

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUM INDUSTRIAL TECHNOLOGY, INC.
Petitioner

v.

PATENT OWNER RAIL COMPANY, INC.
Patent Owner

Case IPR2023-00538
Patent No. 9,365,223

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

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

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I. INTRODUCTION

1. I, Steven Ricca, hereby declare that the following is true and correct. I previously provided a declaration filed as Ex. 1003 in support of Paper No. 1, Petition for *Inter Partes* Review (“Petition”), and my testimony from that first Declaration remains the same. I am competent to make this Declaration based upon my personal knowledge and technical expertise, which I addressed in my first declaration. If called to testify, I could and would testify honestly, under oath, to the matters set forth herein.

2. I have been asked to provide my opinion on whether the substitute claims of Patent Owner’s Revised Motion to Amend for the ’223 Patent (the “Motion”) are unpatentable over certain prior art references. As explained below, it is my opinion that each of substitute claims 33–61 is unpatentable because each would have been obvious to a PHOSITA in view of the prior art.

3. I have also been asked to provide opinions regarding whether certain limitations of the substitute claims are supported by the original disclosure of the ’223 Patent.

II. MATERIALS CONSIDERED

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

III. OVERVIEW OF THE SUBSTITUTE CLAIMS

5. The substitute claims that I considered are reproduced in the table below. In this table, I understand that deletions from the original '223 patent claims are struck or double bracketed, and newly added limitations are underlined.

6. For ease of reference, I have adopted a shorthand numbering for the claims, and individual claim limitations that is similar to the shorthand numbering I adopted in my first declaration for the original claims of the '223 Patent. For example, as indicated in the table below, I may use “Limitation 33(a)” as a shorthand reference to the limitation “a housing providing a first piece mountable on a railcar” in claim 33.

Claim Limitation	Claim Language
Claim 33 Preamble	A sensor device for monitoring temperature on a railcar, comprising:
Limitation 33(a)	a housing <u>providing a first piece mountable</u> on a railcar;
Limitation 33(b)	a temperature sensor;
Limitation 33(c)	electrical circuitry in communication with said temperature sensor <u>via a cable</u> for obtaining information regarding the temperature being sensed, <u>wherein said electrical circuitry is positioned within said housing, and said cable has a proximal end disposed in the housing and a distal end residing external to said housing;</u>
Limitation 33(d)	a power source electrically connected to said electrical circuitry <u>to</u> [[for]] provide[[ing]] power thereto, said power source positioned within said housing;
Limitation 33(e)	a probe <u>providing a second piece external to and separated from the first piece provided by said housing, said second piece and which probe comprising a sensor probe head that</u> (i) is spaced apart from the housing, (ii) has a body formed of a <u>heat conductive material</u> , (iii) has a connector electrically

Claim Limitation	Claim Language
	<u>interfaced with said temperature sensor and configured to connect to a corresponding electrical connector at the distal end of the cable and</u> includes said temperature sensor, and (iv) <u>has a magnet positioned in the body adjacent to a portion of the connector extending inside the body, the magnet configured to magnetically attract the part of the railcar against which the sensor probe head will be placed; and</u>
Limitation 33(f)	a communication device <u>configured to</u> ~~capable of~~ broadcast[[ing]] information regarding the temperature sensed, said communication device positioned within said housing;
Limitation 33(g)	wherein the power consumption of said sensor device is managed by placing said sensor device in a standby state and periodically awakening said sensor device to collect readings from said temperature sensor and to transmit the information regarding the temperature sensed via said communication device ~~circuitry~~ .
Claim 34 Preamble	A system for monitoring a railcar, comprising:
Limitation 34(a)	a plurality of sensor devices <u>each located on and mounted to a sidewall of a bearing adapter of the railcar for monitoring parameters or conditions of a bearing of the railcar</u> , each of said sensor devices being separate from one another and including a sensor for monitoring one of said parameters or conditions <u>of the bearing of the railcar</u> ;
Limitation 34(b)	said plurality of sensor devices including at least one temperature sensor device having:
Limitation 34(c)	a housing <u>comprising a non-flexible material that is resistant to environmental damage</u> ;
Limitation 34(d)	a temperature sensor in thermal communication with an item <u>consisting of the bearing adapter of the railcar</u> for which the temperature is being monitored, which item is external to said housing;
Limitation 34(e)	electrical circuitry in communication with said temperature sensor for obtaining information regarding the temperature being ~~sensed~~ <u>monitored</u> , said electrical circuitry positioned

Claim Limitation	Claim Language
	within said housing;
Limitation 34(f)	a power source electrically connected to said electrical circuitry for providing power thereto, said power source positioned within said housing;
Limitation 34(g)	a communication device capable of broadcasting information regarding the temperature <u>being monitored sensed</u> via wireless communication, said communication device positioned within said housing, <u>wherein said information regarding the temperature being monitored comprises data representing a condition of a bearing</u> ; and
Limitation 34(h)	a communication management unit, mounted on the railcar, capable of two way wireless communication with each of said plurality of sensor devices for receiving information therefrom, said communication management unit having a wireless communication device for broadcasting information about the parameter or condition being monitored <u>to a land-based remote station</u> ,
Limitation 34(g)	<u>wherein at least one of the communication management unit or the remote station is configured to (i) correlate one or more numeric values derived from the data to the condition of the bearing, (ii) determine a severity of a condition of the bearing, and (iii) determine an alarm condition based on the severity of the condition of the bearing, wherein said alarm condition comprises one or more recommended actions to be taken with respect to the bearing.</u>
Claim 35	The system of ~~claim 2~~ <u>claim 34</u> , wherein said communication management unit can make a determination of an alarm condition based on data collected by two or more of said sensor devices.
Claim 36	The system of ~~claim 2~~ <u>claim 34</u> , wherein each of said plurality of sensor devices is capable of exchanging data with other of said plurality of sensor devices and with said communication management unit.
Claim 37	The system of ~~claim 2~~ <u>claim 34</u> , wherein said

Claim Limitation	Claim Language
	communication management unit applies heuristics to analyze data collected from said ~~one or more~~ <u>plurality of</u> sensor devices (a) to determine if an actual failure exists and (b) to predict potential or imminent failures based on a statistical analysis of said collected data.
Claim 38	The system of ~~claim 2~~ <u>claim 34</u> , further comprising a second temperature sensor located on said railcar for measuring ambient air temperature, wherein said system uses information obtained from said second temperature sensor about the ambient temperature to calibrate the temperature data received from said first sensor regarding the item of the railcar being monitored.
Claim 39	The system of ~~claim 2~~ <u>claim 34</u> , wherein said communicating management unit is capable of communicating data and alarms to a remote location located off of the train of which the railcar is a part.
Claim 40	The system of ~~claim 2~~ <u>claim 34</u> , wherein the power consumption of each of said sensor devices is managed by placing each said sensor device in a standby state and periodically awakening said sensor device to collect readings from said sensor device and to transmit the information regarding the parameter or condition being sensed via said communication circuitry.
Claim 41	The system of ~~claim 2~~ <u>claim 34</u> , wherein said communication management unit and said plurality of sensor devices form a wireless mesh network for said railcar.
Claim 42 Preamble	A system for monitoring the operation of a railcar comprising:
Limitation 42(a)	a. one or more sensor units mounted <u>to a sidewall of a bearing adapter</u> on said railcar, each of said sensor units monitoring an operating parameter of said railcar wherein each of said sensor units comprises

