

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.

**PETITIONER'S OPPOSITION TO
PATENT OWNER'S REVISED MOTION TO AMEND**

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EXHIBIT LIST

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1001	U.S. Patent No. 10,137,915 (“the ’915 Patent”)
1002	Prosecution History of the ’915 Patent
1003	Expert Declaration of Steven Ricca
1004	<i>Curriculum Vitae</i> for Steven Ricca
1005	U.S. Patent Publication No. 2007/0152107 A1 to LeFebvre et al. (“LeFebvre”)
1006	U.S. Patent Publication No. 2011/0282540 A1 to Armitage et al. (“Armitage”)
1007	U.S. Patent Publication No. 2007/0208841 A1 to Barone et al. (“Barone”)
1008	U.S. Patent No. 7,706,213 to Winfree et al. (“Winfree”)
1009	Bonnie Baker, <u>Filtering? Before or After?</u> , EDN (February 20, 2003), https://www.edn.com/filtering-before-or-after/
1010	Potting and Encapsulation, Master Bond Inc., https://www.masterbond.com/applications/potting-and-encapsulation
1011	Amsted Rail Company, Inc.’s Complaint filed against Hum Industrial Technology, Inc. (ECF No. 1) filed on April 18, 2022
1012	Waiver of the Service of Summons upon Hum Industrial Technology, Inc. (ECF No. 4) dated June 14, 2022
1013	<i>Intentionally Omitted</i>
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1017	Defendants' Stipulation of Invalidity Contentions
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1020	Transcript of Conference Call Before James P. Calve, Kevin W. Cherry, and Michael L. Woods (June 8, 2023)

Ex #	Exhibit Description
1021	International Heavy Haul Association Order Confirmation for Electronic Copy of 2007 Conference Proceedings (<i>Not Filed</i>)
1022	International Heavy Haul Association 2007 Conference Proceedings (<i>Not Filed</i>)
1023	June 18, 2011 Wayback Machine Web Capture of “Past Conferences” page on International Heavy Haul Association website (<i>Not Filed</i>)
1024	Declaration of Steven Ricca in support of Exhibits 1009-1010 (<i>Not Filed</i>)
1025	Expert Declaration of Steven Ricca in Support of Petitioner’s Reply
1026	MSP430F1611 Manual (Texas Instruments)
1027	MSP430FG4618 Manual (Texas Instruments)
1028	Expert Declaration of Steven Ricca in Support of Petitioner’s Opposition to Motion to Amend
1029	U.S. Patent Publication No. 2011/0231039 A1 to Leitel et al. (“Leitel”)
1030	Expert Declaration of Steven Ricca in Support of Petitioner’s Opposition to Revised Motion to Amend

Patent Owner's ("PO's") Revised Motion to Amend (Paper 23 ("Motion")) should be denied because claims 38-48 are indefinite, lack written description, violate statutory requirements, and/or are obvious in view of the prior art.

I. SUBSTITUTE CLAIM 43 LACKS WRITTEN DESCRIPTION

Substitute claims must be supported by the written description of the original application and may not introduce new subject matter. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121(A)(2)(ii). To satisfy this requirement, "the description must clearly allow persons of ordinary skill in the art to recognize that the inventor invented what is claimed." *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (cleaned up). "The written description requirement is particularly important when, as here, claims are added later during prosecution in response to development by others." *FWP IP ApS v. Biogen MA, Inc.*, 749 F. App'x 969, 974 (Fed. Cir. 2018).

Substitute claim 43 includes 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."¹ The portions of the specification identified by PO as support for

¹ For purposes of written description, Petitioner assumes "detections" means "detectors" and "railyard" means "railcar," but those meanings are not reasonably certain as discussed in Section II.C, *infra*.

amendment, however, do not teach a single embodiment comprising two sets of detectors as claimed. *See* Mot., 11-12 (citing EX1001, FIGS. 4, 12, 5:35-42, 6:28-26, 10:55-12:51); EX1030, ¶ 15. “[A]n amalgam of disclosures plucked selectively from the [original] application” does not satisfy the written description requirement. *Novozymes A/S v. DuPont Nutrition Biosciences APS*, 723 F.3d 1336, 1349 (Fed. Cir. 2013). Rather, the original application must support each claim “as an integrated whole rather than as a collection of independent limitations.” *Id*; *see also Hyatt v. Dudas*, 492 F.3d 1365, 1371 (Fed. Cir. 2007).

