

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 IPR2023-00539
Patent No. 9,981,673

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
MOTION TO AMEND**

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 Motion to Amend and Request for Preliminary Guidance for the ’673 Patent (the “Motion”) are unpatentable over certain prior art references. As explained below, it is my opinion that each of substitute claims 23–43 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 ’673 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 '673 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 '673 Patent. For example, as indicated in the table below, I may use "Limitation 23(b)" as a shorthand reference to the limitation "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" in claim 23.

Claim Limitation	Claim Language
23	A method of monitoring operational characteristics of a railcar comprising the steps of:
23(a)	a. receiving data or processed information regarding ~~[[said]]~~ <u>an</u>

	operational characteristic <u>of a railcar</u> from one or more sensing units, each mounted on a <u>sidewall of a bearing adapter</u> on said railcar, said sensing units monitoring <u>[[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;</u>
23(b)	b. applying a heuristic to said received data to determine deviations from nominal operating conditions, <u>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;</u>
23(c)	c. assigning a severity level to said deviations from nominal operating conditions, <u>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</u>
23(d)	d. determining an alarm condition based on said assigned severity level.
24	The method of ~~claim 1~~ <u>claim 23</u> , wherein steps (a) through (d) can be carried out at different event engines distributed among at least two of said ~~sensors~~ <u>sensing</u> units, a communication management unit, and a mobile or land base station.
25	The method of ~~claim 1~~ <u>claim 23</u> , further comprising the initial step of establishing wireless communication with said one or more remote sensing units.
26	The method of ~~claim 2~~ <u>claim 25</u> , wherein said one or more remote sensing units form a mesh network.
27	The method of ~~claim 2~~ <u>claim 25</u> , wherein steps a-d are executed by a processing unit located on said railcar.
28	The method of ~~claim 4~~ <u>claim 27</u> , wherein said processing unit located

	on said railcar is a part of ~~[[said]]~~ a mesh network.
29	The method of ~~claim 2~~ claim 25, further comprising the step of transmitting said alarm condition to a location remote from said railcar.
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.
31(a)	The method of ~~claim 2~~ claim 25, further comprising the steps of: receiving <u>acceleration</u> data from a plurality of railcars;
31(b)	applying ~~[[a]]~~ the heuristic to said received <u>acceleration</u> data to determine the deviations from nominal operating conditions;
31(c)	assigning ~~[[a]]~~ the severity level to said deviations from nominal operating conditions;
31(d)	determining ~~[[an]]~~ the alarm condition based on said assigned severity level; and
31(e)	transmitting ~~[[said]]~~ a raised alarm to a display unit on a train of which said plurality of railcars are a part, <u>said raised alarm comprising the assigned severity level.</u>
32(a)	The method of ~~claim 6~~ claim 29, further comprising the steps of a. determining a recommended course of action based on said alarm condition; and
32(b)	b. transmitting said recommended course of action to a display unit on a train of which said railcar is a part.
33	A method of monitoring a temperature <u>and condition</u> of a desired part of a railcar, comprising:
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 <u>and sensing accelerations by use of an accelerometer attached to said other part;</u>
33(b)	(b) determining the temperature of the desired part by use of the temperature <u>of the part</u> sensed in step (a) <u>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</u>

	<u>calculated numeric values based on the accelerations sensed in step (a);</u>
33(c)	<u>(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</u>
33(d)	<u>(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 defined reference value or range of values indicating a severity of the detected condition of the desired part.</u>
34	A method of monitoring a temperature <u>and condition</u> of a desired part of a railcar in accordance with ~~claim 10~~ <u>claim 33</u> , further comprising the step of determining ~~a the~~ temperature of the ambient air, which temperature is used in the determination of step (b).
35	A method of monitoring a temperature <u>and condition</u> of a desired part of a railcar in accordance with ~~claim 10~~ <u>claim 33</u> , wherein steps (a) through (d) are carried out by a single unit attached to said railcar.
36	A method for monitoring the operation of a railcar performed by a communication management unit disposed on said railcar comprising the steps of:
36(a)	a. wirelessly receiving <u>acceleration</u> data from one or more sensing units which periodically collect readings from one or more sensors disposed <u>on a sidewall of a bearing adapter</u> on said railcar;
36(b)	b. heuristically analyzing said received <u>acceleration</u> data to: <u>determine a value for a condition of a bearing based on correlations between a plurality of different values for the condition</u>

