

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUM INDUSTRIAL TECHNOLOGY, INC.,
Petitioner,

v.

AMSTED RAIL COMPANY, INC.,
Patent Owner.

IPR2023-00538

PATENT NO. 9,365,223

ISSUED: JUNE 14, 2016

TITLE: SYSTEM AND METHOD FOR MONITORING
RAILCAR PERFORMANCE

DECLARATION OF MICHAEL I. SHAMOS, PH.D.

ON BEHALF OF PATENT OWNER

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1. I, Michael I. Shamos, declare as follows in connection with the proceedings identified above.

I. INTRODUCTION AND QUALIFICATIONS

2. I have been retained as an expert on behalf of Patent Owner to provide technical analysis and opinions relating to the Petition for *Inter Partes* Review (“Petition,” Paper 2) filed by Hum Industrial Technology, Inc. (“Hum” or “Petitioner”) challenging the validity of Claims 1–10, 13–18, and 20–32 (the “Challenged Claims”) of U.S. Patent No. 9,365,223 (“the ’223 Patent” or “the Patent”). I have also been asked to provide opinions on the Declaration of Mr. Steven Ricca (“Ricca Declaration,” Ex. 1003).

3. I am aware of contemporaneous litigation involving the parties in a case styled *Amsted Rail Company, Inc. v. Hum Industrial Technology, Inc. and Brett Wilson*, 4:22-cv-00445-AGF (E.D. Mo.) (the “Litigation”).

4. I currently hold the title of Distinguished Career Professor in the School of Computer Science at Carnegie Mellon University in Pittsburgh, Pennsylvania. I am a member of two departments in that School, the Software and Societal Systems Department and the Language Technologies Institute. I was a founder and Co-Director of the Institute for eCommerce at Carnegie Mellon from 1998-2004 and from 2004-2018 was Director of the eBusiness Technology graduate program in the Carnegie Mellon University School of Computer Science. Since 2018, I have been

Director of the M.S. in Artificial Intelligence and Innovation degree program at Carnegie Mellon. My Curriculum Vitae is attached as Ex. 2002.

5. I have an A.B. degree from Princeton University in Physics, an M.A. degree from Vassar College in Physics, an M.S. degree from American University in Technology of Management, an M.S. degree from Yale University in Computer Science, an M. Phil. from Yale University in Computer Science, a Ph.D. from Yale University in Computer Science, and a J.D. degree from Duquesne University.

6. I have taught graduate courses at Carnegie Mellon in Electronic Commerce, including eCommerce Technology, Electronic Payment Systems, Electronic Voting, Internet of Things, Electronic Payment Systems and eCommerce Law and Regulation, as well as Analysis of Algorithms. Since 2007, I have taught an annual course in Law of Computer Technology. I currently also teach Artificial Intelligence and Future Markets. That course covers AI in preventive maintenance, including predicting failures based on sensor data.

7. From 2001-2021, I was a Visiting Professor at the University of Hong Kong, where I taught an annual graduate course in Electronic Payment Systems, one of the few graduate courses in the world on this subject.

8. My course on Law of Computer Technology is required for all students in the Master of Science in Artificial Intelligence and Innovation program, the

Privacy Engineering program and the Ph.D. in Societal Computing program at Carnegie Mellon.

9. I am the author and lecturer in a 24-hour video course on Internet protocols and have taught computer networking, wireless communication and Internet architecture since 1999.

10. I was engaged by Carnegie Mellon to deliver lectures to the Indian Railways on the topic “The Internet of Trains,” which specifically dealt with train sensor systems and remote communication.

11. From 1979-1987, I was the founder and president of two computer software development companies in Pittsburgh, Pennsylvania, Unilogic, Ltd. and Lexeme Corporation.

12. I am an attorney admitted to practice in Pennsylvania and have been admitted to the Bar of the U.S. Patent and Trademark Office since 1981. I have been asked to render opinions in this declaration as a technical expert. I have not been asked to offer any opinions on patent law or procedure in this proceeding.

13. I am a named co-inventor on the following six issued patents relating to electronic commerce: U.S. Patent Nos. 7,330,839, 7,421,278, 7,747,465, 8,195,197, 8,280,773, and 9,456,299.

14. I have previously served as an expert in over 350 cases concerning computer technology. In particular, I have been involved in multiple cases involving remote sensing.

15. The statements made and opinions provided in this Declaration are based on my own personal knowledge and, if called as a witness, I could and would testify in a manner consistent with the material in this Declaration.

II. MATERIALS CONSIDERED

16. I have been asked by counsel for Patent Owner to address Petitioner's assertions that the Challenged Claims would have been obvious. Petitioner does not allege that any Challenged Claim is anticipated.

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

18. I have also relied on my education, skill, training, and experience in the relevant fields of technology. I have further considered the viewpoint of a person of ordinary skill in the art ("POSITA") at the time of the invention of the '223 Patent.

19. I reserve the right to supplement my opinions as expressed in this Declaration to address any new information obtained in the course of this proceeding, or based on any new positions taken by Petitioner.

20. In this Declaration, all emphasis has been added unless otherwise noted.

III. COMPENSATION

21. I am being compensated at my regular rate of \$600/hour. My compensation is in no way dependent on the testimony I give or on the outcome of this proceeding, and my compensation in no way affects the substance of my statements and opinions in this Declaration.

22. I have no financial interest in this case, the Litigation, Petitioner, or the '223 Patent.

IV. SUMMARY OF MY OPINIONS

23. The following table summarizes the grounds of challenge ("Grounds") raised in the Petition:

Grd.	Sec.	References	Challenged Claims
1	§ 103	LeFebvre	2–10, 18, 20, 21, 23, 25–32
2	§ 103	LeFebvre in view of Barone	13–17, 22, and 24
3	§ 103	LeFebvre in view of Denny and Provasnik	1, 24
4	§ 103	Armitage	2, 3, 5, 7, 13–18, 20–22, 26–28, 32
5	§ 103	Armitage in view of LeFebvre	4, 6, 8, 9, 10, 23, 25, 29–31
6	§ 103	LeFebvre, Denny, and Provasnik	1, 24

24. After a review of the '223 Patent and the alleged prior art asserted by Petitioner, it is my opinion that the Challenged Claims are not invalid under any of

the Grounds. My opinions, and the bases therefor, are detailed throughout this Declaration.

V. LEGAL PRINCIPLES

25. Counsel for Patent Owner has informed me of the legal principles that apply in this proceeding.

26. A prior art reference can disclose a limitation that is not expressly disclosed in the reference if it is “inherently present” in the reference. I further understand that to be “inherently present,” the missing disclosure must necessarily and inevitably be present in the element or process described in the reference. It is my understanding that a limitation is not disclosed by inherency if the missing limitation is only probably present or if there is merely a possibility that it is present.

27. A claim is invalid as obvious under 35 U.S.C. § 103 if the differences between the subject matter sought to be patented and the prior art are such that the subject matter of the claim as a whole would have been obvious at the time of the patent’s filing date to a person having ordinary skill in the art. I have been informed that the following factors are used to determine whether or not the claimed subject matter would have been obvious: (i) the scope and content of the prior art; (ii) the differences between the prior art and the claimed invention; (iii) the level of ordinary skill in the field of the invention; and (iv) any relevant objective considerations of non-obviousness.

28. A party asserting obviousness based on a combination of prior art references must demonstrate that one of ordinary skill in the art would have been motivated to combine the teachings of those references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so. It is my understanding that it is not enough to show that one skilled in the art could combine elements of multiple references, but instead there must be some reason that would have prompted a person of ordinary skill in the art to combine the elements in the way the claimed invention does. I understand that there must be some reasoned explanation as to why one of ordinary skill in the art would combine the references.

29. A combination of references would not have been obvious if the alleged modification(s) to be made to the reference(s) would have been inconsistent with a reference's stated goals or would have rendered the combination inoperable for its intended purpose. I further understand that for something to have been obvious, the party asserting obviousness must explain why a POSITA would have selected components for combination in the manner claimed.

