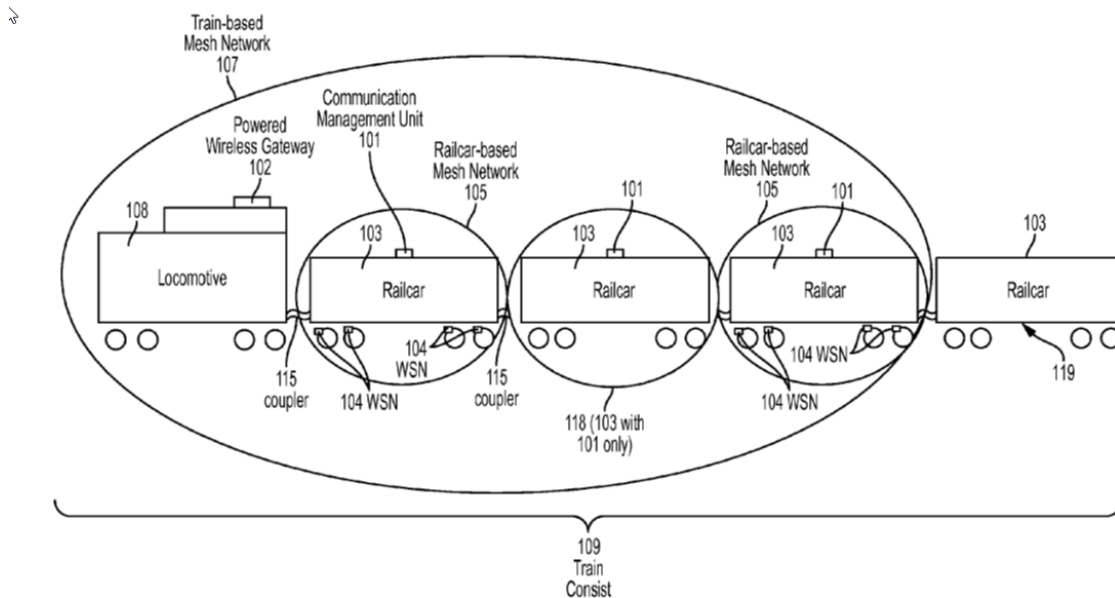


FIG. 2

Figure 2 is a schematic of a train-based mesh network that forms train consist 109 having two railcars 103 each equipped with communication management unit (CMU) 101 and multiple wireless sensor nodes (WSNs) 104, railcar 103 without a CMU or WSN, and powered wireless gateway (PWG) device 102 installed on locomotive 108. *Id.* at 2:36–41; 3:18–20. CMU 101 includes a processor, a power source (e.g., a battery, solar cell, energy harvester, or internal power-generating capability), a global navigation satellite system (GNSS) device such as a global positioning system (GPS) receiver, Wi-Fi, satellite, and/or cellular capability, wireless communications capability for maintaining railcar-based mesh network 105, wireless communication with train-based mesh network 107 and one or more sensors 104, including, but not limited to, accelerometer 404, gyroscope, or temperature sensor 406. *Id.* at 3:27–37. CMU 101 is capable of receiving data and/or alarms from one or more WSNs 104 and processing the data received, and is capable drawing inferences from this data or alarms

regarding the performance of railcar 103, and of transmitting data and alarm information to a remote receiver, such as a powered wireless gateway 102 (preferably located in locomotive 108), or remote railroad operations center 120. *Id.* at 4:4–13.

An illustrative embodiment of a sensor is depicted in Figure 4, reproduced below.

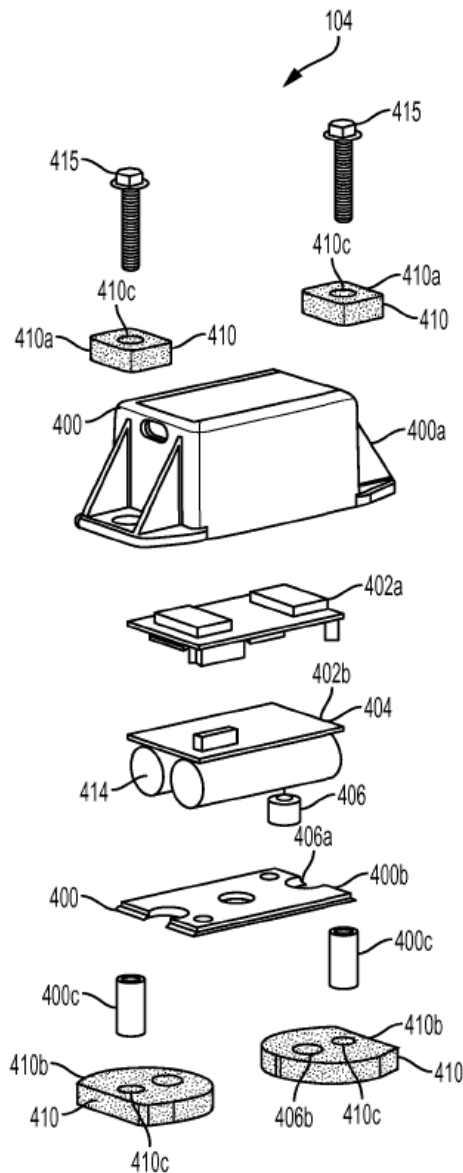


FIG. 4

Figure 4 is an exploded view of sensor node 104 which can be used, for example, for monitoring bearing temperature and wheel acceleration. *Id.* at 2:44–46. Sensor node 104 is used to detect acceleration and temperature events and is typically located on wheel bearing fitting 111 of railcar 103, and its components are contained in housing 400 having enclosure 400a and enclosure base 400b. *Id.* at 4:65–5:6. One of the components in housing 400 is mechanical filter 410 consisting of upper sections 410a and lower sections 410b that mechanically filter high and low frequency types of accelerations that are considered noise and which are preferably removed from the signal of interest. *Id.* at 5:23–27. The '915 patent explains that in one embodiment, the logic in CMU 101 is capable of analyzing both acceleration and temperature events received from each WSN 104 under its control and determining if an alarm or event condition actually exists. *Id.* at 9:36–40. However, acceleration events are independent of temperature events and CMU 101 may be configured to either analyze only acceleration events, or to analyze only temperature events, such that CMU 101, and WSNs 104 under its control, form a distributed event processing engine which is capable of determining various types of events. *Id.* at 9:40–46. When CMU 101 determines that an alarm or event has occurred, a message is sent to the next level in the hierarchy that is either to PWG 102 located elsewhere on train consist 109 or off train consist 109 to remote railroad operation center 120, depending upon the severity of the event and the need to immediately address the event, perhaps by altering train consist 109's operating condition. *Id.* at 9:49–58.

F. Illustrative Claim

Petitioner challenges claims 1, 21–30, 36, and 37 of the '915 patent. Pet. 5. Of the challenged claims, claims 1, 30, and 36 are independent. Claim 1, reproduced below with Petitioner's identifiers for the claim limitations, is illustrative of the subject matter recited in the challenged claims.

- [1 Pre, 1(a)]** A system for detecting operational anomalies on a train consist or railcar comprising:
- [1(b)]** (a) one or more communication management units mounted on one or more railcars;
- [1(c)]** (b) one or more sensors located on said one or more railcars configured to sense an operational parameter of said one or more railcars, said sensors being in communication with said one or more communication management units, wherein the one or more sensors comprise one or more sensors configured to measure accelerations of the railcar; and
- [1(d)]** (c) one or more filters configured to filter at least a portion of the accelerations,
- [1(e)]** wherein said communication management units perform the functions of:
- (i) collecting data regarding said one or more railcar operational parameters;
- [1(f)]** (ii) analyzing said collected data for trends or events indicative of an anomalous operational condition; and
- [1(g)]** (iii) communicating a message to a remote receiver when said trend or event is detected.

Ex. 1001, 17:48–18:2; *see also* Pet. 21–33 (addressing claim 1 with Petitioner's identifiers).

Independent claims 30 and 36 recite similar limitations to claim 1.
Ex. 1001, 20:39–55, 21:35–22:17.

G. Level of Ordinary Skill in the Art

We consider the asserted grounds of unpatentability in view of the understanding of a person of ordinary skill in the art. In assessing the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quoting *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)). “[O]ne or more factors may predominate.” *Id.*

Relying on the declaration testimony of Mr. Ricca, Petitioner contends that an ordinarily skilled artisan for the ’915 patent “would have been a person with at least a B.S. degree in electrical or mechanical engineering or a related field with at least two years’ experience designing railcar, train, vehicle, or any other similar monitoring systems for similar industrial equipment with rotating components.” Pet. 15 (citing Ex. 1003 ¶ 45). Petitioner also contends that “[l]ess work experience may be compensated by a higher level of education, such as a master’s degree, and vice versa.” *Id.* Relying on the declaration testimony of Dr. Shamos, Patent Owner contends that an ordinarily skilled artisan for the ’915 patent would have “at least a B.S. degree in electrical or computer science or a related field, with at least two years’ experience analyzing, designing, and/or building sensor and monitoring systems for railcars or similar industrial equipment and who has a familiarity with wireless networks.” PO Resp. 1

(citing Ex. 2006 ¶ 30). Patent Owner also contends that “[l]ess work experience could be compensated by a higher level of education, such as a master’s degree or doctorate degree, and vice versa.” *Id.*

It appears that the main distinction between Petitioner’s ordinarily skilled artisan and Patent Owner’s is that Patent Owner further requires familiarity with wireless networks. We note, however, that the monitoring systems of the asserted prior art include wireless networks. In view of this, because Petitioner’s requirement of experience designing railcar, train, vehicle, or any other similar monitoring systems includes some familiarity with wireless networks, we adopt Petitioner’s articulation of the level of ordinary skill in the art, which is consistent with the ’915 patent and the asserted prior art, and we apply it in our obviousness evaluations below. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art, itself, can reflect appropriate level of ordinary skill in art). We note that our decision would be the same applying either party’s definition of a person of ordinary skill in the art. *See* Inst. Dec. 12 (citing *Okajima*, 261 F.3d at 1355).

II. CLAIM CONSTRUCTION

In this *inter partes* review, claims are construed using the same claim construction standard that would be used to construe the claims in a civil action under 35 U.S.C. § 282(b). *See* 37 C.F.R. § 42.100(b) (2021). The claim construction standard includes construing claims in accordance with the ordinary and customary meaning of such claims as understood by one of ordinary skill in the art at the time of the invention. *See id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc). In construing claims in accordance with their ordinary and customary meaning, we take

into account the specification and prosecution history. *Phillips*, 415 F.3d at 1315–17.

If the specification “reveal[s] a special definition given to a claim term by the patentee that differs from the meaning it would otherwise possess[,] . . . the inventor’s lexicography governs.” *Phillips*, 415 F.3d at 1316 (citing *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002)). Another exception to the general rule that claims are given their ordinary and customary meaning is “when the patentee disavows the full scope of a claim term either in the specification or during prosecution.” *Uship Intellectual Props., LLC v. United States*, 714 F.3d 1311, 1313 (Fed. Cir. 2013) (quoting *Thorn v. Sony Comput. Ent. Am., LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012)).

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

A. Patent Owner’s Proposed Constructions

Patent Owner proposes that the term “one or more digital filters” (claim 28) be construed as “a digital filter ‘filters digital signals—not analog signals.’” PO Resp. 4 (emphasis omitted). Patent Owner also proposes that the term “one or more software filters configured to isolate one or more types of accelerations” be construed as “a software program executed by a processor programmed to decrease noise from unwanted acceleration

frequencies and increase signals from acceleration frequencies of interest.” *Id.* at 5 (emphasis omitted). Petitioner does not believe any construction is necessary, but agrees that Patent Owner’s constructions are consistent with the plain and ordinary meaning of the claim terms. Pet. Reply 1–2. As we explain below in our analysis of claims 25 and 28, the prior art meets these limitations even applying Patent Owner’s proposed constructions. Thus, we do not believe any construction of these terms is necessary.

B. Other Claim Terms

The parties do not dispute the construction of any other claim terms and we find that no other terms require express construction to resolve the controversy between the parties. Accordingly, we do not construe any other claim terms expressly. *See Realtime Data*, 912 F.3d at 1375 (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’”)(quoting *Vivid Techs.*, 200 F.3d at 803).

III. ANALYSIS

A. Legal Standards – Obviousness

The U.S. Supreme Court set forth the framework for applying the statutory language of 35 U.S.C. § 103 in *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966):

Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc.,

might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.

The Supreme Court explained in *KSR International Co. v. Teleflex Inc.* that

[o]ften, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit.

550 U.S. 398, 418 (2007) (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (“[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” (alteration in original))).

“Whether an ordinarily skilled artisan would have been motivated to modify the teachings of a reference is a question of fact.” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1327 (Fed. Cir. 2016). “[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan ‘would have had a reasonable expectation of success from doing so.’” *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) (quoting *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1068–69 (Fed. Cir. 2012)).

B. Ground 1: Obviousness over Armitage and Barone

Petitioner contends that claims 1, 22, 24, 25, 27–30, 36, and 37 of the ’915 patent are unpatentable under 35 U.S.C. § 103 as obvious over

Armitage and Barone. Pet. 20–44. Patent Owner offers counterarguments.
PO Resp. 5–30.

1. Scope and Content of the Prior Art

a. Armitage (Ex. 1006)

Armitage is entitled “Dynamic Monitoring of Mobile Railway Car Undercarriage.” Ex. 1006, code (54). Armitage discloses a plurality of sensor nodes are “configured to monitor the undercarriage portion of the railway car when in motion and transmit information about the undercarriage portion to [a] control node, which “receive[s] the information about the undercarriage portion, process[es] the information to determine a fault condition for the undercarriage portion, and wirelessly report[s] the fault condition to a collection system.” *Id.* ¶ 4.

Figure 1, reproduced below, depicts an exemplary railway car system.

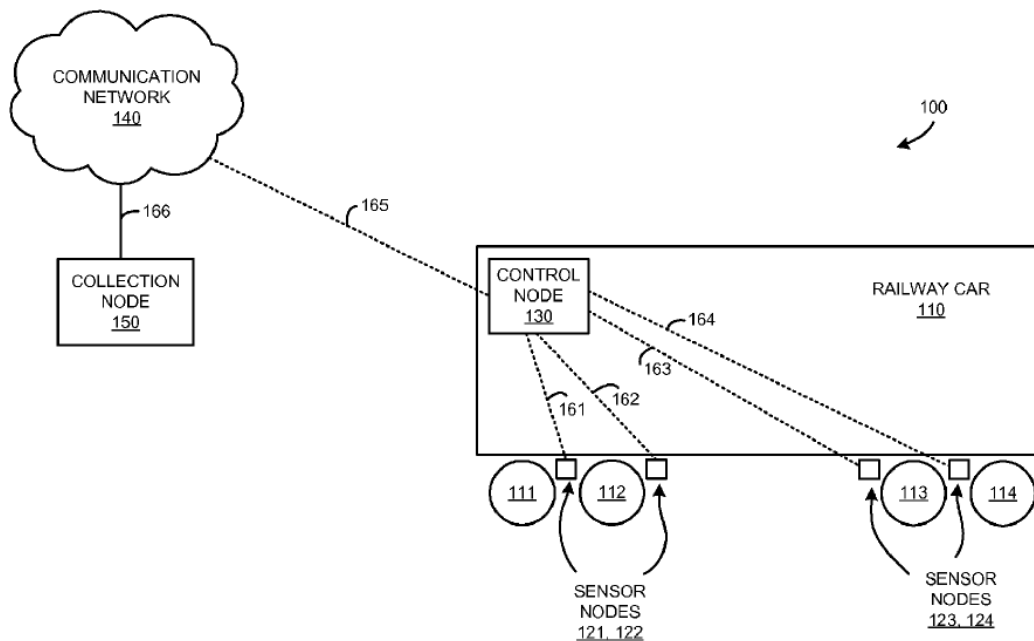


FIGURE 1

Figure 1 is a system diagram illustrating railway car monitoring system 100. System 100 includes railway car 110, undercarriage elements 111–114, sensor nodes 121–124, control node 130, communication network 140, and collection node 150. *Id.* ¶ 12. Control node 130 communicates with sensor nodes 121–124 over links 161–164 and communicates with communication network 140 over wireless link 165, and communication network 140 communicates with collection node 150 over link 166. *Id.*

Sensor nodes 121–124 each include equipment to sense and report information about undercarriage elements of a railway car. *Id.* ¶ 14. Each sensor node 121–124 also includes a transceiver portion for communication with control node 130, using either a wireline transceiver or using a wireless transceiver and antenna for wirelessly communicating with control node 130. *Id.* “Each of sensor nodes 121–124 could also include a processing portion for receiving the sensor information, amplifying, scaling, modifying, adjusting, digitizing, or converting the sensor information, as well as controlling the transceiver portion and sensor portions.” *Id.* Each sensor node 121–124 also includes a power system, such as a battery or solar cell. *Id.*

Control node 130 receives information about the undercarriage portion from each of sensors 121–124 and processes the information to determine a fault condition for the undercarriage portion, which includes conditions such as wheel impact or sliding wheel conditions, and temperature. *Id.* ¶ 27. Control node 130 wirelessly reports any fault condition to collection node 150 through communication network 140. *Id.* ¶ 28. Control node 130 processes the information received from sensor nodes 121–124 over a period of time to determine a threshold for reporting

the fault condition, or processes the sensor information to determine anomalies from an average, such as an anomaly from a running average of the temperature of all wheels on railway car 110. *Id.* ¶ 29.

