

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

Patent No. 10,137,915
Issue Date: November 27, 2018
Title: SYSTEM AND METHOD FOR DETECTING OPERATIONAL
ANOMALIES IN TRAIN CONSISTS AND RAILCARS

Inter Partes Review No. IPR2023-00540

**DECLARATION OF STEVEN RICCA
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 10,137,915**

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I, Steven Ricca, offer this declaration in support of the Petition for *Inter Partes* Review of U.S. Patent No. 10,137,915 (“the ’915 patent”). I am over the age of 18, competent to make this declaration, and have personal knowledge of the facts set forth below. If called to testify, I could and would testify honestly, under oath, to the matters set forth herein.

I. INTRODUCTION

1. I, Steven Ricca, offer this declaration in support of the Petition for *Inter Partes* Review of U.S. Patent No. 10,137,915 (“the ’915 Patent”). I am over the age of 18, competent to make this declaration, and have personal knowledge of the facts set forth below. If called to testify, I could and would testify honestly, under oath, to the matters set forth herein.

2. I am not an attorney, and I have not been asked to offer any legal opinions. I have been informed and understand the law to be applied for determining invalidity, which I explain in places below. I have applied the law told to me in developing my technical opinions in this Declaration.

II. BACKGROUND AND QUALIFICATIONS

A. Education and Work Experience

3. I have over 30 years of experience in electrical and systems engineering, including in the railroad industry specifically. I have direct experience within a variety of private companies and industries. I earned my B.S. and M.S. in Electrical Engineering from Ohio University in 1986 and 1988, respectively. My

curriculum vitae attached to this declaration as Exhibit 1004 contains a detailed description of my work history and education.

4. At Toledo Scale (1988-1990) I was the lead software engineer for a new railcar scale. Much of the work I did at Toledo Scale led to applications that were industry firsts. For example, I developed systems and software that measured weight. This included railcar weight, and within that sector some of the first in-motion weighers and automated tank car fillers. Often the wayside communication systems were located near the weighing equipment due to electrical runs, so understanding the wayside communication systems in combination with the weighing equipment was critical.

5. At IRD Mechanalysis (1990-1995) I developed systems that measured all parameters of rotating machinery. This included all types of sensors within systems that monitored and analyzed data in real-time with authority to shut down or signal the system for a shutdown. These systems often performed complex algorithms and comparisons on the data for shutdown analysis; as well as storing the compressed data for offloading to larger storage locations using a variety of communications methods.

6. At Dynalab, where I was senior electronic engineer from June 1997 to July 2002, I developed several test instruments used by the automotive industry to test automobile cable and harness assemblies prior to final assembly into the

vehicle. This work included designing and developing microprocessor-based relay boards, a DC-DC power supply, and understanding the upcoming trends in automotive wiring. The testing cable analyzers were programmable to check for the continuity of connections, splices and the presence of fuses and surge suppression devices.

7. A few jobs and several years later, I worked at Invensys (2004-2006) as a Senior Electrical Engineer. I was responsible for overseeing the automotive climate controls products division. One of my responsibilities was to design a high-volume microcontroller based automotive product family to replace the existing laser trimmed controls which had become difficult to manufacture. Also, our engineering group developed controls for the HVAC industry which would measure and communicate system health to outside entities for preventive maintenance programs.

8. Since my job at Invensys in 2006, I have continued to work in the electrical and systems engineering industry, leading up to my current job as Lead Electrical Engineer with Vertiv Holdings. My responsibilities include electrical coordination and oversight of multiple product development programs carried out in four design centers worldwide. I also have my own consulting/product development company, Ricca Engineering, LLC, that I have operated since around 2002. Some of my projects have included embedded firmware, analog and digital

hardware design, building prototypes, schematic circuit design, simulation and PCB layout, and motorized controls for museum exhibits among others.

9. I have held numerous other positions in my 30-plus years in the engineering field, as shown on my curriculum vitae. Not all have been discussed in detail in my declaration.

10. I have prepared numerous written documents over my career in the engineering field, including operating manuals, technical specifications, and internal research and development documents. With few exceptions, these documents have been kept confidential by the companies that own them, and have not been publicly disclosed or otherwise made available to competitors. For this reason, none of these documents are listed on my curriculum vitae (EX1004).

11. My background demonstrates an expertise and strong understanding of railroad monitoring systems, as well as communications networks used in these systems, such as wireless networks.

B. Engagement

12. I have been retained as an independent expert consultant by Hum Industrial Technology, Inc. (“Petitioner”) in connection with a petition for *inter partes* review of U.S. Patent No. 10,137,915 (EX1001) (the “Petition”).

13. Specifically, I was asked to investigate and opine on the technology claimed in, and the patentability or unpatentability of certain claims of the ’915

Patent. Specifically, I was asked to opine on the validity of Claims 1, 21-30, 36, and 37 (the “Challenged Claims”) of the ’915 Patent.

14. Although I am being compensated for my services in this matter at my standard consulting rate of \$375 per hour, my compensation is not contingent upon the opinions I render or the outcome of this proceeding. I have no financial interest in any of the parties, and I have no other interest in this proceeding.

15. This report is based on information currently available to me. I reserve the right to amend or supplement my analysis in this report and/or to respond to any additional submissions prepared by or on behalf of the Patent Owner. I also reserve the right to amend or supplement my opinions based on further discovery and information provided in the case.

16. I reserve the right to create any additional summaries, tutorials, demonstrations, charts, drawings, tables, and/or animations that may be appropriate to supplement and demonstrate my opinions as necessary.

17. All of the opinions stated in this report are based on my own personal knowledge and professional judgment.

III. MATERIALS CONSIDERED

18. I have considered the following list of materials in formulating my opinions in this matter:

Ex #	Exhibit Description
1001	U.S. Patent No. 10,137,915 (“the ’915 patent”)
1002	Prosecution History of the ’915 Patent
1005	U.S. Patent Publication No. 2007/0152107 A1 to LeFebvre et al. (“LeFebvre”)
1006	U.S. Patent Publication No. 2011/0282540 A1 to Armitage et al. (“Armitage”)
1007	U.S. Patent Publication No. 2007/0208841 A1 to Barone et al. (“Barone”)
1008	U.S. Patent No. 7,706,213 to Winfree et al. (“Winfree”)
1009	Bonnie Baker, <u>Filtering? Before or After?</u> , EDN (February 20, 2003), https://www.edn.com/filtering-before-or-after/
1010	Potting and Encapsulation, Master Bond Inc., https://www.masterbond.com/applications/potting-and-encapsulation
1011	Amsted Rail Company, Inc.’s Complaint filed against Hum Industrial Technology, Inc. (ECF No. 1) filed on April 18, 2022
1012	Waiver of the Service of Summons upon Hum Industrial Technology, Inc. (ECF No. 4) dated June 14, 2022
1013	<i>Intentionally Omitted</i> ¹
1014	<i>Intentionally Omitted</i>
1015	<i>Intentionally Omitted</i>
1016	Third Generation On-Board Monitoring and Control System Based on Controller Area Network Technology Dr. John Donelson III, et al.
1017	Defendants' Stipulation of Invalidity Contentions

¹ The Exhibits have been numbered to maintain consistency with the concurrently filed Petitions directed to U.S. Patent Nos. 9,365,223 B2 and 9,981,673 B2.

IV. OVERVIEW OF THE PATENT AT ISSUE

A. Specification and Claims

19. I have read and considered the '915 Patent, filed Dec. 24, 2013, as well as its prosecution history. EX1002. I have been told that the '915 Patent has a priority date of Dec. 24, 2013.

20. It is my understanding that the claims of the '915 Patent relate to a system for processing data in order to monitor the operation of railcars and trains. EX1001, Abstract. The claims disclose the processing of data at least three different levels within a wireless system. EX1001, 1:59-65, Fig. 1. The components in the wireless system can continuously collect data and communicate with each other in real-time, so to alert the user of issues promptly. EX1001, 1:13-17. Fig. 2 of the '915 Patent shows the structure of the disclosed wireless system.

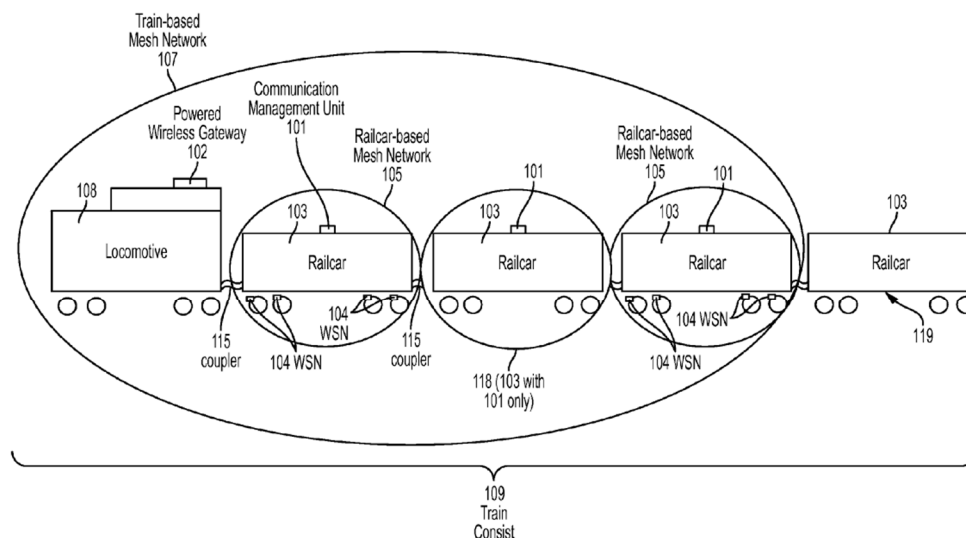


FIG. 2

21. Each railcar contains at least one wireless sensor, communication management unit (“CMU”), and a wireless network including a gateway. *Id.*, 1:66-2:4, Fig. 2. The CMU contains a processor, power source, global navigation system (i.e., GPS), and wireless communication capability—in other words, the CMU is a wireless processor. EX1001, 1:22-36. The system includes the sensors collecting the data, the sensors sending the data to the CMU(s), which further filters and processes the data to ultimately be sent to the gateway—all part of a wireless network. EX1001, 2:4-25.

