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 IPR2023-00539
Patent No. 9,981,673

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

PETITIONER'S CORRECTED OPPOSITION TO PATENT OWNER'S MOTION TO AMEND

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1009	U.S. Patent No. 6,339,397 to Baker et al. ("Baker")
1010	U.S. Patent No. 6,487,478 to Azzaro et al. ("Azzaro")
1011	Amsted Rail Company, Inc.'s Complaint filed against Hum Industrial Technology, Inc. (ECF No. 1) filed on April 18, 2022
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1019	~~Expert Declaration of Steven Ricca in Support of Petitioner's Reply~~*Intentionally Omitted*
1020	~~U.S. Provisional Application No. 61/333,428 to Armitage et al. ("Armitage Provisional")~~ Transcript of Conference Call Before James P. Calve, Kevin W. Cherry, and Michael L. Woods (June 8, 2023)

Ex #	Exhibit Description
1021	Expert Declaration of Steven Ricca in Support of Petitioner's Opposition to Patent Owner's Motion to Amend
1022	U.S. Patent No. 6,672,681 to Moretti et al. ("Moretti")
1023	International Publication No. WO 82/00805 to Sinha ("Sinha")
1024	U.S. Patent No. 6,539,293 to Bächtiger et al. ("Bächtiger")
1025	U.S. Patent No. 2,818,508 to Johanson et al. ("Johanson")
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1031	U.S. Provisional Application No. 61/333,428 to Armitage et al. ("Armitage Provisional")

Amsted's Motion to Amend (Paper 17 ("Mot.")) should be denied because substitute claims 23–43 lack written description support, fail to meet the enablement or definiteness standards of 35 U.S.C. § 112, and are obvious in view of the prior art under 35 U.S.C. § 103.

I. SUBSTITUTE CLAIMS 23–43 LACK 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 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." *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 in prosecution in response to development by others." *FWP IP ApS v. Biogen MA, Inc.*, 749 F. App'x 969, 974 (Fed. Cir. 2018).

In an attempt to provide written description support for the substitute claims, Amsted presents a claim chart purporting to show where each individual limitation may be found in the specification. *See* Mot., 6–17. As discussed below, many of the added limitations are not, in fact, disclosed anywhere in the specification. But even if Amsted could successfully identify support for each individual limitation, "an 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); *accord Ariad Pharms.,* , 598 F.3d at 1352 (Fed. Cir. 2010). Rather, the original application must support each claim "as an integrated whole rather than as a collection of independent limitations." *Novozymes*, 723 F.3d at 1349.

Amsted cannot make this showing. Each of the proposed new independent claims (23, 33, 36, and 42) includes multiple new limitations, plucked from disparate portions of the specification, that have been arbitrarily combined in an attempt to evade the prior art. For example, all four independent claims have newly added limitations that require the use of acceleration data. But as explained below, much of the disclosure Amsted relies upon for support is directed to temperature monitoring—not acceleration. The specific, acceleration-focused embodiments Amsted now claims are simply not disclosed anywhere in the specification, and the Board should decline Amsted's invitation to introduce new matter into the claims. *See Hyatt v. Dudas*, 492 F.3d 1365, 1371 (Fed. Cir. 2007) (upholding a rejection for lack of written description where "each element [was] *individually* described in the specification," but specification failed to "provide support for the *linkage of the claimed elements* creating the embodiment") (emphasis in original).

A. Claim 23: "on a sidewall of a bearing adapter," "acceleration data"

In support of its proposed additions to Limitation 23(a), Amsted improperly

relies upon "an amalgam of disclosures" plucked from unrelated portions of the specification. *Novozymes*, 723 F.3d at 1349. The specific embodiment Amsted now claims—a mote comprising an ***accelerometer*** mounted to the ***sidewall*** of a bearing adapter—is disclosed nowhere in the specification. EX1021, ¶ 17.

The '673 Patent is broadly directed to a monitoring system comprising sensors "mounted on a railcar," (EX1001, (57) Abstract) and its specification describes a wide variety of sensor types and mounting locations. For example, the specification states broadly that "[s]ensor 20 can be any type of sensor," which is followed laundry list of different sensor types. EX1001, 4:51–58. Nothing in the specification, however, connects the listed sensors to the specific mounting location required by claim 23 (the sidewall of a bearing adapter). EX1021, ¶ 18. To the contrary, a PHOSITA would understand that many of the listed sensors (e.g., strain gauges, gyroscopes, reed switches, limit switches) would serve no purpose if mounted on a bearing adapter, and the specification expressly recognizes that different sensors will require different housing configurations and mounting locations. EX1001, 4:49–51 ("As one of ordinary skill would recognize, the configuration of the motes 10 with respect to the sensor 20 is dependent upon the type of sensor and the type of data desired."); EX1021, ¶ 18.

Additionally, claim 23 expressly requires a sensor unit mounted on the ***sidewall*** of a bearing adapter. A PHOSITA would understand that a bearing

adapter has multiple surfaces suitable for mounting sensor devices. EX1021, ¶ 19. LeFebvre, for example, discloses sensors mounted to "the upper rectangular surface of the bearing adapter." EX1005, ¶ [0020].

Amsted relies heavily on the embodiment disclosed in Figs. 3 and 3A of the '673 Patent, which it describes as mounted to the sidewall of a bearing adapter. But the embodiment of Figs. 3 and 3A is expressly described as a ***temperature*** sensing device. EX1001, 5:44–47. ("As an example, FIGS. 3 and 3A show a temperature sensing mote 10 of the type described above mounted to a bearing adapter…"). The '673 Patent does not indicate this embodiment comprises an ***accelerometer***, or indeed any type of sensor other than a temperature sensor. EX1021, ¶ 20.