30. It is my further understanding that obviousness cannot be based on a hindsight combination of components selected from prior art references. I also understand that an invention would not have been obvious simply because all of the elements of the invention may have been known separately in the prior art.

31. I understand that claims must be enabled by the original disclosure of the patent. For the claims to be enabled, the information contained in the disclosure must be sufficient to inform those skilled in the relevant art how to make and use the claimed invention without undue experimentation. I also understand the original disclosure must contain a written description of the claimed invention. I understand that the written description requirement is separate and distinct from the enablement requirement. To satisfy the written description requirement, the original disclosure must describe (in writing or drawings) the claimed invention in sufficient detail that one skilled in the art can reasonably conclude the inventor had possession of the claimed invention. In other words, the question is whether one of skill in the art can discern or visualize, from the original disclosure, that the named inventor actually invented the subject matter later claimed.

32. I understand that a reference patent, i.e. an alleged prior art patent used in a ground to prove invalidity, is only entitled to claim the benefit of the filing date of its provisional application if the disclosure of the provisional application provides support for at least one claim in the reference patent in compliance with § 112 ¶ 1. In other words, to be entitled to the provisional priority date, the provisional application's written description must provide written description support for at least one claim of the later patent. Additionally, the subject matter relied upon in the ground must be effectively filed, i.e. be present, in the provisional application. If

either of these requirements are not met, the reference is not entitled to its provisional filing date as an effective filing date.

33. I have been informed and I understand that claim construction is a matter of law and the construction of a claim term will be determined by the Board. In this declaration, I have been informed and I understand that the claim terms should be interpreted under “the Phillips standard.” I have been informed and I understand that under the Phillips standard, claim terms are given their ordinary and customary meaning as understood by a person of ordinary skill in the art at the time of the invention in light of the claim language and the patent specification. I have been informed and I understand that the claim terms, as construed, encompass the embodiments disclosed in the specification. I have been informed and I understand that the patentee can serve as their own lexicographer. As such, if the specification provides a definition of a claim term, I understand that I should interpret that claim term in light of the particular definition provided in the specification. I further understand that different claim terms in a patent are presumed to have different meanings. I further understand that extrinsic evidence such as dictionaries are among the tools that can assist the Board in determining the meaning of particular claim terms to those of skill in the art.

VI. PRIORITY DATES

34. The Patent, which issued from Application 13/842,427 (“the ’427 Application”), claims priority to U.S. Provisional Patent Application 61/661,661, (the “’661 Application”), filed Jun. 19, 2012, and U.S. Patent Application 12/861,713 (the “’713 Application”), filed Aug. 23, 2010, now U.S. Patent 9,026,281, of which it is a continuation-in-part.

35. The ’713 Application incorporates by reference the entire disclosure of U.S. Patent No. 7,688,218 (“the ’218 Patent”). See Ex. 1014 at 11; see also Ex. 1001 at 15:20-24 (incorporating by reference the ’218 Patent).

36. Petitioner has challenged the priority dates of independent claims 1, 2, 5, and 23 of the ’223 Patent, but provides no substantial analysis or evidence to support its allegations. See Petition at 7. As explained below, at least claims 2, 4, 23, 24, 27, 28, and 29 are entitled to the earliest priority date of August 23, 2010.

A. Claim 2

37. Petitioner does not present any evidence to support its assertion that claim 2 of the ’223 Patent is only entitled a priority date of June 19, 2012. Claim 2 recites “a temperature sensor.” As noted above, the ’223 Patent claims priority to and incorporates by reference the ’713 Application, which in-turn incorporates by reference the ’218 patent. See Ex. 1001 at 1:6-10; Ex. 1014 at 11. The ’218 Patent does disclose such a sensor. See *e.g.*, Ex. 1015 at 1:50-51, 5:47-50, 6:25-29, 9:16-

27. It is my opinion that a POSITA reading the '713 Application in combination with the incorporated '218 Patent would find that the inventors of the '223 patent had possession of the of the invention recited in claim 2 and would understand that the combination of the '713 Application and '218 Patent provides adequate written description support for claim 2 as of the filing date of the '713 Application on August 23, 2010. As shown in the table attached as Appendix A, each element of claim 2 is fully supported by the '713 Application. The table in Appendix A also demonstrates that a POSITA would find that the inventors also had possession of the inventions claimed in dependent claims 3, 4, and 27-30 as of the filing date of the '713 Application on August 23, 2010.

38. Thus, it is my opinion, in view of the disclosures cited to above, that a POSITA would recognize that that the inventors had possession of the invention claimed in claims 2, 3, 4, and 27-30 of the '223 patent as of August 23, 2010.

B. Claim 23

39. Petitioner does not present any evidence to support its assertion that claim 23 of the '223 Patent is only entitled a priority date of June 19, 2012. Claim 23 includes the limitation “a temperature sensor.” As noted above, the '223 patent claims priority to the '713 Application which incorporates by reference the '218 patent. See Ex. 1014 at 11. The '218 Patent does disclose a temperature sensor. It is my opinion that a POSITA reading the '713 Application in combination with the

incorporated '218 Patent would find that the inventors of the '223 patent had possession of the of the invention recited in claim 2 and would understand that the combination of the '713 Application and '218 Patent provides adequate written description support for claim 23, as of the filing date of the '713 Application on August 23, 2010. As shown in the table attached as Appendix A, each element of claim 23 is fully supported by the '713 Application.

40. Thus, it is my opinion, in view of the disclosures cited to above, that a POSITA would recognize that that the inventors had possession of the invention claimed in claim 23 of the '223 patent as of August 23, 2010.

VII. ARMITAGE IS NOT PRIOR ART TO CLAIMS 2 AND 23

41. I have been informed that Armitage is entitled to a filing date of May 11, 2011. Because the Petitioner failed to submit a copy of the Armitage provisional application, a POSITA would have no basis in the record as it has been presented to the Board to determine an earlier effective filing date for Armitage. Therefore, I have applied the May 11, 2011 filing date in this opinion.

VIII. LEVEL OF ORDINARY SKILL IN THE ART

42. Petitioner defines a person of ordinary skill in the art ("POSITA") as "a person with at least a B.S. degree in electrical or mechanical engineering or a related field with at least two years' experience designing monitoring systems for railcar components, or monitoring systems for similar industrial equipment with

rotating components. ... Less work experience could be compensated by a higher level of education, such as a master's degree, and vice versa." Pet., 14 (citations omitted). Neither Petitioner nor its expert, Mr. Ricca, offers any explanation why this would be a correct characterization of a POSITA. Mr. Ricca says that he applied the criteria listed in ¶ 43 of his declaration, but does not explain which factors were applicable or how they led to the characterization.

43. I note that Mr. Ricca has 24 years of experience in the field, which is 12 times as much experience as he says a POSITA would have, thus classifying him as one of extraordinary skill. This is significant because that which may appear obvious to one of ordinary skill would not necessarily be obvious to one of ordinary skill.

44. The Patent defines the field of the invention at 1:14-20:

This invention relates to a real-time monitoring and analysis system for railcars, and, more particularly, to a system that gathers data regarding various operating parameters and conditions from remote sensors and applies heuristics to analyze the data to detect and/or predict operational failures. Specific uses for monitoring temperatures on a railcar are also disclosed.

45. The claims are drawn to sensor devices, wireless communication systems, including wireless mesh networks, communication management systems, and heuristic and statistical data analysis to predict failure. Petitioner's

characterization of a POSITA does not reflect familiarity with wireless communication systems, communication management systems, or heuristic and statistical data analysis.

46. In my opinion, a POSITA would be a person with at least a B.S. degree in electrical engineering or computer science or a related field, with at least two years' experience with sensing systems for railcars or similar industrial equipment, including familiarity with wireless networks and heuristics and statistical data analysis for failure prediction. Less work experience could be compensated for by a higher level of relevant education, and vice versa.

IX. CLAIM CONSTRUCTION

47. It is my understanding that Petitioner believes that no claim term requires claim construction in this proceeding. Pet., 15. However, in my opinion Petitioner does not appear to have applied the ordinary and customary meaning of certain claim terms as they would be understood by a POSITA, and, further, it takes positions in this proceeding that are inconsistent with positions it took in the Litigation. For those reasons, I believe that express construction is required for the term "housing," which appears in independent claims 1, 2 and 23.