II. SUBSTITUTE CLAIMS 38, 43, 46, AND 47 ARE INDEFINITE

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

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 it is not a term of art reasonably understood to a PHOSITA. EX1030, ¶ 16. The claim thus “fail[s] to inform, with reasonable certainty, those skilled in the art about the scope of the invention.” *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898, 901 (2014).

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”

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 47.² Claim 46 includes a substantially similar limitation 46(c) that is indefinite for the same reasons as claims 38 and 47. 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 it thus “fail[s] to inform, with reasonable certainty, those skilled in the art about the scope of the invention.” *Nautilus*, 572 U.S. at 901; EX1030, ¶ 17.

C. Claim 43

Claim 43 requires that a “second one of the plurality of detections...is disabled when the railyard is traveling slower than the specific speed.” “[T]he plurality of detections” and “the railyard” lack antecedent basis and it is unclear what is being referenced.

III. SUBSTITUTE CLAIMS 38-48 ARE INVALID UNDER 35 U.S.C. § 103

The Motion should be denied pursuant to 37 C.F.R. §42.121(d)(2) because the newly amended claims are unpatentable under 35 U.S.C. § 103. A PHOSITA would

² PO failed to underline new limitation 38(c)(ii) in the Motion and Claims Appendix, thereby violating 37 CFR §42.121(b).

have understood substitute claims 38–48 are obvious under at least the following grounds (EX1030, ¶¶ 18-19): 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. Armitage, LeFebvre, Barone, Winfree, and Leitel are Analogous Art

Armitage, LeFebvre, Barone, and Leitel are analogous art and a PHOSITA would have found it obvious to combine them. *See* Pet., 20-21, 44-45, 49-50; EX1003, ¶¶ 66, 135, 137, 145; EX1030, ¶¶ 20-21. Each describes 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; EX1029, ¶ [0004]; EX1030, ¶¶ 20-21. 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]; EX1029, ¶¶ FIG. 11, [0018], [0144]–[0146], [0062], [0066]; EX1030, ¶¶ 20-21. Winfree teaches a filter for mechanical waves from an accelerometer entering a sensor. EX1008, (57) Abstract; EX1030, ¶ 22. A PHOSITA therefore would have understood that Armitage, LeFebvre, Barone, Leitel, and Winfree are analogous art. *See* Pet. at 45-49, 77-80; EX1003, ¶¶ 138-143, 225-230; EX1030, ¶ 23.

B. Independent Claim 38

Grounds 1, 2: 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; EX1030, ¶ 24. Grounds 5, 6: 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; EX1030, ¶ 25. The new limitations of claim 38 not previously addressed are discussed below.

i. Limitation 38(b)

Grounds 1, 2: Armitage discloses a railcar monitoring system comprising a

plurality of sensor nodes, each attached to a separate undercarriage element of a railcar. EX1003, ¶¶ 70, 74; EX1006, Figs. 1, 3, 5, ¶¶ [0012], [0014], [0020]; Pet., 23-25. The sensor nodes communicate wirelessly with a control node (i.e., a communication management unit) located on the same railcar. EX1003, ¶¶ 70, 74; EX1006, ¶¶ [0004], [0012], [0014], [0027], [0033], [0054], Figs. 1, 3, 5; *see also* Abstract, Fig. 6, [0015]-[0016], [0025]-[0026], [0029]-[0031], [0034]-[0035], [0050], [0053]; EX1030, ¶ 27.