Amsted also relies on the table spanning cols. 7–12, which includes two examples that reference an "adapter mounted accelerometer." But neither example states that the accelerometer is mounted specifically to the ***sidewall*** of a bearing adapter as expressly required by the claim. EX1021, ¶ 21.

In sum, there are no "blaze marks" in the application that would direct a PHOSITA to the specific combination of a mounting location (i.e., the sidewall of a bearing adapter) and a sensor type (i.e., accelerometer) that is now claimed. *See Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1326–1327 (Fed. Cir. 2000) ("one cannot disclose a forest in the original application, and then later pick a tree out of the forest and say here is my invention. In order to satisfy the written

description requirement, the blaze marks directing the skilled artisan to that tree must be in the originally filed disclosure").

B. Claim 23: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

Claim 23 introduces three new claim terms that represent "values" associated with accelerations of a railcar bearing: (1) "**calculated numeric values** based on acceleration data obtained at the bearing adapter," in Limitation 23(a); (2) "**a plurality of defined parameter values** associated with the condition of the bearing," in Limitation 23(b), and (3) "a **defined reference value** or range of values indicating nominal operating conditions for the bearing" in Limitation 23(c). None of these terms is used in the specification, and it is unclear how each term corresponds to the original disclosure. EX1021, ¶ 22.

For example, with respect to Limitation 23(a), Amsted has not identified any disclosure relating to "calculated numeric values." Mot., 6. With respect to Limitation 23(b), Amsted cites two examples of "heuristics" that can be applied to acceleration data: (1) calculation of FFTs, and (2) calculation of kurtosis. Mot., 6–7. It is not clear how the cited examples could support the new claim language—for example, is kurtosis a "calculated numeric value," a "defined parameter value," or both? Amsted's motion is unclear. EX1021, ¶ 23. In Limitation 23(c), the alleged support for "defined reference value" at col. 13:30–14:3 is directed to

temperature monitoring. Mot., 7. But the specification provides no thresholds for use with ***acceleration*** monitoring, which is what claim 23 requires. EX1021, ¶ 24.

C. Claim 30: "and performing steps b-d at said location remote from said railcar"

In support of this limitation, Amsted cites to generic statements that heuristics "may be performed by either mobile base station 42 or land-based based station 44." EX1001, 11:52–54. But the specification does not describe any embodiment wherein ***all three*** of the ***specific steps*** required by claim 33 are performed at a remote location. EX1021, ¶ 25. "Boilerplate language" that the specification encompasses various combinations "is not sufficient to show adequate disclosure of the actual combinations" that are now claimed. *D Three Enters., LLC v. SunModo Corp.*, 890 F.3d 1042, 1050–51 (Fed. Cir. 2018).

D. Claim 33: "and sensing accelerations by use of an accelerometer attached to said other part"

The specification does not disclose any embodiments that include ***both*** a temperature sensor and an accelerometer as required by claim 33. More generally, nothing in the specification states, or even suggests, that a single "sensor unit" may include multiple sensors. EX1021, ¶ 26. The specification therefore fails to provide written description support for the specific combination of features recited by claim 33. *See Novozymes*, 723 F.3d at 1349 (specification must support the claim "as an integrated whole rather than as a collection of independent limitations.").

E. Claim 33: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

See the discussion of the same terms in Section I.B, *supra*.

F. Claim 33: "an acceptable range of temperatures"

Limitation 33(c) introduces a new claim term, "an acceptable range of temperatures," which is defined in the claim as "a defined range of temperatures expected during normal operation of the railcar." Mot., 11. Amsted has not identified any disclosure in the specification that provides a "defined range of temperatures" as required by the claim. EX1021, ¶ 28.

G. Claim 36: "on a sidewall of a bearing adapter," "acceleration data"

See the discussion of the same terms in Section I.A, *supra*.

H. Claim 36: "a plurality of defined parameter values," "defined reference value"

See the discussion of the same terms in Section I.B, *supra*.

I. Claim 36: "heuristically analyzing said received acceleration data to: determine a value for a condition of a bearing based on correlations between a plurality of different values for the condition of the bearing and a plurality of defined parameter values associated with the bearing adapter that specify operating conditions expected for the bearing during operation of the railcar"

The specification does not disclose any "defined parameter values" or "operating conditions expected" with respect to ***acceleration*** data as required by claim 36. The alleged support at col. 13:30–14:3 is directed only to ***temperature*** monitoring. EX1021, ¶ 31. The cited disclosure at cols. 7–12 also fails to provide

"defined parameter values" or "expected operating conditions" with respect to acceleration. *Id.* Additionally, the specification does not disclose "correlations between a plurality of different values" as required by the claim. *Id.*

J. Claim 36: "determine if an actual failure exists on said railcar or predict potential or imminent failures based on a statistical analysis of said received acceleration data"

Amsted does not cite any disclosure that supports the detection of actual, potential, or imminent failures based on a statistical analysis of ***acceleration*** data, as specifically claimed. *See* Sections I.B and I.I, *supra*.

K. Claim 42: "on a sidewall of a bearing adapter," "acceleration data"

See the discussion of the same terms in Section I.A, *supra*.