b. Barone (Ex. 1007)

Barone is entitled “Self-Assembling Wireless Network, Vehicle Communications System, Railroad Wheel and Bearing Monitoring System and Methods Therefor.” Ex. 1007, code (54). Barone relates to “the field of wirelessly networking vehicles, especially where the vehicles are railroad cars, and where the communications are part of a system for monitoring the degree of wear on the wheel bearings of railroad cars.” *Id.* ¶ 2. Figure 1 of Barone is reproduced below

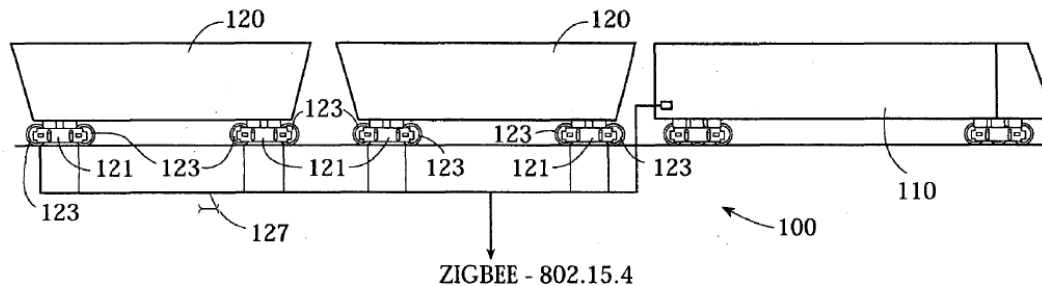


FIG. 1

Figure 1 is a schematic diagram illustrating a railroad train equipped with an exemplary network system. *Id.* ¶ 47. Network system 100 is an Autonomous Rolling Stock Monitoring System (ARMS) used on railroad trains, where the train includes locomotive 110 and a plurality of serially connected railroad cars 120 each supported on two trucks 121 having wheels 123. *Id.* ¶ 85. The ARMS includes onboard monitoring devices that wirelessly communicate status and data to existing remote database and monitoring infrastructure. *Id.* ¶ 86. The communication system architecture

includes for each wheel 123 a self-contained monitoring and diagnostic ARMS device 125 containing an IEEE 802.15.4 Zigbee wireless communication radio. *Id.*; Fig. 4A. Each wheel-mounted device or node 125, when powered, will autonomously form a network, and wirelessly transmit status and diagnostic data as required to locomotive 110, either by direct wireless communication with a Zigbee radio-equipped computer system supported on and powered by locomotive 110, or by a leap-frog or mesh network using other nodes 125 by Zigbee communications to act as intermediaries to receive and forward communications for the locomotive system. *Id.*

Figure 8 of Barone is reproduced below.

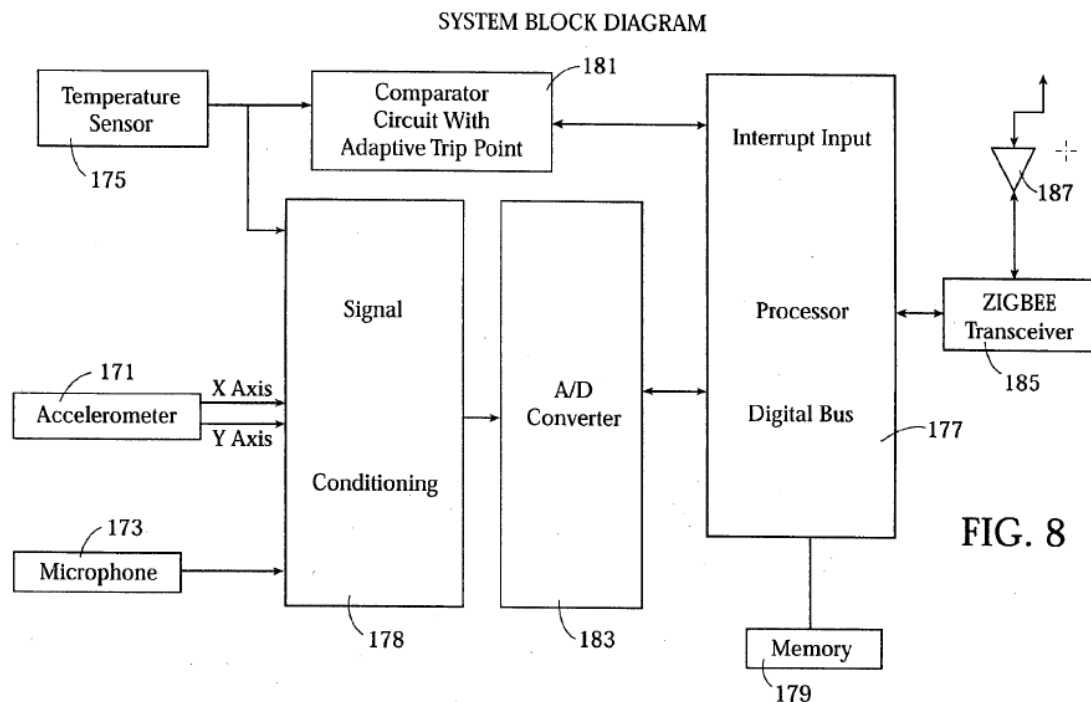


FIG. 8

Figure 8 is a system block diagram for the invention of Barone.

Figure 8 shows that the output of accelerometer 171, microphone 173, and temperature sensor 175 (as well as the output of any other analog sensors) are transmitted to signal conditioning 178, where analog signals are

“amplified and/or filtered as appropriate,” and then routed to fast analog to digital (A/D) converter 183. *Id.* ¶ 114. Fast A/D converters 183 coupled with high speed processor 177 allow all high speed, wide bandwidth calculations and data manipulations to occur on the node. *Id.* ¶ 115.

Data points that are acquired are subjected to a focused discrete Fourier transform to identify the presence of cup, cone and/or roller defect frequencies. *Id.* ¶ 201. Barone explains that the continuous monitoring of the frequencies allows for a trending analysis at the node, which provides high reliability of the bearing monitoring. *Id.* ¶ 237. A “microprocessor stores at least partial data representative of historical peak levels in dB or other units, and changes therein that exceed a pre-selected threshold trigger special processing and alarm data generation and transmission to the locomotive system.” *Id.* In one embodiment, temperature sensor 175 connects with a comparator circuit with an adaptive trip point 181 that triggers an interrupt when the temperature detected exceeds a certain preselected threshold value, and the interrupt generated by the comparator 181 is processed as a failure alarm. *Id.* ¶ 240.

2. Differences Between the Prior Art and the Claims

Petitioner maps claims 1, 22, 24, 25, 27–30, 36, and 37 to the disclosure of Armitage and Barone. We discuss that mapping, and Patent Owner’s arguments regarding this challenge below.

a. Claim 1

- i. [1 Pre] A system for detecting operational anomalies on a train consist or railcar comprising*

Petitioner contends that the preamble “states an intended use of detecting operational anomalies on a train consist or railcar,” and does not

have any “patentable weight.” Pet. 21. According to Petitioner, to the extent the preamble is limiting, Armitage meets this limitation because Armitage’s mobile railway car monitoring system uses sensor nodes together with a control node that “determines a fault condition, and wirelessly reports the fault condition to a collection system.” *Id.* at 22 (citing Ex. 1003 ¶ 69; Ex. 1006, code (57), ¶¶ 3, 19, 20, 27–29, 37, 38, 48, 49). Patent Owner does not raise any arguments regarding the preamble. *See* PO Resp. We find that Petitioner has shown sufficiently that Armitage accounts for the preamble, to the extent that it is limiting.

- ii. *[I(b)] (a) one or more communication management units mounted on one or more railcars*

Petitioner contends that Armitage teaches one or more “control nodes 130,” which Petitioner identifies as “a communication management unit” coupled to one or more railway cars. Pet. 23 (citing Ex. 1003 ¶ 72; Ex 1006, Figs. 1, 3, 5, ¶¶ 4, 12, 14, 17, 20, 26, 36, 38). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that Armitage accounts for this limitation.

- iii. *[I(c)] (b) one or more sensors located on said one or more railcars configured to sense an operational parameter of said one or more railcars, said sensors being in communication with said one or more communication management units, wherein the one or more sensors comprise one or more sensors configured to measure accelerations of the railcar*

Petitioner argues that “Armitage teaches a plurality of ‘sensors nodes 121–124’ located on one or more railway cars, which contain a ‘sensor

portion’ and is configured to sense operational parameters of one or more railcars.” Pet. 23–24 (citing Ex. 1003 ¶ 73; Ex. 1006, Figs. 1, 3, 5, ¶¶ 4, 12, 14). Petitioner asserts that “Armitage’s system also includes a ‘control node’ on each railcar,” and “[t]he control node receives ‘sensor information, or modified sensor information’ collected by each of the sensor nodes on the same railcar.” *Id.* at 24 (citing Ex. 1006 ¶¶ 14, 12, 27, Figs. 1, 3, 5; Ex. 1003 ¶ 74). Petitioner contends that “[t]he sensor nodes and the control node communicate over a wireless network,” and “[t]he sensor portion of the ‘sensor nodes 121–124’ in Armitage can be accelerometers for measuring accelerations.” *Id.* at 24–25 (citing Ex. 1003 ¶ 74; Ex. 1006 ¶¶ 14, 21, 33, 45, 46, 56, Figs. 1, 3, 5). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that Armitage accounts for this limitation.

iv. [1(d)] (c) one or more filters configured to filter at least a portion of the accelerations

Petitioner argues that Armitage meets limitation [1(d)] for several reasons, including because Armitage’s sampling of accelerometer data at the CMU level is equivalent to the claimed “filtering at least a portion of the accelerations.” Pet. 25 (citing Ex. 1003 ¶ 76; Ex. 1006 ¶ 45). In particular, Petitioner argues that “Armitage teaches sampling accelerations for only a portion of a wheel rotation, and filters out radial accelerations.” *Id.* (citing Ex. 1006 ¶¶ 45–46). According to Petitioner, an ordinary artisan “would understand Armitage’s teachings of sampling data and ignoring radial accelerations equates to filtering at least a portion of accelerations.” *Id.* at 26 (citing Ex. 1003 ¶ 76).

Petitioner also argues that Armitage filters at the sensor level because Armitage’s “sensor 630” can include “amplifiers, analog-to-digital-converters, [and] microcontrollers,” and an ordinary artisan would understand that inclusion of these components “in the sensor would mean the sensor is capable of filtering at least a portion of accelerations.” *Id.* (citing Ex. 1003 ¶ 77). According to Petitioner, because “filtering is excluding some portion of a data set,” an ordinary artisan “would understand Armitage’s teachings of sampling and ignoring certain data points equates to filtering data.” *Id.* at 26–27 (citing Ex. 1003 ¶¶ 78–79).

Petitioner asserts that to the extent Armitage’s “sampling and ignoring data” is not filtering, Barone shows filtering acceleration data was known and used in the art because Barone “teaches output of an ‘accelerometer 171’ being transmitted to ‘signal conditioning 178’, where the analog signals are amplified and/or filtered as appropriate (electronic filter), and then routed to analog to digital (A/D) converters for wide bandwidth calculations and data manipulations (digital filter).” *Id.* at 27 (citing Ex. 1003 ¶ 80; Ex. 1006 ¶¶ 114–115, 150, 172–185, Fig. 8). Petitioner notes that, in Barone, the filtering takes place at the sensor, but a person of ordinary skill in the art would understand that the filtering can take place anywhere in the system. *Id.* at 27–28 (citing Ex. 1003 ¶ 80; Ex. 1007 ¶¶ 114–115). Petitioner asserts that “Barone further teaches the use of . . . high-pass, low-pass, and/or band-pass filters, all of which can utilize both electronic and digital filters.” *Id.* at 28 (citing Ex. 1003 ¶ 81; Ex. 1007 ¶¶ 172–185). According to Petitioner, an ordinary artisan “would be motivated to include the filtering taught by Barone to remove unwanted data and/or amplify particularly relevant accelerations data.” *Id.* (citing Ex. 1003 ¶ 81).

Patent Owner argues that neither Armitage nor Barone teaches or suggests this limitation. PO Resp. 6–10. With respect to Armitage, Patent Owner asserts that “Petitioner and its expert are simply wrong to equate sampling—which Petitioner admits occurs only ‘for a portion of a wheel rotation’—with filtering.” *Id.* at 6. Patent Owner contends that a person of ordinary skill in the art “would recognize that acceleration data is constantly available and the term ‘sampling’ as used in cited paragraph 45 of Armitage does not filter out acceleration data but is rather referring to how often this available data is collected for subsequent processing.” *Id.* (citing Ex. 2006 ¶ 49) (emphasis omitted). Patent Owner asserts that “[o]btaining data through sampling—at different intervals—is a distinct concept from filtering data.” *Id.* at 7 (citing Ex. 2006 ¶¶ 44–49).

With a complete record, we find that Petitioner has shown that Armitage discloses the claimed filtering. In our Institution Decision, we initially agreed with Patent Owner that merely sampling data, as taught in Armitage, is not the claimed filtering. Inst. Dec. 25. As Petitioner notes, the ’915 patent teaches that its “digital data filter” selects certain categories and ignores others. Pet. Reply 4. For example, the ’915 patent discloses that

These sensor sections select the data to be analyzed using a digital data filter 1204, 1210 or 1216, and passes this data on to a feature detector 1206, 1212 or 1218. Data selection can be based on, for example, direction (e.g. vertical or longitudinal components), frequency (e.g. high-frequency clangs or low frequency rocking), overall magnitude (combination of 2 or 3 directional components), or other variations of the collected data.

Ex. 1001, 13:17–24.

Based on these teachings, we find Mr. Ricca’s opinion that a person of ordinary skill in the art would understand that the “filters” of the ’915 patent

include selection of data along certain axes or combinations of axes measured by the accelerometer and ignoring unselected data, well-supported and entitled to substantial weight. *See* Ex. 1025 ¶¶ 4–6. We find Dr. Shamos’s testimony to the contrary, Ex. 2006 ¶¶ 40–42, inconsistent with the disclosure of the challenged patent, and entitled to little weight. Patent Owner argues that Armitage does not monitor all of the axes, like the ’915 patent. *See* Sur-reply 1–3. However, the ’915 patent, just like in Armitage, isolates the data from a single axis for further analysis. *See* Ex. 1001, 13:17–24. Thus, we do not find Patent Owner’s distinction to be persuasive. Accordingly, we find that Petitioner has shown that Armitage accounts for this limitation.

Additionally, we find that Petitioner has shown that Barone independently accounts for this limitation. As for Barone, Patent Owner’s only argument in the Patent Owner Response about Barone relates to the timing of the filtering. *See* PO Resp. 9–10; Sur-reply 3–6. In particular, Patent Owner asserts that the claims require filtering to occur after the data are sensed. PO Resp. 9–10. In the Patent Owner Response, Patent Owner does not explain how this argument relates to Barone. As best we can understand, Patent Owner is maintaining its argument in the Preliminary Response that “all Barone does is precondition an analog signal and does so by preserving acceleration data.”⁶ Prelim. Resp. 31–32 (citing Ex. 2001

⁶ Patent Owner is reminded that arguments must be made in the Patent Owner Response to be preserved, and incorporation by reference from the Preliminary Response is not permitted. We exercise our discretion to address this argument for completeness although it is questionable whether Patent Owner has preserved it with its incomplete arguments in the Patent Owner Response.

¶¶ 53–59). In that argument, Patent Owner asserted that “no acceleration data is filtered out of the R signal . . . [and t]he signal conditioner 178 simply removes unwanted noise from the analog signal R prior to converting to a digital signal S.” *Id.* at 33.

In our Institution Decision, we disagreed with Patent Owner’s contention that Barone’s filtering is outside the scope of the claims because it is only removing unwanted noise from the signal. Inst. Dec. 26–27. We reasoned that claim 26, which depends from claim 1, recites “wherein the one or more filters comprise one or more mechanical filters,” Ex. 1001, 20:31–32, and thus, claim 1 appears to be broad enough to include “mechanical filters.” Inst. Dec. 26 (citing *Baxalta Inc. v. Genentech, Inc.*, 972 F.3d 1341, 1346 (Fed. Cir. 2020)). We explained that the Specification states that “mechanical filter 410 . . . serve[s] to mechanically filter high and low frequency types of accelerations that are considered noise which are preferably removed from the signal of interest.” *Id.* at 27 (citing Ex. 1001, 5:23–27) (alterations in the original). Thus, we disagreed that noise filtering was outside of the scope of the claims.

Without reproducing the argument or explaining how it relates to Barone, Patent Owner argues that “[a]ny accelerations removed by the mechanical filter of claim 26 are necessarily removed before they are detected by the accelerometer because that is how a mechanical filter works.” PO Resp. 9 (citing Ex. 2006 ¶ 51). Patent Owner contends that “such accelerations filtered by the mechanical filter are not measured ‘accelerations of the railcar’ and therefore are not within the scope of claim 1.” *Id.*

We disagree with Patent Owner’s reasoning that claim 1 (and claims 30 and 36) is necessarily discussing already measured accelerations; thereby excluding any kind of filtering to reduce noise. *See* Pet. Reply 8–9. Claim 1 recites “sensors configured to measure accelerations of the railcar,” and “one or more filters configured to filter at least a portion of the accelerations.” (Claims 30 and 36 have similar limitations.) Contrary to Patent Owner’s reading, we agree with Petitioner that the “accelerations of the railcar” are not necessarily the output of the sensor; they are the physical property of the railcar that the sensors measure. Claim 1 does not recite filtering “*measured* accelerations” as Patent Owner now rewrites the claim, but merely “accelerations” generally. This indicates that the filtering can take place before the accelerations are measured or after they are measured. We find that claim 1 (and claims 30 and 36) is entirely agnostic as to when the filtering takes place.