Armitage discloses the sensor portion of its “sensor nodes” may comprise an accelerometer. EX1006, ¶¶ [0014], [0033], [0045], [0046], [0056]; EX1030, ¶ 28. Armitage’s accelerometer may be “a three-dimensional accelerometer,” which a PHOSITA would understand measures accelerations along three perpendicular axes, including along the width, length, and height of the railcar. EX1006, ¶ [0045]; EX1030, ¶ 29. Armitage discloses a preferred embodiment 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.” *Id.* In this example, the z-, x-, and y-axes extend along the width, length, and height dimensions of the railcar, respectively. *Id.*

Grounds 5, 6: LeFebvre discloses a wireless system for continuously monitoring the behavior and condition of trucks, wheels, and bearings of a railcar using a multiplicity of instrumented pads (i.e., wireless sensor nodes) that

communicate wirelessly with a communications management unit on the railcar. Pet., 52-54, 72-73; EX1003, ¶¶ 152, 155, 206; EX1005, ¶ [0006], [0021], [0024]-[0026], [0031]-[0032], Fig. 1; EX1030, ¶ 30.

LeFebvre discloses its sensor nodes may include accelerometers but does not expressly teach a triaxial accelerometer. EX1005, Claims 28, 30; EX1003, ¶ 152; EX1030, ¶ 31. A PHOSITA would have understood, however, that there were compelling reasons to select a triaxial accelerometer (as opposed to, for example, a single-axis accelerometer) for a railcar sensor. *Id.*

First, LeFebvre teaches its communication management unit (comprising data control unit **23** and communications device **24**) may comprise “a triaxial accelerometer...for triggering certain analysis modes or verifying readings made by the pad and providing information on a variety of car body motions.” EX1005, ¶ [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. EX1030, ¶ 32. Moreover, because the sensor nodes are not limited to any particular type of accelerometer, a PHOSITA would understand that triaxial accelerometers, the only specifically identified accelerometer in the specification, would also be used in the sensor nodes. *Id.*

Second, Armitage discloses its sensor nodes may comprise a triaxial

accelerometer that measures accelerations along three perpendicular axes, which may be aligned with the width, length, and height of the railcar, respectively. A PHOSITA would have been motivated to use a triaxial accelerometer in LeFebvre's sensor node because it can monitor a wider variety of conditions, as discussed in further detail in Sections III.B.ii and III.B.iii, *infra*. EX1030, ¶ 33.

Third, a PHOSITA would have understood that a tri-axis accelerometer is, in practical effect, simply a combination of three perpendicular, single-axis accelerometers into a single device. EX1030, ¶ 34. A triaxial accelerometer is less expensive, requires less work to install than three separate single-axis units, and a PHOSITA would have been motivated to select a triaxial accelerometer due to its simplicity, ease of installation, and cost-effectiveness. *Id.*

ii. Limitation 38(c)(i)

Ground 1: Armitage discloses a filter that filters output signals from a plurality of sensor sections of a sensor node and isolates accelerations from each sensor section corresponding to each axis to detect a variety of railcar conditions:

The accelerations monitored by the 3-D accelerometer are interpreted as vibrations. In some examples, axial vibration is monitored along a single axis, such as a z-axis aligned with the axle of a particular wheel or wheel assembly, and vibrations in other axes are ignored, such as radial axes including an x-axis aligned with the horizontal and a y-axis aligned with the vertical with respect to the railway car or wheel.

EX1006, ¶ [0045]; *see also id.*, ¶ [0014]; EX1030, ¶¶ 35-36.

Armitage teaches selecting data corresponding to one of the three measured axes and ignoring or discarding data corresponding to the other two axes. EX1030, ¶¶ 37-38. This is precisely the type of filtering taught by the '915 Patent and encompassed by Limitation 38(c)(i). *See* EX1001, 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).

PO argues that Armitage only isolates vibrations from a single axis, and therefore “teaches away” from the system of claim 38. Mot., 19. But Armitage “does not criticize, discredit, or otherwise discourage” a PHOSITA from filtering a tri-axial accelerometer’s output into three separate outputs (corresponding to the three axes), and therefore does not “teach away” from claim 38. *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). To the contrary, while Armitage provides “some examples” of filtering data corresponding to the z-axis, a PHOSITA would understand these are mere examples and that vibrations along any of the three axes, alone or in combination, could and would be filtered to detect various conditions of a railcar. EX1006, ¶ [0045]; EX1030, ¶ 39.