Claim Limitation	Claim Language
Limitation 42(b)	a sensor,
Limitation 42(c)	a power source,
Limitation 42(d)	a processor,
Limitation 42(e)	memory,
Limitation 42(f)	communications circuitry, and
Limitation 42(g)	software, stored in said memory and executed by said processor, said software performing the functions of collecting data from said sensor at periodic intervals <u>and calculating one or more numeric values based on the collected data, wherein the one or more numeric values represent a condition of a bearing;</u> and
Limitation 42(h)	b. a communication management unit, mounted on said railcar, said communication management unit in wireless communication with said one or more sensor units;
Limitation 42(i)	wherein said communication management unit applies heuristics to analyze data collected from said one or more sensor units
Limitation 42(j)	(a) to determine if an actual failure exists and
Limitation 42(k)	(b) to predict potential or imminent failures based on a statistical analysis of said collected data <u>by correlating one or more numeric values derived from the data to the condition of the bearing and determining a severity of the condition of the bearing;</u>
Limitation 42(l)	<u>c. a land-based remote base unit, in wireless communication with said communication management unit, configured to:</u> <u>(i) receive data from said communication management unit;</u> <u>(ii) determine a severity of the condition of the bearing based on the data received from the communication management unit;</u> <u>(iii) determine an alarm condition based on the severity of the condition of the bearing, wherein said alarm condition comprises a recommended action with respect to the bearing.</u>
Claim 43	The system of ~~claim 5~~ <u>claim 42</u> , wherein said determination of an alarm condition can be made by one of said sensor units.

Claim Limitation	Claim Language
Claim 44	The system of ~~claim 5~~ <u>claim 42</u> , wherein said determination of an alarm condition can be made by said communication management unit based on data collected by two or more of said sensor units.
Claim 45	The system of ~~claim 5~~ <u>claim 42</u> , wherein ~~each of~~ said sensor ~~units~~ comprises: <u>a. a vibration sensor or accelerometer configured to sample dynamic vibration data; and</u> <u>b. a power source;</u> <u>c. a processor;</u> <u>d. memory;</u> <u>e. communications circuitry; and</u> <u>f. wherein software, stored in said memory and executed by said processor, said software further performs performing the functions of collecting <u>sampld dynamic vibration data</u> from said sensor at periodic intervals, wherein the one or more <u>numeric values is calculated from the sampled dynamic vibration data</u>, and wherein the severity of the condition of the bearing is determined based on the one or more numeric values.</u>
Claim 46	The system of ~~claim 8~~ <u>claim 45</u> , wherein said software further performs the function of: assessing the ~~collected~~ <u>sampld dynamic vibration data</u> to determine if an alarm condition exists; ~~and~~ communicating said alarm condition to said communication management unit via said communications circuitry; and managing the power consumption of said sensor unit by placing said sensor unit in a standby state and periodically awakening said sensor unit to collect data from said sensor and to transmit information regarding said operating parameter to said communication management unit via said <u>communications circuitry</u> .
Claim 47	The system of ~~claim 5~~ <u>claim 42</u> , wherein said one or more sensor units and said communication management unit are in

Claim Limitation	Claim Language
	wireless communication with each other and form a local area wireless network for said railcar.
Limitation 48(a)	The system of ~~claim 5~~ <u>claim 42</u> , ~~further comprising a~~ wherein said land-based remote base unit <u>is further configured to</u> , ~~said base unit being in wireless communication with said communication management unit,~~ <u>said based unit performing the functions of:</u>
Limitation 48(b)	a. ~~collecting~~ <u>collect</u> data and alarms from said communication management unit;
Limitation 48(c)	b. ~~displaying~~ <u>display</u> one or more alarm conditions raised by said communication management unit, <u>said alarm conditions are based on the severity of the condition of the bearing and comprises a recommended action with respect to the bearing;</u> and
Limitation 48(d)	c. ~~determining~~ <u>determine</u> high level alarms based on data and alarms collected from said communication management unit <u>by comparing the one or more numeric values with a plurality of defined parameter value ranges associated with the bearing.</u>
Claim 49	The system of ~~claim 13~~ <u>claim 48</u> , wherein said base unit is in wireless communication with multiple communication management units.
Claim 50	The system of ~~claim 14~~ <u>claim 49</u> , wherein said base unit uses distributed event processing to perform trend analysis based on alarms and data collected from one or more communication management units to determine if a high level alarm should be raised.
Claim 51	The system of ~~claim 14~~ <u>claim 50</u> , wherein said base unit applies heuristics to data collected from said one or more communication management units to determine if a high level alarm should be raised.
Claim 52	The system of ~~claim 16~~ <u>claim 51</u> , wherein said base unit and

Claim Limitation	Claim Language
	said one or more communication management units communicate with each other via a satellite communications capability or a cellular network capability.
Claim 53	The system of ~~claim 5~~ <u>claim 42</u> , wherein said sensor is selected from a group consisting essentially of temperature sensors, pressure sensors, strain sensors, load cell sensors, hand brake position sensors, magnetic sensors, vibration sensors, gyroscopes, acceleration sensors, hall effect sensors, piezoelectric resistive microphones and switches.
Claim 54	The system of ~~claim 5~~ <u>claim 42</u> , wherein said alarm <u>condition</u> is determined using distributed event processing based on a comparison between current data and statistical models of behavior.
Claim 55	The system of ~~claim 5~~ <u>claim 42</u> , wherein said ~~alarms are~~ <u>alarm condition</u> is determined based on a comparison of currently collected data versus data collected over a pre-determined preceding time period.
Claim 56	The system of ~~claim 5~~ <u>claim 42</u> , wherein an alarm is raised based one or more of the following criteria: a. a pre-determined percentage of current data readings exceeds allowable peak readings; b. a pre-determined percentage of current data readings exceeds a determined value; c. a pre-determined percentage of current data readings exceeds a standard deviation from readings from the same railcar; d. a pre-determined percentage of current data readings exceeds a standard deviation from all railcars in the fleet; or e. the rate of change of current data readings exceeds a pre-determined threshold
Claim 57	The system of ~~claim 5~~ <u>claim 42</u> , wherein the power consumption of each of said sensing units is managed by

