

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

Case IPR2023-00540
US Patent No. 10,137,915

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

**DECLARATION OF STEVEN RICCA IN SUPPORT OF PETITIONER'S
OPPOSITION TO PATENT OWNER'S REVISED MOTION TO AMEND**

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. MATERIALS CONSIDERED	1
III. OVERVIEW OF THE SUBSTITUTE CLAIMS	1
IV. LEGAL PRINCIPLES	7
A. Obviousness	7
B. Written Description	7
C. Indefiniteness	7
V. LEVEL OF ORDINARY SKILL IN THE ART	8
VI. CLAIM CONSTRUCTION	8
VII. SUBSTITUTE CLAIM 43 LACKS WRITTEN DESCRIPTION	8
VIII. SUBSTITUTE CLAIMS 38, 43, 46, AND 47 ARE INDEFINITE (35 U.S.C. § 112)	9
A. Claims 38, 46, and 47: “ones of the accelerations”	9
B. Claims 38, 46, and 47: “a plurality of detectors respectively coupled to the plurality of filters” and “a respective one of a plurality of different railcar conditions”	9
IX. SUBSTITUTE CLAIMS 38-48 ARE INVALID AS OBVIOUS	10
A. Motivation to Combine	12
B. Independent Claim 38	14
C. Claim 43	34
D. Claims 46 and 47	36
E. Dependent Claims 39–42, 44-45 and 48	37
i. Dependent Claim 39	37
ii. Dependent Claim 40	37
iii. Dependent Claim 41	38
iv. Dependent Claim 42	38
v. Dependent Claim 44	39
vi. Dependent Claim 45	39
vii. Dependent Claim 48	40

I. INTRODUCTION

1. I, Steven Ricca, hereby declare that the following is true and correct. I previously provided a declaration filed as EX1003 in support of Paper No. 1, Petition for *Inter Partes* Review (“Petition”), and my testimony from that first Declaration remains the same. I am competent to make this Declaration based upon my personal knowledge and technical expertise, which I addressed in my first declaration. If called to testify, I could and would testify honestly, under oath, to the matters set forth herein.

2. I have been asked to provide my opinion on whether the substitute claims of Patent Owner’s Revised Motion to Amend for the ’915 Patent (the “Motion”) are unpatentable over certain prior art references. As explained below, it is my opinion that each of substitute claims 38-48 is unpatentable because each would have been obvious to a PHOSITA in view of the prior art, lacks written description, and/or is indefinite.

II. MATERIALS CONSIDERED

3. In preparing this Declaration, I have considered all the materials filed through the date of this Declaration in this proceeding and any other materials cited in this Declaration.

III. OVERVIEW OF THE SUBSTITUTE CLAIMS

4. The substitute claims that I considered are reproduced in the table below. In this table, I understand that deletions from the original ’915 patent claims

are struck or double bracketed, and newly added limitations are underlined.

5. For ease of reference, I have adopted a shorthand numbering for the claims, and individual claim limitations that is similar to the shorthand numbering I adopted in my first declaration for the original claims of the '915 Patent. For example, as indicated in the table below, I may use "Limitation 38(a)" as a shorthand reference to the limitation "one or more communication management units mounted on one or more railcars" in claim 38.

Claim Limitation	Claim Language
Claim 38 Preamble	A system for detecting operational anomalies on a train consist or railcar, comprising:
Limitation 38(a)	(a) one or more communication management units mounted on one or more railcars;
Limitation 38(b)	(b) one or more <u>wireless sensor</u> [[s]] <u>nodes</u> located on said one or more railcars <u>and</u> configured to sense an operational parameter of said one or more railcars, said <u>one or more wireless sensor</u> [[s]] <u>nodes</u> being in communication with said one or more communication management units, wherein the one or more <u>wireless sensor</u> [[s]] <u>nodes</u> comprise <u>a tri-axis ~~one or more~~ sensor</u> [[s]] configured to measure accelerations of the railcar <u>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;</u> and
Limitation 38(c)(i)	(c) <u>a plurality of ~~one or more~~ sensor sections that are provided with the one or more wireless sensor nodes and that comprise</u> (i) <u>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</u>

Claim Limitation	Claim Language
	<u>axes, and</u>
Limitation 38(c)(ii)	(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;
Limitation 38(d)	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 parameter[[s]] of said one or more railcars;
Limitation 38(e)	(ii) analyzing said collected data to detect a[[for]] trend[[s]] or event[[s]] indicative of an anomalous operational condition of said one or more railcars; and
Limitation 38(f)	(iii) communicating a message to a remote receiver when said trend or event is detected.
Claim 39	The system of claim 38[[1]], wherein at least one of said communication management units includes at least one of said sensor[[s]] <u>configured to measure accelerations of the railcar.</u>
Claim 40	The system of claim 38[[1]], further comprising a powered wireless gateway configured to control a train-based network that includes said powered wireless gateway and a plurality of said communication management units.
Claim 41	The system of claim 38[[1]], wherein the one or more <u>wireless sensor nodes further</u> ~~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 <u>tri-axis</u> ~~one or more~~ sensor[[s]] that <u>is</u> [[are]] configured to measure accelerations.
Claim 42	The system of claim 38[[1]], ~~further comprising one or more wireless sensor nodes in communication with at least one of the communication management units, wherein the one or more sensors form part of the one or more wireless sensor~~

Claim Limitation	Claim Language
	~~nodes~~ , wherein one or more of the wireless sensor nodes comprise a protective housing, wherein the <u>tri-axis ~~one or more~~ sensor</u> [[s]] <u>is</u> [[are]] mounted within the protective housing, wherein the protective housing comprises a <u>potting material configured to tune the wireless sensor nodes by absorbing at least a portion of undesirable accelerations.</u>
Claim 43	The system of claim <u>38</u> [[1]], ~~further comprising one or more wireless sensor nodes in communication with at least one of the communication management units, wherein the one or more sensors form part of the one or more wireless sensor nodes~~ , 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, wherein the firmware comprises one or more software filters configured to isolate one or more types of accelerations, and wherein a first one of the <u>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 railyard is traveling slower than the specific speed.</u>
Claim 44	The system of claim <u>38</u> [[1]], wherein the one or more <u>wireless sensor nodes</u> ~~filters further~~ comprise one or more mechanical filters.
Claim 45	The system of claim <u>38</u> [[1]], wherein said remote receiver is located off-train.
Claim 46 Preamble	A method for detecting operational anomalies on a train consist or railcar comprising the steps of:
Limitation 46(a)	sensing, by a ~~one or more~~ <u>tri-axis sensor</u> [[s]] <u>of one or more wireless sensor nodes</u> located on one or more railcars, one or more operational parameters of the one or more railcars, wherein the one or more operational parameters comprise one or more accelerations <u>and the tri-axis sensor is configured to measure accelerations of the ~~one or more~~ railcar</u> [[s]] <u>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;</u>
Limitation 46(b)	filtering, by <u>each of a plurality of ~~one or more~~ filters of a</u>