For 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 and wheel flat conditions (EX1005, ¶ [0054]; EX1006, ¶ [0045]; EX1030, ¶ 40); accelerations along the vertical axis can be used to monitor conditions including track and wheel derailments (EX1005, ¶¶ [0054], [0061], [0066]; EX1029, ¶ [0066]; EX1030, ¶ 40); and accelerations along the longitudinal axis extending along the length of the railcar can be used to monitor conditions including track switching impacts, truck hunting movements involving yaw displacement, and changes in velocity (including collisions) (EX1005, ¶ [0062]; EX1029, ¶ [0064]; EX1030, ¶ 40).

To the extent Armitage does not teach multiple filters corresponding to different axes, a PHOSITA would have been motivated to use multiple filters to monitor multiple axes and thereby detect a wider range of potential conditions. EX1030, ¶ 41. Under controlling precedent, merely duplicating parts or features that are known in the art is not patentable. *In re Harza*, 274 F.2d 669, 671 (C.C.P.A. 1960) (“It is well settled that the mere duplication of parts has no patentable significance....”); *see also* MPEP § 2144.04(VI) (citing *Harza*). Here, using three copies of a single-axis filter—the filter disclosed by Armitage, duplicated for each of the x-, y-, and z-axes—does not provide any new or unexpected results. EX1030, ¶ 42. Instead, three copies of the single-axis filter will provide ***exactly*** the result a PHOSITA expects: three output signals corresponding to accelerations along the (1)

x-axis, (2) y-axis, and (3) z-axis. *Id.*

It would also have been obvious to a PHOSITA to filter the output signals from the triaxial accelerometer in Armitage using the techniques taught in Barone. Pet., 25-29. Barone teaches output of an “accelerometer 171” is 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; EX1007, ¶¶ [0114]-[0116], Fig. 8; EX1030, ¶ 43. Barone teaches the use of 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; EX1030, ¶ 44. Barone shows filtering accelerations with electronic and digital filters was well-known in the art and a PHOSITA 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. EX1003, ¶¶ 81-82; EX1030, ¶¶ 44-45; *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

Combining the selection/ignoring of vibration data (i.e., filtering) taught by Armitage and the filtering of vibration frequencies taught by Barone would have predictably resulted in the filtering of accelerations data isolated from each of the

three axes measured by Armitage's triaxial accelerometer. EX1003, ¶¶ 76, 79, 82; EX1030, ¶ 46. In other words, the data 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. EX1030, ¶ 46. In fact, Leitel discloses both types of data filtering. EX1029, ¶¶ [0122], [0125], [0128], [0151]-[0164]; EX1030, ¶ 46.

Armitage further teaches data processing, which a PHOSITA would understand includes data filtering, at either the CMU or sensor nodes. Pet., 25-28; EX1006, ¶¶ [0045]-[0046], [0056]; EX1030, ¶ 47. However, 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]; EX1030, ¶ 47. A PHOSITA would have understood various considerations impact where filtering occurs in the system, including, for example, reduced data storage and transmission. EX1030, ¶ 47.

Ground 2: The discussion of Ground 1 applies equally to Ground 2 and is incorporated herein by reference. A PHOSITA would have found it obvious in view of Armitage to process the output of a tri-axis accelerometer using multiple filters—specifically, one filter for each of the x-, y-, and z-axes. EX1030, ¶ 48. Leitel

expressly teaches monitoring acceleration data from “sensor sections” corresponding to each of the x-, y-, and z-axes. *Id.*

Like 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) on a railcar. *See, e.g.*, EX1029, ¶¶ [0004], [0010], [0013], [0035], [0044], [0071], [0077], [0134]; EX1030, ¶ 49. The wireless sensor nodes include acceleration sensors capable of detecting conditions, i.e., wheel damage (¶ [0062]) and wheel derailments (¶ [0066]). *Id.*; EX1030, ¶ 49.