L. Claim 42: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

See the discussion of the same terms in Section I.B, *supra*.

II. SUBSTITUTE CLAIMS 23–43 ARE INVALID UNDER 35 U.S.C. § 112

A. Indefiniteness

1. Claim 23: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

See the discussion of the same terms with respect to written description in Section I.B, *supra*. As discussed above, the terms "calculated numeric values," "a plurality of defined parameter values," and "defined reference value" do not appear in the specification, and it is not clear what each term represents or how the terms

relate to one another. EX1021, ¶ 36. Given this lack of clarity, the claim "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).

2. Claim 31: "said raised alarm comprising the assigned severity level"

A PHOSITA cannot understand, with reasonable certainty, what it means for an alarm to ***comprise*** an "assigned severity level." For example, it is not clear if (a) the alarm must comprise a written message that expressly recites the "level" (e.g., "Stage 2"), or (b) the alarm must comprise a written message that describes the alarm condition (e.g., "Axle Differential Alarm"), or (c) whether the claim can be satisfied without either of those elements. *See* EX1001, 13:31–14:3; EX1021, ¶ 37.

3. Claim 33: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

See Section II.A.1, *supra*.

4. Claim 36: "a plurality of defined parameter values," "defined reference value"

See Section II.A.1, *supra*.

5. Claim 36: "determine if an actual failure exists on said railcar or predict potential or imminent failures based on a statistical analysis of said received acceleration data"

This claim limitation is grammatically ambiguous. Specifically, if one were to "determine if an actual failure exists" *without* using statistical analysis, it is unclear whether this limitation would be satisfied. EX1021, ¶ 40.

6. Claim 42: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

See Section II.A.1, *supra*.

B. Enablement

1. Claim 23: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

See the discussion of the same terms with respect to written description in Section I.B, *supra*. As discussed above, the specification does not disclose any "defined parameter values" or "defined reference values" that could be used in connection a method for monitoring acceleration as required by claim 23. While the specification provides examples that involve temperature monitoring, it does not provide any teaching or examples that would enable the claimed methods of monitoring acceleration. EX1021, ¶ 42.

2. Claim 33: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

See Section II.B.1, *supra*.

3. Claim 33: "an acceptable range of temperatures"

See the discussion of the same terms with respect to written description in Section I.F, *supra*. The specification of the '673 Patent does not disclose any "acceptable range of temperatures" that could be used by a PHOSITA to practice this claim without undue experimentation. EX1021, ¶ 45.

4. Claim 33: "calibrated correlations"

Limitation 33(b) requires the use of "calibrated correlations between a plurality of temperature values for the desired part and a plurality of temperatures that are expected for the part during standard operations of the railcar." The evidence of record indicates that a team of academic researchers at UTRGV worked diligently for several years to develop a set of temperature correlations for use with the monitoring system claimed in the '673 Patent. *See* EX2013 at ¶ 9 (work began "in the 2008 and 2009 timeframe"); ¶ 41 (referencing May 18, 2011 call regarding ongoing "node temperature calibration and data analysis"); ¶ 44 ("by at least August 2, 2011, we believed the condition monitoring system would work"). The temperature correlations developed by UTRGV are not disclosed in the '673 Patent, and the specification does not enable a PHOSITA to independently develop the required correlations without undue experimentation. EX1021, ¶ 46.

5. Claim 36: "defined parameter values," "defined reference value"

See Section II.B.1, *supra*.

6. Claim 42: "calculated numeric values," "a plurality of defined parameter values," "defined reference value"

See Section II.B.1, *supra*.

III. SUBSTITUTE CLAIMS 23–43 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 claims are unpatentable over Armitage in view of LeFebvre, Barone, and Moretti (Ground 1) and/or LeFebvre in view of Armitage, Barone, and Moretti

(Ground 2). EX1021, ¶ 50.

A PHOSITA would have found it obvious to combine the disclosures of Armitage, LeFebvre, Barone, and Moretti. All four references describe systems for wirelessly monitoring railcars, and utilize nearly identical components that function in a similar way. *See* EX1005, (57) Abstract; EX1006, (57) Abstract; EX1007, (57) Abstract; EX1022, (57) Abstract. Specifically, each reference discloses a system that utilizes a plurality of sensors to monitor the wheel bearings on a railcar, wherein the sensors communicate with a control unit located on the railcar. *Id.* Each reference discloses that collected data is analyzed to determine, for example, if bearing failure is approaching or imminent. EX1005, ¶¶ [0058]–[0059]; EX1006, ¶¶ [0013]–[0015], [0025]; EX1007, ¶¶ [0201]–[0220]; EX1022, 3:57–62. And each reference discloses that an alarm should be raised when a failure condition is detected. EX1005, ¶¶ [0055]–[0056], [0095]; EX1006, ¶¶ [0042]–[0043]; EX1007, ¶ [0045]; EX1022, 4:8–12. A PHOSITA therefore would have understood that Armitage, LeFebvre, Barone, and Moretti are analogous art. EX1021, ¶ 51. A PHOSITA would have been motivated to combine the teachings of these references for the reasons discussed in detail below.

A. Claim 23

Ground 1: Most limitations of claim 23, including all limitations present in original claim 1, are disclosed by Armitage. *See* Petition, 50–57; EX1003, ¶¶ 188–

203; EX1021, ¶ 52. Ground 2: Most limitations of claim 23, including all limitations present in original claim 1, are disclosed by LeFebvre. *See* Petition, 18–24; EX1003, ¶¶ 70–86; EX1021, ¶ 53. New limitations of claim 23 not previously addressed in this proceeding with respect to claim 1 are discussed in detail below.