The dependent claims confirm this reading. Claim 3 recites, in part, “a mechanical filter which includes a resilient material selected to *filter out undesirable accelerations, said mechanical filter disposed to remove said undesirable accelerations before said undesirable accelerations reach said accelerometer.*” Ex. 1001, 18:27–31 (emphasis added). As Patent Owner admits, the mechanical filter necessarily acts before the accelerometer senses the accelerations. *See* PO Resp. 9. This claim confirms that “accelerations” are not the output of any sensor, but the physical property being measured. Claims 23 also supports this reasoning. Claim 23 recites:

wherein *the one or more filters* comprise one or more mechanical filters that include a resilient material configured to *filter out undesirable accelerations from the accelerations*, wherein the one or more mechanical filters are disposed to

remove the undesirable accelerations before the undesirable accelerations reach the one or more sensors that are configured to measure acceleration.

Ex. 1001, 20:3–10 (emphasis added). Claim 23 directly ties the filtering of “undesired accelerations” to both the claimed “one or more filters” in this limitation (limitation 1(d)) and to “the accelerations” referred to in the sensor limitation. Both of these claims are consistent with our reading of claim 26 in the Institution Decision. Inst. Dec. 26–27.

Patent Owner’s only response to this reasoning is that claim 26 is a drafting error and was not intended to modify limitation 1(d), but rather claim 26 serves to add another limitation to claim 1. PO Resp. 9–10; Sur-reply 4–6. However, Patent Owner ignores claims 3 and 23. Indeed, claim 26 appears entirely consistent with the other claims. Thus, we are not persuaded that claim 26 is a drafting error.

We finally note that, even if correct, Patent Owner’s argument that filtering must occur after sensing does not distinguish Barone. *See* Ex. 1007 ¶¶ 114–115, Fig. 8. Barone’s filtering takes place after the accelerations are sensed by the accelerometer. *Id.* Thus, even if Patent Owner was correct that the filtering must take place after sensing, Barone meets that requirement. Besides this alleged temporal limitation on filtering, Patent Owner offers no other argument why Barone’s filters would not meet the claim limitation. Accordingly, we find that Petitioner has shown that Barone also would account for limitation 1(d). *See* Pet. 27–28; Ex. 1003 ¶¶ 80–81.

- v. *wherein said communication management units perform the functions of: (i) collecting data regarding said one or more railcar operational parameters*

Petitioner argues that “Armitage teaches a ‘control node[s] 130’ which collects data from a plurality of sensors on the railcar regarding one or more railcar operational parameters,” and “each sensor node contains one or more sensors that collect data regarding the railcar, and wirelessly transmits the collected data to the ‘control node 130.’” Pet. 30 (citing Ex. 1003 ¶¶ 84, 85; Ex. 1006 ¶¶ 12, 20). Petitioner asserts that “[t]he ‘control node 130’ collects this data and analyzes it to determine whether a fault condition is present,” and “[i]f a fault condition is detected, the ‘control node 130’ wirelessly reports it (i.e., sends an alarm message) to a collection system.” *Id.* (citing Ex. 1006 ¶¶ 27, 28; Ex. 1003 ¶ 85). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that Armitage accounts for this limitation.

- vi. *(ii) analyzing said collected data for trends or events indicative of an anomalous operational condition*

Petitioner argues that “Armitage teaches a ‘control node 130’ (i.e., CMU), which can include ‘user interface systems, memory devices, computer-readable storage mediums, software, [or] processing circuitry’ for analyzing data.” Pet. 30–31 (citing Ex. 1003 ¶ 86; Ex. 1006 ¶ 16). Petitioner asserts that “Armitage teaches the ‘control node[s] 130’ analyzes the collected data for trends or events indicative of an anomalous operational condition.” *Id.* at 31 (citing Ex. 1003 ¶ 86; Ex. 1006 ¶¶ 16, 40). Petitioner notes that “[t]he control node can also perform statistical analysis on the collected data to detect failure conditions, such that it is ‘drawing inferences’

regarding the performance of the railcar.” *Id.* (citing Ex. 1003 ¶ 87; Ex. 1006 ¶ 42). Petitioner asserts that “[t]he control node can ‘process the sensor information to determine anomalies from an average, such as an anomaly from a running average of the temperature of all wheels on railway car.’” *Id.* at 32 (citing Ex. 1006 ¶ 29). Petitioner argues that “Armitage also discloses the use of a ‘moving average and trend analysis’ to detect ‘statistically significant deviations’ that are indicative of failure,” and “Armitage indicates its system can distinguish between potential failures (which warrant maintenance) and actual failures (which require immediate service).” *Id.* (citing Ex. 1006 ¶¶ 30, 44, 45; Ex. 1003 ¶ 88). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that Armitage accounts for this limitation.

vii. *(iii) communicating a message to a remote receiver when said trend or event is detected*

Petitioner contends that Armitage discloses the control node on each railcar (i.e., communication management unit) wirelessly transmits information, such as sensor data and alarm messages, to a collection node (i.e., a base unit). Pet. 32 (citing Ex. 1003 ¶ 89; Ex. 1006 ¶¶ 4, 19–20, 38, Fig. 1). Petitioner submits that “[i]n Armitage’s system, if the control node detects a fault condition, it wirelessly reports the fault (i.e., sends an alarm message),” and “Armitage further discloses the collection node can be in a remote location located off the train (i.e., remote).” *Id.* at 32–33 (citing Ex. 1006 ¶¶ 28, 39, Fig. 2; Ex. 1003 ¶¶ 89, 90). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that Armitage accounts for this limitation.

viii. Motivation to Combine

A motivation to combine may be found “explicitly or implicitly in market forces; design incentives; the ‘interrelated teachings of multiple patents’; ‘any need or problem known in the field of endeavor at the time of invention and addressed by the patent’; and the background knowledge, creativity, and common sense of the person of ordinary skill.” *ZUP, LLC v. Nash Mfg., Inc.*, 896 F.3d 1365, 1371 (Fed. Cir. 2018) (quoting *Plantronics, Inc. v. Aliph, Inc.*, 724 F.3d 1343, 1354 (Fed. Cir. 2013)). “The motivation-to-combine analysis is a flexible one.” *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1379 (Fed. Cir. 2023) (“*PACT XPP*”). And “[a] person of ordinary skill is also a person of ordinary creativity, not an automaton.” *KSR*, 550 U.S. at 421.

Petitioner explains that Armitage and Barone are in the same field of endeavor and describe similar devices with similar components and a common goal of determining anomalous conditions of a rail car. Pet. 20. Petitioner submits that to the extent that Armitage does not disclose filtering, a person of ordinary skill would have been motivated to include the filter taught by Barone with Armitage because “the advantage of filtering is to remove unwanted data and/or amplify particularly relevant data, and the purpose of both systems is to analyze data in a train monitoring system to accurately predict anomalous conditions and avoid false or inaccurate data processing.” *Id.* at 21 (citing Ex. 1003 ¶ 67). Petitioner contends that “[c]ombining the sampling of data (i.e., filtering) in Armitage and the electronic and digital filtering taught in Barone would have predictably resulted in the filtering of accelerations data.” *Id.*

Patent Owner argues that “Petitioner does not provide any evidence to support this motivation other than the declaration of Mr. Ricca.” PO Resp. 10. Patent Owner also argues this is improper hindsight and “would frustrate the principle of operation of Armitage and render the Armitage invention unsatisfactory for its intended purpose (accurately identifying outlier sensor data).” *Id.* at 11 (citing Ex. 2006 ¶¶ 53–59). In particular, Patent Owner contends that “incorporating the filters of Barone “would exclude portions of accelerations data that are relied upon by Armitage to identify outlier sensors that are indicative of failure,” and would “prevent Armitage from quantifying the severity of outlier sensor data.” *Id.* at 11–12 (citing Ex. 2006 ¶ 53; Ex. 1006 ¶¶ 40, 43, 44). Patent Owner asserts that combining Armitage with Barone would “change the principle of operation of Armitage” and “render the Armitage invention unsatisfactory for its intended purpose.” *Id.* at 12 (citing Ex. 2006 ¶ 53). Patent Owner argues that “Armitage relies on a specific type of analysis that requires using all of the raw data from the accelerometers.” *Id.* (citing Ex. 2006 ¶¶ 54–58). Patent Owner asserts that Armitage uses data from the entire population of nodes to establish a “moving average” of the population against which it compares individual sensor data to identify outliers. *Id.* (citing Ex. 2006 ¶ 55). Patent Owner contends that a person of ordinary skill in the art would recognize that all of the data from the sensors must be passed along to establish the “moving average” to identify outlier sensors. *Id.* (citing Ex. 2006 ¶ 54). Patent Owner argues that a person of ordinary skill in the art would recognize that including the filters taught by Barone would (a) remove important sensor data and thus impact the moving average analysis (thereby altering the principle of operation of Armitage), and (b) potentially remove sensor data

that should have served as the basis for identification of an outlier (thereby rendering Armitage unsatisfactory for the intended purpose of accurately identifying outlier sensors).

Id. at 12–13 (citing Ex. 2006 ¶ 55). Patent Owner submits that this argument applies to other embodiments of Armitage as well. *Id.* at 13–14.

We find that Petitioner has shown a motivation to combine Armitage and Barone. As the Federal Circuit has explained, “[t]here is a motivation to combine when a known technique ‘has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way,’ . . . using the ‘prior art elements according to their established functions.’” *PACTXPP*, 61 F.4th at 1380–81. That is the case here. Armitage and Barone are similar systems, the filter of Barone has been used to improve Barone’s systems by allowing the removal of unwanted data from the sensors, and this technique could be predictably applied to Armitage’s system, as well, with the benefit of improving data processing. Ex. 1003 ¶¶ 66–67; Ex. 1025 ¶ 13.

We do not agree with Patent Owner’s contention that the combination would render Armitage inoperative. As Armitage recognizes, noise can affect the operation of its system. Ex. 1006 ¶ 29. As Barone explains, the filters are used to filter out “frequencies substantially above the highest frequencies of interest.” Ex. 1007 ¶ 176. Moreover, Barone provides some guidance regarding how to select the frequency ranges for the filters employed. For example, Barone explains that

Alternatively, a simple band-pass or low-pass filter transmitting only a range of frequencies that includes some of the major resonance spikes of the railroad truck, such as, for the truck of the preferred embodiment, 2000 Hz or less, and preferably below 800 Hz, and even a range wholly below approximately 300 Hz, can be used to condition the

accelerometer output. Different frequencies may be used, however, with different railroad trucks, since these may have differences in their resonance frequencies. Fundamentally, the range of frequencies transmitted must include the defect frequencies of interest, and at least one resonant frequency of the truck, to ensure that any repeating peaks formed by acceleration resonance at that frequency are permitted to pass.

Id. ¶ 179.

Thus, Patent Owner's contention that all data points must be allowed to pass is simply not supported by Armitage or the other prior art of record. Instead, the evidence indicates that a person of ordinary skill would understand that there are certain frequency ranges of interest that need to be isolated, and, while outliers within that range are useful, there is no need to pass on every single data point yielded by the sensor. *See* Ex. 1025 ¶¶ 14–15. Indeed, as Mr. Ricca explains, Armitage does not seek to determine whether there are individual outlier datapoints coming from a sensor, but whether that sensor is providing data that are outliers with respect to the other sensor units. *See id.*; Ex. 1006 ¶ 42. As Mr. Ricca persuasively explains, a person of ordinary skill in the art “would understand that [Barone's] filter is used to remove outlier data points *before* assessment of the data set for the sensor unit and determination of whether an entire sensor unit is an outlier.” Ex. 1025 ¶ 14. Consistent with Barone's teachings, Mr. Ricca testifies that

The most extreme outliers from a data collection are data points you want to exclude from your fully processed data set, as they are frequently noise, like sporadic electrical or mechanical anomalies caused by measurement errors, AM/FM/CB radio transmissions, and even sun-spot activity. These negatively impact the data set. A [person of ordinary skill in the art] would have known it is a very basic statistical concept that if you do

not filter out extreme outliers in a data set your entire analysis will be skewed.

Id.

We find this reasoning consistent with the prior art and well-reasoned, and give it substantial weight. Dr. Shamos’s testimony, on the other hand, appears to be based on an unsupported assumption that every data point is necessary for the operation of Armitage. *See* Ex. 2006 ¶¶ 54–59. As Mr. Ricca persuasively testifies, Dr. Shamos’s testimony is not correct, so we give Dr. Shamos’s testimony little weight. *See* Ex. 1025 ¶ 15.

Finally, Patent Owner argues that Petitioner fails to explain exactly how the combination would operate. Sur-reply 10. We disagree. Petitioner provides an explanation of what was known in the art and how it would be combined. The ’915 patent does not provide any detailed implementation details, which corroborates Petitioner’s contentions that the implementation of the combination would have been within the level of skill in the art. *See Uber Techs., Inc. v. X One, Inc.*, 957 F.3d 1334, 1339 (Fed. Cir. 2020) (noting that the challenged patent “was silent” as to implementation details “suggesting that a person of ordinary skill in the art was more than capable of selecting between the known methods of accomplishing this”).

Moreover, “[f]or obviousness under § 103, all that is required is a reasonable expectation of success.” *See In re O’Farrell*, 853 F.2d 894, 904 (Fed. Cir. 1988). Here, the prior art indicates that it was well within the level of skill in the art to configure the filters such that the filters would isolate the particular frequencies indicative of problems. *See* Ex. 1007 ¶¶ 175–179. Patent Owner’s contentions that the Petition needs to provide a detailed explanation of the combination fail to take into account the background

knowledge of a person of ordinary skill. We agree with Petitioner that the combination would not result in an inoperative device.

Patent Owner also argues that Petitioner has not shown a motivation to combine Armitage and Barone for power saving purposes. PO Resp. 15–16. However, as Petitioner explains, power saving is not offered as a reason to combine Armitage and Barone. Pet. Reply 13–14. Rather, Petitioner offered the argument as a reason to modify the combination further to locate the filtering in the control node. Pet. 25–28. Thus, we agree with Petitioner that Patent Owner’s argument is not commensurate with the actual argument in the Petition.

Accordingly, we find that Petitioner has shown sufficiently that a person of ordinary skill in the art would have been motivated to combine the teachings of Armitage and Barone in the manner suggested.

ix. Summary as to Claim 1

We find that Petitioner has shown sufficiently that the combination accounts for the limitations of claim 1, and that a person of ordinary skill would have been motivated to combine Armitage and Barone with a reasonable expectation of success. Accordingly, we find that Petitioner has shown by a preponderance of the evidence that claim 1 would have been obvious over Armitage and Barone.

b. Claim 25

i. The system of claim 1, further comprising one or more wireless sensor nodes in communication with at least one of the communication management units,

Petitioner relies on its analysis of claim 1 above. *See* Pet. 24. Petitioner submits that Armitage teaches a plurality of sensor nodes located

on one or more railway cars in wireless communication with a control node (i.e., communication management unit) that receives sensor information collected by each of the sensor nodes on the same railcar. *Id.* at 24–25, 36. Patent Owner does not raise any arguments regarding this limitation, besides its arguments raised above with respect to claim 1. *See* PO Resp. We have addressed those arguments above. Thus, we find that Petitioner has shown sufficiently that Armitage accounts for this limitation.

ii. wherein the one or more sensors form part of the one or more wireless sensor nodes,

Petitioner submits that Armitage accounts for this limitation. *See* Pet. 36. In particular, Petitioner notes that Armitage teaches “sensor nodes 121–124” having a “sensor portion,” which communicate over a wireless network. *Id.* at 36 (citing Ex. 1006 ¶¶ 14, 33; Ex. 1003 ¶ 104), 24 (citing Ex. 1006 ¶¶ 14, 33, 54). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that Armitage accounts for this limitation.

iii. wherein one or more of the wireless sensor nodes comprises a microprocessor configured to execute firmware to control operation of the one or more of the wireless sensor nodes,

Petitioner argues that Armitage accounts for this limitation. *See* Pet. 36–37. As Petitioner explains, “[i]n one embodiment, Armitage teaches the sensor nodes include ‘processing system 620’ configured to execute ‘software 622’ which can include ‘firmware’ for the purpose of controlling the sensor nodes, sensor 630, and power system 640.” *Id.* at 36 (citing Ex. 1003 ¶ 105; Ex. 1006 ¶¶ 53–56, Fig. 6). Patent Owner does not raise

any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that Armitage accounts for this limitation.

- iv. *wherein the firmware comprises one or more software filters configured to isolate one or more types of accelerations.*

Petitioner submits that the combination of Armitage and Barone accounts for this limitation. As explained above with respect to claim 1, Petitioner contends that Barone discloses filtering, and that filtering can take place at different locations within the system. *See* Pet. 37. Petitioner argues that Barone’s filter can be implemented as a software filter in the firmware. *See id.* at 37–38 (citing Ex. 1003 ¶ 108).

Patent Owner’s argument focuses on the disclosure of Barone and argues that Barone fails to disclose a software filter. *See* PO Resp. 18. In particular, Patent Owner argues that Barone’s signal conditioning takes place in the analog domain, but any software filter would have to be in the digital domain of Barone’s system. *Id.* at 18–19.