48. The ordinary and customary meaning of "housing," in the context of the Patent, is "enclosure." The term "housing" is used consistently 18 times in the specification and 16 times in the claims, examples of which are presented below.

49. That the housing must “enclose” (i.e., have an interior) is clear because the specification refers to various components as being mounted “within the housing.” See, e.g., “various components are installed within the housing 14,” (4:11); “A sensor 20 ... may be mounted within the housing 14” (4:23-24).

50. Further, the housing is described as having “openings”: “openings in the housing” (4:12-13); “an opening 24 in the housing 14” (4:28). If the housing were not an enclosure, it would not need openings.

51. The claims also make clear that a housing is an enclosure. See, e.g., claim 1: “said electrical circuitry positioned within said housing”, “said power source positioned within said housing,” “a probe external to said housing,” “said communication device positioned within said housing.” Likewise in claims 2 and 23. It is my opinion that these disclosures in the specification and the limitations recited in the claims would inform a POSITA that the claimed “housing” is an “enclosure.”

52. While Petitioner states that no construction is required for “housing,” its application of that term to the prior art is at odds with its plain meaning. Indeed, Petitioner appears to have implicitly adopted the construction it proposed in the Litigation, which is “one or more parts that covers, encloses, supports, or protects other components.” That construction is clearly wrong. The legs of a

chair support the seat of the chair, but are not a “housing.” An umbrella protects a person from rain but is not a “housing.”

53. The Patent discloses two distinct embodiments: (1) one in which sensors are housed in a housing; or (2) one in which the sensors are built into the railcar. (“[i]n another alternate embodiment of the invention, one or more notes may be housed in alternative housings or built into the railcar itself. In one such embodiment, notes can be built into the form of an adapter pad similar to the type shown in U.S. Pat. Nos. 7,698,962 and 7,688,218.” (’223 Patent, 15:18-24.) U.S. Patent. 7,688,218 (Ex. 1015) is the issued patent corresponding to the LeFebvre reference, which is a patent application publication. That is, the Patent distinguishes between a “housing” and the built-in sensors of LeFebvre, which are “pads” offering no enclosure. Ex. 1001 at 15:18-24. The term “housing” does not appear in LeFebvre. This is consistent with the testimony of William Lefebvre. *See* Ex. 2008.

54. The table below summarizes the constructions of the term that Patent Owner asserts require construction.

Term	Construction
“housing”	plain and ordinary meaning, which is “enclosure”

55. I have accorded all of the other terms their plain and ordinary meaning to a POSITA.

**X. PETITIONER HAS NOT SHOWN A REASONABLE LIKELIHOOD
OF PREVAILING ON ANY GROUND**

**A. Ground 1: Petitioner has failed to show a reasonable likelihood
that Claims 2–10, 18, 20, 21, 23, and 25–32 are obvious over
LeFebvre**

56. Ground 1 relies solely on LeFebvre for claims 2–10, 18, 20, 21, 23, and 25–32. Of these, claims 2-4 and 26-30 recite, or depend from claims reciting a “housing.” LeFebvre does not disclose or suggest a “housing.”

57. Claim 5 and its dependents 6-10, 18, 20, 21, 31, and 32, do not claim a “housing,” but claim “heuristics to analyze data collected from said one or more sensor units” and “statistical analysis of said collected data.” LeFebvre does not disclose or suggest “heuristics” or the claimed “statistical analysis.”

58. Claim 23 is independent and claim 25 depends from it. Claim 23 recites “a housing mountable on a railcar,” which is the same “housing” as in Claim 2. For the same reason as in claim 2, LeFebvre does not teach or suggest a “housing mountable on a railcar.”

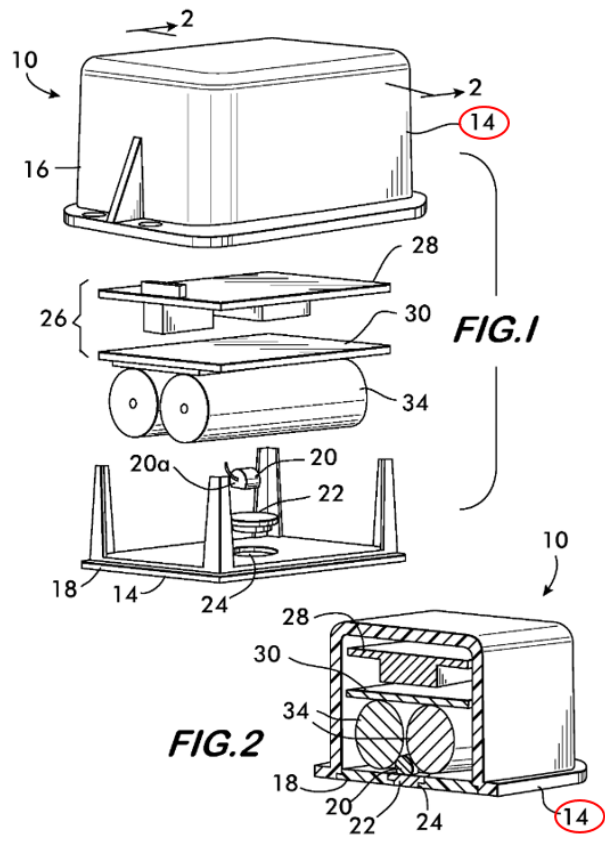
1. Claims 2-4 and 26-30

a. LeFebvre does not disclose a housing

59. As discussed in connection with claim construction, above, LeFebvre does not disclose a “housing.”

60. LeFebvre does not teach or suggest “at least one temperature sensor device having: a housing,” as required by independent claim 2. It follows that

LeFebvre also does not teach or suggest (1) “electrical circuitry,” (2) a “power source,” or (3) a “communication device” “positioned within said housing” as required by independent claim 2. A POSITA reading the ’223 Patent would understand that the term “housing” refers to an enclosure within which electronic components may be disposed. See Ex. 1001 at Figs. 1, 2, 3, 3A. FIGS. 1 and 2 (reproduced below), show that circuitry 26 (including main board 28 having communications circuitry) and power source 34 are clearly positioned within an enclosing housing 14.



61. Housing 14 includes a lid section 16 and base 18 which together enclose sensors.

62. The Petition seizes on the phrase “embedded into” of LeFebvre:

FIG. 3 shows, in schematic form, an adapter pad 16 modified to carry out the objectives of the present invention. The pad contains a plurality of sensors 5 which are preferably embedded into its upper, side and lower surfaces or into other locations such as its end surfaces as may be necessary for the purposes of the invention as explained more fully below.

Ex. 1005, [0021]

63. Fig. 3 of Lefebvre is reproduced below.

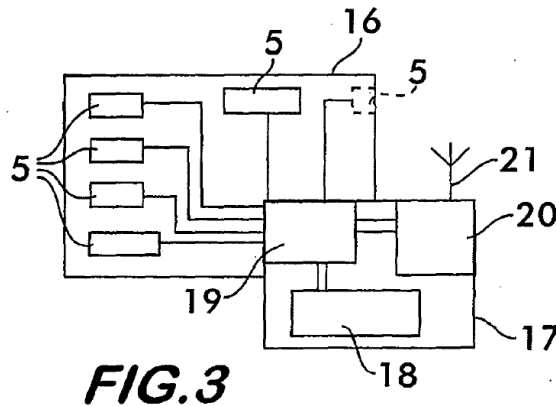
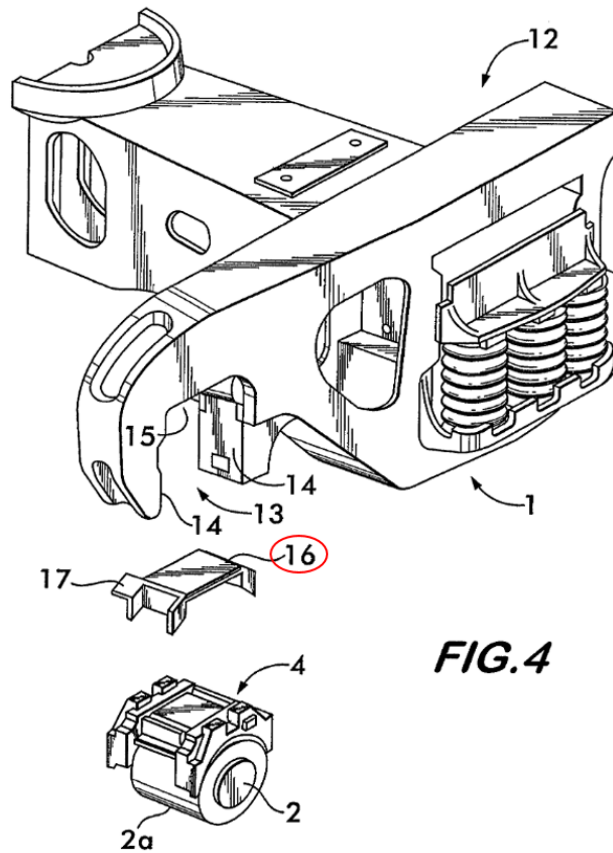