1. Limitation 23(a): "wherein the operational characteristic is a condition of a bearing and wherein the received data or processed information includes one or more calculated numeric values based on acceleration data obtained at the bearing adapter"

Grounds 1 and 2: There is nothing inventive about using an accelerometer to measure vibrations emanating from a wheel bearing. It was known in the railroad industry as early as the 1980s that "vibrations of bearing boxes change their nature when faults arise." EX1023, 3:17–19; EX1021, ¶ 55. Armitage, LeFebvre, Barone, and Moretti each disclose sensor nodes for monitoring wheel bearings that may include accelerometers, either alone or in combination with temperature sensors. EX1006, ¶¶ [0013]–[0015]; ¶ [0025] ("The information monitored could include undercarriage element **temperature**, ambient temperature, **vibration**, noise, among other information."); ¶ [0027] ("The fault condition could include conditions such as hotbox conditions…bearing **temperature**, **vibration** signatures…"); EX1005, claim 12 ("at least one sensing device being a **temperature** sensor disposed on the pads adjacent a bearing for sensing bearing temperature,"), claim 21 (a system according to claim 12 having a "second sensing

device being a **vibration** sensing device"); EX1007, ¶ [0045] (disclosed system "monitors bearing **temperature**, bearing **vibration**…and reports critical situations back to the central monitoring station, thus allowing continuous monitoring and true trending data analysis"); EX1022, 3:57–62 ("In a preferred embodiment, besides the **vibration** and motion sensors, also a **temperature** sensor (not shown) is included for signalling the occurrence of temperatures higher than those of normal operation and indicating that the friction within the bearing is exceeding a pre-set threshold value of admissibility."). In a sensor unit for monitoring a wheel bearing, it would have been obvious to include both a temperature sensor and a vibration sensor because both temperature and vibration are known indicators of bearing degradation and damage. EX1021, ¶ 56.

As explained in detail in the Petition, both LeFebvre and Armitage perform calculations (or "heuristics") on collected sensor data, which naturally results in "calculated numeric values" which represent the operational state of the bearing. EX1005, claim 9 ("values indicative of critical departures of the performance criteria"), claim 12 ("values derived by said sensors"); EX1006, ¶ [0045] (calculating averages, minimums, and maximums based on acceleration data.) EX1021, ¶ 57. *See also* Petition, 18–24, 50–57; EX1003, ¶¶ 70–86, 188–203.

2. Limitation 23(a): "mounted on a sidewall of a bearing adapter"

Ground 1: It would have been obvious to mount Armitage's sensor node to

the sidewall of a bearing adapter. Armitage discloses that its sensor nodes are "attached or coupled to the associated undercarriage element," which may be a "bearing or bearing box," and can include a variety of sensor types including "thermometers" and "accelerometers." EX1006, ¶¶ [0013]–[0015]. The sensor node is preferably attached to a "non-rotating structure," such as a "bearing mount." *Id.*, ¶ [0034]. While Armitage does not expressly identify the ***sidewall*** of the bearing adapter, a PHOSITA would have understood that accelerometers can be mounted to the sidewall to measure vibrations emanating from the bearing. EX1021, ¶ 58. Barone expressly discloses a sensor node comprising accelerometers and mounted on the sidewall of a bearing adapter as required by the substitute claims. EX1007, ¶¶ [0289]–[0293], Figs. 11–13. Moretti teaches that it is preferable to mount a vibration sensor on the bearing box wall "at a position vertically aligned with the axis of rotation of the bearing, where the vibrations are more intense." EX1022, 3:22–28; EX1021, ¶ 59. In sum, a PHOSITA would have been motivated to mount a sensor node on the sidewall of a bearing adapter because it is an obvious, easily accessible, non-rotating surface that transmits vibrations emanating from the bearing. EX1021, ¶ 60.

Ground 2: LeFebvre discloses that its sensor unit can include a load sensor to "monitor vibrations emitted from the bearing (transmitted through the roller bearing adapter)." EX1005, ¶ [0059]. Although LeFebvre's preferred embodiment

is mounted on the upper surface of the bearing adapter, a PHOSITA would have understood that the shape, size, or location of the housing could be changed (e.g., to accommodate mounting a sensor device in a different location on the railcar) without affecting the operation of the sensors or electronic circuitry contained within the housing. EX1021, ¶ 61. For example, a PHOSITA could have modified LeFebvre's device to extend down the sidewall of the bearing adapter in order to place an accelerometer on the sidewall at the location identified by Barone. EX1007, ¶¶ [0289]–[0293], Figs. 11–13; EX1021, ¶ 62.

3. Limitation 23(b): "wherein the heuristic includes a comparison of at least one of said calculated numeric values with a plurality of defined parameter values associated with the condition of the bearing"

Grounds 1 and 2: Patent Owner alleges that neither Armitage nor LeFebvre discloses this limitation, because neither reference discloses comparing collected data with "***defined*** values to determine deviations from nominal operating conditions." Paper 17 at 21; *id.* at 22; *id.* at 23.