Although Patent Owner is correct in its characterization of Barone, the problem with its analysis is that it attacks the references individually while Petitioner relies on the combination of the references to account for this limitation. *See In re Merck & Co., Inc.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). Rather, obviousness concerns the combined teachings of the references. *See id.* (“[T]he test is whether the references, taken as a whole, would have suggested appellant’s invention to one of ordinary skill in the [art].”).

Here, Petitioner has proposed implementing the filters of Barone in the firmware found in Armitage’s sensors. *See* Pet. 37–38; Ex. 1003 ¶ 108. As Mr. Ricca testifies, filters, such as those described in Barone, can be

implemented in different ways (electronically, mechanically, and digitally) depending on demands. *See* Ex. 1003 ¶ 79 (“In summary, in any data collection analysis, data is almost always filtered in some manner, and the system can utilize the various types of filters alone or in combination to achieve the most effective filtering of data to achieve more accurate and/or targeted data analysis for detection of fault conditions.”); Ex. 1009 (“There are times when you should build the filter with analog hardware and times when it is appropriate to implement it with a controller or processor in firmware.”). Thus, although Patent Owner is correct that Barone’s signal conditioning is analog, not digital, and not in software, Petitioner does not propose bodily incorporating Barone’s signal conditioning into Armitage. *See* Pet. 37–38; *Allied Erecting & Dismantling Co. v. Genesis Attachments, LLC*, 825 F.3d 1373, 1381 (Fed. Cir. 2016) (“The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference . . .”). Instead, Petitioner proposes taking the teachings of Barone regarding filtering and implementing those teachings as a digital filter in the firmware (i.e., software) of Armitage. We find Petitioner’s contentions persuasive and well-supported by the evidence. Thus, we find that Petitioner has shown that the combination of Armitage and Barone accounts for this limitation.

c. Claim 28

- i. The system of claim 1, wherein the one or more filters comprise one or more digital filters.*

Petitioner contends that the combination of Armitage and Barone accounts for the recited “digital filters.” As discussed above with respect to claim 25, Petitioner contends that the combination accounts for a “software

filter,” which Petitioner equates to a digital filter. *See* Pet. 37–38. Patent Owner reiterates its arguments addressed above with respect to claim 25. *See* PO Resp. 25 (“claim 28 is patentable for the same reasons explained above with respect to claim 25”). For the reasons stated above with respect to claim 25, we do not find them persuasive. Accordingly, we have reviewed Petitioner’s evidence and argument and find Petitioner has shown sufficiently that the combination of Armitage and Barone accounts for all the limitations of claim 28, and that a person of ordinary skill in the art would have had a reason to combine the references in the manner proposed with a reasonable expectation of success. *See id.* at 37–38.

d. Claim 30

Claim 30 is an independent claim reciting a “method for detecting operational anomalies on a train consist or railcar.” Ex. 1001, 20:39–55. Claim 30 recites method steps corresponding to the limitations of system claim 1. *Compare id.* (claim 30), *with id.* at 17:48–18:2 (claim 1). Petitioner provides a detailed mapping, supported by the testimony of Mr. Ricca, for how the combination of Armitage and Barone accounts for the limitations of claim 30. *See* Pet. 21–33, 38–39. We disagree with Patent Owner’s contention that “Petitioner does not provide any analysis at all to support its assertion that claim 30 is unpatentable beyond a cross referencing to the limitations of [c]laim 1.” *See* PO Resp. 28. Instead, we find that Petitioner does provide a detailed analysis of sufficient depth to cover claim 30 as well. Patent Owner repeats its argument that neither Armitage nor Barone teaches the “filtering, by one or more filters, at least a portion of the accelerations” that was considered above with respect to claim 1. *See id.* For reasons set forth above, we do not find Patent Owner’s argument

persuasive. *See supra* III.B.2.a.iv. We have reviewed Petitioner’s evidence and argument and, based on the full trial record, we find it sufficient.

Accordingly, we find that Petitioner has shown sufficiently that the combination of Armitage and Barone accounts for the subject matter of claim 30, and that a person of ordinary skill in the art would have had reason to combine the teachings of those references in the manner proposed with a reasonable expectation of success.

e. Claim 36

Claim 36 is an independent claim reciting a “system for detecting operational anomalies on a railcar that is part of a train consist.” Ex. 1001, 21:35–22:37. Claim 36 recites limitations almost identical to claim 1. *Compare id.* (claim 36), *with id.* at 17:48–18:2 (claim 1). Petitioner provides a detailed mapping, supported by the testimony of Mr. Ricca, for how the combination of Armitage and Barone accounts for the limitations of claim 36. *See* Pet. 21–33, 38–39. There is one limitation of claim 36 that does significantly differ—“drawing inferences from the data received from at least two of the sensors regarding the performance of the railcar” (as compared to “analyzing said collected data for trends or events indicative of an anomalous operational condition” of claim 1). However, Petitioner discusses this limitation in detail in its Petition. *See* Pet. 30–32. Thus, we disagree with Patent Owner’s contention that “Petitioner does not provide any analysis at all to support its assertion that claim 36 is unpatentable beyond a cross reference to limitation 1(d).” *See* PO Resp. 29. Instead, we find that Petitioner does provide a detailed analysis of sufficient depth to cover claim 36 as well. As for its other arguments regarding claim 36, Patent Owner repeats its argument that neither Armitage nor Barone teaches

the “filtering, by one or more filters, at least a portion of the accelerations” that was considered above with respect to claim 1. *See* PO Resp. 29. For reasons set forth above, we do not, on this record, find Patent Owner’s argument persuasive. *See supra* III.B.2.a.iv. We have reviewed Petitioner’s evidence and argument and find it sufficient. Accordingly, we find that Petitioner has shown sufficiently that the combination of Armitage and Barone accounts for the subject matter of claim 36, and that a person of ordinary skill in the art would have had reason to combine the teachings of those references in the manner proposed with a reasonable expectation of success.

f. Remaining Claims

Petitioner provides a detailed mapping for how the combination of Armitage and Barone accounts for the limitations of claims 22, 24, 27, 29, and 37. Pet. 34–38, 40–44. Patent Owner does not raise any arguments regarding these claims beside the arguments considered above with respect to claims 1, 30, and 36. *See* PO Resp. We have reviewed Petitioner’s evidence and argument, and we find it sufficient. Accordingly, we find that, on the full trial record, Petitioner has shown by a preponderance of the evidence that Armitage and Barone account for the subject matter of claims 22, 24, 27, 29, and 37, and that a person of ordinary skill in the art would have had reason to combine the teachings of those references in the manner proposed with a reasonable expectation of success.

3. Collective Considerations of the Graham Factors

“Once all relevant facts are found, the ultimate legal determination [of obviousness or nonobviousness] involves the weighing of the fact findings to conclude whether the claimed combination would have been obvious to

an ordinary artisan.” *Arctic Cat*, 876 F.3d at 1361. Based upon consideration of the entire record, and for the reasons discussed above, we determine Petitioner has shown by a preponderance of the evidence that the combination of Armitage and Barone teaches each limitation of claims 1, 22, 24, 25, 27–30, 36, and 37 of the ’915 patent, that a person of ordinary skill in the art would have had reasons with rational underpinning to combine Armitage and Barone in the manner suggested and would have had a reasonable expectation of success in so doing. Patent Owner did not present any evidence of objective indicia of nonobviousness. *See* PO Resp.

On the whole and considering the *Graham* factors collectively, Petitioner has shown by a preponderance of the evidence that would have rendered the subject matter of claims 1, 22, 24, 25, 27–30, 36, and 37 of the ’915 patent obvious to one of ordinary skill in the art at the time of the invention in view of the combination of Armitage and Barone.

C. Ground 2: Obviousness over Armitage, Barone, and LeFebvre

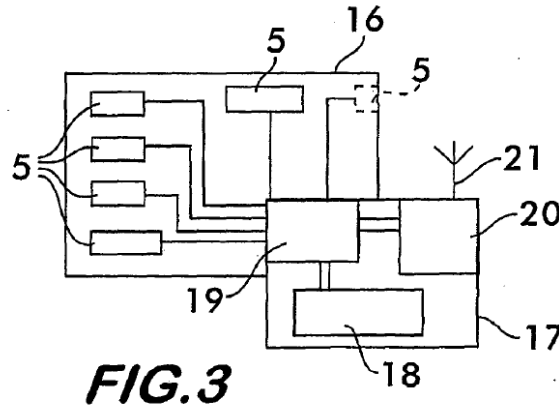
Petitioner contends that claim 21 of the ’915 patent is unpatentable under 35 U.S.C. § 103 as obvious over Armitage, Barone, and LeFebvre. Pet. 44–45. Patent Owner offers no counterarguments beyond those considered above with respect to claim 1. PO Resp. 29.

1. Scope and Content of the Prior Art

a. LeFebvre (Ex. 1005)

LeFebvre is entitled “Railroad Train Monitoring System.” Ex. 1005, code (54). LeFebvre discloses “sensors for monitoring temperature pressure, shifting loads, truck hunting and the like and . . . circuitry for processing information received from the sensors and for processing and reporting departures of performance variables to a remote source.” *Id.* at code (57).

Figure 3, reproduced below, provides an illustration of an adapter pad having a plurality of sensors.



Ex. 1005, Fig. 3. Figure 3 depicts adapter pad 16 containing a plurality of sensors 5 which are embedded into its upper side and lower surfaces or into other locations such as its end surfaces. *Id.* ¶ 21. Figure 3 also depicts extended attachment portion 17, which is relatively isolated from the forces transmitted through adapter 16, and contains power source 18, analog/signal conditioning means and analog to digital conversion means and an associated microprocessor unit 19, as well as communications unit 20 which may be a low power radio transmitter/receiver having antenna 21. *Id.* The sensors are electrically connected to the analog to digital conversion circuit unit and the microprocessor unit which, in turn, is connected to and controls the communications unit so that messages can be sent and received. *Id.*

Figure 4, reproduced below provides an illustration of an adapter pad 16 *in situ*.

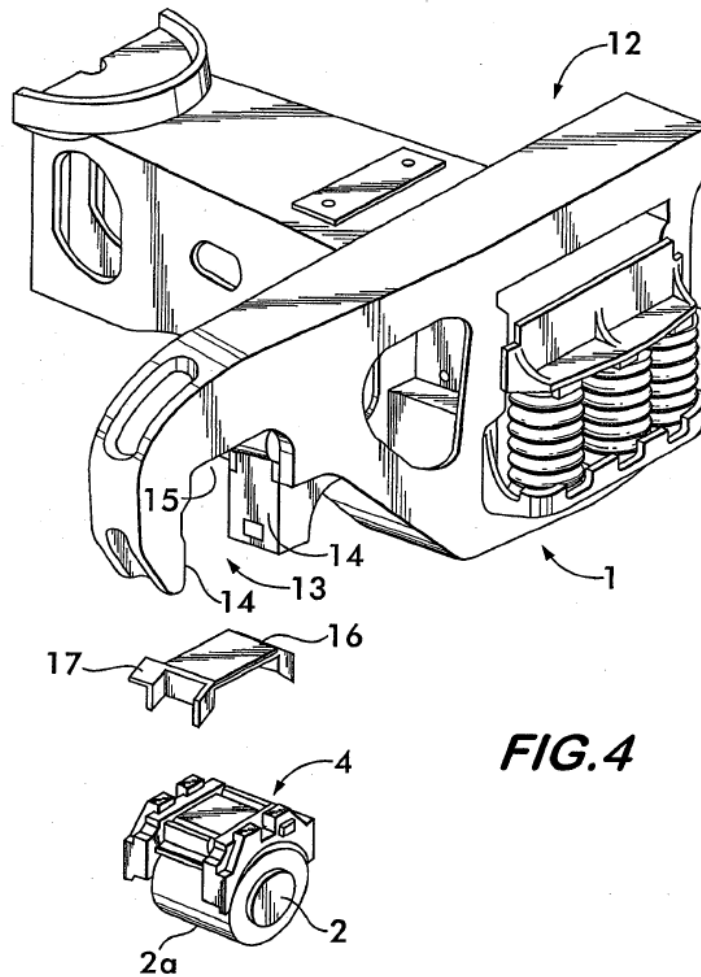


FIG. 4

Figure 4 is an exploded perspective view of portions of a railcar truck illustrating the position of an adapter pad (instrumented pad 16) with respect to the railcar truck. *Id.* ¶ 15. As depicted in Figure 4, truck 1 having axle 2 with axle bearing 2a and bearing adapter 4, is configured so that each bearing transmits the load which it carries and heat that it may generate through pad 16 and to the truck. *Id.* ¶ 17. Bearing adapters 4 have a generally rectangular upper surface with depending legs extending from the corners of the top structure, and the legs have facing curved side surfaces which are configured so as to rest on the outer surface of bearing 2a

mounted on the end of wheel bearing axle 2. *Id.* ¶ 19. Adapter pad 16 is generally rectangular in plan view and has depending legs, and is formed to seat upon the upper surface of adapter 4. *Id.* Railroad freight car 22 having trucks 1 with adapter/instrumented pads 16 also includes data control unit 23 having a radio/receiver which has the ability to communicate with the radios on the pads 4 on its own railcar. *Id.* ¶ 24, Fig. 1.

LeFebvre explains that wireless communication is available and adaptable to allow instrumented pads 16 and data control units 23 to establish a network of connections without external intervention. *Id.* ¶ 32. These elements can be set up to recognize the relationship of truck and axle location on a railcar or set up so that the digital communication unit is informed of the configuration providing thereby a multi-hop means of linking the network together. *Id.* According to LeFebvre, a purpose of the invention is to be able to monitor the behavior of all the trucks and bearings and wheels on a train so that an alarm message can get through from any railcar to the locomotive or to the remote data handling service as quickly as possible. *Id.* ¶ 52. Because a large amount of data is monitored, “the system is designed to process the raw sensor data, looking for signs of trouble and then send only essential indicative information,” using a distributed inference engine, which shares the essential functions between the microprocessors at instrumented pads 16 and at data control unit 23. *Id.* ¶ 53. Microprocessors 19 at instrumented pads 16 take a series of measurements and treat them as a time series. *Id.* ¶ 54. Then, search algorithms, forming an inference engine, can identify, for example, periodicities and cross correlations in and between time series so that any behavior detectable at pad level will be seen. *Id.* If a particular “behavior is

inferred at the instrumented pad and the magnitude is sufficient to cause alarm, relevant attributes and timing (relative to the time of transmission of report) can be passed to the car's data control unit.” *Id.* ¶ 55. LeFebvre monitors bearing temperature, bearing condition, wheel condition, brake force, and track defects, among others. *Id.* ¶¶ 57–66.

2. Differences Between the Prior Art and the Claimed Invention

Besides the arguments considered above with respect to claim 1, Patent Owner does not argue that the combination of Armitage, Barone, and LeFebvre fails to disclose the additional limitations recited by claim 21. *See* PO Resp. 29. Accordingly, Patent Owner has waived any argument directed to those limitations. *See* Paper 11, 9 (“Patent Owner is cautioned that any arguments for patentability not raised in the response will be deemed waived.”). We reviewed Petitioner’s evidence and argument and adopt it as our own. For the reasons provided therein, Petitioner demonstrates that the combination of Armitage, Barone, and LeFebvre accounts for the limitations of claim 21 and that a person of ordinary skill in the art would have been motivated to combine the references in the manner proposed, and would have had a reasonable expectation of success in doing so.

3. Conclusion as to Obviousness

Accordingly, we find that Petitioner has shown by a preponderance of the evidence that claim 21 would have been obvious over the combination of Armitage, Barone, and LeFebvre. *See* Pet. 44–45; Ex. 1003 ¶¶ 135–137.

D. Ground 3: Obviousness over Armitage, Barone, Winfree

Petitioner contends that claims 23 and 26 of the '915 patent are unpatentable under 35 U.S.C. § 103 as obvious over Armitage, Barone, and Winfree. Pet. 45–49.

1. Scope and Content of the Prior Art

a. Winfree (Ex. 1008)

Winfree is entitled “Mechanical Filter for Sensors.” Ex. 1008, code (54). Winfree relates to “protection of sensors from mechanical shock, vibration, and impact, and to the enhancement of a sensor’s response by improving its coupling to the environment.” *Id.* at 1:19–22. In particular, Winfree’s device includes one or more layers of material placed between a sensor and its environment and is used as a filter to selectively transmit, attenuate, or amplify various frequencies of incident elastic waves that would otherwise propagate from the environment and into the sensor. *Id.* at 2:24–29. In one embodiment, a single layer of material is placed between a sensor and a surface to which it is mounted in order to alter the transmission of frequencies into the sensor near some critical frequency f_c . *Id.* at 3:57–61.

2. Differences Between the Prior Art and the Claimed Invention

Besides the arguments considered above with respect to claim 1, Patent Owner does not argue that the combination of Armitage, Barone, and Winfree fails to disclose the additional limitations recited by claims 23 and 26. *See* PO Resp. 30. Accordingly, Patent Owner has waived any argument directed to those limitations. *See* Paper 11, 9 (“Patent Owner is cautioned that any arguments for patentability not raised in the response will be deemed waived.”). We reviewed Petitioner’s evidence and argument and

adopt it as our own. For the reasons provided therein, Petitioner demonstrates that the combination of Armitage, Barone, and Winfree accounts for the limitations of claims 23 and 26 and that a person of ordinary skill in the art would have been motivated to combine the references in the manner proposed, and would have had a reasonable expectation of success in doing so.