Fig. 3 simply shows sensors 5 embedded in a pad. There is no “housing.”

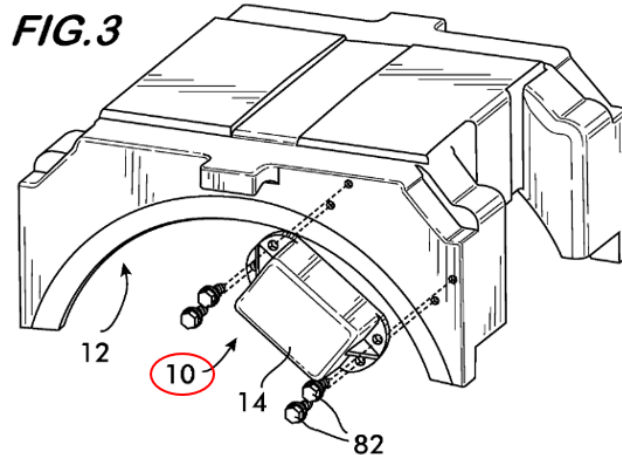
64. As shown in Fig. 4 of LeFebvre (reproduced below), a POSITA would recognize that instrumented pad 16 is not a “housing” as that term is used throughout the '223 Patent.



65. LeFebvre never refers to pad 16 as a “housing” or an “enclosure.” Indeed, it is neither. Rather, LeFebvre explains that more details concerning the adapter pad 16 are described in U.S. Pat. Pub. 2005/0268813 to Van Aukun, Ex. 2006. Ex. 1005 at ¶19. Van Aukun (Ex. 2006), as with LeFebvre, never refers to any of its adapter pad embodiments as a “housing” or “enclosure.” It discloses three planar-shaped adapter pad embodiments 32, 232, and 332. Ex. 2003, Figs. 8-12. A POSITA would recognize that each of the Van Aukun adapter pad embodiments, just like the LeFebvre adapter pad embodiment, are merely flat pads that are required to be installed in a load-bearing position in direct contact with a

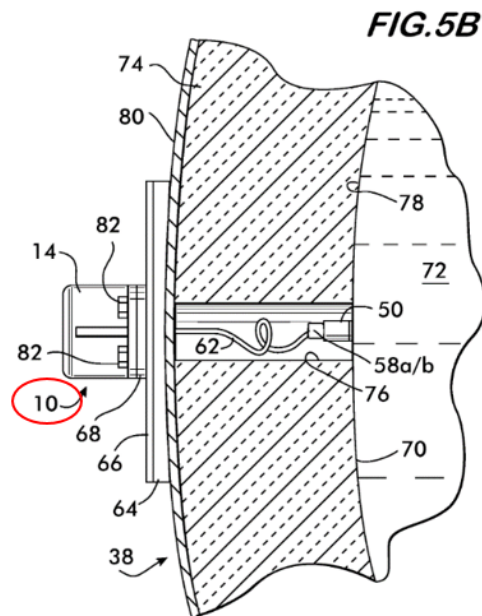
corresponding shaped planar surface of a “bearing adapter.” Ex. 2008 at ¶6. A POSITA, who is assumed to be familiar with LeFebvre and Van Auken, would see that each adapter pad necessarily requires the pad to be placed in a specific orientation on a correspondingly shaped “bearing adapter” to function properly. *Id.* at ¶6, 10. A POSITA would also know that the term “pad” is a term of art having a specific meaning for a load-bearing component of a railcar directly between a bearing adapter and the frame, i.e., in the exact position shown in LeFebvre Fig. 4.

66. The “pad” of LeFebvre, which must be mounted in a horizontal, load-bearing position, differs greatly from the mountable “housing” of the ’223 Patent which allows the sensor to be mounted anywhere on a railcar and does not require specially-dimensioned bearing adapters. In a preferred embodiment, sensor mote 10 of the ’223 Patent may be mounted vertically on a sidewall of a bearing adapter rather than in a horizontal load-bearing position. See Ex. 1001, fig. 3 (reproduced below).



In the figure, mote 10, being upside-down, is clearly not in a load-bearing position. This installation is not possible with the sensor pad disclosed in LeFebvre.

67. In another preferred embodiment, the housing of the '223 Patent (mote 10) may be mounted vertically on a sidewall of a liquid holding tank. See Ex. 1001, fig. 5B (reproduced below). This installation is also not possible with the sensor pad disclosed in LeFebvre.



68. A POSITA familiar with the teachings of the '223 Patent that distinguish the invention over the prior pad embodiment of LeFebvre and Van Aucken, would understand that the “housing” recited in independent claim 2 is structurally distinct from the “pad” of the LeFebvre reference. Therefore, it is my opinion that a POSITA would not find that independent claim 2 obvious over the LeFebvre. It is also my opinion that a POSITA would not find claims 3, 4 and 26-30, which depend from independent claim 2, as obvious over LeFebvre.

b. LeFebvre does not disclose electrical circuitry within said housing

69. Because LeFebvre does not teach or suggest a “housing,” it also does not teach or suggest “electrical circuitry positioned within said housing,” as required by independent claim 2. When addressing this limitation, the Petition at 23 alleges that “[t]he instrumented pad 16 comprises electrical circuitry, specifically: ‘a power source 18, an analog/signal conditioning means . . . and a communications unit 20’,” citing LeFebvre at [0021]. Petitioner’s reading of LeFebvre is incomplete and incorrect. What LeFebvre actually discloses at [0021] is that the extended portion 17 contains these components, not pad 16: “[t]he extended portion 17 contains a power source 18, an analog/signal conditioning means and analog to digital conversion means and an associated microprocessor unit 19 and a communications unit 20 which is preferably a low power radio transmitter/receiver having an antenna 21.”

70. Petitioner does not explain how or why the extended portion 17 and adapter 16, which are not a housing at all, can form the single housing required by independent claim 2. Further, LeFebvre teaches away from combining components 16 and 17 to form a unitary single component: “[i]n preferred form, the pad 16 has an extended attachment portion 17 located so as to be relatively isolated from the forces transmitted through the adapter 16.” Ex. 1005 at [0021]. See also LeFebvre Fig. 3, which clearly delineates the boundaries of extended portion 17 and adapter pad 16, showing them to be different components.

71. Because LeFebvre does not disclose a “housing,” it also does not teach or suggest a “power source positioned within said housing,” as required by independent claim 2. For the same reason, LeFebvre does not teach or suggest a “communication device positioned within said housing,” as required by independent claim 2. In addressing this element, the Petition again ignores the distinction between extended portion 17 and adapter pad 16. Petition at 23-25, relying on Fig. 3 of LeFebvre (see above). In Fig. 3, components 16 and 17 are separated by a boundary. Therefore, components 18 (power source) and 20 (communications unit) are not within the same housing, as required by independent claim 2. Furthermore, fig. 3 clearly shows the antenna 21 outside of the boundary of extended portion 17. Therefore, LeFebvre does not disclose a “communication

device capable of broadcasting information . . . via wireless communication . . .

positioned within said housing,” as required by independent claim 2.