Claim Limitation	Claim Language
	<u>plurality of sensor sections that are provided with the one or more wireless sensor nodes, 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</u>
Limitation 46(c)	<u>detecting, by each of a plurality of detectors of the plurality of sensor sections, 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; and</u>
Limitation 46(d)	by one or more communication management units associated with the one or more railcars: <u>collecting, from the one or more wireless sensor nodes, data regarding said ~~one or more railcar~~ operational parameters of said one or more railcars;</u>
Limitation 46(e)	<u>analyzing said collected data to detect a[[for]] trend[[s]] or event[[s]] indicative of an anomalous operational condition of said one or more railcars; and</u>
Limitation 46(f)	communicating a message to a remote receiver when said trend or event is detected.
Claim 47 Preamble	A system for detecting operational anomalies on a railcar that is part of a train consist comprising:
Limitation 47(a)	(a) at least one communication management unit (CMU) mounted on the [[a]]railcar in said train consist;
Limitation 47(b)	(b) at least two <u>wireless sensor[[s]] nodes</u> located on the [[said]]railcar <u>and[[for]] configured to sense operational parameters of the railcar, said wireless sensor[[s]] nodes being in communication with said communication management unit, wherein the at least two ~~one or more~~ wireless sensor[[s]] nodes comprise a tri-axis ~~one or more~~ sensor[[s]] 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</u>
Limitation 47(c)(i)	(c) <u>a plurality of ~~one or more~~ sensor sections that are</u>

Claim Limitation	Claim Language
	<u>provided with the one or more wireless sensor nodes and that comprise</u> <u>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</u>
Limitation 47(c)(ii)	<u>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;</u>
Limitation 47(d)	wherein said communication management unit performs the following functions: (i) receiving data from said <u>at least two wireless sensor</u> [[s]] <u>nodes</u> ;
Limitation 47(e)	(ii) drawing inferences from the data received from at least two <u>wireless</u> ~~of the~~ <u>sensor</u> [[s]] <u>nodes</u> regarding the performance of the railcar; and
Limitation 47(f)	(iii) communicating a message to a remote receiver when an anomaly is detected.
Claim 48 Preamble	The system of claim 47[[36]],
Limitation 48(a)	wherein said <u>tri-axis</u> sensors comprise accelerometers positioned at different locations of the railcar,
Limitation 48(b)	wherein said step of drawing inferences comprises the comparison of data from ~~two or more of~~ said accelerometers,
Limitation 48(c)	wherein said accelerometers are positioned on the railcar to provide data for carrying out one or more of the following functions:
Limitation 48(d)	(i) compare accelerations from one railcar wheel with that of another railcar wheel on the same axle but opposite side of the railcar,
Limitation 48(e)	(ii) compare accelerations from one railcar wheel with that of at least one other wheel on the same side of said railcar, and

Claim Limitation	Claim Language
Limitation 48(f)	(iii) compare accelerations from one railcar wheel with that of at least one other railcar wheel on the same side of said one railcar wheel and which other wheel is on another railcar of the same train consist.

IV. LEGAL PRINCIPLES

A. Obviousness

6. In forming my opinions and considering the subject matter of the '915 patent and substitute claims 38-48, I am relying on certain legal principles that counsel in this case has explained to me, including the legal principle of obviousness.

7. I have applied the same legal principles of obviousness as in my previous declaration, and I incorporate them by reference here. EX1003, ¶¶ 57-64.

B. Written Description

8. Counsel has informed me that substitute claims must be supported by the written description of the original application, and may not introduce new subject matter. I have been informed that to satisfy the written description requirement, the description must clearly allow persons of ordinary skill in the art to recognize that the inventor invented what is claimed. Thus, a claim fails to satisfy the written description requirement if it includes a limitation that is not disclosed by the original specification of the '915 Patent.

C. Indefiniteness

9. Counsel has informed me that a claim is indefinite if, when read in light of the patent specification and its prosecution history, it fails to inform those skilled

in the art about the scope of the invention with reasonable certainty. In particular, I have been informed that a claim is indefinite if a PHOSITA could not clearly understand what is covered by the claim in order to avoid infringement.

V. LEVEL OF ORDINARY SKILL IN THE ART

10. In my first declaration, I provided my opinion on the level of ordinary skill in the art. EX1003, ¶¶ 42-45. In my opinion, the same level of ordinary skill in the art applies to the proposed substitute claims.

VI. CLAIM CONSTRUCTION

11. As I noted in my first declaration, I have been informed that in a proceeding for *inter partes* review, claim terms in an unexpired patent are to be given their plain and ordinary meaning, as understood by a person having ordinary skill in the art, in view of the patents' specification. *See* 42 CFR § 42.100(b); 83 FR 51340; *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).

12. It is my understanding that Patent Owner has not proposed a construction of any new words or phrases that have been added to the substitute claims.

13. It is my opinion that all claim terms, for the purposes of *inter partes* review can be given their plain and ordinary meaning.

VII. SUBSTITUTE CLAIM 43 LACKS WRITTEN DESCRIPTION

14. In my opinion, substitute claim 43 includes limitations that are not supported by the specification of the '915 Patent.

15. Substitute claim 43 has new limitations requiring “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 railyard is traveling slower than the specific speed.” In my opinion, the claimed combination of features is not disclosed anywhere in the specification of the '915 Patent, nor does Patent Owner point to a single embodiment in the specification of the '915 Patent that teaches the two sets of detectors as claimed.

VIII. SUBSTITUTE CLAIMS 38, 43, 46, AND 47 ARE INDEFINITE
(35 U.S.C. § 112)

A. Claims 38, 46, and 47: “ones of the accelerations”

16. To me, it is unclear what the term “ones of the accelerations” means in substitute claims 38, 46, and 47. The term does not appear in the specification, and in my opinion, it is not a term of art reasonably understood to a PHOSITA.

B. Claims 38, 46, and 47: “a plurality of detectors respectively coupled to the plurality of filters” and “a respective one of a plurality of different railcar conditions”

17. To me, it is unclear what 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” means in substitute claims 38 and 47. Claim 46 includes a similar limitation (46(c))

that I believe is indefinite for the same reasons as claims 38 and 47. In reading this limitation, a PHOSITA would have a number of questions. Do these terms require a one-to-one correlation between detectors and filters, or between detectors and railcar conditions? Does one detector determine one type of railcar condition? Can multiple detectors determine one type of railcar condition? Can one detector determine several different railcar conditions? There is no explanation in the specification and therefore, in my opinion, this claim fails to inform, with reasonable certainty, those skilled in the art about the scope of the invention.