Claim Limitation	Claim Language
	placing each sensing unit in a standby state and periodically awakening said sensing unit to collect readings from said sensor and to transmit information via said communications circuitry.
Claim 58	The system of ~~claim 5~~ <u>claim 42</u> , wherein said communication management unit is capable of communicating with a remote location located off of a train of which said railcar is a part.
Claim 59 Preamble	A monitoring device for monitoring temperature on a railcar, comprising:
Limitation 59(a)	A housing mountable on a railcar;
Limitation 59(b)	a temperature sensor configured to be in thermal communication with a portion of the railcar to be monitored for temperature, which portion is external to said housing, <u>the temperature sensor positioned within a probe head and interfaced with an electrical connector, the probe head configured to receive a cable having a corresponding electrical connector;</u>
Limitation 59(c)	electrical circuitry in communication with said temperature sensor <u>via the cable</u> for obtaining information regarding the temperature being sensed, said electrical circuitry positioned within said housing, <u>said electrical circuitry positioned within said housing, said cable having a proximal end disposed in the housing and a distal end residing external to said housing;</u>
Limitation 59(d)	a power source electrically connected to said electrical circuitry for providing power thereto, said power source positioned within said housing; and
Limitation 59(e)	a communication device capable broadcasting information regarding the temperature sensed, said communication device positioned within said housing;
Limitation 59(f)	wherein the power consumption of said monitoring device is managed by placing said monitoring device in a standby state and periodically awakening said monitoring device to collect readings from said temperature sensor and to

Claim Limitation	Claim Language
	transmit the information regarding the temperature sensed via said communication circuitry.
Claim 60	The monitoring device of ~~claim 23~~ <u>claim 59</u> , wherein at least a section of said temperature sensor is disposed outside of and spaced from said housing to be capable of contacting the surface of the railcar for which the temperature is to be monitored.
Claim 61	The monitoring device of ~~claim 23~~ <u>claim 59</u> , wherein said circuitry is configured to apply heuristics to analyze data collected from said temperature sensor to determine if a problem exists.

IV. LEGAL PRINCIPLES

7. In forming my opinions and considering the subject matter of the '223 Patent and substitute claims 33–61, I am relying on certain legal principles that counsel in this case has explained to me. My understanding of these concepts is summarized below.

A. **Written Description**

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

satisfy the written description requirement if it includes a limitation that is not disclosed by the original specification of the '223 Patent.

B. Indefiniteness

9. Counsel has informed me that a claim is indefinite if, when read in light of the patent specification and its prosecution history, it fails to inform those skilled in the art about the scope of the invention with reasonable certainty. In particular, I have been informed that a claim is indefinite if a PHOSITA could not clearly understand what is covered by the claim in order to avoid infringement.

C. Enablement

10. Counsel has informed me that, to satisfy the enablement requirement, the original specification must enable any person skilled in the art to make and use the claimed invention without undue experimentation. I have been informed that many factors may be considered when determining whether a claim satisfies the enablement requirement and whether any necessary experimentation is “undue.” I have been informed that these factors include, but are not limited to, the following:

- (A) The breadth of the claims;
- (B) The nature of the invention;
- (C) The state of the prior art;
- (D) The level of one of ordinary skill;
- (E) The level of predictability in the art;
- (F) The amount of direction provided by the inventor;

(G) The existence of working examples; and

(H) The quantity of experimentation needed to make or use the invention based on the content of the disclosure.

I have also been informed that a patent is not required to disclose concepts that are well-known in the art in order to satisfy the enablement requirement.

D. Obviousness

11. I have applied the same legal principles of obviousness as in my previous declaration, and I incorporate them by reference here. EX1003, ¶¶ 60–68.

V. LEVEL OF ORDINARY SKILL IN THE ART

12. In my first declaration, I provided my opinion on the level of ordinary skill in the art. EX1003, ¶¶ 44–45. In my opinion, the same level of ordinary skill in the art applies to the proposed substitute claims.

VI. CLAIM CONSTRUCTION

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

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

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

VII. UNPATENTABILITY

A. Written Description

16. In my opinion, substitute claims 34-58 each include limitations that are not supported by the specification of the '223 Patent.

1. Claims 34 and 42: “mounted to a sidewall of a bearing adapter”

17. Substitute claims 34 and 42 specifically claim a sensing unit mounted to a sidewall of a bearing adapter. In my opinion, the claimed combination of features is not disclosed anywhere in the specification of the '223 Patent.

18. I understand that, to support this limitation, Patent Owner has cited to the disclosure at col. 4:52–59, which states that “[s]ensor 20 can be any type of sensor.” EX1001, 4:52–59. This passage does not state that the listed sensors are mounted on the sidewall of a bearing adapter. Additionally, a PHOSITA would understand that many of the listed sensors would serve no purpose if mounted on a bearing adapter. For example, a PHOSITA would understand that strain gauges, gyroscopes, reed switches, and limit switches (to name a few) would not serve any purpose if mounted on the sidewall of a bearing adapter. The specification states that “as one of ordinary skill would recognize, the configuration of the moles 10 with respect to the sensor 20 is dependent upon the type of sensor and the type of data desired.” EX1001, 4:39–42. A PHOSITA would understand this statement to

mean that different sensors will require different housing configurations and mounting locations, which is an obvious concept that would have been familiar to a person of ordinary skill.

19. Additionally, a PHOSITA would understand that a bearing adapter has multiple surfaces suitable for mounting sensor devices. The sidewall of a bearing adapter is a common, obvious mounting location because it is easily accessible from outside the train. However, sensors can be mounted to other surfaces. LeFebvre, for example, discloses sensors mounted to “the upper rectangular surface of the bearing adapter.” EX1005, ¶ [0020].

20. I understand that Patent Owner also cites to the embodiment disclosed in Figs. 3 and 3A of the '223 Patent. The embodiment of Figs. 3 and 3A is expressly described as a temperature sensing device. EX1001, 5:31–34. (“As an example, FIGS. 3 and 3A show a temperature sensing mote 10 of the type described above mounted to a bearing adapter...”). The specification does not indicate that the embodiment of Figs. 3 and 3A comprises any type of sensor other than a temperature sensor. In the '223 Patent, the only type of sensor that is mounted on the sidewall of a bearing adapter is a temperature sensor. The '223 Patent does not disclose any other type of sensor mounted at this location.

21. I understand that Patent Owner also cites to the table spanning cols. 7–12 of the '223 Patent, which includes two examples that reference an “adapter

mounted accelerometer.” Neither example states that the accelerometer is mounted specifically to the sidewall of a bearing adapter. As I have discussed above, other mounting locations are possible, such as the upper surface of the bearing adapter.

2. Claims 34 and 42: “one or more numeric values derived from the data,” “one or more numeric values based on the collected data”

22. The term “numeric values” does not appear in the ’223 Patent specification. It is unclear to me how the term corresponds to the original disclosure.

3. Claims 34 and 42: “land-based remote station”/“land-based remote unit”

23. I understand that Claim 42 requires that data collected by the sensor units is processed by both the CMU (Limitations 42(i)–(k)) and by the “land-based remote unit” (Limitation 42(l)). I understand that Claim 34 requires that a similar analysis is performed by *at least one* of the CMU and a “land-based remote station.” As far as I can tell, neither of these combinations is supported by the specification. The specification discloses that heuristics “may be performed by *either* mobile base station 42 *or* land-based based station 44” (EX1001, 11:40–42 (emphasis added)), but it does not disclose any embodiment wherein *both* the CMU *and* a “land-based remote unit” perform the claimed steps as required by claim 42 and expressly encompassed by claim 34.