Leitel teaches a tri-axial accelerometer that outputs signals from “sensor sections” 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...”); *see also* ¶¶ [0073], [0122], [0125], [0128], [0151]–[0164]; EX1030, ¶ 50.

Leitel teaches the output of the tri-axial accelerometer is split into three separate signals, SX, SY, and SZ, associated with each of the three axes. EX1029, ¶¶ [0122]; *see also* ¶¶ [0125], [0128], [0151]–[0164]; EX1030, ¶ 51. Leitel demonstrates these signals are useful to detect a variety of conditions associated with

a railcar, including conditions detected based on acceleration data along a single axis or multiple axes. *See* EX1029, ¶¶ [0037], [0047], [0049], [0054], [0056], [0060], [0065], [0068], [0069], [0071], [0122], [0151], [0154], [0156]-[0158], [0161], [0164]; EX1030, ¶ 52. Leitel notes that each output signal may be filtered in the sensor node before transmission to the telematics unit (i.e., the CMU, referenced as “device 3”). EX1029, ¶¶ [0125], [0128]; EX1030, ¶ 53.

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. EX1029, ¶¶ [0125]; *see also* ¶ [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.).”); EX1030, ¶ 53.

Leitel also teaches the desirability of filtering 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.”); EX1030, ¶ 54. A PHOSITA would understand this disclosure describes filtering noise and outlier data to provide more accurate data analysis. *Id.*

A PHOSITA would have been motivated to filter the output of Armitage’s tri-

axial accelerometer into three distinct outputs corresponding to each axis as disclosed by Leitel. EX1030, ¶ 55. A PHOSITA would have understood that accelerations corresponding to each axis are useful to detect a variety of problems and other railcar conditions, either alone or as a combination of data from multiple selected axes. *Id.* Leitel also teaches such accelerations can be filtered and processed on the sensor nodes, prior to transmission to the CMU, consistent with the manner Armitage and Barone collect and process data. *Id.*

Ground 5: As discussed above, a PHOSITA would have been motivated to select a tri-axial accelerometer in LeFebvre's sensor node. *See* Limitation 38(b), Grounds 5-6, *supra*; EX1030, ¶ 56. Similarly, a PHOSITA would have been motivated to filter the output of the tri-axial accelerometer into three distinct sets of data, corresponding to accelerations along the length, width, and height axes of the railcar and use multiple filters, corresponding to multiple axes, to monitor and detect a wider range of potential conditions than would be possible with monitoring a single axis. *See* Section III.B.ii, Ground 1, *supra*; EX1030, ¶ 57. And for the reasons discussed in Ground 1 and the Petition, a PHOSITA would have been motivated to combine the filtering of Barone with LeFebvre's system. Pet., 55-57; EX1003, ¶¶ 160-162; EX1030, ¶ 57.

LeFebvre teaches a triaxial accelerometer can be used to determine "a variety of car body motions." EX1005, ¶ [0037]; EX1030, ¶ 58. A PHOSITA would have

understood that accelerations pertaining to particular axial orientations can determine certain events and/or failure conditions of the railcar. *Id.* LeFebvre explicitly describes the use of certain directional measurements that “correspond[] to a particular inference that may be drawn if the data justifies it.” EX1005, ¶ [0086]; EX1030, ¶ 58.

For example, LeFebvre discusses the detection of truck hunting, which requires the detection of longitudinal, lateral, and yawing forces. EX1005, ¶ [0062]; EX1030, ¶ 59. LeFebvre also discloses the detection of brake performance by monitoring longitudinal forces (i.e., x-axis), which requires filtering data in the other two directions to provide meaningful information. EX1005, ¶ [0065]; EX1030, ¶ 59. A PHOSITA would have understood that detection of these events in LeFebvre can only be accomplished by analyzing accelerations along the x, y, and z axes. EX1030, ¶ 59.