3. Conclusion as to Obviousness

Accordingly, we find that Petitioner has shown by a preponderance of the evidence that claims 23 and 26 would have been obvious over the combination of Armitage, Barone, and Winfree. *See* Pet. 45–49; Ex. 1003 ¶¶ 138–144.

E. Ground 4: Obviousness over LeFebvre and Barone

Petitioner contends that claims 1, 21, 22, 25, 27–30, 36, and 37 of the '915 patent are unpatentable under 35 U.S.C. § 103 as obvious over LeFebvre and Barone. Pet. 49–72. Patent Owner opposes. PO Resp. 30–37. The references are described above, so we proceed directly to Petitioner's contentions and Patent Owner's arguments.

1. Claim 1

- i. A system for detecting operational anomalies on a train consist or railcar comprising:*

Petitioner contends that to the extent the preamble is limiting, LeFebvre discloses a system for detecting operational anomalies on a railcar. *See* Pet. 51 (citing Ex. 1003 ¶¶ 147–149; Ex. 1005, code (57), ¶¶ 3, 6). Patent Owner does not raise any arguments regarding the preamble. *See*

PO Resp. We find that Petitioner has shown sufficiently that LeFebvre accounts for the preamble, to the extent that it is limiting.

- ii. *(a) one or more communication management units mounted on one or more railcars;*

Petitioner submits that LeFebvre teaches a “communications device 24” mounted on a railcar and “data control unit 23” linked by a “cable 23a” to the “communications device 24.” Pet. 52 (citing Ex. 1003 ¶ 150; Ex. 1005 ¶¶ 8, 24, Fig. 1). Petitioner notes that “communications device 24” and “data control unit 23” can be contiguous. *Id.* (citing Ex. 1005 ¶¶ 24, 68, Fig. 1). Petitioner explains that the “data control unit 23” communicates with pads on the railcar. *Id.* (citing Ex. 1003 ¶ 151; Ex. 1005 ¶¶ 24–26). Therefore, Petitioner concludes that LeFebvre discloses one or more communication management units mounted on one or more railcars. *Id.* (citing Ex. 1003 ¶ 151; Ex. 1005 ¶¶ 8, 24–26, 68). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that LeFebvre accounts for this limitation.

- iii. *(b) one or more sensors located on said one or more railcars configured to sense an operational parameter of said one or more railcars, said sensors being in communication with said one or more communication management units, wherein the one or more sensors comprise one or more sensors configured to measure accelerations of the railcar; and*

Petitioner asserts that “LeFebvre discloses a railcar monitoring system comprising a plurality of ‘instrumented pads 16’, each of which comprises one or more sensors that measure operational parameters of the railcar.”

Pet. 52 (citing Ex. 1005 ¶¶ 19, 23, 52; Ex. 1003 ¶ 152). LeFebvre further discloses “a plurality of sensors 5” mounted on a railcar that measure accelerations located on one or more railcars in wireless communication with the “communications device 24” and “data control unit 23.” *Id.* at 52–54 (citing Ex. 1003 ¶¶ 152–155; Ex. 1005 ¶¶ 21, 24, 36, 39, Fig. 4, claims 28, 30). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that LeFebvre accounts for this limitation.

iv. (c) one or more filters configured to filter at least a portion of the accelerations,

Petitioner contends both that LeFebvre and the combination of LeFebvre and Barone account for this limitation. *See* Pet. 54–57. Petitioner argues that “LeFebvre teaches filtering at both the sensor and CMU level for purposes of identifying ‘essential indicative information’ from a large data set.” *Id.* at 54 (citing Ex. 1003 ¶ 156; Ex. 1005 ¶ 53). First, Petitioner asserts that “LeFebvre discloses a ‘preliminary analysis’ performed by the ‘microprocessor’ within the instrumented pad which samples frequencies from sensors depending on the type of behavior being monitored (i.e., accelerations).” *Id.* (citing Ex. 1003 ¶ 156; Ex. 1005 ¶¶ 34–36). Petitioner argues that a person of ordinary skill in the art “would understand LeFebvre’s preliminary analysis equates to filtering at least a portion of accelerations.” *Id.* (citing Ex. 1003 ¶ 156).

Second, Petitioner contends that “LeFebvre teaches the microprocessors within the instrumented pads and the ‘data control unit 23’ serve the important functions of processing and filtering the raw data to only send ‘essential indicative information.’” *Id.* (citing Ex. 1003 ¶ 157; Ex.

1005 ¶ 53). Petitioner further explains that a person of ordinary skill in the art “would understand LeFebvre’s processing of data to identify and send essential indicative information equates to filtering at least a portion of accelerations.” *Id.* at 54–55 (citing Ex. 1003 ¶ 157).

Petitioner also submits that “[t]o the extent LeFebvre does not explicitly require a ‘filter’, Barone shows filtering accelerations was well-known in the art and conventionally used in the field at the time of the invention.” *Id.* at 55 (citing Ex. 1003 ¶ 160; Ex. 1007, Fig. 8, ¶¶ 114–115, 150, 172–185). Specifically, Petitioner contends that “Barone explicitly teaches output of an ‘accelerometer 171’ being transmitted to ‘signal conditioning 178’, where the analog signals are amplified and/or filtered as appropriate (electronic filter), and then routed to analog to digital (A/D) converters for wide bandwidth calculations and data manipulations (digital filter).” *Id.* (citing Ex. 1003 ¶ 160; Ex. 1007 ¶¶ 114–115, Fig. 8).

Petitioner argues that “Barone explicitly discloses filtered data (both digital and electronic), which shows filtering accelerations was well-known in the art and a [person of ordinary skill in the art] would be motivated to include the filtering taught by Barone to remove unwanted data and/or amplify particularly relevant accelerations data.” *Id.* (citing Ex. 1003 ¶ 161).

We note that we already determined that Barone accounts for this limitation for the reasons discussed above with respect to Group 1. *See supra* III.B.2.a.iv. As for Petitioner’s contentions that LeFebvre satisfies this limitation, we decline to reach them because we have already found that Barone accounts for this limitation.

- v. *wherein said communication management units perform the functions of: (i) collecting data regarding said one or more railcar operational parameters;*

Petitioner argues that “LeFebvre teaches a ‘data control unit 23’ and ‘communications device 24’ (which can be contiguous).” Pet. 58 (citing Ex. 1003 ¶ 163; Ex. 1005 ¶¶ 24, 36). Petitioner submits that “[t]he ‘data control unit 23’ (CMU) compares information it receives from the instrumented pads regarding one or more railcar operational parameters to determine the status of the railcar.” *Id.* (citing Ex. 1003 ¶ 163; Ex. 1005 ¶¶ 24, 36). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that LeFebvre accounts for this limitation.

- vi. *(ii) analyzing said collected data for trends or events indicative of an anomalous operational condition; and*

Petitioner relies on LeFebvre to account for this limitation. Petitioner argues that “[t]he system in LeFebvre processes raw sensor data to look for anomalous operational conditions—with analysis occurring in the ‘data control unit 23’ to recognize faults.” Pet. 58 (citing Ex. 1003 ¶ 164; Ex. 1005 ¶¶ 24, 36, 53). Petitioner notes that “[i]n LeFebvre’s system, the data control unit acts as an ‘aggregator of information,’ collecting data from each of the instrumented pads on the railcar,” which collect data about the railcar. *Id.* (citing Ex. 1005 ¶¶ 36, 56, 95; Ex. 1003 ¶ 164). Petitioner argues that “[t]he data control unit then uses ‘inference engine techniques’ (i.e., ‘drawing inferences’) to analyze the collected data.” *Id.* (citing Ex. 1005 ¶¶ 36, 56, 95; Ex. 1003 ¶ 165). LeFebvre discloses that “[a]s an aggregator of information, [the data control unit] is programmed to compare

information from all of the trucks on the railcar and draws inferences from them as the status of the car, for example, the data control unit uses inference engine techniques to identify unsatisfactory behavior such as swaying, bouncing or even partial derailment.” Ex. 1005 ¶ 36. LeFebvre further discloses “[g]iven that more than one instrumented pad may report misbehavior, then the components of the inference engine in the data control unit take responsibility for making assessments for the whole truck and ultimately for the freight car.” *Id.* ¶ 56. “When serious trouble is inferred, then messages are sent via the communications link 23a, 24 to the locomotive, etc.” *Id.*; *see also id.* ¶¶ 58–66 (using statistical analysis); Ex. 1003 ¶¶ 166–167. Petitioner contends that LeFebvre teaches that “[i]f an alarm condition is present, the data control unit is responsible for sending an alarm message upstream (i.e., to the locomotive and/or a remote data handling location).” Pet. 59–60.

Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that LeFebvre accounts for this limitation.

- vii. (iii) *communicating a message to a remote receiver when said trend or event is detected.*

Petitioner contends that LeFebvre discloses this limitation. *See* Pet. 60–61 (citing Ex. 1005 ¶¶ 25, 38, 52, 56, 95; Ex. 1003 ¶¶ 168–170). Petitioner argues that “LeFebvre discloses, ‘the data control unit 23 passes messages on to the communications device 24 for onward transmission to the locomotive or to other remote receivers.’” *Id.* at 60 (citing Ex. 1005 ¶ 38; Ex. 1003 ¶ 168). Petitioner asserts that “[i]f the detected condition is sufficiently severe that an alarm is warranted, the data control unit will send

an alarm message upstream (i.e., to the locomotive and/or a remote data handling location).” *Id.* at 60–61 (citing Ex. 1005 ¶¶ 56, 95; Ex. 1003 ¶ 170).

Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that LeFebvre accounts for this limitation.

viii. Motivation to Combine

Petitioner notes that LeFebvre and Barone disclose similar systems and similar topology, and that “LeFebvre discloses the periodic sampling of frequencies from sensors depending on the type of behavior being monitored (i.e., accelerations), which a [person of ordinary skill in the art] would understand requires an electronic or digital filter.” Pet. 49 (citing Ex. 1003 ¶ 146; Ex. 1005 ¶¶ 34–35). Petitioner argues that a person of ordinary skill in the art “would understand it is general knowledge filtering means excluding or amplifying certain ranges of data (or signals) within a data set—and would require an actual filter to achieve said filtering.” *Id.* (citing Ex. 1003 ¶ 146). Petitioner submits that “[t]o the extent LeFebvre does not explicitly disclose a filter, Barone shows filtering accelerations with an electronic or digital filter was well-known in the art and conventionally used in the field at the time of the invention.” *Id.* at 50 (citing Ex. 1003 ¶ 146; Ex. 1007, Fig. 8, ¶¶ 114–115, 150, 172–185). Petitioner argues that a person of ordinary skill in the art “would have been motivated to include the filter taught by Barone with LeFebvre because the advantage of filtering is to remove unwanted data and/or amplify particularly relevant data, and the purpose of both systems is to analyze data in a train monitoring system to accurately predict anomalous conditions and avoid false or inaccurate data

processing.” *Id.* at 50–51 (citing Ex. 1003 ¶ 146). Petitioner contends that “[c]ombining the preliminary analysis and sampling of data in LeFebvre using an electronic filter and the filter taught in Barone would have predictably resulted in the electronic or digital filtering of accelerations data.” *Id.* at 51 (citing Ex. 1003 ¶ 146).

Patent Owner argues that Petitioner’s allegations are conclusory and derived from hindsight. PO Resp. 32–33. Patent Owner also argues that a person of ordinary skill in the art would not have been motivated to combine LeFebvre and Barone because doing so would frustrate the principle of operation of LeFebvre and render LeFebvre unsatisfactory for its intended purpose (accurately identifying sensor data with a magnitude indicating an alarm condition). *Id.* at 33. Patent Owner asserts that LeFebvre relies on “an accelerometer to validate the identification of defects by other types of sensors rather than using the accelerometer data to make independent decision making.” *Id.* at 34 (citing Ex. 2006 ¶ 90). Patent Owner argues that “filtering out the upper and lower portions of accelerometer data as taught by Barone would prevent LeFebvre from identifying the accelerometer data having a magnitude sufficient to warrant an alarm.” *Id.*

We find that Petitioner has shown a sufficient motivation to combine LeFebvre and Barone. Just as with the combination of Armitage and Barone, we agree with Petitioner that the evidence shows that a person of ordinary skill in the art would have been motivated to incorporate the filtering of Barone for the advantage of removing unwanted data and/or amplifying particularly relevant data, and the purpose of both systems is to analyze data in a train monitoring system to accurately predict anomalous conditions and avoid false or inaccurate data processing. Ex. 1003 ¶ 146.

As the Federal Circuit has explained, “[t]here is a motivation to combine when a known technique ‘has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way,’ . . . using the ‘prior art elements according to their established functions.’” *PACT XPP*, 61 F.4th at 1380–81. That is the case here. LeFebvre and Barone are similar devices, the filter of Barone has been used to improve Barone’s device by allowing the removal of unwanted data from the sensors, and this technique could be predictably applied to LeFebvre’s device, as well, with the benefit of improving data processing.

Patent Owner’s argument that the combination would render LeFebvre inoperative is not persuasive. Even if LeFebvre uses acceleration data to verify information obtained from other sensors, Barone makes clear that particular defects correlate to certain identifiable frequencies, and that noise can affect the accuracy of the reading obtained. *See* Ex. 1007 ¶¶ 175–177. “For obviousness under § 103, all that is required is a reasonable expectation of success.” *See In re O’Farrell*, 853 F.2d at 904. Here, the prior art clearly indicates the benefits of the combination and would give a person of ordinary skill in the art a reasonable expectation that the combination would succeed. Accordingly, we find that Petitioner has shown a sufficient motivation to combine LeFebvre and Barone.

ix. Conclusion as to Claim 1

We find that Petitioner has shown sufficiently that the combination accounts for the limitations of claim 1, and that a person of ordinary skill would have been motivated to combine LeFebvre and Barone with a reasonable expectation of success. Accordingly, we find that Petitioner has

shown by a preponderance of the evidence that LeFebvre and Barone account for all the limitations of claim 1 and that a person of ordinary skill in the art would have had a reason to combine the references with a reasonable expectation of success.

2. *Claim 25*

- i. *The system of claim 1, further comprising one or more wireless sensor nodes in communication with at least one of the communication management units,*

Petitioner relies on its reasoning set forth above to account for the limitations of claim 1. Petitioner submits that LeFebvre discloses a railcar monitoring system comprising a plurality of “instrumented pads 16,” which are separately mounted on a railcar. Pet. 62 (citing Ex. 1005 ¶¶ 19, 23, 52, Fig. 4; Ex. 1003 ¶ 174). Petitioner notes that each “instrumented pad 16” communicates wirelessly with a “data control unit 23,” which is mounted on the railcar body. *Id.* (citing Ex. 1005 ¶ 24; Fig. 5; Ex. 1003 ¶ 174). Patent Owner does not raise any arguments regarding this limitation, besides its arguments raised above with respect to claim 1. *See* PO Resp. We have addressed those arguments above. We find that Petitioner has shown sufficiently that LeFebvre accounts for this limitation.

- ii. *wherein the one or more sensors form part of the one or more wireless sensor nodes,*

Petitioner contends that LeFebvre discloses a plurality of “instrumented pads 16,” each of which comprises one or more sensors that measure operational parameters of the railcar. Pet. 63 (citing Ex. 1005 ¶¶ 19, 23, 52; Ex. 1003 ¶ 175). Petitioner argues that “[t]he ‘plurality of sensors 5’ located within the instrumented pads are located on one or more

railcars and are configured to sense ‘a variety of car body motions’ in communication with the ‘communications device 24’ and ‘data control units 23.’” *Id.* (citing Ex. 1003 ¶ 175; Ex. 1005 ¶¶ 21, 36, 37, 93). Petitioner submits that “LeFebvre further claims the sensors in the instrumented pads measure accelerations,” and are in wireless communication with data control unit 23. *Id.* (citing Ex. 1003 ¶ 175; Ex. 1005 ¶ 24, Fig. 5, claims 28, 30). Patent Owner does not raise any arguments regarding this limitation. *See* PO Resp. We find that Petitioner has shown sufficiently that LeFebvre accounts for this limitation.

- iii. *wherein one or more of the wireless sensor nodes comprises a microprocessor configured to execute firmware to control operation of the one or more of the wireless sensor nodes,*

Petitioner contends that the combination of LeFebvre and Barone accounts for this limitation. *See* Pet. 63–65. Petitioner notes that Lefebvre discloses the “instrumented pad 16” (wireless sensor node) having a “microprocessor” which controls the sensors within the instrumented pad. *Id.* at 63 (citing Ex. 1003 ¶ 176; Ex. 1005 ¶¶ 21, 24, 34, 36, 39–41). Petitioner contends that a person of ordinary skill would understand that the instrument pads of LeFebvre include firmware. *Id.* at 63–64 (citing Ex. 1003 ¶ 176). Petitioner argues that “[t]o the extent LeFebvre does not explicitly disclose a microprocessor within the wireless sensor node with firmware to control the wireless sensor node, a [person of ordinary skill in the art] would be motivated to combine the teachings of LeFebvre with Barone,” which “discloses a ‘microprocessor’ within the sensor nodes, which analyzes information to control the sensor nodes.” *Id.* (citing

Ex. 1003 ¶ 177; Ex. 1007 ¶¶ 24–26). We have reviewed Petitioner’s contentions and find them sufficient. Patent Owner does not raise any arguments regarding this limitation, besides the arguments considered above with respect to claim 1. *See* PO Resp. We have addressed those arguments above. We find that Petitioner has shown sufficiently that the combination of LeFebvre and Barone accounts for this limitation.