	<u>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</u> determine if an actual failure exists on said railcar or [[to]]predict potential or imminent failures based on a statistical analysis of said received <u>acceleration</u> data; <u>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</u>
36(c)	c. communicating the results of said analysis <u>performed in step (b)</u> to an off-railcar location.
37(a)	The method of ~~claim 14~~<u>claim 36</u>, 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
37(b)	b. communicating said alarm condition to an off-railcar location.
38(a)	The method of ~~claim 14~~<u>claim 36</u>, 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
38(b)	b. communicating said alarm condition to an off-railcar location.
39	The method of ~~claim 14~~<u>claim 36</u>, 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.
40	The method of ~~claim 14~~<u>claim 36</u>, further comprising the step of joining a mesh network consisting of one or more sensing units located on said railcar.
41(a)	The ~~system~~<u>method</u> of ~~claim 14~~<u>claim 36</u>, further comprising the steps of: a. saving data received from said one or more sensing units in memory; and

41(b)	b. comparing data received with said saved data to identify trends or deviations from normal readings of said data stored in memory.
42	A method for monitoring the operation of a railcar comprising:
42(a)	a. collecting data at periodic intervals about one or more operating parameters of said railcar using one or more sensor units provided <u>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;</u>
42(b)	b. communicating said collected data to a communication management unit;
42(c)	c. analyzing said collected data by applying heuristics thereto to (i) determine if an actual failure exists and (ii) <u>[[to]]predict potential or imminent failures based on a statistical analysis of said collected data[.]];</u> <u>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</u> <u>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.</u>
43(a)	The method of ~~claim 21~~ <u>claim 42</u> , further comprising the steps of: assessing the collected data to determine if an alarm condition exists;
43(b)	and wirelessly communicating said alarm condition to an off railcar location.

IV. LEGAL PRINCIPLES

7. In forming my opinions and considering the subject matter of the '673 patent and substitute claims 23–43, 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 '673 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, ¶¶ 55–65.

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, ¶¶ 44–46. 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 23, 30, 33, 36, and 42 each include limitations that are not supported by the specification of the '673 Patent.

1. Claim 23: “on a sidewall of a bearing adapter,” “acceleration data”

17. Substitute claim 23 specifically claims a sensor unit (or “mote”) comprising an accelerometer mounted to the sidewall of a bearing adapter. A sensor unit having this combination of features is not disclosed anywhere in the specification of the '673 Patent.

18. I understand that, to support this limitation, Patent Owner has cited to the disclosure at col. 4:51–58, which states that “[s]ensor 20 can be any type of sensor.” EX1001, 4:51–58. 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 motes 10 with respect to the sensor 20 is dependent upon the type of sensor and the type of data desired.” EX1001, 4:49–51. 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 '673 Patent. 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 specification does not indicate that the embodiment of Figs. 3 and 3A comprises any type of sensor other than a temperature sensor.

21. I understand that Patent Owner also cites to the table spanning cols. 7–12 of the '673 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. Claim 23: “calculated numeric values,” “a plurality of defined parameter values,” “defined reference value”

22. 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 during operation of the railcar,” in Limitation 23(c).

None of these terms is used in the specification. I do not understand what each of these terms represents, and I cannot determine how each term is supported by the original disclosure.

23. For example, with respect to Limitation 23(b), Patent Owner cites two examples of “heuristics” that can be applied to acceleration data: (1) calculation of FFTs, and (2) calculation of kurtosis. Motion, 6–7. It is not clear to me how the claim language corresponds to the provided examples of “heuristics.” For example, is kurtosis a “calculated numeric value,” a “defined parameter value,” or both? Does an FFT represent a “calculated numeric value,” a “defined parameter value,” or both?