4. Claim 34: “a housing comprising a non-flexible durable material for protecting components positioned therein”

24. As far as I can tell, the term “non-flexible durable material” does not appear in the ’223 Patent. In general, the specification does not limit the housing to any particular material, and a PHOSITA would understand that many different types of materials could be used depending on a variety of factors, including the mounting location. The specification describes an example where the housing is “composed of a hard plastic resistant to environmental damage, such as a UV rated polymer, e.g., a polycarbonate/ABS blend, and when fully assembled is weatherproof.” EX1001, 4:5–10. In my opinion, this is just an example, and the specification as a whole does not limit the housing to only these materials. There are many additional materials that could be considered “non-flexible” and “durable,” for example stainless steel, that are not mentioned in the ’223 Patent.

5. Dependent Claims 45 and 46

25. I understand that claim 45 is dependent upon claim 42, and additionally requires that the sensor comprises “a vibration sensor or accelerometer configured to sample dynamic vibration data.” I also understand that claim 46 depends from claim 45 and therefore includes the same limitations. As I have discussed above, the specification only discloses a single embodiment with a *temperature* sensor mounted to the sidewall of a bearing adapter. *See* Section VII.A.1, *supra*. Claims 45 and 46 are directed to a specific combination of

features—a sensor unit comprising a *vibration sensor or accelerometer* mounted to the *sidewall* of a bearing adapter—that, as far as I can tell, is disclosed nowhere in the specification of the '223 Patent.

6. Dependent Claim 48

26. I understand that claim 48 requires “comparing the *one or more numeric values* with *a plurality of defined parameter value ranges associated with the bearing*.” As far as I can tell, neither of these bolded terms are used in the specification, and it is unclear to me how each term corresponds to the language used in the original disclosure.

B. Indefiniteness

27. In my opinion, claims 34 and 42 each include language that is ambiguous or unclear. As I will explain below, a PHOSITA would not be able to determine, with reasonable certainty, what is required by these claims or how to avoid infringement.

1. Claims 34 and 42: “one or more numeric values derived from the data,” “one or more numeric values based on the collected data”

28. As I already discussed, these terms do not appear in the specification, and it is unclear how they relate to the disclosed embodiments. *See* Section VII.A.2, *supra*.

2. Claim 34: “a non-flexible material that is resistant to environmental damage”

29. The term “non-flexible material” does not appear in the ’223 Patent. *See* Section VII.A.4, *supra*. As far as I can tell, the specification does not define how “non-flexible” a material must be to satisfy this limitation, or under what conditions the flexibility should be tested. There are many different ways to measure the flexibility of a material. A “flexible material” is a material that will bend in response to pressure, but snaps back to its original shape and is not damaged once the pressure is removed. Practically every material is flexible to some degree, and although the extent of the flexibility may not be detectable by human senses, specialized equipment can be used to detect and measure flexibility to a high degree of precision. The ’223 Patent does not define how the flexibility of the housing material should be measured, and a PHOSITA would understand that different test methods will generally return different results. The ’223 Patent also does not define what level of flexibility (or inflexibility) is required for a material to be considered “non-flexible.”

30. The specification also fails to define “environmental damage” or how “resistant” a material must be to that type of damage. There are many different ways to measure the “resistance” of a material to “environmental damage.” In general, it can be measured with respect to physical impacts, chemical resistance, exposure to UV radiation (i.e., sunlight), exposure to repeated temperature

changes, exposure to different varieties of grease or lubricants that may be present in the operating environment, and a variety of other factors (or combinations of these factors). The '223 Patent does not define how the resistance of the housing material to environmental damage should be measured, and a PHOSITA would understand that different test methods will generally return different results. The '223 Patent also does not define what level of resistance is required for a material to be considered “resistant to environmental damage” for purposes of claim 34.

31. Depending on what exactly is meant by “non-flexible”, “resistance,” or “environmental damage”, a given material may or may not satisfy this limitation. The '223 Patent does not use or define the term “non-flexible material that is resistant to environmental damage,” and does not provide any clarity about what the term means. It is therefore my opinion that the term “non-flexible material that is resistant to environmental damage” is not defined with reasonable certainty.

C. Enablement

1. Claim 34: “correlate one or more numeric values derived from the data to the condition of the bearing,” “determine a severity of the condition of the bearing”

32. See Section VII.A.2, which is incorporated here by reference. Claim 34 requires collecting temperature data from a sensor mounted on the sidewall of a *bearing adapter*, and *correlating* “numeric values derived from the data” with the

condition of a *bearing*. No temperature correlations between bearing adapters and bearings are disclosed in the '223 Patent, and in my opinion, the specification does not teach a PHOSITA how to develop the temperature correlations needed to practice this claim without undue experimentation.

2. Claim 42: “correlating one or more numeric values derived from the data to the condition of the bearing,” “determining a severity of the condition of the bearing”

33. See Section VII.C.1, which is incorporated here by reference. Claim 42 broadly encompasses monitoring any possible “operating parameter” of a railcar, and using any possible method of “correlating one or more numeric values” with the condition of a wheel bearing. In my opinion, the '223 Patent does not enable a PHOSITA to practice the full scope of this claim.

34. As an example, the '223 Patent does not disclose any teaching or examples that would enable methods of monitoring *acceleration* as required by dependent claims 45 and 46. To the extent the specification provides examples that involve *temperature* monitoring, it is my opinion that those examples do not enable the claimed methods of monitoring *acceleration*. Temperature is a single, measurable value that changes relatively slowly. Acceleration, in contrast, occurs in three axes and rapidly changes in both its magnitude and its direction—often thousands of times per second. Similarly, the '223 Patent does not enable a PHOSITA to practice methods of monitoring other operational characteristics

(other than temperature or acceleration) that are encompassed by the broad scope of claim 42.

35. Claim 42 additionally requires “determining a severity of the condition of the bearing.” In my opinion, the specification does not enable a PHOSITA to assign a “severity level” based on monitoring any possible operational characteristic of a railcar. As one example, the specification does not disclose appropriate “severity levels” for use in acceleration monitoring, and in my opinion a PHOSITA would not be enabled to identify an appropriate severity level based on acceleration data without undue experimentation.

D. Obviousness

36. As I explained in my first declaration in this proceeding (EX1003), original claims 1–10, 13–18, and 20–32 of the ’223 Patent are obvious in view of LeFebvre (EX1005), Armitage (EX1006), Barone (EX1007), Denny (EX1008), and Provasnik (EX1009).

37. The same limitations present in original claims 1–10, 13–18, and 20–32 also appear in substitute claims 33–61. My analysis of these original claim limitations does not differ from my first declaration, EX1003, and I incorporate that analysis here by reference.

38. In my opinion, the newly added limitations of substitute claims 33–61 merely recite specific features that were conventional, obvious, and well-known in

the prior art. Specifically, it is my opinion that the subject matter of claims 33–61 would have been obvious to a PHOSITA under each of the following grounds.

Ground	References	Claims
1	Armitage in view of LeFebvre, Barone, Moretti, and Brandmeier	34–58
2	LeFebvre in view of Armitage, Barone, Moretti, and Brandmeier	34–58
3	Armitage in view of LeFebvre, Denny, Provasnik, and Culbertson	33, 59–61
4	LeFebvre in view of Denny, Provasnik, and Culbertson	33, 59–61

I will explain in detail below where each of these features may be found in the prior art.