72. Because a POSITA would understand that adapter pad 16 and extended portion 17 are separate components that do not collectively form a single housing. A POSITA would understand that the required “power source” and “communication device” are not “within said housing,” as required by claim 2. Each of claims 3, 4 and 26-30 depend from independent claim 2 and are therefore not obvious over LeFebvre.

2. Claims 5-10, 18, 20, 21, 31, and 32 - LeFebvre does not disclose heuristics or statistical analysis

73. As discussed in connection with claim construction, above, LeFebvre does not teach or suggest “a communication management unit [that] applies heuristics to analyze data collected from said one or more sensor units (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.” A POSITA would understand that this limitation (“unit”) requires a single device, i.e., the communication management unit, to perform each of the two different types of analysis recited separately in the claim. The first analysis applies heuristics “to determine if an actual failure exists” and the second analysis applies heuristics for predictive purposes “based on a statistical analysis” of the data collected by the sensor. One aspect of this limitation is the determination of existing failures, i.e., “determine if an actual

failure exists.” The other aspect of this limitation is the application of statistical analysis for predicting failures which have not yet occurred but may potentially develop in the future.

74. The '223 Patent explains: “The CMU is capable of wirelessly collecting data from each of the motes and performing higher-level analysis of the data to detect imminent or actual failures. During such data analysis, heuristics may be applied to determine potential failures **based on statistical models and empirical data.**” '223 Patent, 2:57-62.

75. Petitioner does not address the fact that both “heuristics” and “statistical analysis” are used in the claim and relies on the same disclosure in LeFebvre at [0058]-[0066] for both of these elements, which are distinct. See, e.g., Petition, at 28, stating “The data control unit then uses ‘inference engine techniques’ (i.e., heuristics) to analyze the collected data” then asserting that “[t]he ‘inference engine’ techniques used by the data control unit include, for example, statistical analysis of the collected data”. A “heuristic” does not necessarily require “statistical analysis” and “statistical analysis” does not necessarily involve “heuristics.” Petitioner merely relies on disclosures in LeFebvre of “inference” and an “inference engine.” Neither the term “heuristic” nor the term “statistical” appears in LeFebvre. Inference may be performed without either heuristics or statistical analysis. For example, if a temperate sensor indicates that the

temperature of an axle is at or above the axle's melting point, one may infer that the axle will fail. No heuristic or statistical analysis is needed.

76. The claim requires both “heuristics” and “statistical analysis.” LeFebvre does not teach or suggest using “statistical analysis” to form predictions, and Petitioner fails to identify any such teaching or suggestion. Pet. at 28, 31 (limitation 5(j) not identifying or explaining what “statistical analysis” is applied in LeFebvre [0058]-[0066] to form predictions).

77. The Petition states: “LeFebvre discloses the use of heuristics, based upon data collected from one or more sensor units, to predict potential or imminent failures based upon a statistical analysis of the collected data,” relying on LeFebvre at [0058]-[0066]. However, LeFebvre merely refers to inferences, not both of heuristics and statistical analysis.

78. Petitioner relies entirely upon the disclosure in LeFebvre at [0058] to show supposed “statistical analysis” of the collected sensor data as required by limitation 5(j). However, at most, LeFebvre merely teaches the use of collected data to infer that a condition exists, e.g., the inference engine discussed at [0036] of LeFebvre. A POSITA would recognize that LeFebvre merely describes certain types of conditions that are directly measured and certain types of inferences that may be made based on the directly measured conditions. LeFebvre introduces the scope and purpose of the disclosure in [0058-0066] by explaining that “Examples

of performance that the system is capable of monitoring include ...” Next, LeFebvre explains that a “temperature sensor in instrumented pad 16 monitors relative changes in temperature against other bearings and provides an alarm threshold or long term trends to link to bearing condition. The well-being of a roller bearing can be inferred using either trends or alarm levels, avoiding a potential bearing burn off and possible derailment and providing a direct measurement that can be used to avoid false alarms from wayside hotbox detectors.” LeFebvre, [0058]. This is not a statistical analysis, and a POSITA would understand that this disclosure merely uses a direct measurement to draw an inference of a condition of the roller bearing, which is entirely different from performing “statistical analysis.” Similarly, using “long term trends” of a directly measured condition is not the same as performing “statistical analysis,” even if it could be considered a “heuristic.”

79. Although LeFebvre discloses a “Frequency Spectrum Analysis,” a POSITA would understand that this type of analysis does not refer to a statistical analysis. See LeFebvre, [0059]. Frequency domain analysis techniques merely transform time waveform data into discrete frequency components, e.g., by computing a fast Fourier transform (FFT). A purpose of such an analysis is to detect regular oscillations that may grow in magnitude. One may analyze a load sensor by transforming a time series of amplitude data into a spectral analysis of

frequencies. This type of analysis is not statistical in nature and is therefore entirely different from performing a “statistical analysis.”

80. LeFebvre is silent regarding how a “potential or imminent failure” may be predicted based on first acquiring a measured condition by a sensor as “collected data” and then performing a statistical analysis of the “collected data” to form a prediction. That is, LeFebvre simply does not perform any statistical analysis to form “predictions” and can solely measure actual conditions to form immediate inferences from those measurements. See Ex. 1005 ¶ 58-66.

81. Petitioner relies exclusively on LeFebvre’s power management disclosures when discussing limitations 5(g) and 8(b). Petition at 34. It is my opinion that a POSITA would not understand LeFebvre’s power management features to disclose “collecting data from said sensor at periodic intervals” as recited in limitations 5(g) and 8(b). It appears that, when the inventors of the ’223 patent wanted to claim power management, they did so explicitly as in claim 1 and limitation 1(g). Limitation 1(g) recites:

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 circuitry

Limitations 5(g) and 8(b), in contrast, recite “software performing the functions of collecting data from said sensor at periodic intervals.” The specification also

expressly distinguishes between the two functions. For example, the power management feature, i.e., limitation 1(g), is explicitly described in the specification:

Daughter board 30 includes power conditioning and management circuitry and may include a feature to conserve battery life which keeps mote 10 in a standby state and periodically wakes mote 10 to deliver readings from sensor 20.

Yet, algorithms (i.e., software as recited in limitations 5(g) and 8(b)) are separately discussed:

The Level 2 algorithms use temperature data that had been collected every minute while the railcar had been moving during a period of days directly preceding this analysis.

It is my opinion that a POSITA reviewing the specification and the claim language would understand and recognize the distinction between these two functions and would not look to implement “software performing the functions of collecting data ... at period intervals” with power management techniques. A POSITA would not confuse the two functions the way Petitioner and its expert appear to have.

82. Therefore, it is my opinion that a POSITA would not find independent claim 5 obvious over LeFebvre. Consequently, it is also my opinion that a POSITA would not find claims 6-10, 18, 20, 21, 31, and 32, which depend from independent claim 5, obvious over LeFebvre.

3. Claims 23 and 25 – LeFebvre does not disclose a housing mountable on a railcar

83. As discussed above in connection with claim 2, LeFebvre does not disclose a housing. *See ¶¶59-72, supra*. It is my opinion that a POSITA would not find that LeFebvre teaches or suggests “a housing mountable on a railcar” as required by independent claim 23. Likewise, it is also my opinion that a POSITA would not find that LeFebvre discloses, teaches, or suggests (i) “electrical circuitry,” (ii) a “power source,” and (iii) a “communication device” that are “positioned within said housing,” as required by independent claim 23.

84. Therefore, it is my opinion that a POSITA would not find that independent claim 23 is obvious over LeFebvre. Consequently, it is also my opinion that a POSITA would not find claim 25, which depends from independent claim 23, obvious.