24. With respect to the “defined reference value” in Limitation 23(c), Patent Owner cites to support at col. 13:30–14:3, which is directed to thresholds used for *temperature* monitoring. Motion, 7. But the specification does not provide any values for use with *acceleration* monitoring, which is what claim 23 requires.

3. Claim 30: “and performing steps b-d at said location remote from said railcar”

25. In support of this limitation, Patent Owner cites to col. 11:52–54, which states only that heuristics “may be performed by either mobile base station 42 or land-based based station 44.” EX1001, 11:52–54. The specification does not disclose any embodiment in which all three of the steps required by claim 30 are performed at a remote location.

4. Claim 33: “and sensing accelerations by use of an accelerometer attached to said other part”

26. The specification does not disclose any embodiments that include *both* a temperature sensor *and* an accelerometer as required by claim 33. Nothing in the specification of the '673 Patent would have led a PHOSITA to select this particular combination of sensors. More generally, the '673 Patent does not disclose any “sensor unit” that includes multiple types of sensors.

5. Claim 33: “calculated numeric values,” “a plurality of defined parameter values,” “defined reference value”

27. See the discussion of the same terms in Section VII.A.2, *supra*, which is incorporated here by reference.

6. Claim 33: “an acceptable range of temperatures”

28. 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.” I cannot locate any disclosure in the specification that provides a “defined range of temperatures” as required by the claim.

7. Claim 36: “on a sidewall of a bearing adapter,” “acceleration data”

29. See the discussion of the same terms in Section VII.A.1, *supra*, which is incorporated here by reference.

8. Claim 36: “a plurality of defined parameter values,” “defined reference value”

30. See the discussion of the same terms in Section VII.A.2, *supra*, which is incorporated here by reference.

9. 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”

31. The specification of the '673 Patent does not disclose any “defined parameter values” or “operating conditions expected” with respect to *acceleration* data, as required by claim 36. I understand that Patent Owner has cited col. 13:30–14:3 for support, but that passage is directed to *temperature* monitoring. The specification does not provide any corresponding disclosure with respect to acceleration monitoring. Likewise, the cited disclosure at cols. 7–12 of the '673 Patent does not provide “defined parameter values” or “expected operating conditions” with respect to acceleration. The specification also fails to disclose any “correlations between a plurality of different values,” which is also required by claim 36.

10. 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”

32. I have reviewed the passages that Patent Owner cites as support for this limitation. Motion, 12–13. None of the cited passages disclose or relate to the

detection of actual, potential, or imminent failures based on *acceleration* data, whether as a result of statistical analysis or otherwise. *See* Sections VII.A.2 and VII.A.9, *supra*, which are incorporated here by reference.

11. Claim 42: “on a sidewall of a bearing adapter,” “acceleration data”

33. *See* the discussion of the same terms in Section VII.A.1, *supra*, which is incorporated here by reference.

12. Claim 42: “calculated numeric values,” “a plurality of defined parameter values,” “defined reference value”

34. *See* the discussion of the same terms in Section VII.A.2, *supra*, which is incorporated here by reference.

B. Indefiniteness

35. In my opinion, claims 23, 31, 33, 36, 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. Claim 23: “calculated numeric values,” “a plurality of defined parameter values,” “defined reference value”

36. *See* the discussion of the same terms with respect to written description in Section VII.A.2, *supra*, which is incorporated here by reference. As discussed above, the terms “calculated numeric values,” “a plurality of defined parameter values,” and “defined reference value” do not appear in the specification. It is not clear how each term relates to the various concepts and

examples that are disclosed the '673 Patent. It is also unclear how the terms relate to one another.

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

37. A PHOSITA cannot determine with reasonable certainty what a “raised alarm comprising the assigned severity level” means in the context of the '673 Patent. I have reviewed the portions of the '673 Patent specification cited by Patent Owner (col. 13:31–14:3), but the provided examples fail to provide reasonable clarity about the scope of this limitation. 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 encompasses alarms that do not include a written message (e.g., audible alarms).