A PHOSITA would understand that comparing a measured value (or a calculated value, such as an average of previous measurements) to a predetermined threshold is the simplest way to detect a defect or failure. EX1021, ¶ 63. For example, conventional trackside "hotbox detectors," which were in common use by the 1940s, would calculate the bearing adapter temperature and generate an alarm if it exceeded a predetermined threshold. EX1021, ¶ 64. Following the same

principle, the systems disclosed by Barone and Moretti expressly disclose comparing measured temperature values with predetermined reference values. EX1007, ¶ [0241] ("The microcontroller 177 thus triggers an alert action when the temperature detected for its associated wheel exceeds a pre-selected threshold temperature."), ¶ [0253] ("Similarly, when the absolute temperature or the temperature rate of change exceeds a pre-selected threshold trigger value, a bearing defect or imminent failure may be determined to exist, and appropriate alert action taken responsive to the determination."), claim 37; EX1022, 3:57–62 ("In a preferred embodiment, besides the vibration and motion sensors, also a temperature sensor (not shown) is included for signalling the occurrence of temperatures higher than those of normal operation and indicating that the friction within the bearing is exceeding a pre-set threshold value of admissibility."), 4:8–12 ("When at least one of the signals related to one of the monitored parameters exceeds a predetermined threshold level, the processing unit generates an alarm signal that allows to intervene at the right moment to remove the defect and restore conditions of safe and correct operation."). *See also* EX1008, ¶ [0104] ("If the filtered temperature exceeds the prescribed alarm level an alarm is triggered…"). The Martin Declaration admits, and Mr. Ricca agrees, that standard temperature thresholds for railcar wheel bearings were known in the art. EX2013, ¶ 15 ("The temperature thresholds that we were using during this project was roughly the

same as industry standard thresholds used for analyzing train bearings."); EX1021, ¶ 65.

The prior art also discloses comparing a measured acceleration value with a predetermined reference value. EX1022, 3:57–62, 4:8–12. *See also* EX1008, ¶ [0105] ("If the filtered acceleration exceeds the prescribed alarm level, then an alarm is generated."); EX1024, 2:54–61; EX1021, ¶ 66.

Comparing a value to a predefined threshold is the simplest way to detect a potential failure, and a PHOSITA would have understood that this heuristic could be used in the systems described by LeFebvre and Armitage—for example, to detect dangerously high bearing temperatures and/or vibrations. EX1021, ¶ 67. A PHOSITA would have been motivated to use threshold-based comparisons because they are simple, straightforward to implement, and effective. *Id.* Additionally, a PHOSITA would have understood that threshold-based heuristics can be used in parallel with more complex heuristics if desired. *Id.*

4. Limitation 23(c): "wherein said severity level is one of a plurality of defined severity levels that are based on a deviation of at least one of the calculated numeric values determined for the condition of the bearing from a defined reference value or range of values indicating nominal operating conditions for the bearing during operation of the railcar"

Grounds 1 and 2: A PHOSITA would have understood that larger deviations from normal operating conditions usually indicate the presence of larger, more severe, and more urgent problems. EX1021, ¶ 68; EX1006, ¶ [0043] ("The degree

to which any specific sensor deviates from this population is indicative of the severity of the mechanical condition of the component."), EX1005, ¶ [0055] ("If such behavior is inferred at the instrumented pad **and the magnitude is sufficient to cause alarm**…"), ¶ [0095]. *See also* EX1024, 8:46–57 ("Given sudden changes of smaller scale which are recognized as defects to a bogie 1, the maximum speed can be reduced. Given sudden changes of larger scale, a vehicle stop and an inspection of the affected bogie 1 should be performed.").

A PHOSITA would also have understood that the appropriate response to a problem on a railcar depends on its severity. EX1021, ¶ 70; EX1007, ¶ [0036] ("If the estimated time to bearing failure permits, a maintenance action can be scheduled. If failure is estimated to be imminent, the train can be diverted or stopped before catastrophic bearing failure and derailment."), ¶ [0164] ("Thus, continual monitoring of the same bearing with respect to a constant sensor location allows true trending analysis, allowing for reporting of the bearing condition to a user by an appropriate display device, to arrange for appropriate remediation."), ¶ [0191] ("The locomotive computer system, responsive to that data then generates an appropriate alarm or indication to prompt a human user to take remedial action."). Armitage, for example, uses a color-coded system (corresponding to a "plurality of severity levels") to indicate the severity of the fault. EX1006, ¶ [0044] ("The event ranking could include a 'yellow' condition which indicates that a

railway car requires service, and a 'red' condition which indicates that a sensor has detected a serious deviation…that requires immediate service.").

In the context of a railcar monitoring and alarm system, a PHOSITA would therefore have been motivated to send alarms that indicate the severity of the underlying condition because some conditions warrant immediate, urgent action (e.g., stopping the train) while other, less serious conditions do not. EX1021, ¶ 71.

B. Claims 24–32

Ground 1: The limitations added by dependent claims 24, 25, 27, and 29–32, which correspond to original claims 13, 2, 4, and 6–9 respectively, are disclosed by Armitage. *See* Petition, 58–68; EX1003, ¶¶ 204–215, 240–242; EX1021, ¶ 72. The additional limitations of claims 26 and 28, which correspond to original claims 3 and 5, are disclosed by Armitage in view of LeFebvre. *See* Petition, 70–71; EX1003, ¶¶ 250–253.

Ground 2: The limitations added by dependent claims 24–30, which correspond to original claims 13 and 2–7 respectively, are disclosed by LeFebvre. *See* Petition, 24–27, 33–34; EX1003, ¶¶ 87–99, 120–122; EX1021, ¶ 73. The additional limitations of claims 31 and 32, which correspond to original claims 8 and 9, are disclosed by LeFebvre and Barone. *See* Petition, 42–50; EX1003, ¶¶ 165–183.With respect to Limitation 31(d), which requires a "raised alarm comprising the assigned severity level," *see* Section III.A.4, *supra*.