- iv. wherein the firmware comprises one or more software filters configured to isolate one or more types of accelerations.*

Petitioner contends that the combination of LeFebvre and Barone accounts for this limitation. *See* Pet. 65–66. Petitioner argues that a person of ordinary skill in the art “would understand firmware and software have different purposes and functions, but both can execute the filtering of accelerations data.” *Id.* at 65 (citing Ex. 1003 ¶ 179). Petitioner contends that “[o]ne type of filtering firmware can execute is identifying and isolating certain types of data—in this case, accelerations data.” *Id.* Petitioner asserts that a person of ordinary skill in the art “would understand a function of filtering data by a software filter can be isolating or excluding certain types of accelerations data (i.e., ‘essential indicative information’)—based on programming that would be present in the software filter.” *Id.* at 65–66 (citing Ex. 1003 ¶ 179).

Patent Owner refers back to its arguments for this claim for Ground 1 addressed above. *See supra* III.B.2.a.iv. Petitioner’s combination here, similar to Ground 1, incorporates the filtering of Barone into the firmware of LeFebvre (instead of the firmware of Armitage as in Ground 1). *See* Pet. 65–66. Thus, for the reasons provided above with respect to claim 25 for Ground 1, we do not find Patent Owner’s arguments persuasive.

Accordingly, we have reviewed Petitioner’s evidence and argument and find Petitioner has shown sufficiently that the combination of LeFebvre and Barone accounts for all the limitations of claim 25, and that a person of ordinary skill in the art would have had a reason to combine the references in the manner proposed with a reasonable expectation of success. *See* Pet. 62–66.

3. *Claim 28*

Petitioner contends that the combination of LeFebvre and Barone accounts for the claimed “one or more digital filters.” As discussed above with respect to claim 25, Petitioner contends that the combination accounts for a “software filter,” which Petitioner equates to a digital filter. *See* Pet. 62–66. Patent Owner reiterates its arguments addressed above with respect to claim 25. *See* PO Resp. 35. For the reasons stated above with respect to claim 25, we do not find them persuasive. Accordingly, we have reviewed Petitioner’s evidence and argument and find Petitioner has shown sufficiently that the combination of LeFebvre and Barone accounts for all the limitations of claim 28, and that a person of ordinary skill in the art would have had a reason to combine the references in the manner proposed with a reasonable expectation of success. *See* Pet. 62–66.

4. *Claims 30 and 36*

Claim 30 is an independent claim reciting a “method for detecting operational anomalies on a train consist or railcar.” Ex. 1001, 20:39–55. Claim 30 recites method steps corresponding to the limitations of system claim 1. *Compare id.* (claim 30), *with id.* at 17:48–18:2 (claim 1). Petitioner provides a detailed mapping, supported by the testimony of Mr. Ricca, for how the combination of LeFebvre and Barone accounts for the

limitations of claim 30. *See* Pet. 21–33, 38–39. Claim 36 is an independent claim reciting a “system for detecting operational anomalies on a railcar that is part of a train consist.” Ex. 1001, 21:35–22:17. Claim 36 recites limitations almost identical to claim 1. *Compare id.* (claim 36), *with id.* at 17:48–18:2 (claim 1). Petitioner provides a detailed mapping, supported by the testimony of Mr. Ricca, for how the combination of LeFebvre and Barone accounts for the limitations of claim 36. *See* Pet. 51–61, 66–67. There is one limitation of claim 36 that does significantly differ—“drawing inferences from the data received from at least two of the sensors regarding the performance of the railcar” (as compared to “analyzing said collected data for trends or events indicative of an anomalous operational condition” of claim 1). However, Petitioner discusses this limitation in detail in its Petition. *See* Pet. 58–59. Thus, we disagree with Patent Owner’s contention that Petitioner does not provide any analysis at all to support its assertion that claims 30 and 36 are unpatentable beyond a cross reference to claim 1. *See* PO Resp. 36. Instead, we find that Petitioner does provide a detailed analysis of sufficient depth to cover claims 30 and 36 as well.

As for its other arguments regarding claims 30 and 36, Patent Owner repeats its argument that neither LeFebvre nor Barone teaches the “filtering, by one or more filters, at least a portion of the accelerations” that was considered above with respect to claim 1. *See id.* For reasons set forth above, we do not, on the full trial record, find Patent Owner’s argument persuasive. *See supra* III.B.2.a.iv. We have reviewed Petitioner’s evidence and argument and find it sufficient. Accordingly, we find that Petitioner has shown sufficiently that the combination of LeFebvre and Barone accounts for the subject matter of claims 30 and 36, and that a person of ordinary skill

in the art would have had reason to combine the teachings of those references in the manner proposed with a reasonable expectation of success.

5. Claims 21, 22, 27, 29, and 37

Petitioner provides a detailed mapping for how the combination of LeFebvre and Barone accounts for the limitations of claims 21, 22, 27, 29, and 37. Pet. 61–62, 66. Patent Owner does not raise any arguments regarding these claims beside the arguments considered above with respect to claims 1, 30, and 36. *See* PO Resp. We have reviewed Petitioner’s evidence and argument, and we find it sufficient. Accordingly, we find that, on the full trial record, Petitioner has shown by a preponderance of the evidence that LeFebvre and Barone account for the subject matter of claims 21, 22, 27, 29, and 37, and that a person of ordinary skill in the art would have had reason to combine the teachings of those references in the manner proposed with a reasonable expectation of success.

6. Conclusion

Thus, for the reasons stated above, we find that Petitioner has shown by a preponderance of the evidence that claims 1, 21, 22, 25, 27–30, 36, and 37 are unpatentable as obvious over the combination of LeFebvre and Barone.

F. Ground 5: Obviousness Over LeFebvre, Barone, and Armitage

Petitioner contends that claims 24 and 37 of the ’915 patent are unpatentable under 35 U.S.C. § 103 as obvious over LeFebvre, Barone, and Armitage. Pet. 72–77. Besides the arguments considered above with claims 1 and 36, Patent Owner does not argue that the combination of LeFebvre, Barone, and Armitage fails to disclose the additional limitations recited by

claims 24 and 37. *See* PO Resp. 37. Accordingly, Patent Owner has waived any argument directed to those limitations. *See* Paper 11, 9 (“Patent Owner is cautioned that any arguments for patentability not raised in the response will be deemed waived.”). We reviewed Petitioner’s evidence and argument and adopt it as our own. For the reasons provided therein, Petitioner demonstrates that the combination of LeFebvre, Barone, and Armitage accounts for the limitations of claims 24 and 37 and that a person of ordinary skill in the art would have been motivated to combine the references in the manner proposed, and would have had a reasonable expectation of success in doing so. Accordingly, we find that Petitioner has shown by a preponderance of the evidence that claims 24 and 37 would have been obvious over the combination of LeFebvre, Barone, and Armitage. *See* Pet. 72–77; Ex. 1003 ¶¶ 205–224.

*G. Ground 6: Obviousness Over LeFebvre,
Barone, Winfree*

Petitioner contends that claims 23 and 26 of the ’915 patent are unpatentable under 35 U.S.C. § 103 as obvious over LeFebvre, Barone, and Winfree. Pet. 77–80. Besides the arguments considered above with claim 1, Patent Owner does not argue that the combination of LeFebvre, Barone, and Winfree fails to disclose the additional limitations recited by claims 23 and 26. *See* PO Resp. 37–38. Accordingly, Patent Owner has waived any argument directed to those limitations. *See* Paper 11, 9 (“Patent Owner is cautioned that any arguments for patentability not raised in the response will be deemed waived.”). We reviewed Petitioner’s evidence and argument and adopt it as our own. For the reasons provided therein, Petitioner demonstrates that the combination of LeFebvre, Barone, and Winfree

accounts for the limitations of claims 23 and 26 and that a person of ordinary skill in the art would have been motivated to combine the references in the manner proposed, and would have had a reasonable expectation of success in doing so. Accordingly, we find that Petitioner has shown by a preponderance of the evidence that claims 23 and 26 would have been obvious over the combination of LeFebvre, Barone, and Winfree. *See* Pet. 77–80; Ex. 1003 ¶¶ 225–231.

IV. PATENT OWNER’S MOTION TO EXCLUDE

Patent Owner seeks to exclude Exhibits 1026 and 1027 and the corresponding arguments in Petitioner’s Reply based on these exhibits. MTE 1; *see* MTE Reply. Petitioner opposes Patent Owner’s Motion. MTE Opp. We did not rely on Petitioner’s Exhibits 1026 or 1027 or any of the corresponding arguments in reaching our decision. Thus, we dismiss Patent Owner’s Motion to Exclude as moot.

V. PATENT OWNER’S REVISED MOTION TO AMEND

Pursuant to 35 U.S.C. § 316(d)(1) and 37 C.F.R. § 42.121(a), Patent Owner filed a Contingent Motion to Amend stating that if claims 1, 21–30, 36, and 37 are found unpatentable, Patent Owner requests the Board to substitute “any claims found to be unpatentable” and issue the corresponding substitutes claims 38–48. RMTA 2–3. Having determined that Petitioner has shown by a preponderance of the evidence that original claims 1, 21–30, 36, and 37 of the ’915 patent are unpatentable, we proceed to address Patent Owner’s Motion. Patent Owner proposes substitute claim 38 to replace challenged patent claim 1, proposes substitute claims 39–44 to replace challenged claims 21–36, proposes substitute claims 45 and 46 to replace

challenged claims 29 and 30, and proposes substitute claims 47 and 48 to replace challenged claims 36 and 37. *Id.* A copy of proposed substitute claims 38–48 is provided by Patent Owner in Claims Appendix A of the Revised Motion to Amend.

For the reasons discussed below, Patent Owner has shown that proposed substitute claims 38–48 meet the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. For the reasons discussed below, however, Petitioner has proven by a preponderance of the evidence that proposed substitute claims 38–48 are unpatentable over prior art. Therefore, we deny Patent Owner’s Revised Motion to Amend.

A. Principles of Law

In an *inter partes* review, amended claims are not added to a patent as of right, but rather must be proposed as a part of a motion to amend claims. 35 U.S.C. § 316(d). Ordinarily, the petitioner “bears the burden of persuasion to show, by a preponderance of the evidence, that any proposed substitute claims are unpatentable.” 37 C.F.R. § 42.121(d)(2); *Lectrosonics, Inc. v. Zaxcon, Inc.*, IPR2018-01129, Paper 15, 3–4 (PTAB Feb. 25, 2019) (precedential).

But before considering the patentability of the substitute claims, we first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. *Lectrosonics*, Paper 15 at 4. In that regard, Patent Owner bears the burden of persuasion to show that: (1) the amendment proposes a reasonable number of substitute claims; (2) the amendment responds to a ground of unpatentability involved in the trial; (3) the amendment does not

seek to enlarge the scope of the claims of the patent or introduce new subject matter; and (4) the original disclosure sets forth written description support for each proposed substitute claim. *Id.*; 35 U.S.C. § 316(d); 37 C.F.R. § 42.121(d)(1).

B. The Proposed Substitute Claims

Patent Owner proposes to amend the '915 patent by adding new claims 38–48 as respective substitutes for original claims 1, 21–30, 36, and 37. *See* RMTA 2–3; *see also id.* at Claims App. A. Claim 38 is proposed as a substitute for original claim 1 and is reproduced below. Underlined language reflects subject matter added to original claim 1, and strike-through indicates deletion.

~~1.~~ 38. A system for detecting operational anomalies on a train consist or railcar, comprising:

(a) one or more communication management units mounted on one or more railcars;

(b) one or more wireless ~~sensors~~ sensor nodes located on said one or more railcars and configured to sense an operational parameter of said one or more railcars, said one or more wireless sensor nodes ~~sensors~~ being in communication with said one or more communication management units, wherein the one or more ~~sensors~~ wireless sensor nodes comprise a tri-axis sensor ~~one or more sensor~~ configured to measure accelerations of the railcar along a plurality of axes comprising a first axis extending along a length of the railcar, a second axis extending across a width of the railcar, and a third axis extending along a height of the railcar; and

(c) a plurality of one or more sensor sections that are provided with the one or more wireless sensor nodes and that comprise

(i) a plurality of filters that are each configured to filter at least a portion of the accelerations by receiving an output signal directly from the tri-axis sensor and selecting ones of the accelerations in the output signal that were measured in a dimension represented by a respective axis of the plurality of axes, and

(ii) a plurality of detectors respectively coupled to the plurality of filters, each one of the detectors being configured to detect a respective one of a plurality of different railcar conditions based on ones of the accelerations that are associated with only the respective axis of the plurality of axes;

wherein said communication management units perform the functions of:

(i) collecting, from the one or more wireless sensor nodes, data regarding said ~~one or more railcar~~ operational ~~parameters~~ parameter of said one or more railcars;

(ii) analyzing said collected data to detect a trend or event ~~for trends or events~~ indicative of an anomalous operational condition of said one or more railcars; and

(iii) communicating a message to a remote receiver when said trend or event is detected.

RMTA Claims App. A, i–ii.

Proposed substitute independent claim 46 is a method claim that contains many of the same newly added limitations as proposed substitute system claim 38. *Compare* RMTA Claims App. A, i–ii, *with id.* at iv–v. Indeed, Patent Owner and Petitioner both refer to claim 38 for the limitations of claim 46. *See* RMTA 23–24; RMTA Opp. 22–23. Proposed substitute independent claim 47 contains many of the same newly added limitations as proposed substitute claim 38. *Compare* RMTA Claims App. A, i–ii, *with id.* at v–vi. Patent Owner and Petitioner both refer to claim 38 for the

limitations of claim 47. *See* RMTA 23–24; RMTA Opp. 22–23. The remaining proposed substitute claims depend directly or indirectly from proposed substitute claims 38 and 47. *See* RMTA Claims App. A, ii–iv, vi, vii.

C. Statutory and Regulatory Requirements

1. Reasonable number of substitute claims

A motion to amend must “propose a reasonable number of substitute claims.” 35 U.S.C. § 316(d)(1)(B); *see also* 37 C.F.R. § 42.121(a)(3) (“A motion to amend may cancel a challenged claim or propose a reasonable number of substitute claims.”). “There is a rebuttable presumption that a reasonable number of substitute claims per challenged claim is one (1) substitute claim.” *Lectrosonics*, Paper 15 at 4; *see also* 37 C.F.R. § 42.121(a)(3). Patent Owner proposes no more than one substitute claim for each challenged claim to be replaced. RMTA 3, Claims App. A. Petitioner does not contend that Patent Owner proposes more than a reasonable number of substitute claims. *See generally* RMTA Opp. We determine that Patent Owner proposes a reasonable number of substitute claims.

2. Responsive to ground of unpatentability

“A motion to amend may be denied where . . . [t]he amendment does not respond to a ground of unpatentability involved in the trial.” 37 C.F.R. § 42.121(a)(2)(i). The Petition asserts that challenged claims 1, 21–30, 36, and 37 are unpatentable over prior art. Pet. 5. As shown above, through the Revised Motion to Amend, Patent Owner has sought to change the substantive features of the challenged claims by substituting new claims. “A revised MTA includes one or more new proposed substitute claims in place

of previously presented substitute claims, and may provide new arguments and/or evidence as to why the revised MTA meets statutory and regulatory requirements for an MTA.” 84 Fed. Reg. 9501. At least one amendment presented is responsive to a ground of unpatentability, in that Patent Owner seeks to add limitations such that “[s]ubstitute claims 38 through 48 include additional limitations not found in the prior art,” and asserts that “[e]ach substitute claim is therefore patentable over Armitage, LeFebvre, Barone or Winfree, alone or in combination.” *See* RMTA 1, 25. Petitioner does not argue otherwise. *See generally* RMTA Opp.

Because the amendments attempt to distinguish over at least LeFebvre, Armitage, Barone, and Winfree, we determine that the proposed amendments are responsive to a ground of unpatentability involved in this trial.

3. Does not enlarge the scope of the claims

An amendment may not enlarge the scope of the claims of the patent. 35 U.S.C. § 316(d)(3); 37 C.F.R. §§ 42.121(b)(1), 42.121(b)(2). Patent Owner asserts that the proposed substitute claims do not enlarge the scope of the challenged claims. RMTA 4. Petitioner does not contend that any proposed substitute claim enlarges the scope of any challenged patent claim. *See generally* RMTA Opp. We determine that each proposed substitute claim includes narrowing limitations and does not violate the statutory and regulatory prohibition on enlarging the scope of patent claims.

4. New matter

An amendment may not introduce new matter. 35 U.S.C. § 316(d)(3); 37 C.F.R. §§ 42.121(b)(1), 42.121(b)(2). New subject matter is any addition to the claims that lacks sufficient support in the subject patent’s original

disclosure. *See TurboCare Div. of Demag Delaval Turbomach. v. Gen. Elec. Co.*, 264 F.3d 1111, 1118 (Fed. Cir. 2001) (“When [an] applicant adds a claim . . . , the new claim[] must find support in the original specification.”). Patent Owner also is required to show written description support in “the original disclosure of the patent for each claim that is . . . amended,” and in “an earlier-filed disclosure for each claim for which benefit of the filing date of the earlier filed disclosure is sought.” 37 C.F.R. § 42.121(b).