IX. SUBSTITUTE CLAIMS 38-48 ARE INVALID AS OBVIOUS

18. As I explained in my first declaration in this proceeding (EX1003), original claims 1, 21-30, 36, and 37 of the '915 Patent are obvious in view of Armitage (EX1006), Barone (EX1007), LeFebvre (EX1005), and Winfree (EX1008). Specifically, I explained that:

- 1) Claims 1, 22, 24-25, 27-30, 36, and 37 are obvious in view of Armitage and Barone;
- 2) Claim 21 is obvious in view of Armitage, Barone, and LeFebvre;
- 3) Claims 23 and 26 are obvious in view of Armitage, Barone, and Winfree;
- 4) Claims 1, 21-22, 25, 27-30, 36, and 37 are obvious in view of LeFebvre and Barone;
- 5) Claims 24 and 37 are obvious in view of LeFebvre, Barone, and

Armitage; and

6) Claims 23 and 26 are obvious in view of LeFebvre, Barone, and Winfree. The same limitations present in original claims 1, 21-26, 29, 36, and 37 also appear in substitute claims 38-48. My analysis of these original claim limitations does not differ from my first declaration, EX1003, and I incorporate that analysis herein by reference.

19. In my opinion, the new limitations of substitute claims 38-48 merely recite specific features (e.g., using a triaxial accelerometer) that were conventional, obvious, and well-known in the prior art. It is my opinion that Patent Owner's substitute claims are obvious in view of the prior art in at least the grounds listed below. I will explain in more detail below where each of these features are found in the prior art.

- Ground 1: Claims 38, 40, 42, 43, and 45–48 are unpatentable under 35 U.S.C. § 103(a) in view of Armitage and Barone;
- Ground 2: Claims 38, 40, 42, 43, 45–48 are unpatentable under 35 U.S.C. § 103(a) in view of Armitage, Barone, and Leitel;
- Ground 3: Claim 39 is unpatentable under 35 U.S.C. § 103(a) in view of Armitage, Barone, LeFebvre, and Leitel;
- Ground 4: Claims 41 and 44 are unpatentable under 35 U.S.C. § 103(a) in view of Armitage, Barone, Leitel, and Winfree;

- Ground 5: Claims 38, 39, 40, 42, 43, 45–48 are unpatentable under 35 U.S.C. § 103(a) in view of LeFebvre, Barone, and Armitage;
- Ground 6: Claims 38, 39, 40, 42, 43, 45–48 are unpatentable under 35 U.S.C. § 103(a) in view of Lefebvre, Barone, Armitage, and Leitel; and
- Ground 7: Claims 41 and 44 are unpatentable under 35 U.S.C. § 103(a) in view of LeFebvre, Barone, Armitage, and Winfree.

A. Motivation to Combine

20. As I explained in my declaration submitted with the Petition, Armitage, LeFebvre, and Barone are analogous art and a PHOSITA would have found it obvious to combine their disclosures. *See* Petition (Pet.), 20-21, 44-45, 49-50; EX1003, ¶¶ 66, 135, 137, 145. Armitage, LeFebvre, and Barone each describe systems for wirelessly monitoring rail vehicles and utilize nearly identical components that function in a similar way. *See* EX1005, (57) Abstract; EX1006, (57) Abstract, EX1007, (57) Abstract. Specifically, each reference discloses a system that utilizes a plurality of wireless sensors to monitor the wheels on a rail vehicle, wherein the sensors communicate with a control unit located on the vehicle to determine anomalous conditions of a railcar in real-time and to wirelessly report the anomalous conditions and determine a failure condition. EX1005, ¶¶ [0058]–[0059]; EX1006, ¶¶ [0013]–[0015], [0025]; EX1007, Abstract, ¶¶ [0002], [0006].

21. Like Armitage, LeFebvre, and Barone, Leitel (EX1029) are also

directed to a system for wirelessly monitoring rail vehicles using wireless sensor devices. Leitel describes wireless sensor devices that can be attached, for example, to the shaft of a vehicle axle of a rail vehicle. EX1029, ¶ [0004]. The sensor devices can include a variety of sensors, including temperature sensors capable of detecting bearing temperature (*id.*, ¶ [0018]), and acceleration sensors capable of detecting wheel damage (¶ [0062]), wheel derailments (¶ [0066]), and other conditions. Leitel's sensor devices can wirelessly transmit signals to a telematics unit mounted on the railcar, which in turn is capable of wirelessly transmitting an alarm signal to a remote location. EX1029, ¶¶ [0144]–[0146], Fig. 11.

22. Winfree broadly discloses a filter for mechanical waves entering a sensor. EX1008, (57) Abstract. Again, as I explained in detail in my first declaration submitted with the Petition, a PHOSITA would have been motivated to combine the teachings of Armitage, LeFebvre, and the other cited references with Winfree to add another layer of filtering—with a mechanical filter—to filter out undesirable accelerations. *See* Pet., 45-49, 77-80; EX1003, ¶¶ 138-143, 225-230.

23. In my opinion, a PHOSITA would have understood that Armitage, LeFebvre, Barone, Leitel, and Winfree are analogous art and would have been motivated to combine the teachings of these references for the reasons I will address in more detail below for the substitute claims.

B. Independent Claim 38

24. Grounds 1, 2: As already discussed in my first declaration, most limitations of claim 38, including all limitations present in original claim 1, are disclosed by Armitage and Barone. *See* Pet., 21-33; EX1003, ¶¶ 68-90.

25. Grounds 5, 6: As already discussed in my first declaration, most limitations of claim 38, including all limitations present in original claim 1, are disclosed by LeFebvre and Barone. *See* Pet., 51-61; EX1003 at ¶¶ 147-170.

26. I understand that there are new limitations in claim 38 that I did not previously address, so these will be discussed below.

Limitation 38(b): “one or more wireless sensor[[s]] 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[[s]] nodes being in communication with said one or more communication management units, wherein the one or more wireless sensor[[s]] nodes comprise a tri-axis one or more sensor[[s]] 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;”

27. Grounds 1 and 2: In my first declaration, I discussed what Armitage discloses, including a plurality of sensor nodes that communicate wirelessly with a control node (i.e., CMU) on a railcar, each of which is attached to a separate undercarriage element of a railcar. EX1003, ¶¶ 70, 74; EX1006, Figs. 1, 3, 5, ¶¶ [0004], [0012], [0014], [0020], [0027], [0033], [0054], Figs. 1, 3, 5; *see also* Abstract, Fig. 6, [0015]-[0016], [0025]-[0026], [0029]-[0031], [0034]-[0035],

[0050], [0053]; *see* Pet., 23-25.