22. All of the independent claims of the ’915 Patent require at least one sensor to collect data (i.e., accelerometer), CMU, and filter. EX1001, 17:48-22:37. All of these components are part of a wireless system and are located on the railcar or locomotive. EX1001, 2:4-25, 2:32-41, 4:4-32, Figs. 1-2. These components were all used in the prior art detection systems (i.e., wayside systems); the ’915 Patent simply arranges these components wirelessly on the railcar/train consist instead of at fixed points on the railroad network. EX1001, 1:21-28.

23. In Claim 1, the CMU has three functions. EX1001, 17:48-18:2. The first function of the CMU is to collect data regarding operational parameters of the railcar. EX1001, 17:63-64. The second function of the CMU is to analyze the collected data for a trend or event, and the final function of the CMU is to communicate a message to a remote receiver (i.e., gateway) regarding a detected

trend or event. EX1001, 17:65-18:2. Independent Claims 30 and 36 (also challenged in this Petition) contain the same or similar elements as Claim 1.

B. Prosecution History

24. I understand the '915 Patent, issued on November 27, 2018 from a provisional application filed on December 24, 2013. EX1002, p. 675. The '915 Patent claims priority to a provisional application dated December 24, 2013. EX1002, p. 31. The claims of the '915 Patent disclose a system to detect abnormalities on a train consist or railcar using sensors, CMUs, gateway, and a wireless network. EX1001, 1:66-2:4, Fig. 2. The CMUs perform the functions of collecting data, analyzing data, and communicating a message to a remote receiver (i.e., gateway) when an event is detected. EX1001, 2:4-25.

25. I understand during prosecution of the '915 Patent, Claims 1-30, 33-34, 46, 48-50, and 60-65 were rejected as anticipated by U.S Patent No. 7,668,218 (the "'218 Patent"). EX1002, p. 496-497. The Examiner found the '218 Patent disclosed all limitations in the independent claims. EX1002, p. 496-515. The Examiner also found the CMUs perform the functions of collecting data, analyzing data, and communicating the data—just like the '915 Patent. EX1002, p. 496-498. Additionally, the Examiner found the '218 Patent disclosed the use of one or more wireless sensors in order to collect the data. *Id.*

26. I understand that in response, Amsted first noted that the claims considered by the Examiner appear to be the originally filed claims and not the claims of the Preliminary Amendment which amended and canceled certain claims. EX1002, p. 527-528. Then, the claims were amended by Amsted to import a limitation requiring “one or more filters configured to a filter at least a portion of the accelerations.” EX1002, p. 531. In making these claim amendments, Amsted argued the ’218 Patent does not teach filtering of the accelerations data. EX1002, p. 528. Then, I understand the Examiner accepted Amsted’s filtering claim amendments over the ’218 Patent, without conducting additional prior art searches or further analysis of this well-known and obvious limitation taught by the prior art reference the Examiner based its initial rejection of claims. EX1002, pp. 546, 626, 649-651. As a result of this oversight, the claims of the ’915 Patent were allowed. EX1002, p. 675.

V. STATE OF THE ART

27. It is my opinion that Amsted did not invent railcar monitoring system, and they especially not invent the use of sensors, communication management units, filters, and wireless networks as claimed in the ’915 Patent. In fact, railcar monitoring systems using various levels of wireless components to detect operational anomalies were well-known in the art at the time the ’915 Patent was filed. *See generally* EX1005 (LeFebvre), EX1006 (Armitage), EX1007 (Barone).

The '915 Patent claims simply recite well-known processes and components to yield predictable results that have been employed for decades. *See generally* EX1005 (LeFebvre), EX1006 (Armitage), EX1007 (Barone). There is nothing novel about collecting data with sensors located on a railcar, analyzing and filtering the data, and sending messages through a communication architecture (for example, through a wireless network) to detect operational anomalies and inform the railcar operator of operational conditions of a railcar.

28. As far back as 1999, the Federal Railroad Administration's Office of Research and Development (FRA) sponsored the development of onboard monitoring systems for trains. EX1016, p. 1. In June 1999, the multi-year project commenced, with prototypes being tested as early as November 2000. EX1016, pp. 1-2. In 2003, an onboard monitoring system was developed that used the latest wireless communications and bearing monitoring technology. EX1016, p. 2. By the time Donelson was published (2007), a monitoring system called the "On-Board Monitoring and Control System" ("OBMCS") was under development. EX1016, p. 2. The OBMCS contained a modular architecture with a network of microcontrollers linked by a Controller Area Network ("CAN") bus. EX1016, p. 2.

29. The OBMCS architecture considered cost and power consumption in its development. EX1016, p. 2. The OBMCS contained sensors to monitor mechanical operations, which were mounted on railcars and linked together via a

wireless network (WLAN) to a computer in the locomotive. EX1016, p. 3. The computer in the locomotive displayed system status information and transmitted messages to actuators on the cars, which controlled and operated mechanical systems. EX1016, p. 3. Figure 1 of Donelson shows the architecture generally.

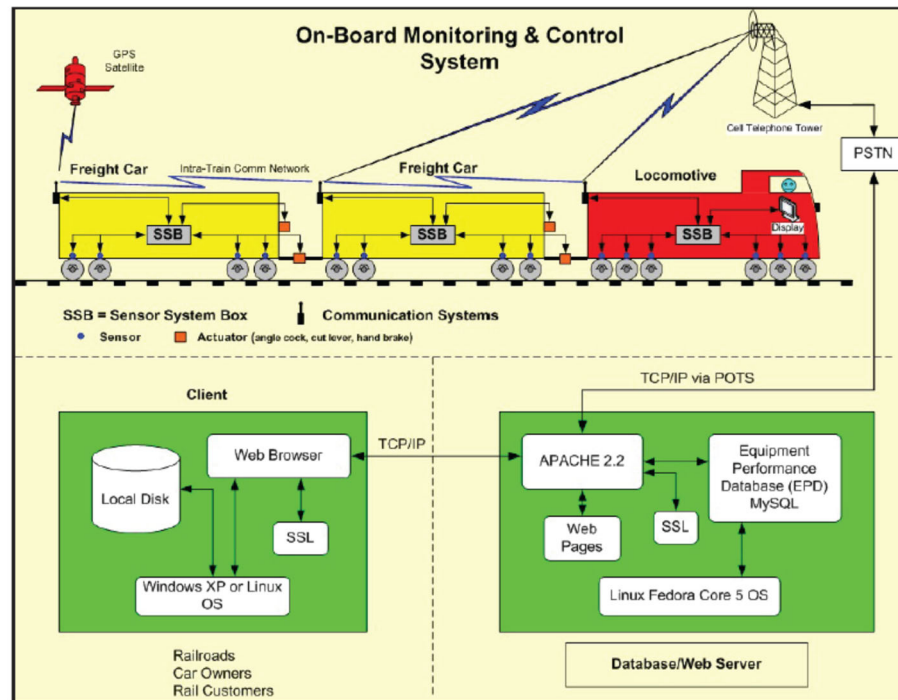


Figure 1: Top-level OBMCS architecture

30. OBMCS can use a number of wireless communications technologies, including Global System for Mobile communications (“GSM”), or a Code Division Multiple Access (“CDMA”) cell phone with 1X Radio Transmission Technology (“1XRTT”) in order to establish a two-way internet connection between the train and database server. EX1016, p. 3. Figure 2 of Donelson shows a diagram of sensors, communications systems, and power subsystem components installed on

the railcars. It also includes a list of mechanical systems that can be monitored remotely from the locomotive, including accelerometers. EX1016, pp. 3-4. These accelerometers generate data which is then analyzed with a digital signal processing algorithm. EX1016, p. 8.

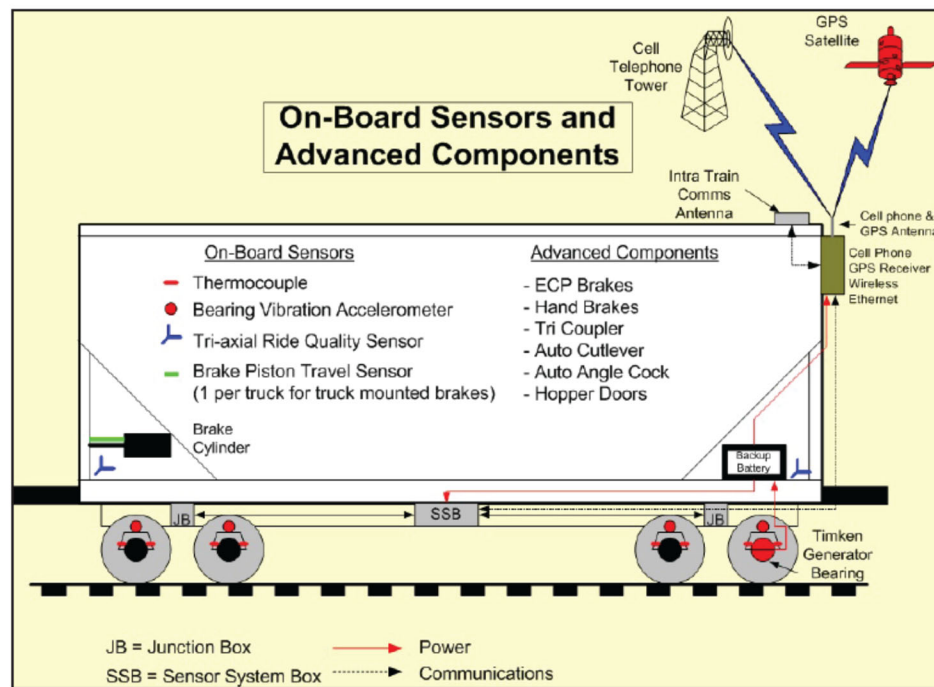


Figure 2: OBMCS sensors, actuators, and communication systems

31. OBMCS includes accelerometers for purposes of continuously monitoring derailment and intermittently monitoring bearing and wheel defects. EX1016, p. 4. It also includes tri-axial accelerometers for monitoring ride quality—including laterally, vertically, and longitudinally oriented sensors for detecting hunting, pitching, bouncing, and shock events. EX1016, p. 4.