According to Patent Owner, the original disclosure of “the ’915 Patent supports each proposed substitute claim,” and is entitled to priority to U.S. Patent App. 15/108,065, from which it issued, “which in turn claims priority to U.S. Provisional App. No. 61/920,700, filed on December 24, 2013.” RMTA 4 (citing Ex. 1002). Despite Petitioner’s assertions to the contrary, having considered the original disclosure of the ’915 patent and the disclosure in the priority application, we find Patent Owner has sufficiently set forth adequate written description support for proposed substitute claims 38–48 and does not introduce new matter.

Petitioner argues that claim 43 “introduce[s] new subject matter.” RMTA Opp. 1. Petitioner asserts that the Specification does “not teach a single embodiment comprising two sets of detectors as claimed.” *Id.* at 1–2 (citing RMTA 11–12 (quoting Ex. 1001, 5:35–42, 6:28–36, 10:55–12:51, Figs. 4, 12); Ex. 1030 ¶ 15).

Dependent claim 43⁷ recites, “a first one of the plurality of detectors is always enabled when the railcar is moving” and “a second one of the

⁷ We refer to claim 43 submitted with the RMTA Reply to correct inadvertent typographical errors.

plurality of detectors is enabled when the railcar is traveling faster than a specific speed and is disabled when the railcar is traveling slower than the specific speed.” RMTA Reply, Claims App. A, vi–vii.

Patent Owner replies, and we agree, that Figure 4 of the ’915 patent depicts two detectors, namely “accelerometer 404 and a temperature sensor 406.” RMTA Reply 2; *see also* Ex. 1001, 1:66–2:7. The ’915 patent discloses, “the temperature analysis is only performed when the train consist 109 is moving.” Ex. 1001, 14:51–56; RMTA Reply 2. The ’915 patent also discloses that if “the critical speed has been reached or exceeded, control proceeds to 1008 where both the vertical impact and wheel damage events are enabled” and if the speed “has fallen below the critical speed, control proceeds to 1022 where both the vertical impact and wheel damage events are disabled,” and that these “acceleration events are all events which are detected by the variety of WSN 104 which is attached to the wheel roller bearing fitting 111 on railcar 103.” Ex. 1001, 10:55–11:25; RMTA Reply 2. Based on this disclosure and given that Figures 1 and 2 of the ’915 patent depict a plurality of WSNs on each railcar, we agree with Patent Owner that the Specification provides adequate written description support for proposed substitute claim 43.

For the above reasons, we determine that Patent Owner has shown that proposed substitute claim 43 meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121.

D. Petitioner’s Assertions of Unpatentability

Petitioner contends that the proposed substitute claims are unpatentable under 35 U.S.C. § 112, first paragraph, as failing to meet the written description requirement, under 35 U.S.C. § 112, second paragraph,

as being indefinite, and under 35 U.S.C. § 103 based on seven grounds. RMTA Opp. 1–25. As to the 35 U.S.C. § 103 grounds, Petitioner contends that proposed substitute claims 38, 40, 42, 43, and 45–48 would have been obvious over Armitage (Ex. 1006) and Barone (Ex. 1007), or alternatively, over Armitage, Barone, and Leitel (Ex. 1029). *Id.* at 5–25. Petitioner contends that claim 39 would have been obvious over Armitage, Barone, LeFebvre (Ex. 1005), and Leitel and that claims 41 and 44 would have been obvious over Armitage, Barone, Leitel, and Winfree (Ex. 1008), or alternatively, over LeFebvre, Barone, Armitage, and Leitel. *Id.* at 23–25. Petitioner contends that claims 38, 39, 40, 42, 43, and 45–48 would have been obvious over LeFebvre, Barone, and Armitage, with or without Leitel. *Id.* at 5–25. We address the written description and indefinite grounds before turning to the obviousness grounds.

1. Written Description

On this record, we find that Patent Owner has shown by a preponderance of the evidence that the original disclosure of the '915 patent provides sufficient written description support for the added limitations recited in the proposed substitute claims for the reasons previously described in Section V.C.4. Petitioner's written arguments regarding claim 43 have been addressed in Section V.C.4 above. *See* RMTA Opp. 1–2.

2. Indefiniteness

Petitioner argues that proposed substitute claims 38, 46, and 47 are indefinite because the meanings of the terms “ones of the accelerations” and “a plurality of detectors respectively coupled to the plurality of filters, each one of the detectors being configured to detect a respective one of a plurality of different railcar conditions based on ones of the accelerations that are

associated with only the respective axis of the plurality of axes”⁸ are not clear. RMTA Opp. 2–3 (citing Ex. 1030 ¶¶ 16, 17); *see also* RMTA Sur-reply 3–4 (further assessing why Petitioner believes the proposed substitute claims are indefinite). Patent Owner disagrees. RMTA Reply 2–4 (citing Ex. 1001, 11:28–12:51, 13:11–14:9, Figs. 12–14; Ex. 2010 ¶¶ 16–18). For the reasons below, we conclude that Petitioner has not proven that the proposed substitute claims 38, 46, and 47 are indefinite.

Under 35 U.S.C. § 112(b), “[t]he specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.” In AIA proceedings, we evaluate indefiniteness of proposed substitute claims in a motion to amend using the same indefiniteness standard as used in *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898 (2014). *See* USPTO Memorandum, Approach to Indefiniteness Under 35 U.S.C. § 112 in AIA Post-Grand Proceedings (Jan. 6, 2021), 5 (“The Office now clarifies that the Board shall follow *Nautilus* in AIA post-grant proceedings.”).⁹ Under *Nautilus*, a claim of a patent challenged for indefiniteness is unpatentable for indefiniteness if the claim, read in light of the patent Specification and the prosecution history, “fail[s] to inform, with reasonable certainty, those skilled in the art about the scope of the invention.” *Nautilus*, 572 U.S. at 901.

⁸ Petitioner contends that claim 46 includes a substantially similar limitation, and thus is indefinite for the same reasons as claims 38 and 47.

⁹ available at <https://www.uspto.gov/sites/default/files/documents/IndefinitenessMemo.pdf>

a. “ones of the accelerations”

Petitioner argues that the meaning of “ones of the accelerations” in proposed substitute claims 38, 46, and 47 is not clear, as this term does not appear in the Specification and it is not understood to a person of ordinary skill in the art; thus, it fails to inform with reasonable certainty about the scope of the invention as required by *Nautilus*. RMTA Opp. 2 (citing Ex. 1030 ¶ 16).

Patent Owner argues that the claims are not indefinite because, as the Specification describes, each of the claims requires a tri-axis sensor, which measures accelerations along three axes—longitudinal, vertical, and lateral. RMTA Reply 3 (citing Ex. 1001, 11:28–12:51). Patent Owner argues that “ones of the accelerations” refers to one of these acceleration measurements taken with a tri-axis sensor for an axis. *Id.* Patent Owner argues that neither Petitioner nor Petitioner’s expert explains how a person of ordinary skill in the art would not understand with reasonable certainty what is meant by this claim term. *Id.* (citing Ex. 1030 ¶ 16; Ex. 2010 ¶ 16; RMTA Opp. 6). Patent Owner asserts that this term reasonably convey the scope of the invention to a person of ordinary skill in the art. *Id.* (citing Ex. 2010 ¶¶ 16–17).

Petitioner responds that Patent Owner’s arguments are centered around the term “one of the accelerations” and not “*ones* of the accelerations” as provided in the substitute claims and that Patent Owner fails to explain what “ones of the accelerations” means. RMTA Sur-reply 3–4. Petitioner argues that Petitioner’s expert explicitly states that “ones of accelerations . . . is not a term of art reasonably understood to a [person of ordinary skill in the art].” *Id.* at 4 (citing Ex. 1030 ¶ 16).

We determine that Petitioner has not met its burden of proving that the term “ones of the accelerations” in substitute claims 38, 46, and 47 is indefinite. We agree with Patent Owner that a person of ordinary skill could reasonably ascertain the scope of the term based on the context of the claims and the Specification. As the Specification describes, each of the claims requires a tri-axis sensor, which measures accelerations along three axes—longitudinal, vertical, and lateral. *See* Ex. 1001, 11:28–12:51. We agree with Patent Owner’s position that “ones of the accelerations” refers to one of these acceleration measurements taken with a tri-axis sensor for an axis. RMTA Reply 3. Moreover, as Patent Owner notes, Petitioner argued that an accelerometer such as the one provided in Armitage “may be ‘a three-dimensional accelerometer,’ which a [person of ordinary skill in the art] would understand measures accelerations along three perpendicular axes, including along the width, length, and height of the railcar.” RMTA Opp. 6. We agree with Patent Owner that this argument is consistent with our conclusion that a person of ordinary skill in the art would understand that “ones of the accelerations” would refer to one of the acceleration measurements taken with a tri-axis sensor for one axis as Patent Owner asserts.

- b. “a plurality of detectors respectively coupled to the plurality of filters, each one of the detectors being configured to detect a respective one of a plurality of different railcar conditions based on ones of the accelerations that are associated with only the respective axis of the plurality of axes”*

Petitioner also argues that the term “a plurality of detectors respectively coupled to the plurality of filters, each one of the detectors being configured to detect a respective one of a plurality of different railcar

conditions based on ones of the accelerations that are associated with only the respective axis of the plurality of axes” in claims 38 and 47 is not clear. RMTA Opp. 2–3. Petitioner argues that claim 46 contains a substantially similar claim limitation, and thus is subject to the same indefiniteness challenge. *Id.* at 3. Petitioner argues that the Specification does not specify the relationship between the detectors, filters, and railcar conditions with reasonable certainty by providing a handful of questions. *Id.* (citing *Nautilus*, 572 U.S. at 901; Ex. 1030 ¶ 17).

Patent Owner argues that Petitioner does not explain why its questions regarding this term would be necessary for a person of ordinary skill in the art to understand the scope of the invention. RMTA Reply 3. Patent Owner argues that the elements of the term are commonly used and understood by a person of ordinary skill in the art, and that Figures 12–14 show the relationship between the detectors and the filters. *Id.* at 4 (citing Ex. 1001, 13:11–14:9, Figs. 12–14; Ex. 2010 ¶ 18).

Petitioner responds that this term does not reasonably convey to a person of ordinary skill in the art the relationship between the “plurality of detectors,” “the plurality of filters,” the “plurality of different railcar conditions,” and the “ones of the accelerations associated with only the respective axis of the plurality of axes.” RMTA Sur-Reply 4. Petitioner repeats the same questions provided in its Opposition, and argues that Figures 12–14 do not provide answers to these questions. *Id.*

We agree with Patent Owner that the Specification, including Figures 12–14, shows the relationship between the filters, the detectors, and the railcar conditions. Thus, we determine that Petitioner has not proven that this term in substitute claims 38, 46, and 47 is indefinite.

3. Asserted Obviousness of Claims 38, 40, 42, 43, and 45–48 Based on Armitage and Barone

Petitioner asserts that Patent Owner’s proposed substitute claims include limitations that were known in the art. RMTA Opp. 3–4.

a. Claim 38

Petitioner asserts that claim 38 includes several new limitations, which we address in turn.

Limitation 38(b)¹⁰ recites, “a tri-axis” sensor configured to measure accelerations of the railcar “along a plurality of axes comprising a first axis extending along a length of the railcar, a second axis extending across a width of the railcar, and a third axis extending along a height of the railcar.” RMTA Reply, Claims App. A, iv. According to Petitioner, “Armitage’s accelerometer may be ‘a three-dimensional accelerometer,’ which [a person of ordinary skill in the art] would understand measures accelerations along three perpendicular axes, including along the width, length, and height of the railcar.” RMTA Opp. 6 (citing Ex. 1006 ¶ 45; Ex. 1030 ¶ 29).

Patent Owner relies on its arguments as to Armitage and Barone, set forth in the Patent Owner Response, which we find unavailing as discussed above. RMTA Reply 4 (citing PO Resp. 5–37). Although Patent Owner also refers to pages 17–24 of the Revised Motion to Amend, those sections deal with different limitations and different grounds, and Patent Owner does not address this limitation in the Revised Motion to Amend.

¹⁰ We refer to the substitute claims in Patent Owner’s “Claim Appendix A” that precedes page 1 of the RMTA Reply with the new limitations in quotations.

Limitation 38(c)(i) recites, “a plurality of sensor sections that are provided with the one or more wireless sensor nodes and that comprise” a plurality of filters that are each configured to filter at least a portion of the accelerations “by receiving an output signal directly from the tri-axis sensor and selecting ones of the accelerations in the output signal that were measured in a dimension represented by a respective axis of the plurality of axes.”

Petitioner asserts that Armitage meets this limitation because “Armitage teaches selecting data corresponding to one of the three measured axes and ignoring or discarding data corresponding to the other two axes.” RMTA Opp. 9 (citing Ex. 1030 ¶¶ 37–38). According to Petitioner, this is the same filter that occurs in the ’915 patent. *Id.* Petitioner asserts that although Armitage discloses an example based on the z-axis, the teachings apply to all axes, at least as a “mere duplication of parts.” *Id.* at 9–10 (citing *In re Harza*, 274 F.2d 669, 671 (CCPA 1960)). Petitioner asserts that Barone also teaches filtering and that an ordinary artisan “would have been motivated to add Barone’s filtering to Armitage’s system to remove unwanted data and/or amplify relevant accelerations data to accurately predict anomalous conditions and avoid false or inaccurate data processing.” *Id.* at 11 (citing Ex. 1003 ¶¶ 81–82; Ex. 1030 ¶¶ 44–45; *KSR*, 550 U.S. at 416).

Patent Owner replies that Petitioner’s “duplication of parts” assertion “has no merit” because “filtering on each axis must be different because each axis detects different events.” RMTA Reply 6 (citing Ex. 1001, 11:28–39, 11:52–67, 12:36–51). As to the modification based on Barone, Patent Owner asserts that the modification is based on “hindsight” because

“Petitioner fails to explain why Armitage, which post-dates Barone by four years, did not itself utilize Barone’s supposedly well-known and superior filtering methods.” *Id.* at 8.

Petitioner responds that Patent Owner conflates the claimed “plurality of filters” with the claimed “plurality of detectors,” because “the filters simply isolate data from a particular axis while the detectors detect different railcar events.” RMTA Sur-reply 7 (citing Ex. 1001, 5:40–42). According to Petitioner, “the claimed ‘plurality of filters’ is a mere duplication of parts because each filter merely isolates acceleration data from a particular axis.” *Id.* (citing Ex. 1030 ¶ 41). For the combination of Armitage and Barone, Petitioner asserts it provides a sufficient “motivation to combine the filtering of Barone with Armitage” and that “there is no requirement in patent law that to prove obviousness a petitioner must explain why a prior art reference does not expressly describe a feature that petitioner argues would have been *obvious* to combine with the prior art reference.” *Id.* at 8.

Petitioner has the better position. Armitage discloses that “vibration could be monitored with a three-dimensional accelerometer,” but chooses to ignore vibrations in certain axes. Ex. 1006 ¶ 45. This is consistent with the ’915 patent, which discloses “accelerations that are considered noise . . . are preferably removed from the signal of interest.” Ex. 1001, 5:23–27. We agree with Petitioner that any of the axes could be a certain axis. We also agree with Petitioner that digital and electronic filtering of accelerations as taught by Barone would “remove unwanted data and/or amplify particularly relevant accelerations data.” Pet. 28. That Barone issued before Armitage does not change whether an ordinary artisan would want to remove

unwanted data and/or amplify particularly relevant accelerations data.

Patent Owner's assertion as to the dates of the references is unavailing.

Limitation 38(c)(ii) requires, "a plurality of detectors respectively coupled to the plurality of filters, each one of the detectors being configured to detect a respective one of a plurality of different railcar conditions based on ones of the accelerations that are associated with only the respective axis of the plurality of axes."

Petitioner relies on Armitage's "processing portion" and asserts that "the 'processing portion' in the sensor nodes would include a detector to detect and process accelerations data to determine different railcar conditions." RMTA Opp. 17–18. Patent Owner does not specifically address limitation 38(c)(ii) as to Armitage and only discusses Leitel for this limitation. *See* RMTA Reply 9.