LeFebvre also discloses filtering data 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 teaches the collection and processing of acceleration data to determine railcar conditions, it would have been obvious to a PHOSITA that the output of an accelerometer (for example, a triaxial accelerometer) would be filtered and analyzed to determine certain car body motions or failure conditions, including the conditions described above. EX1005, ¶¶ [0034]-

[0037]; EX1030, ¶ 60. It would also have been obvious to a PHOSITA to filter the output signals from the triaxial accelerometer using the techniques taught in Barone for the same reasons set forth in Ground 1. Pet., 54-57; EX1003, ¶¶ 156-162; *see also* Section III.B.ii, Ground 1, *supra*; EX1030, ¶ 60.

Ground 6: As explained in Limitation 38(c)(i), Ground 2, *supra*, Leitel teaches the output of its tri-axial accelerometer is split into three separate signals, SX, SY, and SZ, associated with each of the three axes, which is useful to detect a variety of conditions associated with a railcar. EX1029, ¶ [0122]; *see also id.*, ¶¶ [0125], [0128], [0151]–[0164]; EX1030, ¶ 62. A PHOSITA would have been motivated to use a tri-axial accelerometer and filter the resulting accelerations as taught by Armitage, Leitel, and Barone, to identify a wider range of conditions more accurately than would be possible by monitoring only a single axis. *See* Section III.B.ii, Ground 1, *supra*; EX1030, ¶ 62.

iii. Limitation 38(c)(ii)

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.* 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. EX1030, ¶ 63. How detectors detect railcar conditions and process accelerations from certain axial directions to determine different railcar conditions is discussed in detail in Section III.B.i-ii *supra*, and incorporated by reference herein. EX1030, ¶ 64. Just as a PHOSITA would understand Armitage's filtering can occur at either the sensor or CMU level, a PHOSITA would have also understood the detectors for detecting and processing accelerations can occur at either point in the system. *Id.* 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. *Id.*

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 (annotated):

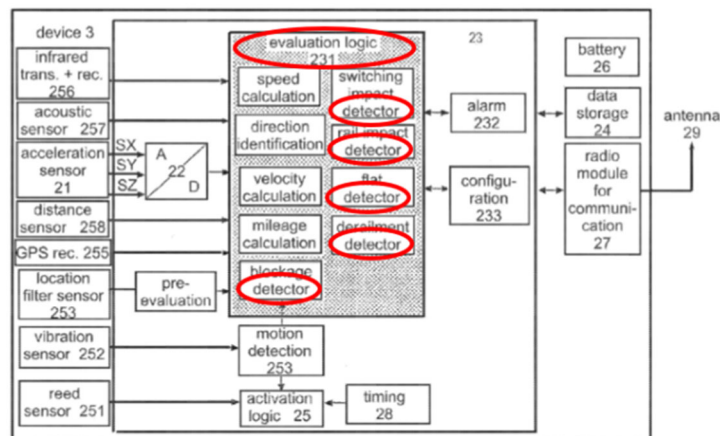


Fig. 3

EX1029. 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]. 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. EX1030, ¶ 65; see also Section III.B.ii, Ground 2.

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. EX1030, ¶

66. Additionally, if the detector is carrying out the task 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). *Id.* A PHOSITA would further 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]; *id.*

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 and filtering it on the sensor node to detect different railcar conditions. EX1005, ¶¶ [0053]-[0055]; EX1030, ¶ 67.

Ground 6: As explained in the Claim 38 limitations, *supra*, 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. EX1030, ¶ 68; *see* Sections III.B.ii-iii.

C. Dependent Claim 43

Grounds 1, 2: Most limitations of claim 43, corresponding to original claim 25, are disclosed by Armitage and Barone. *See* Pet., 36-38; EX1003, ¶¶ 101-108; EX1030, ¶ 69. Grounds 5, 6: Most limitations of claim 43, corresponding to original

claim 25, are disclosed by LeFebvre and Barone. *See* Pet., 62-66; EX1003, ¶¶ 173-179; EX1030, ¶ 70. New limitations of claim 43 not previously addressed with respect to original claim 25 are discussed below.