32. OBMCS includes bearing temperature sensors embedded inboard and outboard on bearing adapters to continuously measure bearing temperature.

EX1016, p. 4. The temperature sensor data is sampled periodically (every 30 seconds), and analyzed to determine whether an alarm message should be sent to the locomotive. EX1016, p. 9.

33. OBMCS also has a Sensor System Box (“SSB”) which includes a single board embedded computer system that manages all communications between OBMCS and external systems (including the locomotive). EX1016, p. 4. The Accessory Interface Box (“AIB”) provides a standard physical connection scheme for interfacing sensors and actuators to the CAN bus. EX1016, p. 5.

34. Donelson discusses various communication systems for the OBMCS, including mesh networks. EX1016, p. 6. The system can also use GPS or cell phone telemetry. EX1016, p. 6. The locomotive computer in OBMCS utilizes software to exchange messages regarding the railcar status information and implement control functions. EX1016, p. 7.

35. OBMCS utilizes a number of algorithms and analog to digital circuitry in microcontrollers to analyze information in the form of sensor signals. EX1016, pp. 8-9. These signals are filtered using a low-pass filter and processed by algorithms and compared to other relational data to classify present situation and determine whether an alarm message needs to be sent. EX1016, p. 9.

36. Like the '915 Patent, the primary objective of the OBMCS disclosed in Donelson is to improve railroad safety and efficiency through new technologies and continuous monitoring to avoid breakdowns and accidents. EX1016, pp. 9-10. In 2007, on-board power, communication networks, and intelligent processing was available and well known. EX1016, p. 10. While cost, performance, and reliability were considerations for the OBMCS, none of these considerations rendered OBMCS impossible even as early as 2007 when Donelson was published. It is my opinion that Donelson accurately depicts the state of the art in 2007, proving the invention claimed in the '915 Patent was already widely known and accepted in the field *at least 6 years* before its filing.

37. As a further example, a prior art reference relied on in the Petition, Barone, also provides a detailed background of the invention and state of the art at the time of Barone in 2007. EX1007, (22), (65), (60). Barone discusses the issues with previous railcar monitoring systems and notes that at the time of Barone, no suitable systems existed for properly monitoring railcars in real time. EX1007, 1:50-55. Barone states that bearing failures of individual railcars are responsible for expensive and potentially disastrous derailments, hence the need for an improved onboard monitoring system for railcars. *Id.*

38. Barone explains that before onboard monitoring systems, wayside monitoring systems were routinely used to monitor railcar operation. EX1007,

1:56-64. In these wayside monitoring systems, sensors adjacent to the railroad track detect passing railroad cars and derive data (i.e., bearing temperature, vibration) that may indicate a problem with an individual railcar. *Id.* These “wayside stations” are typically located in switching yards, passenger points, or cargo loading/unloading points. For example, one such point could be where scales are located, such as when a train car is being loaded. As the train typically stops on the tracks for a few minutes, the scales are a natural place to offload data or observe an alarm existed for a particular axle on a car. Even before data was wirelessly transmitted using these wayside systems, it was common to have optical indicators for a rail car, wheel bearing, or axle that could be noticed by the loading or unloading crew. Wayside detection systems had a number of problems, including minimal time to detect and react to potential railcar problems and lack of real-time continuous monitoring. EX1007, 1:64-2:2. One potential improvement to wayside detection systems could be to increase the number (and thus decreasing the distance) between wayside monitoring systems, but Barone notes that this involves substantial cost associated with installation and maintenance of the trackside detectors. EX1007, 2:2-7.

39. Early onboard monitoring systems, while major improvements on wayside detection systems, were not without their problems. Earlier systems did not address certain factors relevant for feasible, practical, and economical

implementation—including requiring substantial amounts of electrical power.

EX1007, 2:8-25.

40. A large number of publicly available articles and publications cited in Barone, dating as far back as the mid-1990’s, disclose onboarding monitoring systems similar to what is claimed in the ’915 Patent. EX1007, ¶¶ [0014]–[0020]. Barone notes that, because wayside detection systems turned out to be cheaper and easier to implement in the real world, onboard monitoring systems were not widely utilized in the industry. EX1007, ¶ [0021]. But this changed in the mid-2000s, when the general progress of technology meant that electronic components—such as sensors, microprocessors, and wireless networking equipment—became cheap and widely available. By the time Barone was published in 2007, it recognized that “[o]nboard monitoring of fleets of railroad cars is more economically feasible due to the drastic decrease in the cost of modern sensors and electronics when mass produced.” EX1007, ¶ [0042].

41. For the aforementioned reasons, it is my opinion that Barone and Donelson prove the invention claimed in the ’915 Patent is not novel. The invention claimed in the ’915 Patent was well-known in the art as far back as the mid-1990’s. Regardless, Barone (and other prior art references relied on the Petition) addresses and claims any and all limitations with the previous onboard monitoring systems, such that nothing in the ’915 Patent is new.

VI. LEVEL OF ORDINARY SKILL IN THE ART

A. Legal Principles

42. I have been information that patents are considered from the perspective of a person having ordinary skill in the art, and that this is a hypothetical person who is presumed to know the relevant prior art.

43. I have been informed that the following five factors inform the analysis for determining the level of ordinary skill in the art: (1) type of problems encountered in the art; (2) prior art solutions to those problems; (3) rapidity with which innovations are made; (4) sophistication of the technology; and (5) educational level of active workers in the field. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). I apply these factors in the section below in providing my opinion as to the level of one having ordinary skill in the art.

B. Opinion as to the Level of a Person Having Ordinary Skill in the Art of the '915 Patent

44. I have knowledge relevant to what a person having ordinary skill in the art at the time of the invention would understand and do. In 2013, at the priority date of the '915 patent, I had 25 years of experience in this field and was a person having ordinary skill in the art.

45. In my opinion, and applying the factors set forth above in paragraph 43, a person of ordinary skill in the art at the time of the filing of the '915 Patent would be 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 railcar, train, vehicle, or any other similar monitoring systems. It is my opinion that less work experience could be compensated by a higher level of education, such as a master's degree, and vice versa.

VII. CLAIM CONSTRUCTION

A. Legal Principles

46. 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).

B. Opinion of Claim Construction

47. I believe that all claim terms, for the purposes of *inter partes* review can be given their plain and ordinary meaning.

48. The Board does not need to construe the claims and may give each and every term its plain and ordinary meaning because the claims are invalid under the plain and ordinary meaning.

VIII. SUMMARY OF THE PRIOR ART

A. Armitage

49. Armitage broadly discloses a mobile railway car monitoring system. EX1006, Abstract. More specifically, Armitage teaches a "railway car monitoring

system” including “sensor nodes” (wireless sensors), “control node” (CMU), and “communication network” (wireless communication network). EX1006, ¶ [0012]. The “control node” and “communication network” in Armitage communicate wirelessly. *Id.* Armitage discloses filtering of the data collected by the sensors (i.e., accelerometers). EX1006, ¶ [0045]. As shown in Fig. 1 of Armitage (below), all components of the system are located on the railcar and/or train consist. EX1006, Fig. 1. The Figure below further shows the similarities between the system in the railcar monitoring system claimed in ’915 Patent and the monitoring system claimed in Armitage.

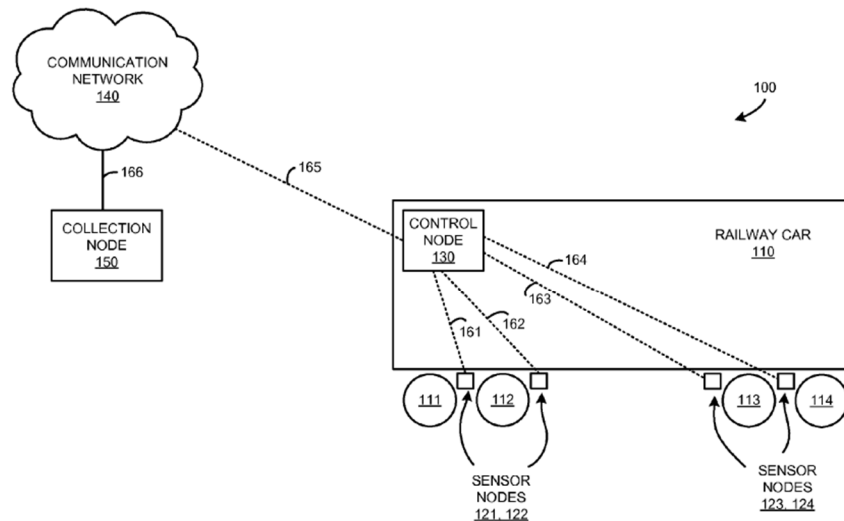


FIGURE 1

B. Barone

50. Barone broadly discloses a low power self-organizing network (wireless communication network) made up of a plurality of wireless communication nodes containing sensors and communicating wirelessly with each

other, similar to the '915 Patent. EX1007, ¶ [0029], Abstract. Barone also discloses sensors for collecting data for physical parameters of the railcar. EX1007, Abstract, ¶¶ [0024], [0029], [0033]-[0034]. When processing the data, the system in Barone utilizes a number of different algorithms known in the art to detect operational anomalies. EX1007, ¶¶ [0037]-[0041]. Barone explicitly teaches output of an “accelerometer 171” being transmitted to “signal conditioning 178”, where the analog signals are amplified and/or filtered. EX1007, ¶¶ [0114]-[0115], Fig. 8.

51. As shown in Fig. 1 below, all the components of the wireless system in Barone are located on the railcar and/or train consist.