28. Armitage also discloses that the sensor portion of the “sensor nodes” may include an accelerometer, and that that accelerometer may be a “three-dimensional accelerometer, such as a solid state accelerometer device.” EX1006, ¶¶ [0014], [0033], [0045], [0046], [0056].

29. In my opinion, a PHOSITA would understand that “a three-dimensional accelerometer” measures accelerations along three perpendicular axes, which could be aligned with the width, length, and height of the railcar, respectively. Armitage, for example, discloses an example where the “z-axis [is] aligned with the axle of a particular wheel or wheel assembly,” the “x-axis [is] aligned with the horizontal,” and the “y-axis [is] aligned with the vertical with respect to the railway car or wheel.” EX1006, ¶ [0045]. In this example laid out in Armitage, the z-, x-, and y-axes extend along the width, length, and height of the railcar.

30. Grounds 5 and 6: In my first declaration, I explained what LeFebvre discloses, including a wireless system for continuously monitoring the behavior and condition of trucks, wheels, and bearings of a railcar. EX1003, ¶¶ 152, 155, 206. LeFebvre’s system also includes instrumented pads (i.e., wireless sensor nodes), which communicate wirelessly with a communications management unit located on the railcar. EX1003, ¶ 152, 155, 206.

31. As I’ve previously noted, the sensor nodes in LeFebvre can include

accelerometers. EX1005, Claims 28, 30; EX1003, ¶ 152. I understand that LeFebvre does not discuss the specific features of the accelerometer in its sensor node and does not expressly state that the accelerometer in the sensor node of LeFebvre is a *triaxial* accelerometer. However, in my opinion, a PHOSITA would have understood that there were compelling reasons to select a triaxial accelerometer (as opposed, for example, to a single-axis accelerometer) for incorporation into a railcar sensor device.

32. Specifically, in my opinion and based on the disclosure of LeFebvre at ¶ [0037], a PHOSITA would have understood that, because a triaxial accelerometer collects acceleration data along *three* axes, it is able to provide information on a wider variety of motions than (for example) a single-axis accelerometer. Also, since the sensor nodes are not limited to any specific type of accelerometer, in my opinion a PHOSITA would understand that triaxial accelerometers, the only specifically identified accelerometer in the specification, would also be used in the sensor nodes.

33. Further, Armitage discloses that its sensor nodes may comprise a triaxial accelerometer that measures accelerations along three perpendicular axes, which can be aligned with the width, length, and height of the railcar. As I will discuss more in Limitation 38(c), in my opinion, a PHOSITA would have been motivated to select a triaxial accelerometer for use in LeFebvre's sensor node (rather than, for example, a single-axis accelerometer) because a triaxial accelerometer is

capable of monitoring a wider variety of conditions.

34. In my opinion, a PHOSITA would have understood that in practice, a tri-axis accelerometer is simply a combination of three perpendicular, single-axis accelerometers into a single device. A PHOSITA would have understood that the cost of a triaxial accelerometer is only slightly greater than that of just one single-axis accelerometer, so it is much less expensive to purchase one triaxial accelerometer instead of three separate single-axis units. Also, a PHOSITA would have known that a triaxial accelerometer requires less work to install than installing three separate, single-axis accelerometers. In my opinion, a PHOSITA would therefore have been motivated to select a triaxial accelerometer for use in LeFebvre's sensor nodes due to its simplicity, ease of installation, and cost-effectiveness.

Limitation 38(c)(i): “(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,”

35. Ground 1: Armitage discloses a filter that filters output signals from a plurality of sensor sections of a sensor node (i.e., a triaxial accelerometer) and isolates accelerations from each sensor section for a single axis to detect a variety of railcar conditions. EX1006, ¶ [0045].

36. I understand the claimed “sensor sections” are described in the

specification of the '915 Patent, but in my opinion, they do not have a well-understood meaning in the art. A PHOSITA would understand there could be many types of “sensor sections.” There could be “sensor sections” that generally detect parameters or “sensor sections” that are tuned or designed to detect specific railcar conditions (i.e., wheel damage). In my opinion, in reading the specification and viewing the figures, the “sensor sections” generally comprise a filter and a detector in order to detect certain railcar conditions.

37. Patent Owner’s expert, Dr. Shamos, admits that Armitage discloses a three-dimensional accelerometer in his declaration. EX2009 at ¶ 17. Yet Dr. Shamos argues that because Armitage monitors vibrations along a single axis and “[v]ibrations along the other two axes...are ignored,” “the sensor is not tri-axial.” *Id.* I disagree. In my opinion, a PHOSITA would understand that a three-dimensional accelerometer—by definition—measures vibrations accelerations along three distinct dimensions. Just because some of the acceleration measurements may be ignored or discarded by other components of the system does not change the nature of the acceleration sensor. Actually, the manner in which Armitage's preferred embodiment processes the output of the three-dimensional accelerometer—selecting data corresponding to one axis and ignoring or discarding data corresponding to the other two axes—is the type of filtering that is encompassed by Limitation 38(c)(i). *See* EX1001 (the '915 Patent), 13:11-24 (“[t]hese sensor sections select the data to

be analyzed *using a digital data filter*...[d]ata selection can be based on, for example, *direction*...frequency..."); 13:36-14:9 (disclosing three sensor sections of the tri-axis accelerometer that extract certain characteristic data of railcar events corresponding to the x, y, and z axes).

38. Going even further, Armitage explains why, when detecting wheel damage, it is beneficial to consider only accelerations along the z-axis (“axial” accelerations), and to ignore accelerations along the x- and y-axes (“radial” accelerations). EX1006, ¶ [0045]. Basically, Armitage describes filtering the output of a three-dimensional accelerometer to isolate vibrations from a single axis is useful to detect failure conditions, such as wheel damage, that are associated with vibrations along a single axis.

39. I understand Patent Owner has argued that Armitage only isolates vibrations from a single axis, and therefore “teaches away” from the system required in claim 38, which requires “a plurality of filters.” Motion, 19. But, in my opinion, Armitage “does not criticize, discredit, or otherwise discourage” a PHOSITA from filtering a tri-axial accelerometer’s output into three separate outputs (corresponding to each of three axes). While Armitage provides “some examples” of filtering data corresponding to the z-axis, a PHOSITA would have understood these are mere examples and that vibrations along any of the three axes (i.e., along each of the x-axis, the y-axis, and the z-axis), alone or in combination, could and would be filtered

to detect various conditions of a railcar. EX1006, ¶ [0045].