1. Grounds 1 and 2: Motivation to combine Armitage, LeFebvre, Barone, Moretti, and Brandmeier

39. 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; EX1028, (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]; EX1028, 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]; EX1028, 4:8–12.

40. As I explained in my first declaration, housings for sensor devices were well-known in the art. A PHOSITA would have understood that housings may be constructed from a variety of materials, and that many different types of sensor housings have been sold commercially for decades. Brandmeier (EX1031) discloses a sensor device housing made from a rigid material that is designed to be mounted a surface of a motor vehicle. In my opinion, Brandmeier provides evidence of what a PHOSITA would have understood, which is that rigid sensor device housings and their benefits were known in the art. EX1031, (57) Abstract, ¶ [0027], claims 11–12.

41. A PHOSITA therefore would have understood that Armitage, LeFebvre, Barone, Moretti, and Brandmeier are analogous art. A PHOSITA would have been motivated to combine the teachings of these references for the reasons I will address in detail below with respect to each substitute claim.

2. Claim 34

42. Ground 1: Most limitations of claim 34, including all limitations present in original claim 2, are disclosed by Armitage. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 188–203.

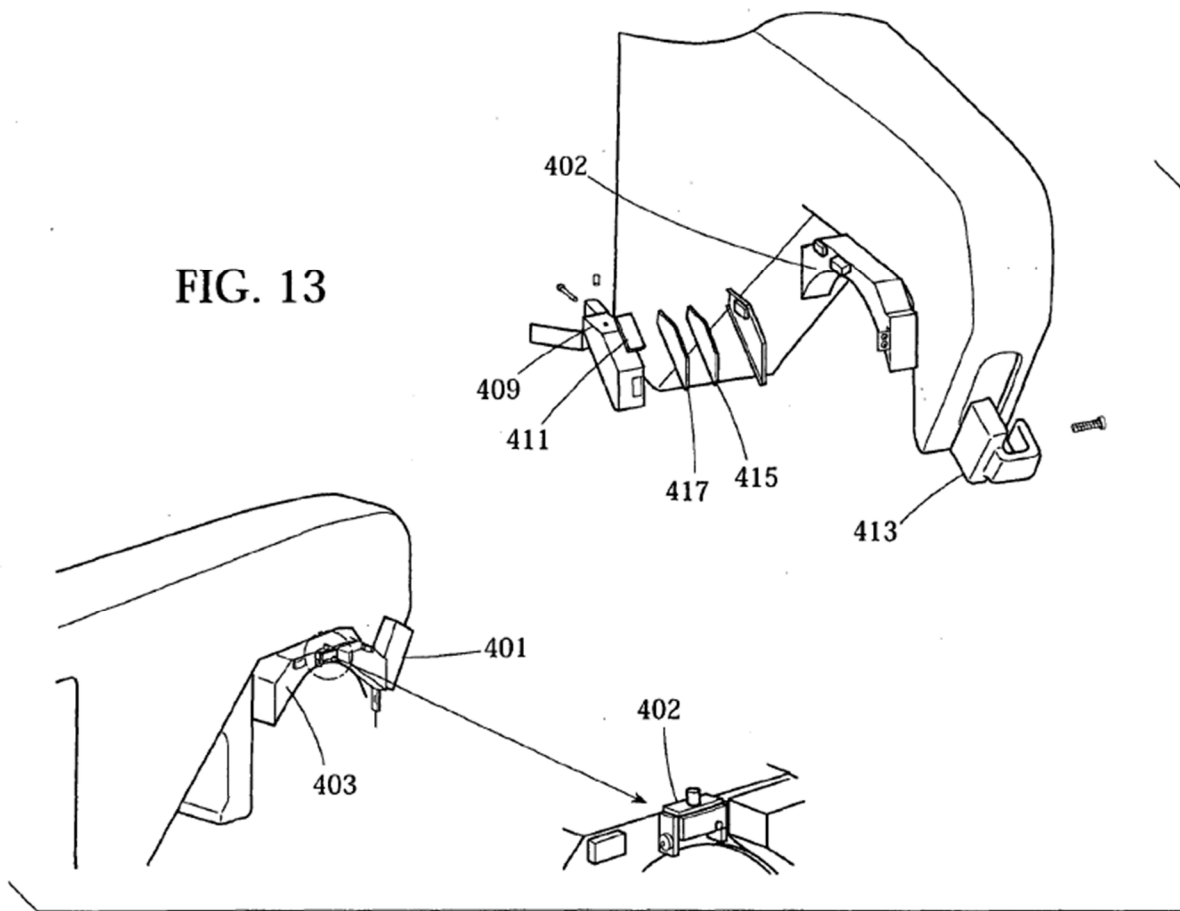
43. Ground 2: Most limitations of claim 34, including all limitations present in original claim 2, are disclosed by LeFebvre. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 74–106.

44. The new limitations of claim 34, which I have not previously addressed in this proceeding, are discussed in detail below.

a. Limitation 34(a), (d), and (g): “mounted to a sidewall of a bearing adapter”, “parameters or conditions of a bearing,” “consisting of the bearing adapter,” “wherein information regarding the temperature being monitored comprises data representing a condition of the bearing”

45. 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]. Armitage does not expressly identify the *sidewall* of the bearing adapter as required by claim 23. However, a PHOSITA would have understood that both thermometers and accelerometers can be mounted to the sidewall to measure heat and vibrations emanating from the bearing. This is commonplace in the railroad industry, and there are many examples in the prior art. For example, Barone expressly discloses a sensor node mounted on the sidewall of a bearing adapter. EX1007, ¶¶ [0289]–[0293], Figs. 11–13. Figure 13 of Barone is reproduced below, and clearly shows the sensor unit **401** mounted (using mounting bracket **402**) on the sidewall of the bearing adapter **403**.



46. Moretti teaches that it is preferable to mount a vibration sensor “at a position vertically aligned with the axis of rotation of the bearing, where the vibrations are more intense,” and preferably “at 12 o'clock, i.e. in correspondence of the zone where the rolling bodies of the bearing undergo the maximum load.” EX1028, 3:22–28. The mounting location disclosed by Figure 13 of Barone is therefore an optimal (or nearly optimal) location on the sidewall of the bearing adapter that is consistent with Moretti’s teachings.

47. In my opinion, 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 heat and vibrations emanating from the bearing. A sensor mounted on the sidewall of a bearing adapter is also less likely to collect rain, snow, and other environmental contaminants than a sensor mounted in most other locations on the railcar.

48. Ground 2: LeFebvre discloses that its sensor unit can include one or more temperature sensors to monitor bearing temperature. EX1005, (57) Abstract, ¶¶ [0021], [0033], [0058]; EX1003, ¶ 79. LeFebvre’s unit can also 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.