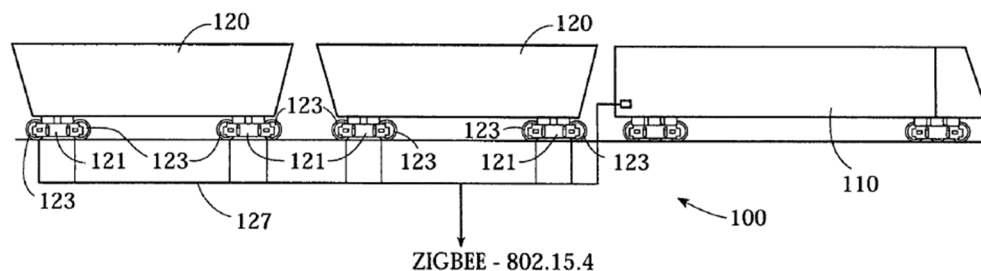


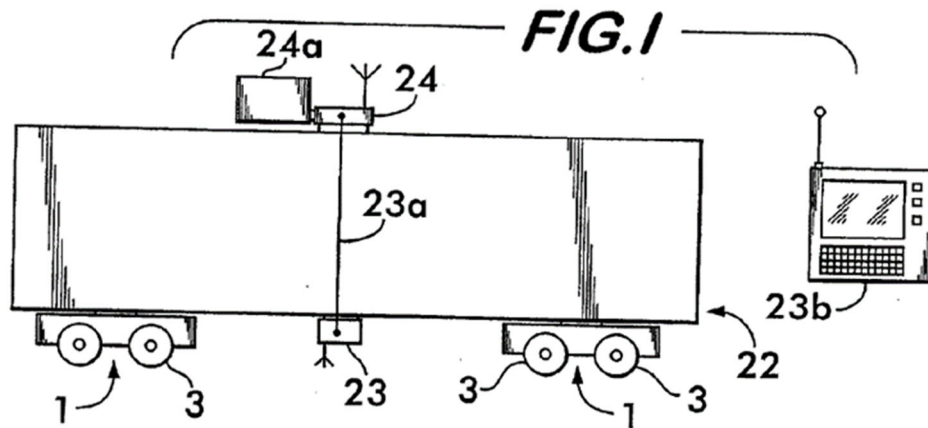
FIG. 1

C. LeFebvre

52. LeFebvre discloses railcar monitoring utilizing instrumented, flexible pads located on the railcar. EX1005, Abstract. LeFebvre teaches a wireless system of continuously monitoring the behavior and condition of trucks, wheels, and bearings of a railroad car. EX1005, ¶ [0006]. Specifically, LeFebvre has a number of sensors, a “data control unit”/“communications device” which can be

contiguous (i.e., a CMU) —all of which communicate together in order to link the railcar to the locomotive and notify the railcar engineer immediately of problem railcars. EX1005, ¶¶ [0024]-[0025], Fig. 1.

53. As shown below in Fig. 1, all of the components of the wireless system in LeFebvre are located on the railcar and/or train consist.



D. Winfree

54. Winfree broadly discloses a filter for mechanical waves entering a sensor. EX1008, Abstract. More specifically, Winfree teaches a “structure of one or multiple layers of material placed between a sensor and its environment.” EX1008, 2:24-29. Winfree further teaches enabling the isolation of a sensor from “incident frequencies” that are undesirable, and can be applied to a variety of sensors, including accelerometers. EX1008, 2:30-33, 2:42-45. Figure 1 of Winfree further shows the similarities between the mechanical filter claimed in '915 Patent (Fig. 4) and the mechanical filter claimed in Winfree.

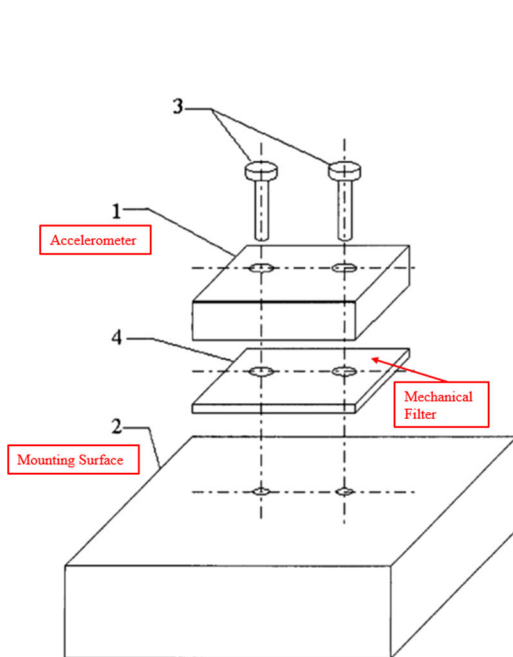


FIG. 1

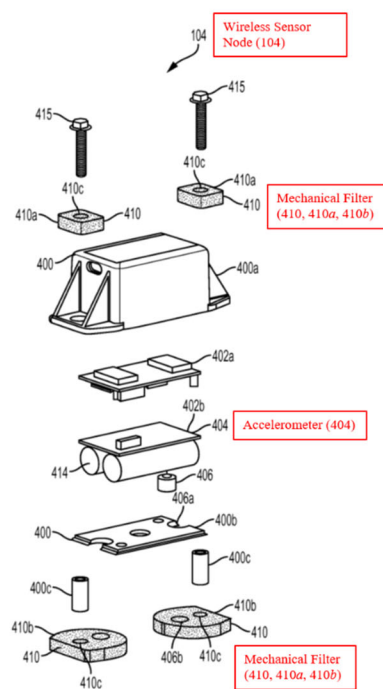


FIG. 4

IX. DISCRETION UNDER § 325(D)

55. It is my understanding that LeFebvre (EX1005) led to issued patent U.S. Patent No. 7,668,218 (the “’218 Patent”). It is my understanding that the ’218 Patent was relied on by the Office during prosecution of the ’915 Patent, however, it is my opinion that the grounds in the Petition do not present the same or substantially the same arguments considered by the Examiner. EX1002, pp. 496-518. Further, in my opinion, the Examiner materially erred in failing to apply the ’218 Patent to the limitations subsequently added to the independent claims when the ’218 Patent explicitly discloses the added filtering limitation. *See* Section X.E.2.d below, which is incorporated here by reference.

56. It is my understanding that during prosecution, the '218 Patent was relied upon by the Examiner as disclosing all limitations of the independent claims. EX1002, pp. 496-518. In response, I understand Amsted amended and canceled certain claims, adding a limitation requiring “one or more filters configured to filter at least a portion of the accelerations” into the independent claims. EX1002, p. 531. The Examiner merely accepted Amsted’s arguments and claim amendments incorporating the filtering limitation and erred materially by: (1) not applying the '218 Patent to the filtering limitation and (2) not considering further obviousness grounds or other prior art references in combination with the '218 Patent to address the filtering limitation. EX1002.

X. OPINION ON GROUNDS OF UNPATENTABILITY

A. Legal Principles of Obviousness

57. I have been told that under 35 U.S.C. § 103(a), “[a] patent may not be obtained though the invention is not identically disclosed or described as set forth in Section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.”

58. When considering the issues of obviousness, I have been told that I am to do the following:

- (a) determine the scope and content of the prior art;
- (b) ascertain the differences between the prior art and the claims at issue;
- (c) resolve the level of ordinary skill in the pertinent art; and
- (d) consider evidence of secondary indicia of non-obviousness (if available).

59. I have been told that the relevant time for considering whether a claim would have been obvious to a PHOSITA is the time of alleged invention.

60. I have been told that a reference may be modified or combined with other references or with the PHOSITA's own knowledge if the person would have found the modification or combination obvious. A PHOSITA is presumed to know all relevant prior art, and the obviousness analysis may consider the inferences and creative steps that a PHOSITA would employ.

61. In determining whether a prior-art reference could have been combined with another prior-art reference or other information known to a person having ordinary skill in the art, I have been told that the following principles may be considered:

- (a) a combination of familiar elements according to known methods is likely to be obvious if it yields predictable results;
- (b) the substitution of one known element for another is likely to be obvious if it yields predictable results;

- (c) the use of a known technique to improve similar items or methods in the same way is likely to be obvious if it yields predictable results;
- (d) the application of a known technique to a prior art reference that is ready for improvement is likely obvious if it yields predictable results;
- (e) any need or problem known in the field and addressed by the reference can provide a reason for combining the elements in the manner claimed;
- (f) a person of ordinary skill often will be able to fit the teachings of multiple references together like a puzzle; and
- (g) the proper analysis of obviousness requires a determination of whether a person of ordinary skill in the art would have a “reasonable expectation of success”—not “absolute predictability” of success—in achieving the claimed invention by combining prior art references.

62. I have been told that whether a prior art reference renders a patent claim unpatentable as obvious is determined from the perspective of a PHOSITA. Further, I have been told that while there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually, as filtered through the knowledge of one skilled in the art. I have also been told that the

inferences and creative steps a PHOSITA would employ are also relevant to the determination of obviousness.

63. I have been told that when a work is available in one field, design alternatives and other market forces can prompt variations of it, either in the same field or in another. If a PHOSITA can implement a predictable variation and would see the benefit of doing so, that variation is likely to be obvious. In many fields, there may be little discussion of obvious combinations, and in these fields market demand—not scientific literature—may drive design trends. When there is a design need or market pressure and there are a finite number of predictable solutions, a PHOSITA has good reason to pursue those known options.

64. I have been told that there is no rigid rule that a reference or combination of references must contain a “teaching, suggestion, or motivation” to combine references. But I also have been told that the “teaching, suggestion, or motivation” test can be a useful guide in establishing a rationale for combining elements of the prior art. This test poses the question whether there is an express or implied teaching, suggestion, or motivation to combine prior art elements in a way that yields the claimed invention and avoids impermissible hindsight analysis.