40. In my experience, there are several examples of why a PHOSITA would want to monitor accelerations along each axis to determine certain problem conditions of a railcar. As one example, a PHOSITA would have understood that accelerations along the transverse axis extending along the width of the railcar can be used to monitor conditions including truck hunting, which is a repetitive movement truck back and forth across the line of the rails (*see, e.g.*, EX1005, ¶ [0054]), wheel flat conditions (EX1006, ¶ [0045]), and bearing defects, among others. As another example, a PHOSITA would have understood that accelerations along the vertical axis can be used to monitor conditions including track defects, which generate large and sudden forces in the wheels and bearings (*see, e.g.*, EX1005, ¶¶ [0054], [0066]), wheel derailments (*see, e.g.*, EX1005, ¶ [0061]; EX1029 (Leitel), ¶ [0066]), and bearing defects, among others. And a PHOSITA would have understood that accelerations along the longitudinal axis extending along the length of the railcar can be used to monitor conditions including track switching impacts (*see, e.g.*, EX1029 (Leitel), ¶ [0064]), truck hunting movements involving yaw displacements (*see, e.g.*, EX1005, ¶ [0062]), changes in velocity (including collisions), and bearing defects, among others.

41. It is my opinion that the claimed limitations would have been obvious to a PHOSITA in view of Armitage. Armitage discloses a three-dimensional

accelerometer, it discloses that the output can be filtered to isolate accelerations corresponding to a single axis, and it expressly gives an example of filtering accelerations along the axis extending along the width of the railcar. EX1006, ¶ [0045]. To the extent that claim 38 requires the use of *multiple* filters, each corresponding to a different axis, it is my opinion that a PHOSITA would have been motivated to use multiple filters in order to monitor multiple axes and thereby detect a wider range of potential problem conditions.

42. In my opinion, using three single-axis filters as disclosed by Armitage, for each of the x-, y-, and z-axes, does not provide any new or unexpected results. Instead, in my opinion, three copies of the single-axis filter would provide exactly the result I would expect: three output signals corresponding to (1) accelerations along the x-axis, (2) accelerations along the y-axis, and (3) accelerations along the z-axis.

43. As I discussed in my first declaration in detail, in my opinion it would have been obvious to a PHOSITA to filter the output signals from the triaxial accelerometer in Armitage using the techniques taught in Barone. 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. EX1003, ¶ 80; EX1006, ¶¶ [0114]-[0115], Fig.

8.

44. Barone further teaches the use of a high-pass, low-pass, and/or band-pass filters to remove unwanted data and/or amplify particularly relevant accelerations data (e.g., using software running on micro-controller 177). EX1003, ¶ 81; EX1007, ¶¶ [0116], [0172]-[0185], Fig. 8. Barone explicitly discloses filtered data (both digital and electronic), which shows filtering accelerations was well-known in the art and a PHOSITA would be motivated to include the filtering taught by Barone to remove unwanted data and/or amplify particularly relevant accelerations data. EX1003, ¶ 81.

45. In my opinion a PHOSITA would have been motivated to apply the filtering techniques taught by Barone to the accelerometer data collected by Armitage for the same reasons discussed in the Petition: the advantage of filtering is to remove unwanted data and/or amplify particularly relevant data, and the purpose of both the Armitage and Barone systems is to analyze data in a train monitoring system to accurately predict anomalous conditions and avoid false or inaccurate data processing. EX1003, ¶ 82; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

46. Combining the selection/ignoring of data (i.e., filtering) in Armitage and the filtering taught in Barone would have predictably resulted in the filtering of accelerations data. EX1003, ¶¶ 76, 79, 82. In other words, the data in Armitage is filtered in two different ways: (1) selecting vibration data corresponding to a

particular axis or axes and ignoring data from the other(s) to determine particular railcar conditions as taught by Armitage; and (2) removing unwanted outlier data and noise and amplifying relevant data based on vibration frequency to improve the accuracy of data processing and detection of fault conditions as taught by Barone. In fact, and as will be discussed in more detail later in my declaration, Leitel discloses both forms of data filtering. EX1029, ¶¶ [0122], [0125], [0128], [0151]-[0164].

47. Armitage further teaches data processing, which a PHOSITA would understand include data filtering, at either the CMU or sensor nodes. Pet., 25-28; EX1006, ¶¶ [0045]-[0046], [0056]. But to the extent Armitage does not expressly teach filtering of accelerations at the sensor node, a PHOSITA would have been motivated to do so in view of Barone, which teaches filtering in the sensor. EX1006, ¶¶ [0114]-[0115]. In my opinion, a PHOSITA would have understood various considerations impact where filtering occurs in the system, including, for example, reduced data storage and transmission.

48. Ground 2: In my opinion and as already discussed in Ground 1, *supra*, Armitage discloses a wireless sensor node comprising a tri-axis accelerometer and filtering the output of the tri-axis accelerometer to isolate accelerations corresponding to a single axis. A PHOSITA would have found it obvious to filter the output of a tri-axis accelerometer using multiple filters for each of the x-, y-, and

z-axes in view of Armitage. Leitel expressly discloses monitoring acceleration data corresponding to each of the x-, y-, and z-axes, and a PHOSITA would have been motivated to combine the teachings of Armitage and Letiel as I will discuss in more detail below.

49. Similar to Armitage, Leitel discloses a wireless system for monitoring railcars, including one or more wireless sensor nodes in communication with a telematics unit (i.e., a communication management unit) located on the railcar. *See, e.g.,* EX1029 at ¶¶ [0004], [0010], [0013], [0035], [0044], [0071], [0077], [0134]. The wireless sensor nodes can include acceleration sensors capable of detecting wheel damage (¶ [0062]), wheel derailments (¶ [0066]), and other conditions. *Id.*

50. Leitel also discloses that the acceleration sensor may be a tri-axial sensor, which outputs signals corresponding to measured accelerations in three axial directions. EX1029, ¶¶ [0056] (“Acceleration 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.*”); ¶ [0060] (“Thus, the *acceleration sensor can be designed as a...3-dimensional sensor...*”); ¶ [0073] (“a device...can be composed of a one to three-axis...acceleration sensor...”); *see also* ¶¶ [0122], [0125], [0128], [0151]–[0164].

51. Leitel also teaches that the output of the tri-axial accelerometer is split

into three separate signals, SX, SY, and SZ, associated with each of the three axes measured by the accelerometer. EX1029, ¶ [0122]; *see also id.* at ¶¶ [0125], [0128], [0151]–[0164].