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

38. *See* Section VII.B.1, *supra*, which is incorporated here by reference.

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

39. *See* Section VII.B.1, *supra*, which is incorporated here by reference.

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”

40. This claim limitation is ambiguous. There are two possible ways to read the claim language: (1) that it is sufficient to “determine if an actual failure

exists on said railcar,” regardless of how this determination is made; or (2) that it is necessary to “determine if an actual failure exists on said railcar...based on a statistical analysis of said received acceleration data.” In other words, there are two different ways of reading the language, and each reading will lead to a different conclusion. If a system were to detect an actual failure without using statistical analysis, that system is covered by reading (1) but is not covered by reading (2).. I cannot tell which of these readings is intended.

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

41. See Section VII.B.1, *supra*, which is incorporated here by reference.

C. Enablement

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

42. See the discussion of the same terms with respect to written description in Section VII.A.2, *supra*, which is incorporated here by reference. 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.

43. 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.

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

44. See Section VII.C.1, *supra*, which is incorporated here by reference.

3. Claim 33: “an acceptable range of temperatures”

45. See the discussion of the same terms with respect to written description in Section VII.A.6, *supra*, which is incorporated here by reference. The ’673 Patent does not disclose any “acceptable range of temperatures” that could be used by a PHOSITA to practice this claim. The ’673 Patent also does not teach a PHOSITA how to determine what an “acceptable range of temperatures” would be.

4. Claim 33: “calibrated correlations”

46. 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.” No temperature correlations are disclosed in the ’673 Patent, and the specification does not teach a PHOSITA how to develop the temperature correlations needed to practice this claim.

5. Claim 36: “defined parameter values,” “defined reference value”

47. See Section VII.C.1, *supra*.

6. Claim 42: “calculated numeric values,” “defined parameter values,” “defined reference value”

48. See Section VII.C.1, *supra*, which is incorporated here by reference.

D. Obviousness

49. As I explained in my first declaration in this proceeding (EX1003), original claims 1–18 and 20–22 of the ’673 Patent are obvious in view of LeFebvre (EX1005), Armitage (EX1006), and Barone (EX1007). Specifically, I explained that:

- 1) Claims 1–7, 10–18, and 20–22 are obvious over LeFebvre;
- 2) Claims 8 and 9 are obvious over LeFebvre in view of Barone;
- 3) Claims 1, 2, 4, 6–11, and 13 are obvious over Armitage; and
- 4) Claims 3, 5, 12–18, and 20–22 are obvious over Armitage in view of LeFebvre.

The same limitations present in original claims 1–18 and 20–22 also appear in substitute claims 23–43. My analysis of these original claim limitations does not differ from my first declaration, EX1003, and I incorporate that analysis here by reference.

50. In my opinion, the newly added limitations of substitute claims 23–43 merely recite specific features (e.g., mounting a sensor on the sidewall of a bearing adapter) that were conventional, obvious, and well-known in the prior art. Specifically, it is my opinion that the substitute 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). I will explain in detail below where each of these features may be found in the prior art.

1. Motivation to Combine

51. 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. 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 23

52. Ground 1: Most limitations of claim 23, including all limitations present in original claim 1, are disclosed by Armitage. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 188–203.

53. Ground 2: Most limitations of claim 23, including all limitations present in original claim 1, are disclosed by LeFebvre. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 70–86.

54. The new limitations of claim 23, which I have not previously addressed in this proceeding, are discussed in detail below.

a. 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”

55. Grounds 1 and 2: Using an accelerometer to measure vibrations emanating from a wheel bearing is commonplace in the railroad industry. It was known as early as the 1980s that “vibrations of bearing boxes change their nature when faults arise.” EX1023, 3:17–19. Accelerometers were originally invented in the 1920s, and the type of accelerometer commonly used today (piezoelectric) was in common use by the late 1950s/early 1960s. Accelerometers are used in many types of rotating applications, from balancing items (turbines, satellites, tires, train

wheels) to monitoring rotating equipment (wheels, fans, power plant generators, pumps) and the like.