B. Ground 1: Claims 1, 22, 24-25, 27-30, 36, and 37 are unpatentable under 35 U.S.C. § 103(a) in view of Armitage and Barone

1. Obviousness in View of Armitage and Barone

65. In my opinion, Claims 1, 22, 24-25, 27-30, 36, and 37 would have been obvious to a PHOSITA in view of Armitage and Barone. This is because I believe that a PHOSITA, having knowledge of these two sources, would have found it obvious to combine the references to create the technology at issue in this case. Armitage and Barone are related to the same field of endeavor (i.e., a system to monitor railcars and train consists in order to predict and/or detect component failure) and describe a similar device with similar components. EX1006 (Armitage), Abstract; EX1007 (Barone), Abstract. Furthermore, Armitage and Barone both use sensors, CMUs, and a wireless network to solve the same problem, namely, to determine anomalous conditions of a railcar in real-time and wirelessly report the anomalous conditions to determine a fault conditions (e.g., degree of wear on wheel bearings of railroad cars). EX1006 (Armitage), Abstract, ¶¶ [0003], [0019], [0020], [0027], [0028], [0029], [0037], [0038], [0048], [0049]; EX1007 (Barone), Abstract, ¶¶ [0002], [0006]. In my opinion, Armitage and Barone are analogous art.

66. Armitage discloses filtering through sampling of data. EX1006 (Armitage), ¶ [0045]. In my opinion, a PHOSITA would understand the sampling in Armitage requires a filter. A PHOSITA would understand it is general

knowledge that filtering means excluding or amplifying certain ranges of data (or signals) within a data set—and would require an actual filter to achieve said filtering. To the extent Armitage does not explicitly disclose a filter, Barone shows filtering accelerations with an electronic or digital filter was well-known in the art and conventionally used in the field at the time of the invention. EX1007 (Barone), Fig. 8, ¶¶ [0114]-[0115], [0150], [0172]-[0185].

67. To the extent Armitage in view of the general knowledge possessed by a PHOSITA doesn't explicitly disclose a filter, Barone shows filtering accelerations with an electronic or digital filter was well-known in the art and conventionally used in the field at the time of the invention. EX1007, Fig. 8, 12:32-46, 15:48-51, 16:32-33. Barone explicitly discloses filtering data, and a PHOSITA would have been motivated to include the filter taught by Barone with Armitage because the advantage of filtering is to remove unwanted data and/or amplify particularly relevant data, and the purpose of both systems is to analyze data in a train monitoring system to accurately predict anomalous conditions and avoid false or inaccurate data processing. *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). It is my opinion that combining the sampling of data (i.e, filtering) in Armitage and the electronic and digital filtering taught in Barone would have predictably resulted in the filtering of accelerations data.

2. Independent Claim 1

a. Preamble/Limitation 1(a): “A system for detecting operational anomalies on a train consist or railcar comprising”

68. I have been informed by counsel that claim preambles are generally not limiting when the content of the claimed preamble is an “intended use.” I have been informed by counsel that preambles are generally statements of intended use when the body of a claim fully sets forth all the limitations of the claimed invention, and the preamble merely states the purpose or intended use of the invention. Here the preamble merely states a system for detecting operational anomalies on a train consist or railcar. In my opinion, this preamble is entirely a statement of use.

69. Regardless, Armitage teaches the entire preamble. Specifically, Armitage teaches a mobile railway car monitoring system which utilizes a plurality of sensor nodes coupled to an undercarriage portion of a railway car and a control node coupled to the railway car which receives information, determines a fault condition, and wirelessly reports the fault condition to a collection system. EX1006 (Armitage), Abstract, ¶¶ [0003], [0019], [0020], [0027], [0028], [0029], [0037], [0038], [0048], [0049].

70. Armitage teaches a “railway car monitoring system 100”, which includes a “railway car 110” and “sensor nodes 121-124” with a wireless

transceiver for communication with “control node 130.” EX1006 (Armitage), Figs. 1, 3, 5, ¶¶ [0012], [0014], [0020].

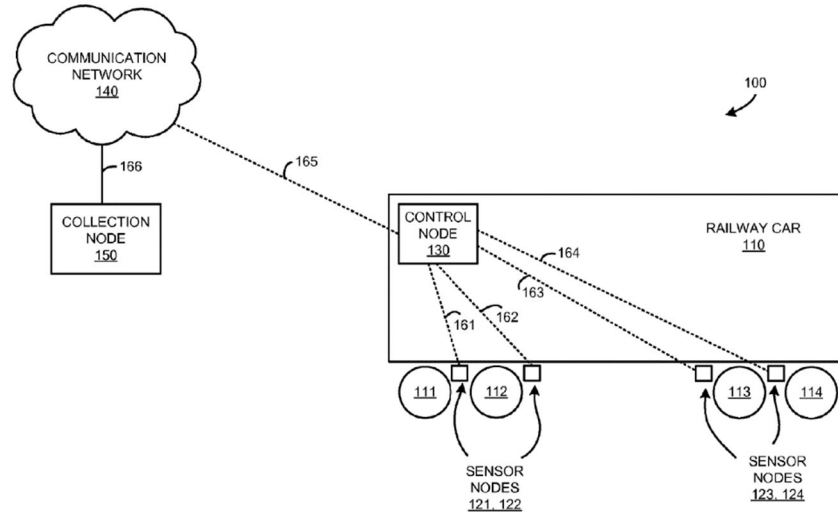


FIGURE 1

71. Therefore, it is my opinion that even though the preamble should not be given patentable weight, Armitage teaches the preamble.

b. Limitation 1(b): “one or more communication management units mounted on one or more railcars”

72. Armitage teaches one or more “control nodes 130” (i.e., communication management unit) coupled to one or more railway cars. EX1006, Figs. 1, 3, 5, ¶¶ [0004], [0012] (“FIG. 1 is a system diagram illustrating railway car monitoring system 100. System 100 includes railway car 110...control node 130”), [0014], [0017] (“**Control node 130 is attached or coupled to railway car 110.**”), [0020], [0026], [0036], [0038]. A PHOSITA would understand the “control node[s] 130” in Armitage are equivalent to “communication management units.” It is well-

known in the art that a “node” is another word for a “processor”—and the CMUs in the '915 Patent are processors. Further, it would be common practice to mount one or more communication units on one or more railcars in order to maximize the amount of processing power throughout the train consist.

c. Limitation 1(c): “one or more sensors located on said one or more railcars configured to sense an operational parameter of said one or more railcars, said sensors being in communication with said one or more communication management units, wherein the one or more sensors comprise one or more sensors configured to measure accelerations of the railcar”

73. Armitage teaches a plurality of “sensors nodes 121-124” located on one or more railway cars, which contains a “sensor portion” and is configured to sense operational parameters of one or more railcars. EX1006, Figs. 1, 3, 5, ¶¶ [0004], [0014]. Figure 1 of Armitage depicts an exemplary embodiment, with four sensor nodes 121–124 attached to a railcar 110. EX1006, ¶ [0012], Fig. 1.

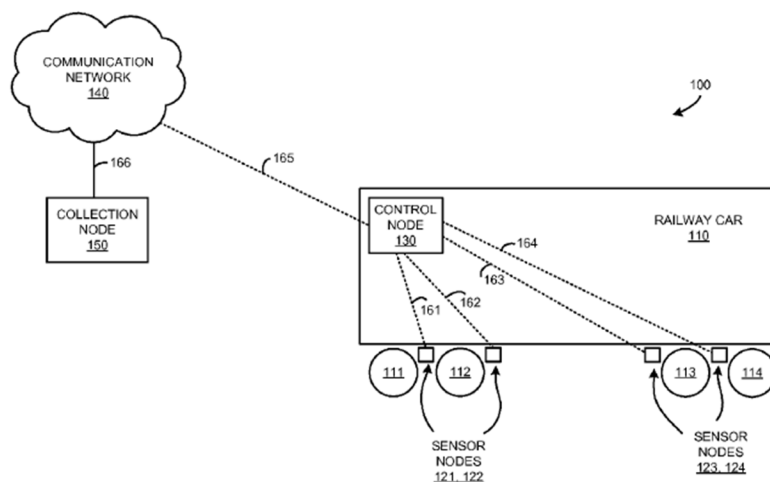


FIGURE 1

74. Armitage’s system also includes a “control node” on each railcar. EX1006, ¶¶ [0004], [0012], Figs. 1, 3, 5. The control node receives “sensor

information, or modified sensor information” collected by each of the sensor nodes on the same railcar. EX1006, ¶ [0027]. The sensor nodes and the control node communicate over a wireless network. EX1006, ¶¶ [0014], [0033], [0054]. For example, in the embodiment of Figure 1, control node 130 communicates with each of sensor nodes 121–124 via wireless links 161–164, respectively. The wireless links can utilize, for example, WiFi or Bluetooth, both of which provide two-way communications. EX1006, ¶ [0021]. The sensor portion of the “sensor nodes 121-124” in Armitage can be accelerometers for measuring accelerations. EX1006, [0014], [0033], [0045], [0046], [0056].

75. In my opinion, a PHOSITA would therefore understand that in Armitage’s system, the control node on each railcar receives data from one or more sensor nodes, said sensor nodes comprising one or more sensors configured to measure accelerations, located on the railcar.

d. Limitation 1(d): “one or more filters configured to filter at least a portion of the accelerations”

76. Armitage teaches samplings of the accelerometer data at the CMU level, which in my opinion, equates to the ’915 Patent’s filtering at least a portion of the accelerations. EX1006, ¶ [0045]. Specifically, Armitage teaches sampling accelerations for only a portion of a wheel rotation, and filters out radial accelerations. EX1006, ¶¶ [0045] (“...the sampling only occurs for a portion of a wheel rotation, **and radial acceleration or vibration (x-axis or y-axis) data**

could be ignored.”), [0046]. The filtering in Armitage is conducted while the control node (i.e., CMU) is processing the data collected by the sensors (i.e., accelerometers), which occurs in the “processing system” within the “control node.” EX1006, ¶¶ [0026]-[0027], [0045]. In my opinion, a PHOSITA would understand Armitage’s teachings of sampling data and ignoring radial accelerations equates to filtering at least a portion of accelerations.