49. For example, a PHOSITA could have modified LeFebvre’s device to extend along the sidewall of the bearing adapter at the location identified by Barone. EX1007, ¶¶ [0289]–[0293], Figs. 11–13. In practice, LeFebvre’s instrumented pad could easily be extended over the edge of the bearing adapter,

and a short distance down the sidewall, to accommodate placing a sensor at this optimal location. In my opinion, a PHOSITA would have been motivated to place a sensor node on the sidewall of the adapter because it is an easily accessible, non-rotating surface that transmits both heat and vibrations emanating from the bearing.

b. Limitation 34(b): “a housing comprising a non-flexible material that is resistant to environmental damage”

50. Grounds 1 and 2: Housings for sensor devices were well-known in the art, and a PHOSITA would have understood that housings may be constructed from a variety of materials. In my opinion, it would have been obvious to incorporate a “non-flexible material that is resistant to environmental damage” into a housing that protects the sensitive electronic components utilized by LeFebvre’s and Armitage’s monitoring systems. Rigid, durable materials, including plastics and metals, have been used to protect sensitive electronic components for as long as electronic components have existed. Brandmeier (EX1031), for example, discloses a sensor device housing made from a rigid material that is designed to be mounted a surface of a motor vehicle. EX1031, (57) Abstract, ¶ [0027], claims 11–12. There are many other, similar examples that a PHOSITA would have been aware of. In fact, rigid housings like the one disclosed by Brandmeier are very common in the art, and have been sold commercially for decades. A PHOSITA would have understood the obvious fact that rigid housings are useful to protect electronics

within the housing from physical impacts, which are commonplace events on the outside of a railcar.

51. Further, it would have been obvious to construct the housing of Armitage's sensor device from a rigid, durable material in order to protect the components within. Similarly, if LeFebvre's sensor device were extended to include a portion attached to the sidewall of the bearing adapter, it would have been obvious to construct at least that part of the housing from a rigid material to protect the sensors from the environment.

c. Limitation 34(h): “a land-based remote station”

52. Ground 1: Armitage discloses that the control node on each railcar (i.e., a CMU) wirelessly transmits information, such as sensor data and alarm messages, to a collection node in a remote location. EX1006, ¶¶ [0019], [0039]. As one example, the collection node can be “a rail-side or handheld device.” EX1006, ¶ [0039]. Alternatively, a PHOSITA would understand that the collection node could be a server, or a collection of servers, located in a data center. EX1006, ¶¶ [0019], [0039]. When Armitage refers to “application servers,” “web servers,” and the like, a PHOSITA would understand that these components are located in a stationary location (i.e., a land-based location) such as a remote data center, and not on a moving train.

53. Ground 2: LeFebvre discloses that its data control unit may communicate with a remote (off-train) base unit via, for example, “a cellular or satellite radio system.” EX1005, ¶¶ [0025], [0038], [0052]. A PHOSITA would understand that the remote base unit is located in a stationary location (i.e., a land-based location) such as a remote data center, and not on a moving train.

d. Limitation 34(h): “correlate one or more numeric values derived from the data to the condition of the bearing”

54. Ground 1: 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]. A PHOSITA would understand that measuring bearing temperature indirectly—Armitage’s preferred embodiment—requires *correlating* the measured temperature of the bearing adapter with the inferred temperature of the bearing. As I explained in my initial declaration submitted with the Petition, Armitage performs calculations on collected data that result in “numeric values” which represent the operational state of the bearing. EX1006, ¶¶ [0029], [0030] (using “moving average and trend analysis” to detect “statistically significant deviations”), [0045] (calculating averages, minimums, and maximums); *see also* Corr. Pet., 56–66.

55. Ground 2: 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. In other words,

LeFebvre’s system *correlates* the measured temperature of the bearing adapter with the inferred temperature of the bearing. Like Armitage, LeFebvre also performs calculations that result in “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”); Corr. Pet., 19–27; EX1003, ¶¶ 74–106.

e. Limitation 34(h): “determine a severity of the condition of the bearing”

56. Grounds 1 and 2: As discussed at length in my initial declaration, all three of Armitage, LeFebvre, and Barone disclose using collected data to infer the well-being of a bearing and determine the severity of any detected problem or defect. EX1005, ¶¶ [0036], [0055]–[0056], [0058]–[0059]; EX1006, ¶¶ [0042]–[0044] (“The degree to which any specific sensor deviates from this population is indicative of the severity of the mechanical condition of the component.”); EX1007, ¶¶ [0201]–[0220]. If a sufficiently severe problem is detected, all three references disclose raising an alarm to alert a human operator to take an appropriate action. EX1005, ¶¶ [0038], [0052]; EX1006, ¶ [0028]; EX1007, ¶ [0036]; EX1003, ¶¶ 51, 54. A large deviation from normal operating conditions usually indicates the presence of a larger, more severe problem. Conversely, a small deviation from normal operating conditions usually indicates the presence of

a smaller, less severe problem. This is a simple concept that would have been obvious to a PHOSITA.

57. This simple concept is also reflected in the prior art. 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.”).

58. Armitage expressly uses a color-coded system to indicate the severity of a detected problem condition. 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.”). LeFebvre similarly discloses the use of bearing temperature “alarm levels,” to infer the severity of a problem, EX1005, ¶ [0058], and the Martin Declaration admits that standard temperature thresholds for bearings were known in the art. EX2160, ¶ 23 (“The temperature thresholds that we were using during this project was roughly the same as industry standard thresholds used for analyzing train bearings.”).

59. Therefore, it is my opinion that a PHOSITA would have understood that a large deviation from expected operating conditions indicates a potentially serious underlying problem, while a small deviation from expected conditions indicates a smaller, less serious issue.

f. Limitation 34(h): “determine an alarm condition based on the severity of the condition of the bearing, wherein said alarm condition comprises one or more recommended actions to be taken with respect to the bearing”

60. The appropriate response to a problem on a railcar depends on the severity of the problem. This is a simple concept that would have been obvious to a PHOSITA, and it is reflected in the prior art. 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 from normal operations that requires immediate service.”); 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.”). More generally, it was obvious to use different “severity levels” to communicate the relative severity of the various faults that could arise on a train.

61. For example, alerts that include recommended corrective actions are commonplace on modern automobiles. EX1038, 2:7–18 (“For example, if the oil pressure drops below some predetermined level, the driver is warned to stop his vehicle immediately.”); EX1036, 17:8–16 (“For example, a lower severity diagnostic result might be accompanied by a notification of the problem and a link to more information, whereas a higher severity diagnostic result might be accompanied by a stronger warning and a link to a dealer to schedule servicing.”). *See also* EX1037, claim 2 (“the performance trend provides indication of a potential need for ***implementing a corrective action*** to address the aircraft system operating condition”).

62. Armitage describes a “railway car health scorecard,” which recommends a course of action based on the level of the alarm that is raised. EX1006, ¶ [0044]; EX1003, ¶ 280. Barone discloses a system that prompts a human to take appropriate action when a problem is detected. 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], ¶ [0191]

(The system “generates an appropriate alarm or indication to prompt a human user to take remedial action.”). *See also* EX1024, 8:46–57. A PHOSITA would therefore have been motivated to send alarms that indicate both the severity of the underlying condition and the appropriate corrective action, because some conditions warrant immediate, urgent action (e.g., stopping the train) to avoid serious damage or injury—while other, less urgent conditions can be addressed by scheduling routine maintenance.