56. 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, a PHOSITA would have found it obvious to include

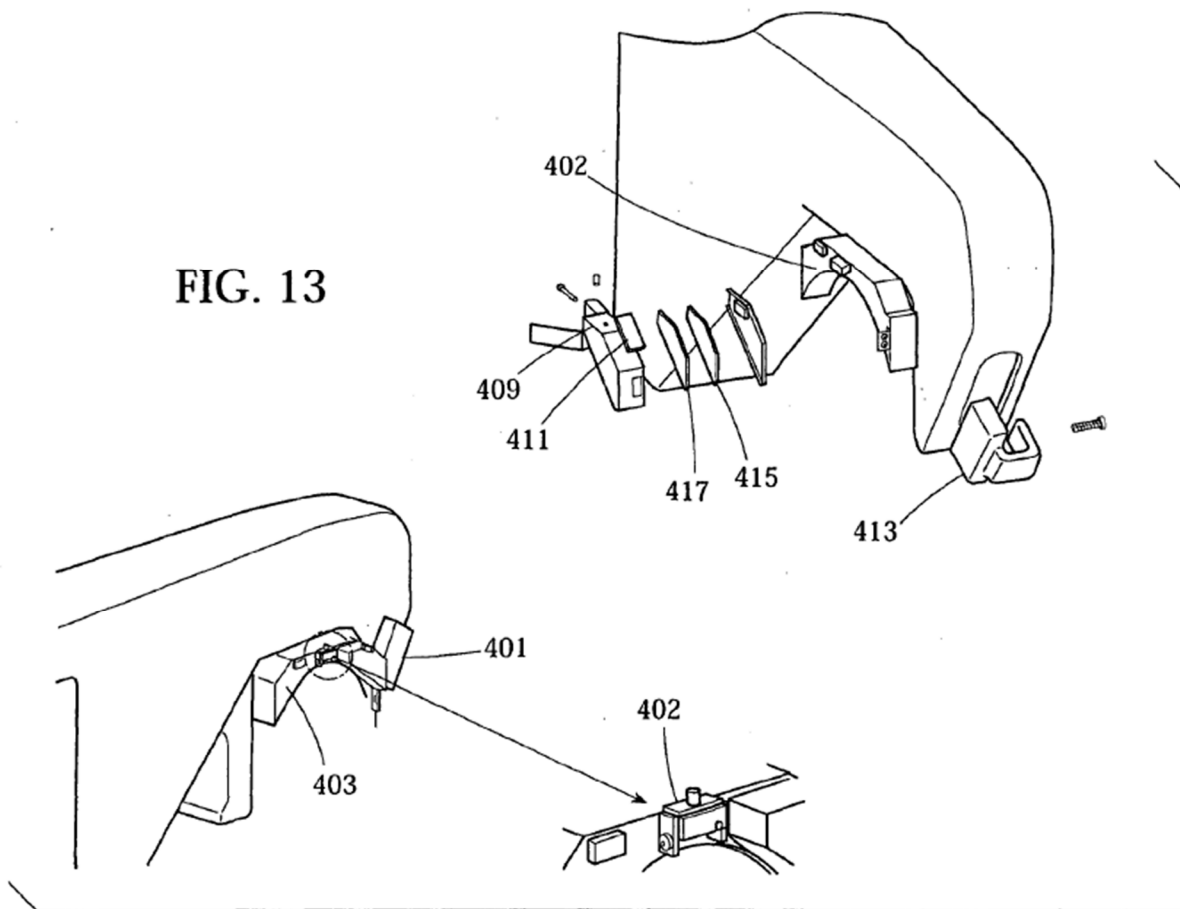
both a temperature sensor and a vibration sensor because both temperature and vibration are known indicators of bearing degradation and damage. In fact, combined accelerometer/temperature sensors are in common use and have been commercially available since at least the early 2000s.