4. A POSITA would not have been motivated to modify LeFebvre - Instrumented pad 16 is not a housing

85. Ground 1 is a single reference obviousness ground. Neither Petitioner nor its expert provide any explanation for how or why a POSITA would modify LeFebvre to arrive at the invention claimed in the Challenged Claims. As explained extensively above, instrumented pad 16 is not a housing, LeFebvre does not refer to it as a housing, and a POSITA would understand it to be structurally different from a housing. Furthermore, a POSITA would understand that the

instrumented pad 16 serves a different purpose and function from that of a housing, e.g., instrumented pad 16 is not an enclosure for protecting electrical components, as is the housing of the '223 Patent. Fig. 4 of LeFebvre shows pad 16 as a thin planar component and a POSITA would understand that a significant vertical load could bear down upon pad 16. See, e.g., Lefebvre [0017] stating that “[t]he axle bearings 2a and bearing adapters 4, best shown in fig. 4, are configured so that each bearing transmits the load which it carries and heat that it may generate through pads 16 and to the truck.” Petitioner simply provides no evidence to support any conclusion that a POSITA would find it obvious to modify LeFebvre to arrive at the invention claimed in claims 2–10, 18, 20, 21, 23, and 25–32.

86. Because there is nothing cited by Petitioner in the LeFebvre reference that suggests that it would be advantageous to position the pad 16 elsewhere on the railcar, or modify to enclose electrical components, it is my opinion that a POSITA would not be motivated to modify the flexible instrumented adapter pads to arrive at the invention claimed in the Challenged Claims.

B. Ground 2: Petitioner has failed to show a reasonable likelihood that Claims 13–17, 22, and 24 are obvious over LeFebvre in view of Barone

1. Claims 13-17 and 22

87. As explained above, Petitioner has not shown that independent claim 5 would have been obvious over LeFebvre in connection with Ground 1. Barone

does not cure any of the above-mentioned deficiencies of LeFebvre. The Petition does not rely on Barone as a basis for any limitation of independent claim 5 at all. Petition at 30-31. Specifically, Barone fails to teach or suggest “a communication management unit [that] applies heuristics to analyze data collected from said one or more sensor units (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,” as required by independent claim 5.

88. Therefore, it is my opinion that a POSITA would not find that independent 5 is obvious over the combination of LeFebvre and Barone. It is also my opinion that a POSITA would not find that each of claims 13-17 and 22, which depend from independent claim 5, are obvious.

2. Claim 24

89. Claim 24 depends from claim 23, which requires “a housing mountable on a railcar.” As shown in connection with Ground 1, LeFebvre does not disclose a housing, and Petitioner has failed to show that LeFebvre teaches or suggests “a housing mountable on a railcar.” For the same reason, Petitioner has failed to show that LeFebvre teaches or suggests (i) “electrical circuitry,” (ii) a “power source,” and (iii) a “communication device” that are “positioned within said housing,” as required by independent claim 23. The Petition does not rely on Barone for disclosing these limitations. See Petition at 50-51. Because it is my

opinion that a POSITA would not find that independent claim 23 is obvious over LeFebvre and Barone, so it is also my opinion that a POSITA would not find that dependent claim 24 is obvious.

C. Ground 3: Petitioner has failed to show a reasonable likelihood that Claims 1 and 24 are obvious over LeFebvre in view of Denny and Provasnik

90. Claim 1 recites “a housing mountable on a railcar,” as does independent claim 23, from which claim 24 depends. As explained in Ground 1, LeFebvre does not disclose a housing. Petitioner has failed to show that LeFebvre teaches or suggests “a housing mountable on a railcar.” Likewise, Petitioner has failed to show that LeFebvre teaches or suggests (i) “electrical circuitry,” (ii) a “power source,” and (iii) a “communication device” that are “positioned within said housing” as required by independent claims 1 and 23. The Petition does not rely on Denny or Provasnik for disclosing these limitations. See Petition at 38, 53. Therefore, Petitioner has not shown that Denny or Provasnik cure these deficiencies of LeFebvre. It is my opinion that a POSITA would not find that independent claims 1 and 23 are obvious over LeFebvre, Denny, and Provasnik. Because claim 24 depends from independent claim 23, it is also my opinion that a POSITA would not find claim 24 is obvious.

D. Ground 4: Petitioner has failed to show a reasonable likelihood that Claims 2, 3, and 26–28 are obvious over Armitage

1. Armitage is not prior art to claims 2, 3, 27, and 28

91. As explained above beginning at ¶¶34-41, Armitage is not prior art to claims 2, 3, 27, and 28 and therefore cannot properly be applied to those claims. Because a POSITA would recognize that claims 2, 3, 27, and 28 have an earlier effective filing date than the earliest priority date to which Petitioner has established that Armitage is entitled, it is my opinion that a POSITA would not find that independent claim 2 and dependent claims 3, 27, and 28 are obvious over Armitage.

2. Armitage does not teach or suggest claim 26

92. Limitations 26(b) and 26(c) are identical to limitations 5(i) and 5(j). As I showed beginning at ¶¶77-80, Armitage does not disclose, teach, or suggest limitations 26(b) and 26(c). Therefore, it is my opinion that a POSITA would not find that claim 26 is obvious in view of Armitage.

E. Ground 5: Petitioner has failed to show a reasonable likelihood that Claims 4-10, 13-18, 20-23, 25, and 29-32 are obvious over Armitage in view of LeFebvre

1. Claims 4, 29, and 30

93. As explained above, Petitioner has not shown that independent claim 2 is obvious over either Lefebvre or Armitage separately. Combining these references does not cure the deficiencies of either of them. Each of claims 4, 29, and 30 depend from independent claim 2 and consequently Petitioner has not shown that they are obvious.

2. Claims 5-10, 13-18, and 20-22

a. **Armitage requires continuous monitoring of sensor data and there is no motivation to combine with LeFebvre**

94. Petitioner fails to explain how or why Armitage and LeFebvre would be combined to teach or suggest “software performing the functions of collecting data from said sensor at periodic intervals,” as required by independent claim 5. Specifically, the Petition contains no explanation for why a POSITA would implement the alleged “power-saving scheme” as disclosed in LeFebvre into the sensor device of Armitage in view of Armitage’s disclosure that its sensors are continuously sending data reports to a data control unit which “continuously analyzes the datastream from the sensors” and enable “continuous monitoring of all critical railway car components.” Armitage at [0044].

95. There is no indication in Armitage that power-saving would even be a desired feature. In any case, it is clear from the disclosures of Armitage and LeFebvre that a POSITA would not be motivated to combine them. For example, LeFebvre discloses that its power feature “is programmed to switch on briefly” but would normally be “in a low powered state most of the time.” LeFebvre at [0034]-[0035]. Mr. Ricca acknowledges that this would be the result of implementing LeFebvre’s power feature. Ex. 1003 at ¶349. A POSITA would not look to make this modification to Armitage because “continuous monitoring of all critical railway components” is a vital feature of Armitage’s monitoring system. Armitage

at [0044]. A POSITA would read this disclosure of Armitage and recognize that sensors 121-124 operate in the conventional manner by continuously performing sensing while the railcar is in motion. For example, Armitage can only analyze sensor data by performing a comparative analysis of one sensor's data to a pool of available sensor data to identify outliers. Armitage [0030], [0042]. Armitage explains, "[w]hen one or more of the sensor nodes begin to deviate from the others in the population, then a failure condition could be determined." Armitage [0030]. Therefore, a POSITA would recognize that Armitage's system is only capable of performing this comparative analysis while all of the sensors are on, i.e., "continuous monitoring" of data from a population of sensors to find outliers. Armitage [0030], [0042]. Forcing the sensor pad to be "in a low powered state most of the time" would frustrate Armitage's continuous monitoring by disrupting the running average calculated from a population of sensors.