- i. **“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 railyard is traveling slower than the specific speed”**

Ground 1: 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]. 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). EX1030, ¶ 71.

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 (i.e., wheel imbalance). EX1030, ¶ 72. 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. *Id.*

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]; EX1030, ¶ 73.

Ground 5: Ground 1 above applies to Ground 5 and is incorporated 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]; EX1030, ¶ 74.

Ground 6: *See* Grounds 1, 2, and 5, above (Section III.C.i), incorporated herein by reference. EX1030, ¶ 75.

D. Independent Claims 46 and 47

Grounds 1, 2: Most limitations of claims 46 and 47, including all limitations present in original claims 30 and 36, are disclosed by Armitage and Barone. *See* Pet., 38-40; EX1003, ¶¶112-125; EX1030, ¶ 76. Grounds 5, 6: Most limitations of claims 46 and 47, including all limitations present in original claims 30 and 36, are disclosed by LeFebvre and Barone. *See* Pet., 66-67; EX1003, ¶¶183-196; EX1030, ¶ 77. PO acknowledges that “claim[s] 46 [and 47 are] limited...to independent substitute claim 38.” Mot., 23-24. Petitioner’s discussion of Claim 38 in Sections III.B.i-iii, *supra* applies equally to claims 46 and 47. Accordingly, the new limitations of claims 46 and 47 that were not previously addressed in this proceeding with respect to claims 30 and 36 are addressed in Sections III.B.i-iii, *supra*; EX1030, ¶ 78.

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

Dependent claims 39-42, 44-45 and 48 depend from substitute independent claims 38, 46, and 47, each of which is unpatentable as obvious for the reasons discussed above. PO has not identified any features of these claims that patentably distinguish the prior art, beyond the features of the independent claims from which they depend. These claims are obvious for the reasons noted below.

Claim 39, Ground 3: The limitations in claim 39, corresponding to original claim 21, are disclosed by Armitage in view of Barone and LeFebvre. *See* Pet., 44-45; EX1003, ¶¶ 136-137; EX1030, ¶ 79. Grounds 5, 6: The limitations in dependent claims 39 and 45 corresponding to original claims 21 and 29 are disclosed by

LeFebvre and Barone. *See* Pet. at 61, 66; EX1003 at ¶¶ 171, 182; EX1030, ¶ 80.

Claim 40, Grounds 1-2: The limitations in claim 40, corresponding to original claim 22, are disclosed by Armitage and Barone. *See* Pet., 34; EX1003, ¶ 91; EX1030, ¶ 81. Grounds 5-6: The limitations in dependent claim 40, corresponding to original claim 22, are disclosed by LeFebvre and Barone. *See* Pet., 61-62; EX1003, ¶ 172; EX1030, ¶ 82.

Claim 41, Ground 4: The limitations in claim 41, corresponding to original claim 23, are disclosed by Armitage, Barone, and Winfree. *See* Pet., 46-49; EX1003, ¶¶ 139-143; EX1030, ¶ 83. Ground 7: The limitations in claim 41, corresponding to original claim 23, are disclosed by LeFebvre, Barone, Armitage, and Winfree. *See* Pet., 77-80; EX1003, ¶¶ 226-230; EX1030, ¶ 84. 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 above with respect to independent claim 38, from which claim 41 depends.

Claim 42, Grounds 1-2: The limitations in claim 42, corresponding to original claim 24, are disclosed by Armitage and Barone. *See* Pet., 34-35; EX1003, ¶¶ 93-100; EX1030, ¶ 86. Grounds 5-6: The limitations in claim 42, corresponding to original claim 24, are disclosed by LeFebvre, Barone, and Armitage. *See* Pet., 72-74; EX1003, ¶¶ 205-214; EX1030, ¶ 87. To the extent claim 42 has been amended to require a “tri-axis sensor,” this limitation is discussed above in independent claim

38, from which claim 41 depends.