57. As I explained in my first declaration, 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. *See* EX1003, ¶¶ 70–86, 188–203, which is incorporated here by reference. LeFebvre, for example, obtains “values” by performing calculations on collected sensor data. EX1005, claim 9 (“values indicative of critical departures of the performance criteria”), claim 12 (“values derived by said sensors”). Armitage expressly discloses calculating numeric values—averages, minimums, and maximums—based on acceleration data. EX1006, ¶ [0045].

b. Limitation 23(a): “mounted on a sidewall of a bearing adapter”

58. 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 accelerometers can be mounted to the sidewall to measure 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 comprising accelerometers and 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**.



59. 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.” EX1022, 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.

60. 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 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.

61. 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.

62. 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 optimal location identified by Barone and Moretti. EX1007, ¶¶ [0289]–[0293], Figs. 11–13; EX1022, 3:22–28, Figs. 1–6. 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.

c. 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”

63. Grounds 1 and 2: Comparing a measured value to a predetermined threshold is the *simplest* way to detect a defect or failure. In my opinion, that is an obvious fact that would be understood by anyone skilled in the art.

64. 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. *See* EX1026 (Utterback), 2:16-21 (“In hot box detectors this signal triggers a warning output if the signal indicates that the temperature of a wheel journal exceeds a predetermined value (generally about 70 degrees C. above the ambient temperature), i.e., if a hot box is detected.”); EX1027 (Doctor), claim 1 (“generating an alarm signal when said temperature indicative signals exceed a preselected limit characterizing an abnormal condition for said wheel”); EX1025 (Johanson), claim 4 (hotbox detector including a means for indicating “bearings having a measured temperature in excess of a predetermined value”). Following the same principle, the systems disclosed by Barone and Moretti 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...”).

65. I understand that Andrew Martin, in a declaration submitted in this proceeding, admitted 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.”). I agree with Mr. Martin that standard temperature thresholds for railcar wheel bearings were known in the art.

66. 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.

67. In summary, comparing a measured value (or a calculated value, such as an average of previous measurements) to a predefined threshold (or a plurality of thresholds) 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 to detect dangerously high bearing temperatures and/or vibrations. In my opinion, a PHOSITA would have been motivated to use threshold-based comparisons because they are simple, straightforward to implement, and effective. A PHOSITA would also have understood that threshold-based heuristics can be used in parallel with more complex types of heuristics. These methods were well established in the rotating machinery monitoring industries generally, and a PHOSITA would have had access to many publications, training courses, and other materials that disclose the same principles I have discussed above with respect to the prior art.

d. 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”

68. Grounds 1 and 2: 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.

69. 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.”).

70. 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.”). Armitage’s color-coded system, for example, corresponds to a “plurality of severity levels” as required by claim 23. 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.

71. 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.

3. Claims 24–32

72. 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. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 204–215, 240–242. 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* EX1003, ¶¶ 250–253.

73. 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* EX1003, ¶¶ 87–99, 120–122. The additional limitations of claims 31 and 32, which correspond to original claims 8 and 9, are disclosed by LeFebvre and Barone. *See* EX1003, ¶¶ 165–183.

74. With respect to Limitation 31(d), which requires a “raised alarm comprising the assigned severity level,” *see* Section VII.D.2.d, *supra*.

4. Claim 33

75. Ground 1: Most limitations of claim 33, including all limitations present in original claim 10, are disclosed by Armitage. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 227–235.

76. Ground 2: Most limitations of claim 33, including all limitations present in original claim 10, are disclosed by LeFebvre. *See* EX1003, ¶¶ 100–110.

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

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

78. See Sections VII.D.2.a and VII.D.2.b, *supra*.

b. 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”

79. Ground 1: As discussed with respect to Limitation 23(a) above, 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]. Measuring bearing temperature indirectly—as in Armitage’s preferred embodiment—requires correlating the temperature of the bearing with the temperature of the non-rotating component that is being directly measured (for example, the bearing mount). In other words, Armitage’s preferred embodiment implicitly involves the use of “calibrated correlations” as required by claim 33. In my experience, bearing mount manufacturers provide threaded mounting locations for precisely this purpose—the railroad industry has been practicing this type of monitoring for more than a century.