96. Further, a POSITA would not expect to successfully combine Armitage and LeFebvre because the dynamic continuous monitoring disclosed in Armitage is incompatible with the power-saving feature of LeFebvre. For example, Armitage utilizes "a dynamic threshold of failure" that is determined using data from a population of sensors. Armitage at [0041]-[0044]. This "dynamic normalization" requires constant and continuous data streams from the respective sensors to properly function. Armitage [0043] (stating that "sensor network on

each railway car is employed to dynamically define norms of operation for each of the critical mechanical components.”). To accommodate LeFebvre’s low power feature, a POSITA would have to navigate the complexities of how to perform the dynamic normalization and comparative analysis of Armitage using sensors that are turned off most of the time. Petitioner fails to explain how that should be done and neither LeFebvre nor Armitage provides any disclosure that would do so. Thus, a POSITA would not be motivated to combine LeFebvre and Armitage together.

b. Armitage does not teach using statistical analysis techniques for predictive purposes

97. Armitage and LeFebvre fail to teach or suggest “wherein said communication management unit applies heuristics to analyze data collected from said one or more sensor units (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,” as required by independent claim 5. Petitioner does not apply LeFebvre against any of limitations 5(j) or 5(k). Petitioner relies only on Armitage. Petition at 75. Petitioner never shows that both heuristic and statistical techniques are taught in the combination.

98. The Petition alleges that Armitage’s control node 130 corresponds to the claimed “communication management unit” and applies heuristics by relying on the same analysis presented with respect to dependent claim 3. See Petition at

64-66 and page 75. However, the Petition does not point to any disclosure of a “prediction.” The Petition simply alleges that the “control node collects this data and analyzes it to determine whether a fault condition is present.” Id. at 64.

99. However, determining whether a fault condition is **currently** present is not the same thing as making a **future** prediction that is “based on a statistical analysis of said collected data.” The limitations in 5(j) and 5(k) require that heuristics be used in two different ways.

100. The first requirement is to “determine if an actual failure exists.” Limitation 5(j). The second requirement is “to predict potential or imminent failures based on a statistical analysis of said collected data.” Limitation 5(k). All that Petitioner has done is show that the combination discloses a system capable of detecting whether a fault condition event currently exists and whether maintenance is immediately required or may be put off until later. See Petition, 58.

101. Armitage [0044] merely discloses establishing a ranking for events based on their severity, e.g., “yellow” or “red” depending on how much a sensor reading deviates from normal. This is not a statistical analysis of the data collected from a specific sensor or even a pool of individual sensors. Rather it is merely a comparative analysis using basic arithmetic, e.g., “if the sensor reading is between 15 and 25, signal condition yellow; if the sensor reads above 25, signal red.”

102. Armitage may only determine a fault condition by scanning for outliers, e.g., by comparing single sensor data against a corresponding pool of sensor data from a plurality of sensors to find outliers. Armitage [0042]. Armitage only determines “failure alerts” of a presently detected fault condition by performing a comparative analysis of sensor information from one sensor node against the corresponding sensor information from a plurality of sensor nodes. For example, “When one or more of the sensor nodes begin to deviate from the others in the population, then a failure condition could be determined.” Armitage [0030]. This is not statistical analysis.

103. Armitage [0041] refers to FIG. 4, which merely contemplates performing a comparative analysis of sensor 325 against the other sensors 320, 322, 327, 326, etc. Armitage explains that “the population of all of sensor nodes 320-327 is taken into account to determine a dynamic threshold of failure.” Id. Next, Armitage explains that a failure condition may be determined by a standard deviation metric, e.g., “when data from a sensor node deviates by more than three standard deviations, among other examples.” Id. Both of these analysis techniques require a pool of sensor data and would not work with data from a single sensor. Armitage may determine “failure alerts” of a presently detected fault condition by performing a comparative analysis of sensor information from one sensor node against the corresponding sensor information from a plurality of sensor nodes.

104. A POSITA would understand that the process taught by Armitage is merely comparative in nature and can only establish a fault condition based on how much a single sensor deviates from the other sensors on the railcar. Furthermore, the system of Armitage requires a plurality of sensors to determine outliers. This is not the same thing as applying a heuristic, i.e., one or more rules, to “predict potential or imminent failures based on a statistical analysis of said collected data,” as required by independent claim 5. Armitage merely performs a comparative analysis that determines a current failure has occurred when a single sensor data is outside of a threshold level (in this case three standard deviations from the average). Furthermore, this type of analysis does not “predict potential or imminent failures,” as explained in more detail below.

c. **Armitage does not teach using statistical analysis techniques for future predictions**

105. When addressing limitation 5(k) Petitioner fails to point to any disclosure in Armitage of a “prediction.” Petition at 64-66, 75. Furthermore, nothing in Petitioner’s prior analysis addresses the claim requirement of “predict[ing] potential or imminent failures based on a statistical analysis of said collected data.” Indeed, the words “predict” are never used by Petitioner. Therefore, for this reason alone, Petitioner has failed to show that claim 5 is obvious over Armitage and LeFebvre.

106. The closest semblance of an argument related to “predictions” is made by Petitioner with reference to Armitage [0044]. See Petition 66. Here, Petitioner alleges that “Armitage’s system . . . distinguishes between potential failures (which warrant maintenance) and actual failures (which require immediate service). Id. For example, when discussing “potential failures” Petitioner merely cites to Armitage [0044]. However, in this example Armitage merely assigns a status to the “event” indicating whether maintenance is currently required or may optionally be performed later. Armitage explains that “yellow” indicates maintenance may optionally be performed later and “red” indicates maintenance must be performed immediately. Armitage [0044].

107. Thus, it is my opinion that a POSITA would not find that independent claim 5 is obvious over Armitage and LeFebvre. It is also my opinion that a POSITA would not find that claims 6-10, 13-18, and 20-22, which depend from independent claim 5 obvious.

3. Claims 23 and 25

108. Armitage is not prior art to independent claim 23 because claim 23 is entitled to the benefit of the earliest claimed priority date.

109. Further, Armitage does not teach or suggest (i) “electrical circuitry,” (ii) a “power source,” and (iii) a “communication device” that are “positioned within said housing” as required by independent claim 23. As explained above,

LeFebvre also does not teach or suggest “a housing,” nor does LeFebvre teach or suggest “a housing mountable on a railcar.” Accordingly, LeFebvre fails to cure the deficiencies of Armitage. Furthermore, this ground of the Petition only relies on LeFebvre for limitation 23(f). See Petition at 72.

110. Petitioner has failed to show that Claim 23 is obvious in view of Armitage and LeFebvre. Claim 25 depends from independent claim 23 and consequently Petitioner cannot show that claim 23 is obvious.

F. Ground 6: Petitioner has failed to show a reasonable likelihood that Claims 1 and 24 are obvious over Armitage in view of LeFebvre, Denny, and Provasnik

111. I have already explained why a POSITA would not be motivated to combine Armitage and LeFebvre in reference to claims 5 and 8. *See* ¶¶94-96, *supra*. To address the requirements of this limitation 1(g), the Petition relies purely on earlier analysis performed with respect to limitation 8(b) found in sections X.A.7.b (Petition at 34) and X.E.3.b (Petition at 71). See Petition at page 86. Each of these sections relies exclusively on LeFebvre. A POSITA would not be motivated to modify Armitage according to the teachings of LeFebvre to reach the subject matter of limitation 1(g) because Armitage’s dynamic continuous monitoring features, critical for Armitage’s system to function properly, would be frustrated by LeFebvre’s power management scheme which requires that “the

sensor node to be in a low powered state most of the time” according to

Petitioner’s own expert. *See* Ex. 1003 at ¶349.

112. Notably, limitations 8(b) and 1(g) have different scopes. In particular, limitation 8(b) requires “said software performing the functions of collecting data from said sensor at periodic intervals.” This is not the same requirement as placing “said sensor device in a standby state,” as required by limitation 1(g). As I explained above, given the differences between the two functions in the specification and claims, a POSITA would not be confused by them the way Petitioner appears to be. *See* ¶81, *supra*.

113. Armitage discloses that the “sensor nodes 121-124 will sense and monitor the equipment while railway car 110 is in motion, such as when rolling.” Ex. 1006 [0021]. A POSITA would understand that Armitage teaches that the sensors 121-124 operate in a conventional manner by continuously performing sensing while the railcar is in motion. Armitage explicitly confirms this by stating that realtime, continuous monitoring of railway car components is performed. *Id.*, [0046]. Therefore, it is my opinion that a POSITA would understand that Armitage’s sensors are never placed in a standby state and/or periodically awakened to collect and transmit readings as required by independent claim 1. It is also my opinion that a POSITA would recognize that attempting to modify Armitage using LeFebvre’s power management scheme would inhibit the critical

realtime, continuous monitoring function of Armitage. A POSITA, then, would not be motivated to combine Armitage and LeFebvre in the manner Petitioner describes.