We agree with Petitioner that the processing portion of Armitage's sensor node would meet this limitation. The '915 patent discloses that "feature detectors may use a variety of techniques to determine if specific features are present," including "pulse peaks or duration, root mean square (RMS) level of magnitude values, or presence or lack of specific frequency components." Ex. 1001, 13:25–29. Similarly, in Armitage, vibration characteristics are determined, in which "60 milliseconds of vibration are sampled every two seconds and the vibrations are averaged (along with determining minimums and maximums) every sixty seconds and stored. Time series analysis could then [be] performed on the readings to determine the failure conditions." Ex. 1006 ¶ 45. We discern no difference between "pulse peaks" as disclosed in the '915 patent and the "maximums" of Armitage. Likewise, we discern no patentable distinction between the RMS

in the '915 patent and the average in Armitage. Petitioner has shown, by a preponderance of the evidence, that proposed substitute claim 38 would have been obvious over Armitage and Barone

b. Claims 46 and 47

As set forth above in Section III.B, proposed substitute independent claims 46 and 47 contain many of the same newly added limitations as proposed substitute claim 38, and Patent Owner and Petitioner both refer to claim 38 for the limitations of claims 46 and 47. *See* RMTA Opp. 22; RMTA Reply 11. Although Patent Owner asserts that “Petitioner does not specifically address any element of independent Claims 46 and 47,” and relies on the discussion of claim 38, but these claims are substantially identical to claim 38. Compare RMTA 5–9 with *id.* at 13–15. Moreover, we find that discussion already adequately accounts for all the limitations of claims 46 and 47. *See* RMTA Opp. 22. Moreover, Patent Owner does not point out which, if any, limitation is not disclosed by the combination of Armitage and Barone. Rather, Patent Owner broadly asserts that “[e]lements (d)(i)-(iii) of Claims 38 and 47 differ with respect to the functions performed by the communication management unit,” but does not explain how the combination of Armitage and Barone does not meet any limitation of claim 47. For the same reasons explained above in our discussion of claim 38 and in our discussion of original claims 1, 30, and 36, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Armitage and Barone teaches each limitation of claims 46 and 47, and that a person of ordinary skill in the art would have had a reason to combine the references in the manner proposed with a reasonable expectation of success. We adopt Petitioner’s arguments and

cited evidence as to these claims and limitations as our own determination and basis. *See* RMTA Opp. 23–24.

c. Claim 43

Proposed substitute claim 43 depends from claim 38. RMTA Reply, Claims App. A, vi. Claim 43 recites, “wherein a first one of the plurality of detectors is always enabled when the railcar is moving, and a second one of the plurality of detections is enabled when the railcar is traveling faster than a specific speed and is disabled when the railcar is traveling slower than the specific speed.” *Id.*

Petitioner asserts that the “limitations of claim 43, corresponding to original claim 25, are disclosed by Armitage and Barone.” RMTA Opp. 20 (citing Pet. 36–38; Ex. 1003 ¶¶ 101–108; Ex. 1030 ¶ 69). According to Petitioner, the new limitation “would have been obvious because it ultimately saves power for when it is needed (i.e., when the railcar is in use and traveling at high speeds).” *Id.* at 21 (citing Ex. 1030 ¶ 71).

Patent Owner asserts that Petitioner speculates as to what was known and “provides no support for its claims about what would be obvious.” RMTA Reply 10. According to Patent Owner, Petitioner does not “explain why detections ‘when the railcar is stopped or moving at a low speed’ are not needed,” and rather, “a sensor that is ‘always enabled when the railcar is moving’ as provided in Claim 43 is contrary to Petitioner’s claim that detections ‘when the railcar is . . . moving at a lower speed’ are not needed.” *Id.* at 10–11 (alteration in the original).

Petitioner responds that Patent Owner’s assertions are unfounded because “Armitage, Barone, and Leitel each disclose enabling sensors only when the railcar is in motion.” RMTA Sur-reply 11. We agree.

Armitage discloses that “sensor nodes 121–124 will sense and monitor the equipment while railway car 110 is in motion, such as when rolling.” Ex. 1006 ¶ 25. As to the second sensor turning on at high speed, we are persuaded by Petitioner’s expert that “there are certain measurements that are meaningless except at higher speeds, so sensors should only be enabled at those speeds.” Ex. 1030 ¶ 72. Thus, we find persuasive Petitioner’s expert testimony that an ordinary artisan “would understand that the second, high-speed detector would not need to be enabled at lower speeds, as it is advantageous to save power and not overload the system with unnecessary data collection and processing.” *Id.*

Thus, for the same reasons explained above in our discussion of claim 38 and in our discussion of original claim 25, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Armitage and Barone teaches each limitation of claim 43. We adopt Petitioner’s arguments and cited evidence as to this claim and limitations as our own determination and basis. *See* RMTA Opp. 20–22.

d. Claims 40, 42, 45, and 48

Proposed substitute claims 40, 42, and 45 depend from claim 38 and claim 48 depends from claim 47. RMTA Reply, Claims App. A, v–vi, ix.

Petitioner asserts that the subject matter of claims 40, 42, 45, and 48 would have been obvious over Armitage and Barone because these claims “correspond to original claims” 22, 24, 29, and 37. RMTA Opp. 20–25. Patent Owner does not raise any arguments specifically directed to claims 40, 42, 45, and 48 aside from the arguments Patent Owner directs to claim 38. *See generally* RMTA Reply. For the same reasons explained above in our discussion of claim 38 and in our discussion of original claims

22, 24, 29, and 37, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Armitage and Barone teaches each limitation of claims 40, 42, 45, and 48. We adopt Petitioner's arguments and cited evidence as to these claims and limitations as our own determination and basis. *See* RMTA Opp. 20–25.

4. Asserted Obviousness of Claims 38, 40, 42, 43, and 45–48 Based on Armitage, Barone, and Leitel

Petitioner contends that claims 38, 40, 42, 43, and 45–48 would have been obvious over the combination of Armitage, Barone, and Leitel. We first provide a brief overview of Leitel before we address Petitioner's contentions.

a. Leitel

Leitel is titled “Device and Method for a Rail Vehicle,” and relates to “devices and methods for measuring and/or testing devices for rail vehicles.” Ex. 1029 ¶ 1, code (54). Leitel recognizes that “from the output signal of the acceleration sensor, in which the acceleration measured by the acceleration sensor is reflected, the mileage and/or travel velocity can advantageously be determined by means of electronic evaluation, and at the same time the most important error signals can be determined.” *Id.* ¶ 52. Leitel discloses that “[a]cceleration sensors typically have one, two or three axial directions orthogonal to each other (also referred to as axes or dimensions), in which they can determine the accelerations. To each of these axial directions (axes, dimensions), an output signal can be provided by the acceleration sensor.” *Id.* ¶ 56. Leitel's acceleration sensor “can measure static accelerations in one, two and/or three directions (X-, Y- and Z-axis according to FIGS. 1 and 2) and accordingly outputs three signals SX, SY

and SZ associated with the axes (3-dimensional sensor).” *Id.* ¶ 122.

According to Leitel, peaks appear proportionally in the signals SX, SZ at periodic distances and are used to identify disturbances, such that “periodicity gives indication that the damage to a rotating part, e.g. flats, or defects on the bearing or running surfaces are present. In addition, the exact position of the damage can be inferred from the sensor signals.” *Id.* ¶ 156.

b. Petitioner’s Assertions

Petitioner relies on its mapping of these claims to Armitage and Barone, but further relies on Leitel to teach the processing of the output of a tri-axis accelerometer. In particular, Petitioner contends that it would have been obvious to use multiple filters—one for each of the x-, y-, and z- axes as taught by Leitel. *See* RMTA Opp. 12. Petitioner notes that Leitel notes several advantages of filtering and processing in the sensor node, including reduction of data storage or transmission, and direct transmission of error codes and failure conditions to the CMU. *See* RMTA Opp. 14 (citing Ex. 1029 ¶¶ 125, 128). Petitioner argues that Leitel also teaches the desirability of filtering out vibrations or disturbances that are unrelated to the conditions being monitored. *Id.* (citing Ex. 1029 ¶ 28; Ex. 1030 ¶ 54). Thus, Petitioner argues that Armitage, Barone, and Leitel account for all the limitations of claims 38, 40, 42, 43, and 45–48.

c. Patent Owner’s Assertions

Patent Owner argues that there is no “motivation to combine Armitage with Leitel to filter data into three distinct outputs corresponding to each axis, as Petitioner claims.” RMTA Reply 7. Patent Owner argues that “[i]nstead, Armitage teaches away from Petitioner’s claimed combination by disclosing monitoring only along the z-axis and ‘ignoring’ data from any

other axis for best results.” *Id.* (citing Ex. 1006 ¶ 45; Ex. 2010 ¶ 22). Patent Owner asserts that “[i]gnoring complete sets of data is not the same thing as the filtering in Claim 38.”

d. Analysis

We find that Petitioner has shown that the combination of Armitage, Barone, and Leitel account for all the limitations of claims 38, 40, 42, 43, and 45–48. We disagree with Patent Owner’s argument that Armitage teaches away from the combination. Instead, we agree with Petitioner that the evidence shows that a person of ordinary skill in the art would have been motivated to improve Armitage by filtering the output of the tri-axis accelerometer as taught by Leitel and that this would have offered the benefits identified by Petitioner. *See* RMTA Opp. 14; Ex. 1030 ¶¶ 65, 66, 68. We adopt Petitioner’s arguments as our own. Accordingly, we find that Petitioner has shown by a preponderance of the evidence that claims 38, 40, 42, 43, and 45–48 would have been obvious over Armitage, Barone, and Leitel.

5. Asserted Obviousness of Claim 39 Based on Armitage, Barone, LeFebvre, and Leitel

Claim 39 depends from claim 38. RMTA Reply, Claims App. A, v.

Petitioner asserts that “[t]he limitations in claim 39, corresponding to original claim 21, are disclosed by Armitage in view of Barone and LeFebvre.” RMTA Opp. 23 (citing Pet. 44–45; Ex. 1003 ¶¶ 136–137; Ex. 1030 ¶ 79).

a. Claim 39

Claim 39 recites, “wherein at least one of said communication management units includes at least one sensor configured to measure accelerations of the railcar.”

Petitioner asserts that LeFebvre’s “‘control unit 23’ (i.e., communication management unit) . . . can include a ‘triaxial accelerometer’ (i.e., sensor).” Pet. 44 (citing Ex. 1005 ¶¶ 37, 93). According to Petitioner, an ordinary artisan “would include the sensor (i.e., accelerometer) in the communication management unit, as disclosed in LeFebvre, because of the efficiency, space, and power benefits.” *Id.* at 45 (citing Ex. 1003 ¶ 137). Petitioner does not rely on Leitel for any of the specific limitations added by claim 39. *See* RMTA Opp.

Patent Owner does not raise any arguments specifically directed to claim 39 aside from the arguments Patent Owner directs to claim 38. *See generally* RMTA Reply. For the same reasons explained above in our discussion of claim 38 and in our discussion of original claim 21, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Armitage, Barone, LeFebvre, and Leitel teaches each limitation of claim 39. We adopt Petitioner’s arguments and cited evidence as to this claim and limitations as our own determination and basis. *See* RMTA Opp. 23–24.

6. Asserted Obviousness of Claims 41 and 44 Based on Armitage, Barone, Leitel, and Winfree

Claims 41 and 44 depend from claim 38. RMTA Reply, Claims App. A, vi–vii.

Petitioner asserts that the limitations in claims 41 and 44, “corresponding to original claim 23, are disclosed by Armitage, Barone and Winfree,” and that any limitations added by amendment “are discussed above with respect to independent claim 38, from which” these claims depend. RMTA Opp. 24–25 (citing Pet. 46–49; Ex. 1003 ¶¶ 139–143; Ex. 1030 ¶ 89). Petitioner does not rely on Leitel for any of the specific limitations added by claims 41 and 44.

Claim 41 recites, “wherein the one or more wireless sensor nodes further comprise one or more mechanical filters that include a resilient material configured to filter out undesirable accelerations from the accelerations, wherein the one or more mechanical filters are disposed to remove the undesirable accelerations before the undesirable accelerations reach the tri-axis sensor that is configured to measure accelerations.” RMTA Reply, Claims App. A, vi. Claim 44 recites, “wherein the one or more wireless sensor nodes further comprise one or more mechanical filters.” *Id.* at vii.

Petitioner asserts that “Winfree teaches a mechanical filter for accelerometers, and [an ordinary artisan] would be motivated to combine the teachings of Armitage and Barone with Winfree to add another layer of filtering—with a mechanical filter—to filter out undesirable accelerations data in the system.” Pet. 46 (citing Ex. 1003 ¶ 138).

Patent Owner does not raise any arguments specifically directed to claims 41 and 44 aside from the arguments Patent Owner directs to claim 38. *See generally* RMTA Reply. Nonetheless, Patent Owner argues that Winfree is not analogous art. RMTA Reply 5. Patent Owner asserts that “Petitioner concedes that Winfree is not within the same field of endeavor”

as the '915 patent, and that Winfree is not pertinent to “the use of mechanical filters to remove undesirable accelerations on a railcar in a demanding environment.” *Id.*

Although we appreciate that Winfree is not used on a railcar in a demanding environment, Winfree “relates to the protection of sensors from mechanical shock, vibration, and impact,” and discloses accelerometers as an exemplary sensor. Ex. 1008, 1:19–20, 2:44–45. Given that a mechanical filter is not a requirement of the invention and is only recited in the dependent claims, Patent Owner’s assertion that the particular problem of the inventor is removing undesirable accelerations on a railcar in a demanding environment is unnecessarily narrow. Instead, we agree with Petitioner that the problem addressed by the '915 patent is more appropriately described as filtering waves from an accelerometer entering a sensor “to selectively transmit, attenuate, or amplify various frequencies of incident elastic waves that would otherwise propagate from the environment and into the sensor,” as also taught by Winfree. *See* RMTA Sur-reply 5 (citing Ex. 1008, 2:24–29; Ex. 1030 ¶ 22).

We also agree with Petitioner that Winfree only criticizes certain bulky, elastomeric mechanical filters, and it is unclear why this is relevant because the '915 patent does not teach these prior art sensors. *See id.* (citing Ex. 1008, 1:24–2:20). Indeed, we agree with Petitioner that both the '915 patent and Winfree explicitly state one of the purposes of mechanical filtering is to remove undesirable accelerations and amplify desirable accelerations. *See id.* (citing Ex. 1001, 5:23–32; Ex. 1008, 2:24–45, 4:54–63). Moreover, both patents also teach mechanical filters can protect sensors from damage. *Compare* Ex. 1001, 5:56–67 *with* Ex. 1008, 1:19–22, 2:30–

33). Accordingly, we agree that because Winfree is “used as a filter to selectively transmit, attenuate, or amplify various frequencies” (Ex. 1008, 2:26–27), Winfree is pertinent to filtering out undesirable accelerations.

Therefore, Winfree is pertinent to a problem faced by the inventor, and thus, is analogous art. For the same reasons explained above in our discussion of claim 38 and in our discussion of original claim 23 (and 26), we determine that Petitioner has shown by a preponderance of the evidence that the combination of Armitage, Barone, Leitel, and Winfree teaches each limitation of claims 41 and 44. We adopt Petitioner’s arguments and cited evidence as to these claims and limitations as our own determination and basis. *See* RMTA Opp. 24–25.

*7. Asserted Obviousness of Claims 38, 39, 40, 42, 43, 45–48
Based on LeFebvre, Barone, and Armitage*

Because we have already determined that the combination of Armitage and Barone teaches each limitation of claims 38, 40, 42, 43, and 45–48, we do not reach whether LeFebvre additionally discloses any of the limitations of claims 38, 40, 42, 43, and 45–48. As to claim 39, we have already determined that LeFebvre discloses the additional limitations of claim 39. *See* Section V.D.5.b. Petitioner relies on LeFebvre in the same manner as for the grounds based on Armitage, Barone, LeFebvre, and Leitel. *Id.*; *see also* RMTA Opp. 23–24.

*8. Asserted Obviousness of Claims 38, 39, 40, 42, 43, and
45–48 Based on LeFebvre, Barone, Armitage, and Leitel*

Because we have already determined that the combination of Armitage and Barone teaches each limitation of claims 38, 40, 42, 43, and 45–48, we do not reach whether LeFebvre or Leitel additionally discloses

any of the limitations of claims 38, 40, 42, 43, and 45–48. As to claim 39, we have already determined that LeFebvre discloses the additional limitations of claim 39. *See* Section V.D.5.b. Petitioner relies on LeFebvre in the same manner as for the grounds based on Armitage, Barone, LeFebvre, and Leitel. *Id.*; *see also* RMTA Opp. 23–24.

9. *Asserted Obviousness of Claims 41 and 44 Based on LeFebvre, Barone, Armitage, and Winfree*

Because we have already determined that the combination of Armitage, Barone, and Winfree teaches each limitation of claims 41 and 44, we do not reach whether LeFebvre additionally discloses any of the limitations of claims 41 and 44. *See* Section III.D.6; *see also* RMTA Opp. 24–25.

VI. SUMMARY

For the reasons discussed above, Petitioner has demonstrated, by a preponderance of the evidence, that claims 1, 21–30, 36, and 37 of the ’915 patent are unpatentable.¹¹ Patent Owner’s Motion to Exclude is dismissed as moot. Patent Owner’s Motion to Amend is denied.

¹¹ 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*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

Our conclusions regarding the Challenged Claims are summarized below:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1, 22, 24, 25, 27–30, 36, 37	103	Armitage, Barone	1, 22, 24, 25, 27–30, 36, 37	
21	103	Armitage, Barone, LeFebvre	21	
23, 26	103	Armitage, Barone, Winfree	23, 26	
1, 21, 22, 25, 27–30, 36, 37	103	LeFebvre, Barone	1, 21, 22, 25, 27–30, 36, 37	
24, 37	103	LeFebvre, Barone, Armitage	24, 37	
23, 26	103	LeFebvre, Barone, Winfree	23, 26	
Overall Outcome			1, 21–30, 36, 37	

Motion to Amend Outcome	Claims
Original Claims Cancelled by Amendment	
Substitute Claims Proposed in the Amendment	38–48
Substitute Claim: Motion to Amend Granted	
Substitute Claim: Motion to Amend Denied	38–48
Substitute Claims: Not Reached	

VII. ORDER

In consideration of the foregoing, it is:

ORDERED that Patent Owner’s Motion to Exclude (Paper 32) is *dismissed as moot*;

FURTHER ORDERED that claims 1, 21–30, 36, and 37 of U.S. Patent No. 10,137,915 B2 are determined to be unpatentable;

FURTHER ORDERED that Patent Owner's Revised Motion to Amend is *denied*; and

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

IPR2023-00540
Patent 10,137,915 B2

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