80. 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). In other words, a PHOSITA would understand that the “calibrated correlations” are inherently used in LeFebvre’s monitoring system as required by claim 33.

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

81. See Sections VII.D.2.a and VII.D.2.c, *supra*.

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

82. See Sections VII.D.2.c and VII.D.2.d, *supra*.

5. Claims 34–35

83. Ground 1: The limitations added by dependent claim 34, corresponding to original claim 11, are disclosed by Armitage. I addressed these limitations in my first declaration, which is incorporated here by reference. See EX1003, ¶¶ 236–239. The limitations added by dependent claim 35, corresponding to original claim 12, are disclosed by Armitage in view of LeFebvre. See EX1003, ¶¶ 254–259.

84. Ground 2: The limitations added by dependent claims 34 and 35 are disclosed by LeFebvre. See EX1003, ¶¶ 111–119.

6. Claim 36

85. Ground 1: Most limitations of claim 36, including all limitations present in original claim 14, are obvious over Armitage in view of LeFebvre. I

addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 261–268.

86. Ground 2: Most limitations of claim 36, including all limitations present in original claim 14, are disclosed by LeFebvre. EX1003, ¶¶ 123–132.

87. The new limitations of claim 36, which I have not previously addressed in this proceeding, are addressed below.

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

88. *See* Sections VII.D.2.a and VII.D.2.b, *supra*.

b. 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”

89. *See* Section VII.D.2.c, *supra*.

c. Limitation 36(b): “a statistical analysis of said received acceleration data”

90. 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.”).

91. Ground 2: LeFebvre discloses the use of statistical techniques to process data collected from its sensor nodes, which can comprise accelerometers as discussed above. *See* Limitation 23(a), *supra*. 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. *See* EX1006, ¶ [0045]. A PHOSITA would also have understood that analyzing a large amount of collected data will necessarily involve the use of statistical techniques. For example, well-known statistical techniques include Fourier analysis to detect underlying frequencies in the vibration data, trend analysis to detect changes in the bearing’s vibration signature over time, and standard deviation thresholds to identify failing components. All of these techniques are disclosed by the prior art and would have been familiar to a PHOSITA. 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”).

d. 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”

92. *See* Sections VII.D.2.c and VII.D.2.d, *supra*.

7. Claims 37–41

93. 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. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 269–281.

94. Ground 2: The limitations added by dependent claims 37–41 are disclosed by LeFebvre. *See* EX1003, ¶¶ 133–145.

8. Claim 42

95. Ground 1: Most limitations of claim 42, including all limitations present in original claim 21, are obvious over Armitage in view of LeFebvre. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 282–286.

96. Ground 2: Most limitations of claim 42, including all limitations present in original claim 21, are disclosed by LeFebvre *See* EX1003, ¶¶ 149–153. The new limitations of claim 42, which I have not previously addressed in this proceeding, are addressed below.

a. Limitation 42(a)

97. *See* Sections VII.D.2.a and VII.D.2.b, *supra*.

b. Limitation 42(c)

98. *See* Sections VII.D.2.c, VII.D.4.b, and VII.D.6.c *supra*.

99. Claim 43

100. Ground 1: The limitations added by dependent claim 43, corresponding to original claim 22, are disclosed by Armitage in view of LeFebvre. I addressed these limitations in my first declaration, which is incorporated here by reference. *See* EX1003, ¶¶ 287–289.

101. Ground 2: The limitations added by dependent claim 43 are disclosed by LeFebvre. *See* EX1003, ¶¶ 154–156.

* * *

As provided in 28 U.S.C. § 1760, I declare under penalty of perjury that the foregoing is true and correct.

Executed on: January 11, 2024



STEVEN RICCA