Claim 44, Ground 4: The limitations in claim 44, corresponding to original claim 23, are disclosed by Armitage, Barone, and Winfree. *See* Pet., 46-49; EX1003, ¶¶ 139-143; EX1030, ¶ 89. Ground 7: The limitations in claim 44, corresponding to original claim 23, are disclosed by LeFebvre, Barone, Armitage, and Winfree. *See* Pet., 77-80; EX1003, ¶¶ 226-230; EX1030, ¶ 90.

Claim 45, Grounds 1-2: The limitations in claim 45, corresponding to original claim 29, are disclosed by Armitage and Barone. *See* Pet., 38; EX1003, ¶ 111; EX1030, ¶ 91. Grounds 5-6: The limitations in claim 45, corresponding to original claim 29, are disclosed by LeFebvre and Barone. *See* Pet., 66; EX1003, ¶ 182; EX1030, ¶ 92.

Claim 48, Grounds 1-2: The limitations in claim 48, corresponding to original claim 37, are disclosed by Armitage and Barone. *See* Pet., 40-44; EX1003, ¶¶ 126-134; EX1030, ¶ 93. Grounds 5-6: The limitations in claim 48, corresponding to original claim 37, are disclosed by LeFebvre, Barone, and Armitage. *See* Pet., 74-77; EX1003, ¶¶ 215-224; EX1030, ¶ 94. To the extent claim 48 has been amended to require a “tri-axis sensor,” this limitation is discussed above in independent claim 47, from which claim 48 depends.

IV. CONCLUSION

Petitioner respectfully requests that the Board deny the Motion.

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

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that on this 19th day of April 2024, the foregoing was served via electronic mail to the attorneys of record for the '915 Patent at the following address:

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LISTING OF CLAIMS

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 axes, and</u>
Limitation 38(c)(ii)	(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 38(d)	wherein said communication management units perform the functions of: (i) <u>collecting, from the one or more wireless sensor nodes, data regarding said ~~one or more railcar~~ operational</u>

Claim Limitation	Claim Language
	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]] configured to measure accelerations of the railcar.
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 wireless sensor nodes further 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 tri-axis one or more sensor[[s]] that is[[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 nodes, wherein one or more of the wireless sensor nodes comprise a protective housing, wherein the tri-axis one or more sensor[[s]] is[[are]] mounted within the protective housing, wherein the protective housing comprises a potting material configured to tune the wireless sensor nodes by absorbing at least a portion of undesirable accelerations.
Claim 43	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 nodes, wherein one or more of the wireless sensor nodes

Claim Limitation	Claim Language
	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 plurality of <u>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 38[[1]], wherein the one or more <u>wireless sensor nodes</u> ~~filters~~ <u>further</u> comprise one or more mechanical filters.
Claim 45	The system of claim 38[[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 plurality of sensor sections that are provided with the one or more wireless sensor nodes</u> , at least a portion of the accelerations <u>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</u>

Claim Limitation	Claim Language
	<u>axes; and</u>
Limitation 46(d)	by one or more communication management units associated with the one or more railcars: collecting, <u>from the one or more wireless sensor nodes</u> , data regarding said ~~one or more railcar~~ operational parameters <u>of said one or more railcars</u> ;
Limitation 46(e)	analyzing said collected data <u>to detect a</u> [[for]] trend[[s]] or event[[s]] indicative of an anomalous operational condition of said one or more railcars; and
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</u> [[s]] <u>nodes</u> located on the [[said]]railcar <u>and</u> [[for]] configured to sense operational parameters of the railcar, said <u>wireless sensor</u> [[s]] <u>nodes</u> being in communication with said communication management unit, wherein the <u>at least two</u> ~~one or more~~ <u>wireless sensor</u> [[s]] <u>nodes</u> <u>comprise a tri-axis</u> ~~one or more~~ <u>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 47(c)(i)	(c) <u>a plurality of</u> ~~one or more~~ <u>sensor sections that are 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</u> , and
Limitation 47(c)(ii)	<u>a plurality of detectors respectively coupled to the plurality</u>

Claim Limitation	Claim Language
	<u>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~~ sensor[[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
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.