C. Claim 33

Ground 1: Most limitations of claim 33, including all limitations present in original claim 10, are disclosed by Armitage. *See* Petition, 65–67; EX1003, ¶¶ 227–235; EX1021, ¶ 74. Ground 2: Most limitations of claim 33, including all limitations present in original claim 10, are disclosed by LeFebvre. *See* Petition, 28–31; EX1003, ¶¶ 100–110; EX1021, ¶ 75. New limitations of claim 33 not previously addressed with respect to claim 10 are discussed below.

1. Limitation 33(a): "sensing accelerations by use of an accelerometer attached to said other part"

See Sections III.A.1 and III.A.2, *supra*.

2. Limitation 33(b): "calibrated correlations between a plurality of temperature values for the desired part and a plurality of temperatures that are expected for the part during standard operations of the railcar"

Ground 1: As discussed with respect to Limitation 23(a) *supra*, Armitage discloses a sensor node that measures bearing temperature and is preferably attached to a "non-rotating structure," such as a bearing mount. *See* EX1006, ¶ [0034]; Petition, 65–66. A PHOSITA would understand that measuring bearing temperature indirectly—Armitage's preferred embodiment—requires correlating the temperature of the bearing itself (the component of interest) with the temperature of the non-rotating component that is directly measured. EX1021, ¶ 79. In other words, a PHOSITA would understand that the "calibrated correlations" of claim 33 are also used by Armitage's preferred embodiment.

Ground 2: As shown in Figure 4, LeFebvre's instrumented pad **16** measures the temperature of wheel bearing adapter **4**, which can be used to infer the temperature of wheel bearing **2a**. EX1005, ¶ [0019], Fig. 4. *See* Petition, 28–29. A PHOSITA would understand that measuring bearing temperature using this arrangement requires a correlation between the temperature of the bearing itself (the component of interest) and the temperature of the bearing adapter (the component that is directly measured). EX1021, ¶ 80. In other words, a PHOSITA would understand that the "calibrated correlations" of claim 33 are also used in LeFebvre's monitoring system.

3. Limitation 33(b): "calculating one or more calculated numeric values based on the accelerations sensed in step (a)"

See Sections III.A.1 and III.A.3, *supra*.

4. Limitations 33(c) and 33(d)

See Sections III.A.3 and III.A.4, *supra*.

D. Claims 34–35

Ground 1: The limitations added by dependent claim 34, corresponding to original claim 11, are disclosed by Armitage. *See* Petition, 67–68; EX1003, ¶¶ 236–239; EX1021, ¶ 83. The limitations added by dependent claim 35, corresponding to original claim 12, are disclosed by Armitage in view of LeFebvre. *See* Petition, 71–72; EX1003, ¶¶ 254–259. Ground 2: The limitations added by dependent claims 34 and 35 are disclosed by LeFebvre. *See* Petition, 31–

33; EX1003, ¶¶ 111–119; EX1021, ¶ 84.

E. Claim 36

Ground 1: Most limitations of claim 36, including all limitations present in original claim 14, are obvious over Armitage and LeFebvre. *See* Petition, 73–74; EX1003, ¶¶ 261–268; EX1021, ¶ 85. Ground 2: Most limitations of claim 36, including all limitations present in original claim 14, are disclosed by LeFebvre. *See* Petition, 35–38; EX1003, ¶¶ 123–132; EX1021, ¶ 86. New limitations of claim 36 not previously addressed with respect to claim 14 are addressed below.

1. Limitation 36(a): "acceleration data" and "disposed on a sidewall of a bearing adapter"

See Sections III.A.1 and III.A.2, *supra*.

2. Limitation 36(b): "determine a value for a condition of a bearing based on correlations between a plurality of different values for the condition of the bearing and a plurality of defined parameter values associated with the bearing adapter that specify operating conditions expected for the bearing during operation of the railcar"

See Sections III.A.1 and III.A.3, *supra*.

3. Limitation 36(b): "a statistical analysis of said received acceleration data"

Ground 1: Armitage expressly discloses the application of statistical analysis to acceleration data. EX1006, ¶ [0045] ("In an example wheel rotation, 60 milliseconds of vibration are sampled every two seconds and the vibrations are averaged (along with determining minimums and maximums) every sixty seconds and stored. Time series analysis could then performed on the readings to determine

the failure conditions."). EX1021, ¶ 90.

Ground 2: LeFebvre discloses the use of statistical techniques to process data collected from its sensor nodes, which can comprise accelerometers as discussed above. EX1021, ¶ 91; *see* Limitation 23(a), *supra*. More specifically, a PHOSITA would have been motivated to take a statistical sampling of acceleration data collected by LeFebvre's sensors because, without statistical sampling, the amount of data to be processed would be extremely large and unmanageable. EX1021, ¶ 91; *see* EX1006, ¶ [0045]. Additionally, statistical techniques are used to analyze collected data—for example, Fourier analysis to detect underlying frequencies in the vibration data, trend analysis to detect changes in the bearing's vibration signature over time, and/or standard deviation thresholds to identify failing components. EX1021, ¶ 91; EX1006, ¶¶ [0030] (trend analysis), [0041] (standard deviation); EX1007, ¶¶ [0042], [0045] ("true trending data analysis"). *See also* EX1024, 2:6–32 ("subjecting sensor signals received from the acceleration sensors to a Fourier transformation").