77. Additionally, Armitage discloses filtering at the sensor level. Armitage’s “sensor 630” can include “amplifiers, analog-to-digital-converters, [and] microcontrollers.” EX1006, ¶ [0056]. In my opinion, a PHOSITA would understand Armitage’s teachings of amplifiers, analog-to-digital-converters, and microcontrollers in the sensor would mean the sensor is capable of filtering at least a portion of accelerations.

78. Filtering data was well-known in the art and a PHOSITA would have understood the Armitage system filters sensor data. A PHOSITA would have understood the meaning of filtering is excluding some portion of a data set, and it is desirable to include a filter in any data collection and processing system to get rid of unwanted data, and/or to identify and amplify particularly relevant data. In this field, filtering can be accomplished by choice of the sensor that has a specific range or resolution, through physical methods (i.e., mechanical filtering), electronic filtering, or digital filtering. Electronic filtering is a type of filtering

which utilizes electrical circuits to process signals (i.e., analog signals), and includes a number of different types of filters. Mechanical filtering is another type of signal processing filtering, that relies on physical parameters in order to remove unwanted high and low frequencies from a signal of interest. Digital filtering uses software to manipulate and filter data in order to decrease unwanted signals and increase signals from a particular area of interest.

79. All three types of filters (electronic, mechanical, digital) have been commonplace in the art for decades and would have been well-understood by a PHOSITA. *See, e.g.*, EX1009 (“There are times when you should build the filter with analog hardware and times when it is appropriate to implement it with a controller or processor in firmware.”). In summary, in any data collection analysis, data is almost always filtered in some manner, and the system can utilize the various types of filters alone or in combination to achieve the most effective filtering of data to achieve more accurate and/or targeted data analysis for detection of fault conditions. A PHOSITA would understand that Armitage’s teachings of sampling and ignoring certain data points equates to filtering data in the ’915 Patent.

80. To the extent Armitage does not explicitly require a “filter”, Barone shows that filtering acceleration data was well-known in the art and conventionally used in the field at the time of the invention. EX1007, Fig. 8, ¶¶ [0114]-[0115],

[0150], [0172]-[0185]. Specifically, Barone explicitly teaches output of an “accelerometer 171” being transmitted to “signal conditioning 178”, where the analog signals are amplified and/or filtered as appropriate (electronic filter), and then routed to analog to digital (A/D) converters for wide bandwidth calculations and data manipulations (digital filter). EX1007, ¶¶ [0114]-[0115], Fig. 8. The filtering in Barone occurs in the sensor. EX1007, ¶¶ [0114]-[0115], Fig. 8. A PHOSITA would have understood filtering of data can take place anywhere in the system—including in either the CMU or sensor. Further, a PHOSITA would understand various considerations impact where the filtering takes place in a data processing system. For example, Barone emphasizes the importance of a low power system, so a PHOSITA would understand power consumption can impact where filtering takes place. EX1007, Abstract, ¶¶ [0026], [0030], [0107], [0116], [0129].

81. Barone further teaches the use of a high-pass, low-pass, and/or band-pass filters, all of which can utilize both electronic and digital filters. EX1007, ¶¶ [0172]-[0185]. Barone explicitly discloses filtered data (both digital and electronic), which shows filtering accelerations was well-known in the art and it would have been obvious to a PHOSITA to remove unwanted data and/or amplify particularly relevant accelerations data. And as I have explained above, a

PHOSITA would have understood that various considerations (e.g., power consumption) impact where the filtering takes place in a data processing system.

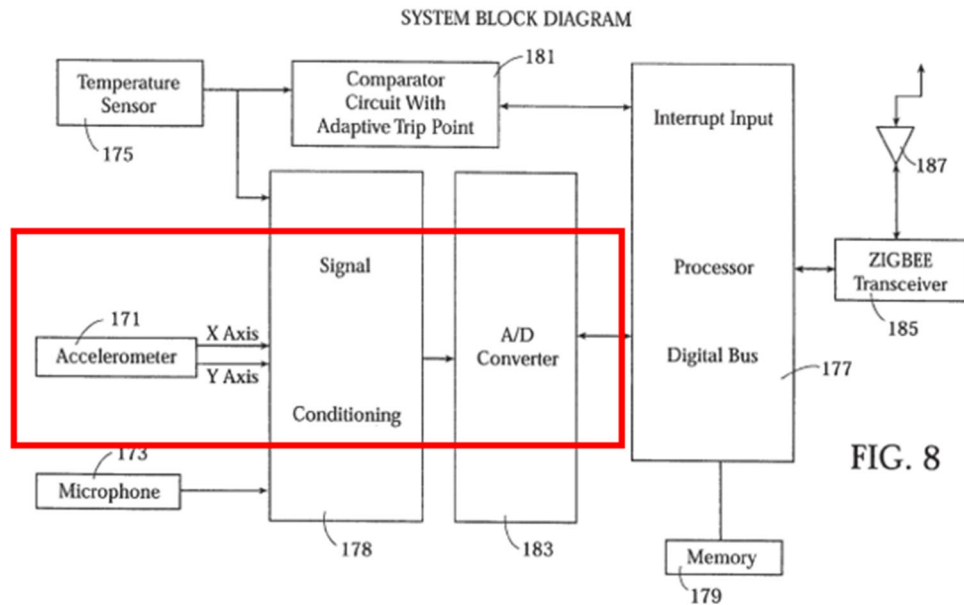


FIG. 8

82. It is my opinion that because Barone explicitly discloses filtering data, a PHOSITA would have been motivated to include the filtering taught by Barone with Armitage because the advantage of filtering is to remove unwanted data and/or amplify particularly relevant data, and the purpose of both the Armitage and Barone systems is to analyze data in a train monitoring system to accurately predict anomalous conditions and avoid false or inaccurate data processing. *KSR*, 550 U.S. at 416. Combining the sampling of data (i.e., filtering) in Armitage and the electronic and digital filtering taught in Barone would have predictably resulted in the filtering of accelerations data.

83. Therefore, it is my opinion that Armitage and Barone render this limitation obvious.

e. Limitation 1(e): “wherein said communication management units perform the functions of: (i) collecting data regarding said one or more railcar operational parameters”

84. Armitage teaches a “control node[s] 130” which collects data from a plurality of sensors on the railcar regarding one or more railcar operational parameters. EX1006, ¶¶ [0012], [0020].

85. Each sensor node in Armitage contains one or more sensors that collect data regarding the railcar, and wirelessly transmits the collected data to the “control node 130.” *See* Section X.B.2.c above, which is incorporated here by reference. The “control node 130” collects this data and analyzes it to determine whether a fault condition is present. Specifically:

The information received could include sensor information, or modified sensor information, from each of sensors 121-124 received over wireline or wireless links. **Control node 130 processes (204) the information to determine a fault condition for the undercarriage portion.**

EX1006, ¶ [0027]. If a fault condition is detected, the “control node 130” wirelessly reports it (i.e., sends an alarm message) to a collection system. EX1006, ¶ [0028].

f. Limitation 1(f): “(ii) analyzing said collected data for trends or events indicative of an anomalous operational condition”

86. Armitage teaches a “control node 130” (i.e., communication management unit or “CMU”), which can include “user interface systems, memory devices, computer-readable storage mediums, software, processing circuitry” for analyzing data. EX1006, ¶ [0016]. Armitage teaches the “control node[s] 130” analyzes the collected data for trends or events indicative of an anomalous operational condition. EX1006, ¶¶ [0016], [0040] (“Control node 330...could **analyze information or data from each of sensor nodes...**”).

87. The control node can also perform statistical analysis on the collected data to detect failure conditions, such that it is “drawing inferences” regarding the performance of the railcar. Armitage describes drawing inferences to determine both the presence and nature of a fault condition. For example, Armitage discloses that “[a] single wheel sensor anomaly might ... indicate a 'wheel out of round' or 'flat spot' condition, where a non-round geometry of a wheel can cause vibrations or shocks at a certain portion of each rotation of a wheel.” EX1006, ¶ [0042]. Conversely, “outliers for sensor nodes on an entire side of railway car 310 could indicate a cornering failure, or an off-track condition.” *Id.* A PHOSITA would understand that these are examples of “drawing inferences” from the data.

88. The control node can “process the sensor information to determine anomalies from an average, such as an anomaly from a running average of the

temperature of all wheels on railway car.” EX1006, ¶ [0029]. Armitage also discloses the use of a “moving average and trend analysis” to detect “statistically significant deviations” that are indicative of failure. EX1006, ¶ [0030]; *see also* EX1006, ¶ [0045] (describing “time series analysis” and statistical sampling of accelerometer data). Armitage indicates that its system can distinguish between potential failures (which warrant maintenance) and actual failures (which require immediate service). EX1006, ¶ [0044] (describing a “health scorecard” that distinguishes “yellow conditions” from “red conditions”).

g. Limitation 1(g): “(iii) communicating a message to a remote receiver when said trend or event is detected.”