3. Claims 35–41

63. Ground 1: The limitations added by dependent claims 35–41, which correspond to original claims 3, 4, and 26–30 respectively, are disclosed by Armitage in view of LeFebvre. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 276–281, 329–343, 363–365.

64. Ground 2: The limitations added by dependent claims 35–41 are disclosed by LeFebvre. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 107–115, 172–186.

4. Claim 42

65. Ground 1: Most limitations of claim 42, including all limitations present in original claim 5, are disclosed by Armitage in view of LeFebvre. I

addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 282–293.

66. Ground 2: Most limitations of claim 42, including all limitations present in original claim 5, are disclosed by LeFebvre. *See* EX1003, ¶¶ 116–137.

67. The new limitations of claim 42, which I have not previously addressed in this proceeding, are addressed below.

a. Limitation 42(a): “mounted to a sidewall of a bearing adapter”

68. *See* Section VII.D.2.a, which is incorporated here by reference.

b. Limitation 42(g)

69. *See* Sections 2.e VII.D.2.d and VII.D.2.e, *supra*. Additionally, as I explained in my initial declaration, both Armitage and LeFebvre disclose calculating numeric values based on collected data at the sensor node. For Armitage, *see* EX1006, ¶¶ [0014], [0053], [0055], Figs. 3, 6; EX1003, ¶¶ 263–264, 287–288. For LeFebvre, *see* citing EX1005, ¶ [0053]; EX1003, ¶¶ 155–156.

c. Limitation 42(k) and 42(l)

70. *See Sections* VII.D.2.c2.e, VII.D.2.d2.e, VII.D.2.e, and VII.D.2.f, *supra*.

5. Claims 43–58

71. Ground 1: The limitations added by dependent claims 43–58, which correspond to original claims 6–10, 13–18, 20–22, and 31–32 respectively, are disclosed by Armitage in view of LeFebvre. I addressed these limitations in my

first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 294–338, 344–354.

72. Ground 2: The limitations added by dependent claims 35–41 are disclosed by LeFebvre in view of Barone. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 139–159, 187, 188, 193–223.

73. New Limitations: With respect to claims 45 and 46, it is my opinion that there is nothing inventive about using an accelerometer to measure vibrations emanating from a wheel bearing. It was known as early as the 1980s that “vibrations of bearing boxes change their nature when faults arise.” EX1029, 3:17–19. As discussed above, Armitage and LeFebvre each disclose sensor nodes that include accelerometers. *See* Section VII.D.2.a, *supra*; EX1006, ¶¶ [0013]–[0015], [0025], [0027]; EX1005, claims 12, 21. Barone also discloses an accelerometer mounted on the sidewall of a bearing adapter, EX1007, ¶¶ [0045], [0289]–[0293], Figs. 11–13, and 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.” EX1028, 3:22–28; With respect to claim 48, *see* Section VII.D.2, *supra*.

6. Grounds 3 and 4: Motivation to combine Armitage, LeFebvre, Denny, Provasnik, and Culbertson

74. A PHOSITA would have found it obvious to combine the disclosures of Armitage, LeFebvre, Denny, and Provasnik for the same reasons I discussed in my first declaration. EX1003, ¶¶ 228–230. All four references are directed to devices for monitoring the temperature of metallic mechanical components—specifically, wheel bearings (Armitage, LeFebvre, and Denny) and engines (Provasnik). Denny (EX1008) provides evidence that external temperature sensors are standard components, commonly used in industrial applications, and provide advantages that would have been clearly understood by a PHOSITA. Provasnik (EX1009) provides evidence that magnetic sensor attachments are standard components, commonly used in industrial applications, and provide advantages that would have been clearly understood by a PHOSITA.

75. Culbertson (EX1032) discloses a temperature sensing probe that is suitable for use in harsh environments including, for example, high vibration and temperature. EX1032, (57) Abstract, 10:37–56. In my opinion, a PHOSITA would have understood that Culbertson’s temperature sensing probe is suitable for monitoring railcar bearings as disclosed by LeFebvre and Armitage, and would have been motivated to combine these references as I will discuss in more detail below.

76. A PHOSITA would have been motivated to combine the teachings of these references for the reasons I will address in detail below with respect to each substitute claim.

7. Claim 33

77. Ground 3: Most limitations of claim 33, including all limitations present in original claim 1, are disclosed by Armitage in view of LeFebvre, Denny, and Provasnik. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 228–245.

78. Ground 4: Most limitations of claim 33, including all limitations present in original claim 1, are disclosed by LeFebvre in view of Denny and Provasnik. EX1003, ¶¶ 367–379.

79. The new limitations of claim 33, which I have not previously addressed in this proceeding, are addressed below.

80. Grounds 3 and 4: As I discussed at length in my first declaration, both Armitage and LeFebvre disclose the use of temperature sensors. There are only two possible locations for a temperature sensor—inside the housing, or outside the housing—and both options have advantages that would have been fully understood by a PHOSITA.

81. For example, in the context of monitoring a railcar, a PHOSITA would have understood that it is advantageous to locate a temperature sensor close to the

part of the railcar whose temperature is to be measured. It was well-known that sensitive electronic components can easily overheat and should not be exposed to high temperatures. It is not uncommon for railcar wheel bearings to have temperatures approaching 200°F, which is outside the operational temperature range of most electronic components. Accordingly, to measure bearing temperature, a PHOSITA would understand that it is advantageous to use an external temperature sensor, which allows the housing to be placed a safe distance away from the bearing.

82. The prior art references provide evidence of these concepts, which would have been obvious to a PHOSITA. For example, Denny (EX1008) states the obvious fact that “[i]n order to obtain an accurate high temperature reading of a wheel assembly, the temperature sensor ... should, preferably, extend deep into the wheel assembly.” EX1008, 2:24–27. Denny explains that its sensor housing 12, which includes electronic circuitry, “is situated away from the outer surface of the wheel assembly so that the electronic circuit will not be subjected to heat from the wheel assembly and may freely dissipate heat produced by its own components.” EX1008, (57) Abstract. For the same reasons, a PHOSITA would have been motivated to equip the sensor device of Armitage or LeFebvre with an external temperature sensor, in order to obtain an accurate measurement of a high-temperature component (e.g., a wheel bearing).

83. Many different designs of external temperature sensors were known in the art. In my opinion, a PHOSITA would have been capable of selecting a temperature sensor design that was appropriate for a particular application. Culbertson discloses an external temperature sensor that is suitable for use in harsh environments including, for example, high vibration and temperature. EX1032, (57) Abstract, 10:37–56. A PHOSITA would have understood that Culbertson’s temperature sensor is suitable for this application, specifically for measuring the temperature of a railcar wheel bearing.

84. Limitations 33(a) and 33(e)(i): Culbertson discloses an assembly comprising a temperature probe **12** that is located external to a housing **28**. EX1032, Fig. 1, 4:13–35.