52. Leitel demonstrates that these signals are useful to detect a variety of conditions associated with a railcar. I am familiar with all of the examples Leitel spells out and a PHOSITA would have known and understood each of these examples. *See* EX1029, ¶¶ [0037], [0047], [0049], [0054], [0056], [0060], [0065], [0068], [0069], [0071], [0122], [0151], [0154], [0156]–[0158], [0161], [0164]. Below I identify some specific examples from Leitel:

- ¶ [0068] Leitel discloses detection of accelerations in the radial direction to determine/verify the rotating speed of the vehicle;
- ¶ [0154] – accelerations along the x-axis and z-axis can be used to determine headway;
- ¶ [0156] – accelerations along the x-axis and z-axis can be used to determine the location of wheel damage;
- ¶¶ [0156]–[0158] accelerations along the x-axis and z-axis can be used to determine vertical and horizontal impacts; and
- ¶ [0161] accelerations measured in the z-axis can be used to determine the speed of the vehicle axle.

53. Leitel also notes that each of the output signals may be filtered in the

sensor node before being transmitted to the CMU in Leitel. EX1029, ¶¶ [0125], [0128]. Leitel notes several advantages of performing this filtering and processing on the sensor node, including reduction of the amount of data for storage or transmission, as well as the direct transmission of error codes and failure conditions to the CMU. EX1029, ¶ [0125]; *see also id.*, ¶ [0128] (“It has become apparent that ***it is advantageous to preprocess numerous sensor data*** such as for example the sensor data SX, SY, SZ in the device 3, as above described, and to output or ***to transmit already the calculated quantities*** (mileage or km reading, blockage of the wheels, error codes etc.).”).

54. As a PHOSITA would expect, Leitel states that it is generally desirable to filter out vibrations or disturbances that are unrelated to the conditions being monitored. EX1029, ¶ [0028] (“It can be determined in that a movement sensor is attached, which determines a movement value, which is filtered and evaluated in order to block out simple vibrations or disturbances.”). Leitel discloses—and a PHOSITA would understand—that such “simple vibrations or disturbances” can be detected by monitoring accelerations collected by the tri-axis accelerometer. EX1029, ¶¶ [0091]-[0093] (explaining acceleration sensors can be used to determine vibrations). In my opinion, a PHOSITA would understand this disclosure in Leitel describes filtering noise and outlier data to provide more accurate data analysis.

55. In summary, it is my opinion that a PHOSITA would have been

motivated to filter the output of Armitage's tri-axial accelerometer into three distinct outputs—one corresponding to each axis—as disclosed by Leitel. A PHOSITA would have understood that accelerations corresponding to each axis are useful to detect a variety of problems and other conditions of a railcar, either alone or as a combination of data from multiple selected axes. Additionally, Leitel teaches that such accelerations can be filtered and processed on the sensor nodes, prior to transmission to the CMU, which is consistent with the way Armitage and Barone collect and process data.

56. Ground 5: Even though LeFebvre does not explicitly discuss a triaxial accelerometer in the sensor node, it is my opinion that a PHOSITA would have been motivated, in view of Armitage, to select a tri-axial accelerometer for use in LeFebvre's sensor node as well. *See* Section IX.B, *supra*.

57. As I already discussed in detail above regarding Armitage, a PHOSITA would also have been motivated to filter the output of the tri-axial accelerometer into three distinct sets of acceleration data, corresponding to accelerations along the length, width, and height axes of the railcar. Also, for the same reasons I discussed in Ground 1, and also in my first declaration, a PHOSITA would have been motivated to combine the filtering of Barone with LeFebvre's system. EX1003, ¶¶ 160-162. In my opinion, a PHOSITA would have been motivated to use multiple filters, corresponding to multiple axes, in order to monitor and detect a wider range

of potential problem conditions than would be possible by monitoring only a single axis.

58. This motivation for a PHOSITA is consistent with the disclosure of LeFebvre, which teaches that a triaxial accelerometer can be used to determine “a variety of car body motions.” EX1005 at ¶ [0037]. And a PHOSITA would have understood that accelerations pertaining to particular axial orientations can determine certain events and/or failure conditions of the railcar. LeFebvre says the use of certain directional measurements which “correspond[] to a particular inference that may be drawn if the data justifies it.” EX1005 at ¶ [0086].

59. In one example, LeFebvre discusses the detection of truck hunting, which requires the detection of longitudinal, lateral, and yawing forces. EX1005 at ¶ [0062]. As another example, LeFebvre discloses the detection of brake performance by monitoring the longitudinal forces in the x-axis, which a PHOSITA would understand requires the filtering of data in the other two directions (z and y) in order to provide useful information. EX1005 at ¶ [0065]. Therefore, in my opinion, a PHOSITA would have understood that detection of these exemplary events in LeFebvre can only be accomplished by analyzing accelerations along the x, y, and z axes as measured by a triaxial accelerometer.

60. Further, as I already discussed in my first declaration, LeFebvre discloses the filtering of data, generally, at both the sensor and CMU level to identify

“essential indicative information” from a large data set. EX1005, ¶ [0053]; Pet., 54-55; EX1003, ¶¶ 156-159. Because LeFebvre generally teaches the collection and processing of acceleration data, it would have been obvious to a PHOSITA that the output of an accelerometer—for example, Armitage’s triaxial accelerometer—could be filtered and analyzed to determine certain car body motions or failure conditions. EX1005, ¶¶ [0034]-[0037]; *see supra* Limitation 38(c)(i), Ground 1. In my opinion, and as I already stated in my previous declaration and in Ground 1 above, it would also have been obvious to a PHOSITA to filter the output signals from the triaxial accelerometer using the techniques taught in Barone. Pet., 54-57; EX1003, ¶¶ 156-162.

61. Ground 6: Having incorporated the elements addressed in the above grounds, it is my opinion that a PHOSITA would have been motivated to select a triaxial accelerometer for use in LeFebvre’s sensor node, and to filter the acceleration outputs as taught in Armitage and Leitel.

62. As explained I explained *supra*, Leitel teaches that the output of its tri-axial accelerometer is split into three separate signals, SX, SY, and SZ, associated with each of the three axes measured by the accelerometer. EX1029, ¶ [0122]; *see also id.* at ¶¶ [0125], [0128], [0151]–[0164]. Leitel notes that these signals are useful to detect a variety of conditions associated with a railcar. In my opinion, a PHOSITA would have been motivated to use a tri-axial accelerometer, and to filter the resulting

accelerations as taught by Armitage and Letiel, in order to identify a wider range of potential problem conditions than would be possible by monitoring only a single axis. *See* Limitation 38(c)(i), Grounds 1-2, *supra*. A PHOSITA would also understand, as I discussed above, that filtering is beneficial in any data collection and processing system for removing unwanted outlier data and noise, as well as amplifying relevant data based on vibration frequency to improve the accuracy of data processing and detection of fault conditions, as taught by both Barone and Leitel.