89. Armitage discloses the control node on each railcar (i.e., communication management unit) wirelessly transmits information, such as sensor data and alarm messages, to a collection node (i.e., a base unit). EX1006, ¶¶ [0004], [0019]–[0020], [0038], Fig. 1. In Armitage’s system, if the control node detects a fault condition, it wirelessly reports the fault (i.e., sends an alarm message). EX1006, ¶ [0028]. See, for example, step 205 in Figure 2 of Armitage:

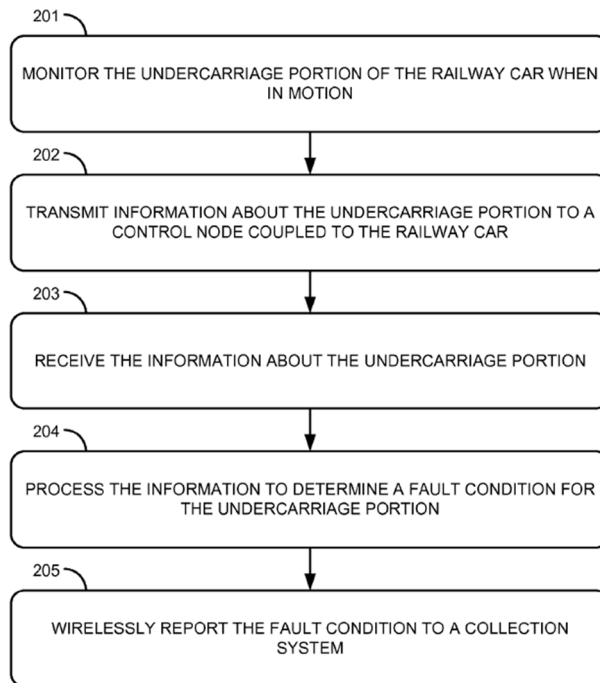


FIGURE 2

90. Armitage further discloses that the collection node can be in a remote location located off the train (i.e., remote). For example, the collection node can be “a rail-side or handheld device.” EX1006, ¶ [0039]. Alternatively, the collection node may comprise “application servers,” “web servers,” and other computing equipment. EX1006, ¶¶ [0019], [0039]. In my opinion, a PHOSITA would understand that “rail side” devices, “web servers,” and “application servers” would not be located on the train, and therefore, would serve as “remote receivers”.

3. Dependent Claim 22: “The system of claim 1, further comprising a powered wireless gateway configured to control a train-based network that

includes said powered wireless gateway and a plurality of said communication management units.”

91. Armitage discloses a “wireless communication network” and “communication network 140”, which further includes “include **base stations... gateways**, or other wireless communication systems, including combinations thereof.” EX1006, ¶¶ [0016], [0018]. Further, Armitage discloses the wireless communication occurring between the “control node[s] 130” (i.e., CMUs) and “base station” of the wireless network, through the use of equipment such as a cellular communication device, satellite, mobile phone, etc. *Id.*

4. Dependent Claim 24

a. Limitation 24(a): “The system of claim 1, further comprising one or more wireless sensor nodes in communication with at least one of the communication management units”

92. *See* Limitation 1(c), Section X.B.2.c above, which is incorporated here by reference.

93. Armitage teaches “control node[s] 130” in communication with the “sensors nodes 121-124.” EX1006, ¶¶ [0012], [0014], [0016], [0018], [0033].

b. Limitation 24(b): “wherein the one or more sensors form part of the one or more wireless sensor nodes”

94. Armitage teaches “sensors nodes 121-124” having a “sensor portion.” EX1006, ¶¶ [0014], [0033].

c. Limitation 24(c): “wherein one or more of the wireless sensor nodes comprise a protective housing”

95. Armitage teaches “sensor nodes 121-124...encased in a weatherproof or sealed enclosure” (i.e., housing). EX1006, ¶¶ [0015], [0034].

d. Limitation 24(d): “wherein the one or more sensors are mounted within the protective housing”

96. *See* Limitation 24(c), Section X.B.4.c above, which is incorporated here by reference.

e. Limitation 24(e): “wherein the protective housing comprises potting material configured to tune the wireless sensor nodes by absorbing at least a portion of undesirable accelerations.”

97. *See* Limitation 1(d), Section X.B.2.d above, which is incorporated here by reference.

98. Armitage teaches “sensor nodes” are encased in a “potted” enclosure. EX1006, ¶¶ [0015], [0034]. A PHOSITA would understand the “potted” enclosure in Armitage would equate to a housing comprising potting material to absorb undesirable accelerations.

99. Potting materials and thin layer conformal coatings are used to protect circuit board and electronic components—such as sensors. *See, e.g.*, EX1010. Potting has been used for decades to isolate components, keep wires from vibrating until they break, as well as provide environmental isolation. Potting material is frequently used in conjunction with mechanical and electrical filters to ensure the data is properly filtered and absorbs unwanted data. *Id.* Electrical filters benefit

from potting because it helps the circuits stay dry and clean to avoid corrosion. For mechanical filters, potting can help absorb physical signals so less “noise” gets to the sensor. In my experience, the majority of products containing electrical components (i.e., circuit boards) utilize potting materials for coating.

100. Therefore, it is my opinion that a PHOSITA would understand that a “potted enclosure” refers to potting material placed within a housing that encases sensors (i.e., accelerometers) to tune said sensors by absorbing undesirable accelerations, as it is the nature of potting material to protect components of an electrical or mechanical system by absorbing unwanted outside factors.

5. Dependent Claim 25:

a. Limitation 25(a): “The system of claim 1, further comprising one or more wireless sensor nodes in communication with at least one of the communication management units”

101. *See* Limitation 1(c), Section X.B.2.c above, and Limitation 24(a), Section X.B.4.a above, both of which are incorporated here by reference.

102. Armitage teaches “control node[s] 130” in communication with the “sensors nodes 121-124.” EX1006, ¶¶ [0012], [0014], [0016], [0018], [0033].

b. Limitation 25(b): “wherein the one or more sensors form part of the one or more wireless sensor nodes”

103. *See* Limitation 24(b), Section X.B.4.b above, which is incorporated here by reference.

104. Armitage teaches “sensors nodes 121-124” having a “sensor portion.”

EX1006, ¶¶ [0014], [0033].

c. Limitation 25(c): “wherein one or more of the wireless sensor nodes comprises a microprocessor configured to execute firmware to control operation of the one or more of the wireless sensor nodes”

105. In one embodiment, Armitage teaches the sensor nodes include “processing system 620” configured to execute “software 622” which can include “firmware” for the purpose of controlling the sensor nodes. sensor 630, and power system 640.” EX1006, ¶¶ [0053]-[0056], Fig. 6. Specifically, paragraph 55 of Armitage states:

Software 622 may include an operating system, logs, utilities, drivers, networking software, and other software typically loaded onto a computer system. *Software 622 could contain* an application program, *firmware*, or some other form of computer-readable processing instructions. When executed by processing system 620, *software 622 directs processing system 620 to operate as described herein*, such as monitor sensor 630, process the sensor information, and transfer sensor information or data.

EX1006, ¶ [0055]. A PHOSITA would understand that firmware’s purpose is to control hardware within a device (i.e., sensors). Therefore, Armitage discloses every element of this limitation.

d. Limitation 25(d): “wherein the firmware comprises one or more software filters configured to isolate one or more types of accelerations.”

106. See Limitation 1(d), Section X.B.2.d above, and Limitation 25(c), Section X.B.5.c above, both of which are incorporated here by reference.

107. As previously discussed, Armitage in combination with Barone discloses digital (i.e., software) filters for purposes of filtering or isolating data. *See* Limitation 1(d), Section X.B.2.d above, which is incorporated here by reference. Specifically, Barone’s disclosure of high, low, and band-pass filters means that certain ranges of data are *isolated* depending on what type of digital filtering is executed by the software. EX1007 (Barone), ¶¶ [0172]-[0185]. As previously discussed in Limitation 1(d), a PHOSITA would understand filtering can occur in various components within the system (i.e., CMUs or sensors).

108. It is my opinion that a PHOSITA would understand firmware is often considered to be more closely related to the hardware (or physical components) of a system (i.e., making a measurement or detecting a switch position), while software is the layer of programming evaluating rules and making complex decisions. One type of filtering firmware can execute is identifying and isolating certain types of data—in this case, accelerations data. In contrast, software is described as programing that acts on the data; in other words, software performs post data collection algorithms—which is different from the functions of firmware. Therefore, a PHOSITA would understand that firmware and software have different functions, and that a software filter would be required in combination with the firmware in order to execute the filtering of the accelerations data. Even further, a PHOSITA would understand a function of filtering data by a software

filter can be isolating or excluding certain types of accelerations data - based on programming that would be present in the software filter.

6. Dependent Claim 27: “The system of claim 1, wherein the one or more filters comprise one or more electronic filters.”

109. *See* Limitation 1(d), Section X.B.2.d above, and Limitation 25(d), Section X.B.5.d above, both of which are incorporated here by reference.

7. Dependent Claim 28: “The system of claim 1, wherein the one or more filters comprise one or more digital filters.”

110. *See* Limitation 1(d), Section X.B.2.d above; Limitation 25(d), Section X.B.5.d above; and Dependent Claim 27, Section X.B.6 above; each of which is incorporated here by reference.

8. Dependent Claim 29: “The system of claim 1 wherein said remote receiver is located off-train.”

111. *See* Limitation 1(g), Section X.B.2.g above, which is incorporated here by reference.

9. Independent Claim 30

a. Preamble/Limitation 30(a): “A method for detecting operational anomalies on a train consist or railcar comprising the steps of:”

112. *See* Limitation 1(a), Section X.B.2.a above, which is incorporated here by reference.

113. It is my opinion that Armitage teaches a method for detecting operational anomalies on a train consist or railcar.

b. Limitation 30(b): “sensing, by one or more sensors located on one or more railcars, one or more operational parameters of the one or more railcars, wherein the one or more operational parameters comprise one or more accelerations of the one or more railcars”

114. *See* Limitation 1(c), Section X.B.2.c above, which is incorporated here by reference.

c. Limitation 30(c): “filtering, by one or more filters, at least a portion of the accelerations; and”

115. *See* Limitation 1(d), Section X.B.2.d above, which is incorporated here by reference.

d. Limitation 30(d): “by one or more communication management units associated with the one or more railcars: collecting data regarding said one or more railcar operational parameters”

116. *See* Limitation 1(e), Section X.B.2.e above, which is incorporated here by reference.

e. Limitation 30(e): “analyzing said collected data for trends or events indicative of an anomalous operational condition; and”

117. *See* Limitation 1(f), Section X.B.2.f above, which is incorporated here by reference .

f. Limitation 30(f): “communicating a message to a remote receiver when said trend or event is detected.”

118. *See* Limitation 1(g), Section X.B.2.g above, which is incorporated here by reference.