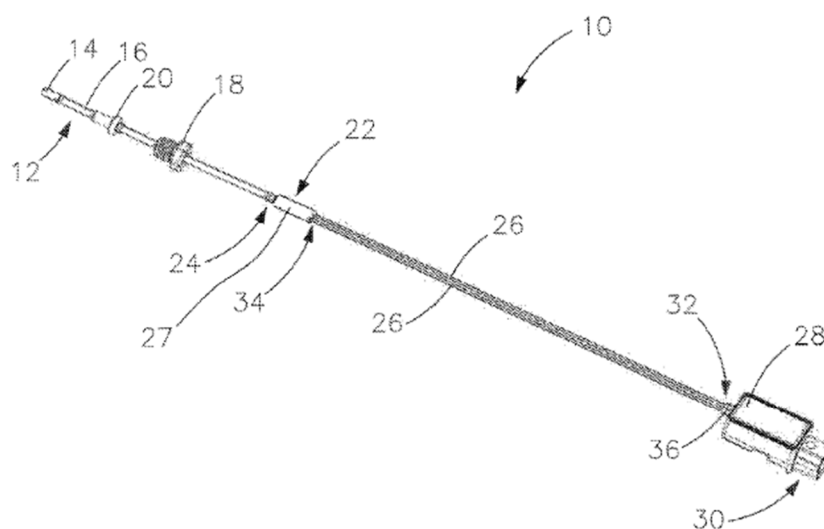


FIG. 1

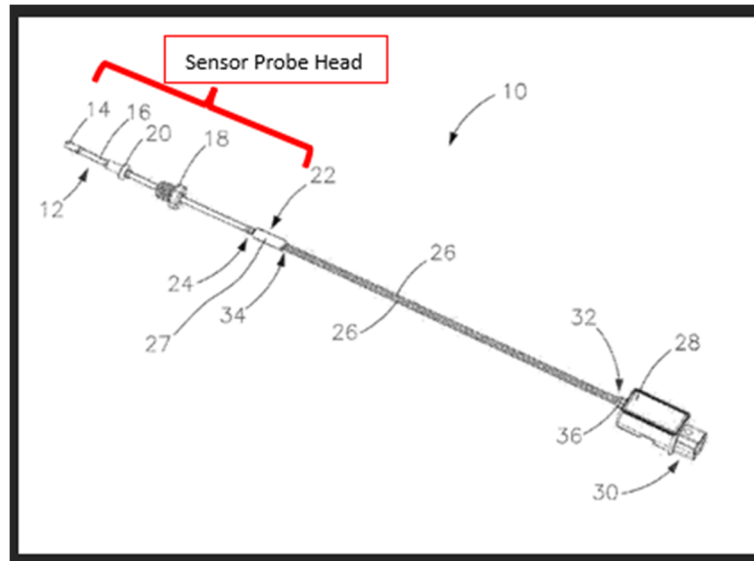
85. In my opinion, a PHOSITA could have easily incorporated Culbertson's external temperature sensor into a railcar monitoring system (specifically the system of LeFebvre or Armitage) with a reasonable expectation of success. The housing **28** includes an output portion **30** for coupling to a temperature measurement system and providing one or more temperature characteristics. *Id.* at 4:29–31, 5:1–9. Culbertson's sensor can output a wide variety of analog or digital signals, which enables it to easily integrate with a wide variety of systems. *Id.* at 5:19–53.

86. Limitation 33(e)(ii): Culbertson discloses an assembly comprising a temperature probe **12** (i.e., a sensor probe head), that has a probe body **16** formed

of a heat conductive material, for example a mineral insulated cable comprising one or more conductors. EX1032, 4:15–18, 4:36–45. Alternatively, probe body **16** may be formed from a metal tube **94**. EX1032, 11:52–63, Fig. 5. The distal end of probe **12** also has a tip cap **14** that is preferably formed of a metal alloy. EX1032, 4:15–18. A PHOSITA would recognize that a metal alloy is a heat conductive material.

87. Limitation 33(e)(iii): A pair of lead wires **26** each have a proximal end disposed within the housing **28** and a distal end that leads to probe **12**, external to the housing. EX1032, Fig. 1, 4:13–35. A transition component **22** (at the end of probe **12**) comprises connectors that terminate conductors of the temperature probe **12** to the distal end of lead wires **26**. *Id.* at 4:21–28. The housing **28** includes an input portion **36** for receiving the proximal end of the lead wires **26**. *Id.* at 5:1–2.

88. Limitation 33(e)(iv): As shown in Fig. 1, Culbertson discloses a sensor probe head—temperature probe **12**—that includes a tip cap **14** at its distal end, a probe body **16**, a collar **20**, a mounting connector **18**, and a proximal end **24**. EX1032, 4:13–28.



Culbertson teaches that probe body **16** can be formed from a metal tube **94**, and “can be formed, bent, or otherwise arranged for mounting on the desired temperature sensing application.” EX1032, 11:52–66. More generally, Culbertson teaches that the external temperature sensor “is adapted for securing the temperature probe **12** to a mounting assembly in an operating environment.” EX1032, 4:46–50.

89. A PHOSITA would have understood that a magnet could be used to attach a temperature sensor to a metallic substrate (e.g., a wheel bearing or other metallic portion of a railcar). For example, Provasnik identifies one obvious advantage of using a magnet: it permits the sensor to be readily attached to, and removed from, the metallic substrate. EX1009, 1:8–15, 1:38–44, 4:65-68. Magnets are a common, well-understood technology and any PHOSITA would have been familiar with their use. Magnets are available in different strengths, and a

PHOSITA could have selected a high-strength magnet if needed based on the weight of the sensor and the expected level of vibrations. With respect to Culbertson's temperature probe, a PHOSITA would have understood that placing a magnet inside probe body **16** (i.e., inside metal tube **94**) would allow the sensor probe head to sit flush against a metal surface to be measured. Additionally, placing a magnet within proximal end **24** of the probe body **16** would be useful to minimize the vibration or movement of the adjacent transition component **22** and prevent the electrical connectors from becoming detached. A PHOSITA would understand that these magnet configurations could be executed with a reasonable expectation of success.

90. It is therefore my opinion that claim 33 is obvious over the cited references and the general knowledge possessed by a PHOSITA.

8. Claim 59

91. Ground 1: Most limitations of claim 59, including all limitations present in original claim 23, are disclosed by Armitage in view of LeFebvre. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 355–362.

92. Ground 2: Most limitations of claim 59, including all limitations present in original claim 23, are disclosed by LeFebvre. *See* EX1003, ¶¶ 161–170.

93. Grounds 3 and 4: The new limitations of claim 59 are substantially the same as the new limitations of claim 33, and are obvious for the same reasons I have discussed above. *See* Section VII.D.7, which is incorporated here by reference.

9. Claims 60–61

94. Ground 1: The limitations added by dependent claim 60 (original claim 24) are obvious over Armitage in view of LeFebvre, Denny, and Provasnik, and limitations added by dependent claim 61 (original claim 25) are obvious over Armitage in view of LeFebvre. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 363, 380.

95. Ground 2: The limitations added by dependent claim 60 are obvious over LeFebvre in view of Denny and Provasnik, and the limitations added by dependent claim 61 are obvious over LeFebvre. *See* EX1003, ¶¶ 225–227.

* * *

As provided in 28 U.S.C. § 1746, I declare under penalty of perjury that the foregoing is true and correct.

Executed on: April 19, 2024



STEVEN RICCA