4. Limitation 36(b): "assign a severity level to said determined actual failure or said predicted potential or imminent failures, wherein the severity level is based on deviations of the value for the condition of the bearing from a defined reference value or range of values"

See Sections III.A.3 and III.A.4, *supra*.

F. Claims 37–41

Ground 1: The limitations added by dependent claims 37–41, corresponding to original claims 15–18 and 20, are disclosed by Armitage in view of LeFebvre. *See* Petition, 74–77; EX1003, ¶¶ 269–281; EX1021, ¶ 93. Ground 2: The limitations added by dependent claims 37–41 are disclosed by LeFebvre. *See* Petition, 38–41; EX1003, ¶¶ 133–145; EX1021, ¶ 94.

G. Claim 42

Ground 1: Most limitations of claim 42, including all limitations present in original claim 21, are obvious over Armitage and LeFebvre. *See* Petition, 77; EX1003, ¶¶ 282–286; EX1021, ¶ 95. Ground 2: Most limitations of claim 42, including all limitations present in original claim 21, are disclosed by LeFebvre. *See* Petition, 41; EX1003, ¶¶ 149–153; EX1021, ¶ 96. New Limitations: For Limitation 42(a), *see* Sections III.A.1 and III.A.2, *supra*. For Limitation 42(c), *see* Sections III.A.3, III.C.2, and III.E.3 *supra*.

H. Claim 43

Ground 1: The limitations added by dependent claim 43 are disclosed by Armitage and LeFebvre. *See* Petition, 77; EX1003, ¶¶ 287–289; EX1021, ¶ 100. Ground 2: The limitations added by dependent claim 43 are disclosed by LeFebvre. *See* Petition, 41; EX1003, ¶¶ 154–156; EX1021, ¶ 101.

IV. CONCLUSION

Petitioner respectfully requests that the Board deny the Motion to Amend.

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that on this 11th day of January, 2024, the foregoing was served via electronic mail to the attorneys of record for the '673 Patent at the following address:

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LISTING OF CLAIMS

Claim Limitation	Claim Language
Claim 23 Preamble	A method of monitoring operational characteristics of a railcar comprising the steps of:
Limitation 23(a)	a. receiving data or processed information regarding [[said]]an operational characteristic of a railcar from one or more sensing units, each mounted on a sidewall of a bearing adapter on said railcar, said sensing units monitoring [[an]]said operational characteristic of said railcar, wherein the operational characteristic is a condition of a bearing and wherein the received data or processed information includes one or more calculated numeric values based on acceleration data obtained at the bearing adapter;
Limitation 23(b)	b. applying a heuristic to said received data to determine deviations from nominal operating conditions, wherein the heuristic includes a comparison of at least one of said calculated numeric values with a plurality of defined parameter values associated with the condition of the bearing;
Limitation 23(c)	c. assigning a severity level to said deviations from nominal operating conditions, wherein said severity level is one of a plurality of defined severity levels that are based on a deviation of at least one of the calculated numeric values determined for the condition of the bearing from a defined reference value or range of values indicating nominal operating conditions for the bearing during operation of the railcar; and
Limitation 23(d)	d. determining an alarm condition based on said assigned severity level.
Claim 24	The method of ~~claim 1~~claim 23, wherein steps (a) through (d) can be carried out at different event engines distributed among at least two of said ~~sensor~~sensing units, a communication management unit, and a mobile or land base station.
Claim 25	The method of ~~claim 1~~claim 23, further comprising the initial

Claim Limitation	Claim Language
	step of establishing wireless communication with said one or more remote sensing units.
Claim 26	The method of ~~claim 2~~claim 25, wherein said one or more remote sensing units form a mesh network.
Claim 27	The method of ~~claim 2~~claim 25, wherein steps a-d are executed by a processing unit located on said railcar.
Claim 28	The method of ~~claim 4~~claim 27, wherein said processing unit located on said railcar is a part of [[said]]a mesh network.
Claim 29	The method of ~~claim 2~~claim 25, further comprising the step of transmitting said alarm condition to a location remote from said railcar.
Claim 30	The method of ~~claim 2~~claim 25, further comprising the step of transmitting said data received from said one or more sensing units to a location remote from said railcar.
Limitation 31(a)	The method of ~~claim 2~~claim 25, further comprising the steps of: receiving acceleration data from a plurality of railcars;
Limitation 31(b)	applying [[a]]the heuristic to said received acceleration data to determine the deviations from nominal operating conditions;
Limitation 31(c)	assigning [[a]]the severity level to said deviations from nominal operating conditions;
Limitation 31(d)	determining [[an]]the alarm condition based on said assigned severity level; and
Limitation 31(e)	transmitting [[said]]a raised alarm to a display unit on a train of which said plurality of railcars are a part, said raised alarm comprising the assigned severity level.
Limitation 32(a)	The method of ~~claim 6~~claim 29, further comprising the steps of