Limitation 38(c)(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;”

63. Ground 1: Armitage discloses sensor nodes that “include equipment to sense and report information about...[the] railway car.” EX1006, ¶ [0014]. The sensor nodes 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.* In my opinion, a PHOSITA would understand that the “processing portion” in the sensor nodes would include a detector to detect and process accelerations data to determine different railcar conditions based on accelerations in certain axial directions.

64. How detectors detect railcar conditions and process accelerations from certain axial directions to determine different railcar conditions is discussed in detail in Section IX.B, *supra*, and incorporated by reference herein. A PHOSITA would understand and find it obvious that the purpose of the “detectors” is to detect the accelerations from certain axial directions as measured by the tri-axial accelerometer to determine (i.e., “detect”) railcar conditions associated with one or more axes. And just as a PHOSITA would understand Armitage’s filtering can occur at either the sensor or CMU level, in my opinion a PHOSITA would have also understood the detectors for detecting and processing accelerations can occur at either point in the system. Further, I believe a PHOSITA would understand various considerations impact where the detecting takes place in a data processing system, including data storage, transmission, and power consumption considerations.

65. Ground 2: The discussion of Ground 1 above applies equally to Ground 2 and is incorporated herein by reference. Leitel explicitly discloses “detectors” that detect railcar conditions as shown in Fig. 3 of EX1029 (annotated):

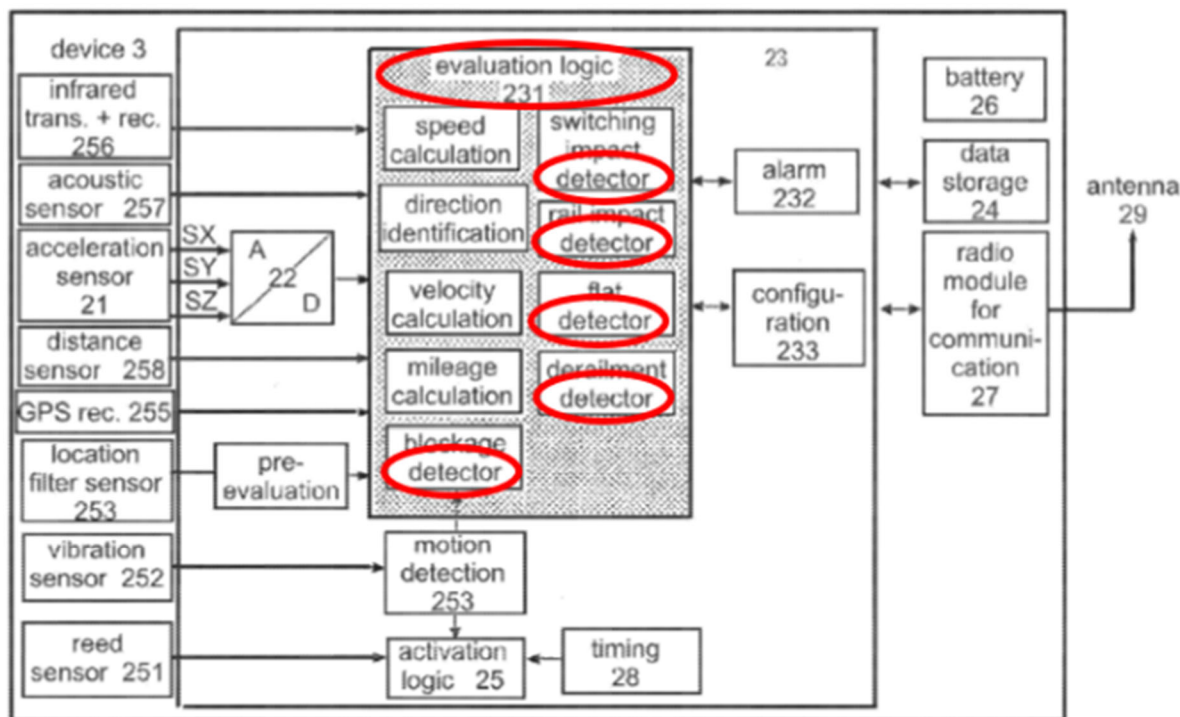


Fig. 3

Leitel discloses an evaluation logic 231 which receives and transmits signals SX, SY, and SZ from the acceleration sensor 21 and performs “evaluation steps”, such as speed calculation, direction identification, rail impact *detector*, flat *detector*, derailment *detector*, blockage *detector*, and others. See EX1029, ¶¶ [0122], [0125], [0128]-[0129]. In my opinion, a PHOSITA would understand that evaluation logic 231 makes evaluations and detects certain railcar conditions based on accelerations associated with a specific axis (or axes) out of the three axes. See also Section IX.B (Limitation 38(c)(i), Ground 2).

66. A PHOSITA would be motivated to combine Leitel with Armitage/Barone because they all describe systems designed to detect railcar

conditions and problems, and a PHOSITA would be motivated to combine the detectors of Leitel with the processing/filtering of accelerations data in Armitage/Barone so to have particular modes of detecting certain conditions more accurately and effectively. The combination of Leitel's detectors with the filters of Armitage/Barone would also be known to a PHOSITA to help reduce the redundant processing of data. Also, if the detector is doing the work of identifying problems at the sensor node level, then the output of the detector is the only information that needs to be transmitted to the CMU and/or user for action (if needed). A PHOSITA would be motivated to combine the detectors and detection of different railcar conditions at the sensor node in Leitel with Armitage/Barone as Leitel explains, it is "advantageous to preprocess numerous sensor data" at the sensor unit. *See* EX1029, ¶ [0128].

67. Ground 5: The discussion of Ground 1 above applies equally to Ground 5 and is incorporated herein by reference. LeFebvre, like Armitage, discloses taking information from a sensor, processing it on the sensor node, to detect different railcar conditions. EX1005, ¶¶ [0053]-[0055].

68. Ground 6: I incorporate the elements and references addressed above, and in my opinion a PHOSITA would have been motivated to use the detectors of Leitel and the triaxial accelerometer for use in LeFebvre's sensor node, in combination with detectors to detect a plurality of different railcar conditions based

on accelerations associated with the axes as taught in Armitage, Leitel, and Barone.
See Section IX.B, *supra*.

C. Claim 43

69. Grounds 1 and 2: Most limitations of claim 43, corresponding to original claim 25, are disclosed by Armitage and Barone. *See* Pet., 36-38; EX1003, ¶¶101-108.

70. Grounds 5 and 6: Most limitations of claim 43, corresponding to original claim 25, are disclosed by LeFebvre and Barone. *See* Pet., 62-66; EX1003, ¶¶173-179. New limitations of claim 43 that I did not previously address with respect to original claim 25 are discussed below.