114. The deficiencies I discuss above are not cured by Denny or Provasnik. I first note that the Petition does not rely on Denny or Provasnik as disclosing limitation 1(g). In addition, Denny requires that the electronic circuit 50 always be active. Ex. 1008 at 7:14-19. Thus, the thermal warning device 10 is never placed in any standby state and periodically awakened to collect and transmit readings from the temperature sensor 16. Provasnik is silent regarding a “standby state”, and it appears that the sensor device is always in an active state when in use.

115. It is my opinion that a POSITA would not be motivated to modify Armitage based on the teachings of LeFebvre to reach the subject matter of limitation 1(g) because of the significant differences in their sensor analysis techniques, as described above. Therefore, it is also my opinion that a POSITA would not find that claims 1 and 24 are obvious over Armitage in view of LeFebvre, Denny, and Provasnik.

XI. CONCLUDING STATEMENT

116. Relying on my education, experience, skill, and training in the relevant field of art, and after reviewing the materials identified above, it is my opinion that Petitioner has not established that any of the Challenged Claims is invalid.

117. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination remotely within the United States during the time allotted for such cross-examination at a time and place agreed by counsel.

118. I reserve the right to supplement my opinions in the future to respond to any arguments that Petitioner raises and to take into account new information as it becomes available to me.

119. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed May 15, 2023 at Waco, Texas.


Michael I. Shamos

APPENDIX A

Limitation	Language	August 23, 2010 35 U.S.C. § 112(a) Support
Claim 2 Preamble	A system for monitoring a railcar, comprising:	Ex. 1014 at ¶1 (“The present invention relates to a device, system and method for monitoring the status of a railcar handbrake, and for providing an alert when the car is in motion while the handbrake is applied.”)
Limitation 2(a)	a plurality of sensor devices located on the railcar for monitoring parameters or conditions of the railcar, each of said sensor devices being separate from one another and including a sensor for monitoring one of said parameters or conditions of the railcar;	Ex. 1014 at ¶¶1, 8, 21, 22, 24-25, 27.
Limitation 2(b)	said plurality of sensor devices including at least one temperature sensor device having:	Ex. 1014 at ¶27. Ex. 1015 at FIG. 2 (showing plural pads 4); 3:27-31; 5:41-50 (“The exemplary instrumented pads 16 also carry temperature sensors to give an indication of the temperature of the associated bearing.”).
Limitation 2(c)	a housing;	Ex. 1014 at FIGS. 3-4 (showing housing 66 and various components disposed within it); ¶¶25 (“The preferred embodiment of the device 40 further includes a housing 66 supported on the load bearing

		member 42 for housing the various components within it, e.g., the electrical circuitry 62 and power source 64.”), 35.
Limitation 2(d)	a temperature sensor in thermal communication with an item of the railcar for which the temperature is being monitored, which item is external to said housing;	Ex. 1014 at ¶27. Ex. 1015 at 5:41-50 (“The exemplary instrumented pads 16 also carry temperature sensors to give an indication of the temperature of the associated bearing.”)
Limitation 2(e)	electrical circuitry in communication with said temperature sensor for obtaining information regarding the temperature being sensed, said electrical circuitry positioned within said housing;	Ex. 1014 at FIGS. 3-4 (showing housing 66 and electrical circuitry 62 positioned within it); ¶¶25 (“The preferred embodiment of the device 40 further includes a housing 66 supported on the load bearing member 42 for housing the various components within it, e.g., the electrical circuitry 62 and power source 64.”), 35.
Limitation 2(f)	a power source electrically connected to said electrical circuitry for providing power thereto, said power source positioned within said housing;	Ex. 1014 at FIGS. 3-4 (showing housing 66 and power source 64 positioned within it); ¶25 (“The preferred embodiment of the device 40 further includes a housing 66 supported on the load bearing member 42 for housing the various components within it, e.g., the electrical circuitry 62 and power source 64.”)
Limitation 2(g)	a communication device capable of broadcasting information regarding the temperature sensed via	Ex. 1014 at FIGS. 3-4 (showing housing 66 and wireless communication device 68 positioned within it); ¶¶27

	wireless communication, said communication device positioned within said housing; and	(“In one form, the means for communicating information related to the status of the handbrake from the monitoring device 40 to a remote receiver 78 includes a wireless communication device 68 mounted within the monitoring device 40 as part of the circuitry 62.”), 28-30.
Limitation 2(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.	Ex. 1014 ¶¶ 27-28, 29 (“The monitoring device 40 and CMU 70 as part of a system can carry out this method, the device 40 communicating the information about the handbrake 22 to the CMU 70 via wireless communication device 68, the CMU then forwarding this and/or other further processed information about the handbrake to the remote receiver 78 via the wireless communication device 68 a.”), 30-32.
Claim 3	The system of claim 2 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.	Ex. 1014 at ¶¶ 1, 8, 21, 22, 24-25, 27.
Claim 4	The system of claim 2 wherein each of said plurality of sensor devices is capable of exchanging data with other of said plurality	The ’713 Application, Ex. 1014 at ¶¶ 27 (“In one preferred embodiment, it can also communicate with, control

	of sensor devices and with said communication management unit.	and/or monitor other devices on the railcar 10.”), 28-32.
Claim 23	A monitoring device for monitoring temperature on a railcar, comprising:	<i>See</i> Claim 2 (Preamble), <i>supra</i> ; <i>see also</i> limitations 2(b) and 2(d), <i>supra</i> . (all incorporated here).
Limitation 23(a)	a housing mountable on a railcar;	<i>See</i> limitation 2(c), <i>supra</i> . (incorporated here).
Limitation 23(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;	<i>See</i> limitation 2(d), <i>supra</i> . (incorporated here).
Limitation 23(c)	electrical circuitry in communication with said temperature sensor for obtaining information regarding the temperature being sensed, said electrical circuitry positioned within said housing;	<i>See</i> limitation 2(e), <i>supra</i> . (incorporated here).
Limitation 23(d)	a power source electrically connected to said electrical circuitry for providing power thereto, said power source positioned within said housing; and	<i>See</i> limitation 2(f), <i>supra</i> . (incorporated here).
Limitation 23(e)	a communication device capable broadcasting information regarding the temperature sensed, said communication device	<i>See</i> limitation 2(g), <i>supra</i> . (incorporated here).

	positioned within said housing;	
Limitation 23(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 transmit the information regarding the temperature sensed via said communication circuitry.	Ex. 1014 at ¶¶36, 37 (“In operation, the monitoring device 40 can sample the strain gauge 60 intermittently to preserve power and increase battery life. For example, in one embodiment the monitoring device 40 powers up every 30 seconds to read the strain gauge 60.”)
Claim 27	The system of claim 2 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.	Ex. 1014 at ¶27. Ex. 1015 at 6:25-34 (““Likewise, if desired, detectors of factors such as ambient temperature and humidity (rain, snow and icing) can be built into the communication device 24 or the data control unit 23 in the distributed inference engine functions for use described below.”); 13:9-14; claim 33.
Claim 28	The system of claim 2 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.	The ’713 Application, Ex. 1014 at ¶8 (“Information regarding the status of the handbrake, including whether it is on or off, can be communicated, such as by wireless transmission, to a remote receiver away from the railcar such as the

		locomotive or a remote monitoring station.”), 9, 26-32
Claim 29	The system of claim 2 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.	<i>See</i> limitation 23(f), <i>supra</i> . (incorporated here).
Claim 30	The system of claim 2 wherein said communication management unit and said plurality of sensor devices form a wireless mesh network for said railcar.	The '713 Application, Ex. 1014 at ¶ 28 (“Wireless devices using a frequency-hopping spread spectrum (FHSS) method of transmitting radio signals and a Time Synchronized Mesh Protocol are preferred for security and ultra low power usage.”).