Claim Limitation	Claim Language
	a. determining a recommended course of action based on said alarm condition; and
Limitation 32(b)	b. transmitting said recommended course of action to a display unit on a train of which said railcar is a part.
Claim 33 Preamble	A method of monitoring a temperature and condition of a desired part of a railcar, comprising:
Limitation 33(a)	(a) sensing the temperature of a part of the railcar other than the desired part by use of a temperature sensor in thermal communication with said other part and sensing accelerations by use of an accelerometer attached to said other part;
Limitation 33(b)	(b) determining the temperature of the desired part by use of the temperature of the part sensed in step (a) and calibrated correlations between a plurality of temperature values for the desired part and a plurality of temperatures that are expected for the part during standard operations of the railcar and calculating one or more calculated numeric values based on the accelerations sensed in step (a);
Limitation 33(c)	(c) determining if said temperature of the desired part is outside an acceptable range of temperatures indicating operating conditions expected for the desired part during the operation of the railcar by comparing the temperature of the desired part determined in step (b) and at least one defined temperature value associated with the desired part and detecting a condition of the desired part by comparing at least one of said calculated numeric values with a plurality of defined parameter values associated with the condition of the desired part, wherein an acceptable range of temperatures is a defined range of temperatures expected during normal operation of the railcar; and
Limitation 33(d)	(d) transmitting an alarm if in step (c) it is determined that the temperature of the desired part is outside [[an]]the acceptable range of temperatures and transmitting an alarm if in step (c) it is determined that the condition of the desired part falls within one of a plurality of severity levels defined by a deviation of at least one of the calculated numeric values determined for the condition of the desired part from a

Claim Limitation	Claim Language
	defined reference value or range of values indicating a severity of the detected condition of the desired part.
Claim 34	A method of monitoring a temperature and condition of a desired part of a railcar in accordance with ~~claim 10~~ claim 33, further comprising the step of determining a ~~the~~ temperature of the ambient air, which temperature is used in the determination of step (b).
Claim 35	A method of monitoring a temperature and condition of a desired part of a railcar in accordance with ~~claim 10~~ claim 33, wherein steps (a) through (d) are carried out by a single unit attached to said railcar.
Claim 36	A method for monitoring the operation of a railcar performed by a communication management unit disposed on said railcar comprising the steps of:
Limitation 36(a)	a. wirelessly receiving acceleration data from one or more sensing units which periodically collect readings from one or more sensors disposed on a sidewall of a bearing adapter on said railcar;
Limitation 36(b)	b. heuristically analyzing said received acceleration data to: determine a value for a condition of a bearing based on correlations between a plurality of different values for the condition of the bearing and a plurality of defined parameter values associated with the bearing adapter that specify operating conditions expected for the bearing during operation of the railcar; and determine if an actual failure exists on said railcar or [[to]]predict potential or imminent failures based on a statistical analysis of said received acceleration data; assign a severity level to said determined actual failure or said predicted potential or imminent failures, wherein the severity level is based on deviations of the value for the condition of the bearing from a defined reference value or range of values; and
Limitation 36(c)	c. communicating the results of said analysis performed in

Claim Limitation	Claim Language
	step (b) to an off-railcar location.
Limitation 37(a)	The method of ~~claim 14~~claim 36, wherein each of said sensing units can make a determination of an alarm condition based on data collected by the sensing unit, said method further comprising the step of: a. wirelessly receiving notice of said alarm condition from said sensing unit; and
Limitation 37(b)	b. communicating said alarm condition to an off-railcar location.
Limitation 38(a)	The method of ~~claim~~ 14claim 36, further comprising the steps of: a. making a determination of an alarm condition based on data received from two or more of said sensing units; and
Limitation 38(b)	b. communicating said alarm condition to an off-railcar location.
Claim 39	The method of ~~claim 14~~claim 36, further comprising the step of placing said one or more sensing units in a stand-by state when said one or more sensing units is not reading data from any of said sensors or transmitting data.
Claim 40	The method of ~~claim 14~~claim 36, further comprising the step of joining a mesh network consisting of one or more sensing units located on said railcar.
Limitation 41(a)	The ~~system~~method of ~~claim 14~~claim 36, further comprising the steps of: a. saving data received from said one or more sensing units in memory; and
Limitation 41(b)	b. comparing data received with said saved data to identify trends or deviations from normal readings of said data stored in memory.
Claim 42	A method for monitoring the operation of a railcar comprising:

Claim Limitation	Claim Language
Limitation 42(a)	a. collecting data at periodic intervals about one or more operating parameters of said railcar using one or more sensor units provided on a sidewall of a bearing adapter on said railcar, wherein the one or more operating parameters comprise a condition of a bearing and wherein the collected data includes one or more calculated numeric values based on acceleration data obtained at the bearing adapter;
Limitation 42(b)	b. communicating said collected data to a communication management unit;
Limitation 42(c)	c. analyzing said collected data by applying heuristics thereto to (i) determine if an actual failure exists and (ii) [[to]]predict potential or imminent failures based on a statistical analysis of said collected data[[.]]; wherein the heuristics include a comparison of at least one calculated numeric value with a plurality of defined parameter values associated with the condition of the bearing, wherein application of the heuristics produces a value for the condition of the bearing based on correlations between a plurality of different values for the condition of the bearing and a plurality of defined parameter values associated with the bearing adapter of the railcar that specify operating conditions expected for the bearing during operation of the railcar; and wherein a result of said statistical analysis comprises a deviation of the value for the condition of the bearing from a defined reference value or range of values indicating operating conditions expected for the bearing during standard operations of the railcar.
Limitation 43(a)	The method of ~~claim 21~~claim 42, further comprising the steps of: assessing the collected data to determine if an alarm condition exists;
Limitation 43(b)	and wirelessly communicating said alarm condition to an off railcar location.