“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”

71. Armitage discloses a railcar monitoring system that is only “enabled” when it is in motion and disabled when it is stopped. EX1006, Abstract, Fig. 2, ¶¶ [0004], [0025], Claims 1, 11. Barone discloses the same, noting accelerations are detected only while the railcar is in motion and the system only “wakes up” from a “sleep” condition when the railcar begins to move. EX1007, ¶¶ [0027]; [0094]; [0044]-[0045]; [0107]; *see also* [0116], [0128]-[0135], [0267], [0279]-[0280]. In my opinion, a PHOSITA would have known it is desirable to save power in railcar

monitoring systems and a system that disables a detector when it is not needed (i.e., when the railcar is stopped or moving at a low speed) 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).

72. In my opinion, it would have also been obvious to a PHOSITA to include a second detector designed to turn on when the railcar is traveling faster than a specific speed because, for example, high speeds can cause different types of railcar conditions that lower speeds do not and some conditions require immediate action only when they occur at higher speeds. A PHOSITA would understand that there are certain measurements that are meaningless except at higher speeds, so sensors should only be enabled at those speeds. One example is using an accelerometer to measure wheel balance – at low speeds the acceleration is undetectable or so low it would be in the noise margin but at higher speeds the signal stands out so enabling the sensor and taking the measurement makes sense. A PHOSITA 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.

73. Ground 2: The discussion of Ground 1 above applies equally to Ground 2 and is incorporated herein by reference. Additionally, Leitel discloses a device with activation log 25 and motion detection 253, which determine whether to turn

on or enable the plurality of detectors based on whether the railcar is moving. EX1029, ¶¶ [0122]; *see also* [0016], [0020], [0035]-[0036], [0123], [0167].

74. Ground 5: The discussion of Ground 1 above applies equally to Ground 5 and is incorporated herein by reference. LeFebvre discloses a railcar monitoring system, that includes detectors turned on periodically to ensure the device is functional for several years, “consistent with the normal service life of the bearing components used in the trucks.” EX1005, ¶ [0021]; *see also id.* at ¶¶ [0036] (“information may also be used to inhibit sensor checks when no purpose is thereby to be served in order to preserve energy usage”) [0003], [0034]-[0035], [0077]-[0088].

75. Ground 6: *See* Grounds 1, 2, and 5, above, incorporated herein by reference. *See* Section IX.C, *supra*.

D. Claims 46 and 47

76. Grounds 1, 2: Most limitations of claims 46 and 47, including all limitations present in original claim 30, are disclosed by Armitage and Barone. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 38-40; EX1003, ¶¶ 112-125.

77. Grounds 5, 6: Most limitations of claims 46 and 47, including all limitations present in original claim 30, are disclosed by LeFebvre and Barone. I addressed these limitations in my first declaration, which is incorporated herein by

reference. *See* Pet. at 66-67; EX1003, ¶¶ 183-196.

78. I understand that Patent Owner acknowledges that “claim[s] 46 [and 47 are] limited in a manner similar to independent substitute claim 38.” Mot., 23-24. I agree, so the new limitations of claims 46 and 47 that I did not previously address for original claims 30 and 36 are addressed in Claim 38, *supra*.

E. Dependent Claims 39–42, 44-45 and 48

i. Dependent Claim 39

79. Ground 3: The limitations in dependent claim 39, corresponding to original claim 21, are disclosed by Armitage in view of Barone and LeFebvre. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 44-45; EX1003 at ¶¶ 136-137.

80. Ground 6: The limitations in dependent claims 39 and 45 corresponding to original claims 21 and 29 are disclosed by LeFebvre and Barone. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 61, 66; EX1003 at ¶ 171, 182.

ii. Dependent Claim 40

81. Grounds 1 and 2: The limitations in dependent claim 40, corresponding to original claim 22, are disclosed by Armitage and Barone. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 34; EX1003 at ¶ 91.

82. Grounds 5 and 6: The limitations in dependent claim 40, corresponding

to original claim 22, are disclosed by LeFebvre and Barone. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 61-62; EX1003 at ¶ 172.

iii. Dependent Claim 41

83. Ground 4: The limitations in dependent claim 41, corresponding to original claim 23, are disclosed by Armitage, Barone, and Winfree. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 46-49; EX1003 at ¶¶ 139-143.

84. Ground 7: The limitations in dependent claim 41, corresponding to original claim 23, are disclosed by LeFebvre, Barone, Armitage, and Winfree. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 77-80; EX1003 at ¶¶ 226-230.

85. To the extent claim 41 has been amended to require “one or more wireless sensor nodes” and a “tri-axis sensor,” these limitations are discussed in my declaration with respect to independent claim 38, from which claim 41 depends.

iv. Dependent Claim 42

86. Grounds 1 and 2: The limitations in dependent claim 42, corresponding to original claim 24, are disclosed by Armitage and Barone. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 34-35; EX1003 at ¶ 93-100.

87. Grounds 5 and 6: The limitations in dependent claim 42, corresponding to original claim 24, are disclosed by LeFebvre, Barone, and Armitage. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 72-74; EX1003 at ¶¶ 205-214.

88. To the extent claim 42 has been amended to require a “tri-axis sensor,” this limitation is discussed in my declaration with respect to independent claim 38, from which claim 41 depends.

v. Dependent Claim 44

89. Ground 4: The limitations in dependent claim 44, corresponding to original claim 23, are disclosed by Armitage, Barone, and Winfree. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 46-49; EX1003 at ¶¶ 139-143.

90. Ground 7: The limitations in dependent claim 44, corresponding to original claim 23, are disclosed by LeFebvre, Barone, Armitage, and Winfree. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 77-80; EX1003 at ¶¶ 226-230.

vi. Dependent Claim 45

91. Grounds 1 and 2: The limitations in dependent claim 45, corresponding to original claim 29, are disclosed by Armitage and Barone. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See*

Pet. at 38; EX1003 at ¶ 111.

92. Grounds 5 and 6: The limitations in dependent claim 45, corresponding to original claim 29, are disclosed by LeFebvre and Barone. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 66; EX1003 at ¶ 182.

vii. Dependent Claim 48

93. Grounds 1 and 2: The limitations in dependent claim 48, corresponding to original claim 37, are disclosed by Armitage and Barone. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 40-44; EX1003 at ¶¶ 126-134.

94. Grounds 5 and 6: The limitations in dependent claim 48, corresponding to original claim 37, are disclosed by LeFebvre, Barone, and Armitage. I addressed these limitations in my first declaration, which is incorporated herein by reference. *See* Pet. at 74-77; EX1003 at ¶¶ 215-224.

95. To the extent claim 48 has been amended to require a “tri-axis sensor,” this limitation is discussed in my declaration with respect to independent claim 47, from which claim 48 depends.

* * *

Pursuant to 28 U.S.C. § 1746, I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed on: April 19, 2024



STEVEN RICCA