10. Independent Claim 36

a. Preamble/Limitation 36(a): “A system for detecting operational anomalies on a railcar that is part of a train consist comprising:”

119. *See* Limitation 1(a), Section X.B.2.a above, which is incorporated here by reference.

b. Limitation 36(b): “(a) at least one communication management unit (CMU) mounted on the [a] railcar in said train consist”

120. *See* Limitation 1(b), Section X.B.2.b above, which is incorporated here by reference.

c. Limitation 36(c): “(b) at least two sensors located on the said railcar for configured to sense operational parameters of the railcar, said sensors being in communication with said communication management unit, wherein the one or more sensors comprise one or more sensors configured to measure accelerations of the railcar; and”

121. *See* Limitation 1(c), Section X.B.2.c above, which is incorporated here by reference.

d. Limitation 36(d): “(c) one or more filters configured to filter at least a portion of the accelerations”

122. *See* Limitation 1(d), Section X.B.2.d above, which is incorporated here by reference.

e. Limitation 36(e): “wherein said communication management unit performs the following functions: (i) receiving data from said sensors;”

123. *See* Limitation 1(e), Section X.B.2.e above, which is incorporated here by reference.

f. Limitation 36(f): “(ii) drawing inferences from the data received from at least two of the sensors regarding the performance of the railcar; and”

124. *See* Limitation 1(f), Section X.B.2.f above, which is incorporated here by reference.

g. Limitation 36(g): “(iii) communicating a message to a remote receiver when an anomaly is detected.”

125. *See* Limitation 1(g), Section X.B.2.g above, which is incorporated here by reference.

11. Dependent Claim 37

a. Limitation 37(a): “The system of claim 36,”

126. *See* Limitation 1(a), Section X.B.2.a above, which is incorporated here by reference.

b. Limitation 37(b): “wherein said sensors comprise accelerometers positioned at different locations of the railcar,”

127. *See* Limitation 1(c), Section X.B.2.c above, which is incorporated here by reference.

c. Limitation 37(c): “wherein said step of drawing inferences comprises the comparison of data from two or more of said accelerometers,”

128. *See* Limitation 1(f), Section X.B.2.f above, which is incorporated here by reference. For example, Armitage discloses *comparing* sensor data collected from multiple sensor nodes on the same side of a rail car to detect potential cornering failure or an off-track condition. EX1006, ¶ [0042].

d. Limitations 37(d)-(g): “wherein said accelerometers are positioned on the railcar to provide data for carrying out one or more of the following functions:”, “i) compare accelerations from one railcar wheel with that of another railcar wheel on the same axle but opposite side of the railcar,”, “ii) compare accelerations from one railcar wheel with that of at least one other wheel on the same side of said railcar, and”, “iii) compare accelerations from one railcar wheel with that of at least one other railcar wheel on the same side of said one railcar wheel and which other wheel is on another railcar of the same train consist.”

129. Armitage teaches a plurality of “sensors nodes 121-124” located on one or more railway cars, which contain a “sensor portion” and is configured to sense operational parameters of one or more railcars. EX1006, Figs. 1, 3, 5, ¶¶ [0004], [0014]. This limitation precedes the next three limitations (Limitations 37(e), (f), and (g)), and only requires one of the three limitations to be present to satisfy the claim. *See* EX1001, Claim 37 (...wherein said accelerometers are positioned on the railcar to provide data **for carrying out one or more of the following functions...**”).

(1) Limitations 37(e) and 37(f)

130. Armitage discloses both Limitations 37(e) and 37(f). Figure 3 of Armitage below shows the location on the railcar of various sensors (sensors 320-327).

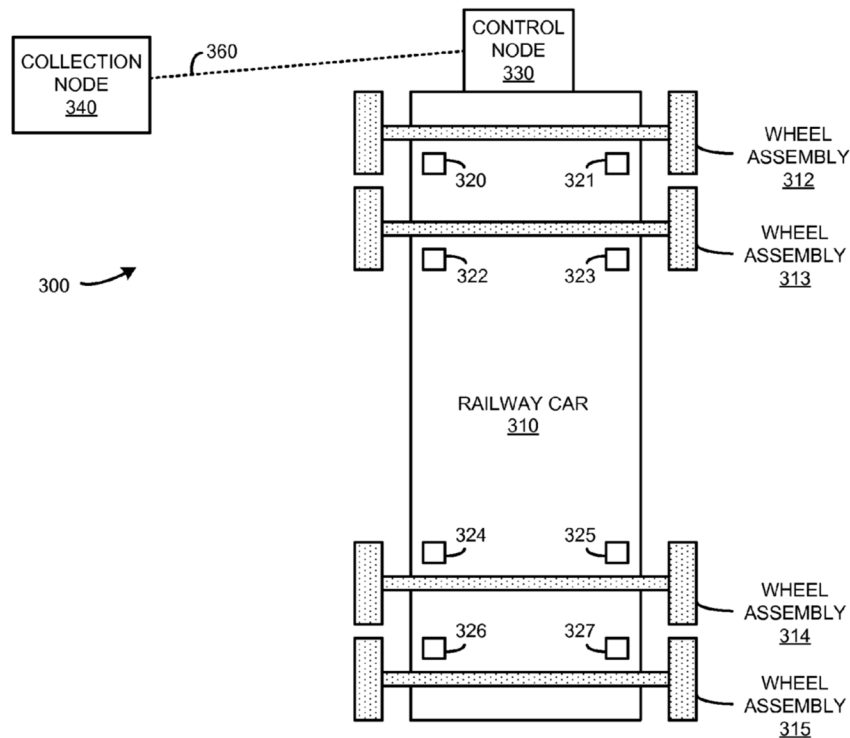


FIGURE 3

131. Paragraph 42 of Armitage states the following:

Failure alerts could be tailored to the number of sensor nodes 320-327 which become outliers, or based on the value of the monitored parameter if outside of expected norms. For example, when only one of sensor nodes 320-327 indicates outlier data as shown in FIG. 4, it could be determined that a wheel bearing or hotbox condition for a single wheel has occurred. A single wheel sensor anomaly might also indicate a ‘wheel out of round’ or ‘flat spot’ condition, where a non-round geometry of a wheel can cause vibrations or shocks at a certain portion of each rotation of a wheel. Taking sensor node 325 as an outlier in this example, then the right wheel of wheel assembly 314 could have a failure. **In examples where two outliers occur for the same wheel assembly, then a failure of the entire wheel assembly could be determined, such as when an axle is damaged or brake applied mistakenly. Likewise, outliers for sensor nodes on an entire side of railway car 310 could indicate a cornering failure, or an off-track condition.** Wheel assemblies can be referred to as ‘trucks’ in some examples, where two trucks are included on a railcar, each truck

including four wheels on two axles. **If four sensors, all on the same truck, deviate from the other four sensors on a railcar, a truck bearing failure condition could be determined.** Other failure modes could be determined based on outlier data determined by any of sensor nodes 320-327.

EX1006, ¶ [0042]. Armitage teaches, “where two outliers occur for the same wheel assembly, then a failure of the entire wheel assembly could be determined...”

EX1006, ¶ [0042]. A PHOSITA would understand, based on the disclosure in Armitage, that comparing data to determine outliers for the same wheel assembly would equate to comparing accelerations from one railcar wheel with that of another railcar wheel on the same axle but opposite side of the railcar.

132. Further, Armitage teaches “outliers for sensor nodes on an entire side of railway car 310 could indicate a cornering failure, or an off-track condition.”

EX1006, ¶ [0042]. A PHOSITA would understand, based on the disclosure in Armitage, that comparing data to determine outliers on the same side of a railway car would equate to comparing accelerations from one railcar wheel with that of at least one other wheel on the same side of said railcar. Therefore, Armitage discloses all elements of Limitations 37(e) and 37(f), and renders the entirety of Claim 37 obvious.

(2) Limitation 37(g)

133. Armitage also teaches the “[c]ontrol node 130 could process the sensor information to determine anomalies from an average, such as an anomaly

from a running average of the temperature of all wheels on railway car 110”, and further, notes that a “dynamic threshold” could be determined as conditions (i.e., accelerations) change across a railcar. EX1006, ¶ [0029]. First, a PHOSITA would understand this running average analysis across all wheels on a railcar could be for acceleration measurements (not just temperature), and could also incorporate sensor data from railcar wheels on the same side but on different railcars.

134. In my opinion, a PHOSITA would know that sensors located on the same side of the railcar, but on different railcars, could be used to compare acceleration data and determine the status of the railcar and events. It has been well-known in the art for years that data from accelerometers on the same side of a train consist can be analyzed to determine certain kinds of hunting and other railway events. For example, a PHOSITA would know to use acceleration data collected from wireless sensor nodes on the same side of different railcars to detect some sort of “vehicle dynamic event,” which is not anything new or novel in the railroad industry or otherwise. Publicly available information clearly indicates that detecting vertical and lateral accelerations to determine hunting in a locomotive was well-known in the art at least as far back as 2007, and again, it would be obvious to a PHOSITA to place sensors on the same side of different railcars to detect these accelerations and ultimately determine railcar and train consist events. EX1016, p. 9. Vertical or lateral acceleration measurements from sensors on the

same side of different railcars can be analyzed and compared in order to detect vertical or lateral hunting events. Therefore, a PHOSITA would understand Armitage renders this limitation obvious.

C. Ground 2: Claim 21 is unpatentable under 35 U.S.C. § 103(a) in view of Armitage, Barone, and LeFebvre

135. Like Armitage and Barone, LeFebvre teaches monitoring components of a railcar in order to predict and/or detect component failure and describes a system for monitoring railcar and train consist operational parameters. EX1005, Abstract. Therefore, in my opinion, LeFebvre is analogous art.

1. Dependent Claim 21: “The system of claim 1 wherein at least one of said communication management units includes at least one of said sensors.”

136. LeFebvre discloses a “control unit 23” (i.e., communication management unit) which can include a “triaxial accelerometer” (i.e., sensor). EX1005, ¶¶ [0037] (“the data control units 23 or the communications device 24 may contain a triaxial accelerometer...”), [0093] (“The commands can be influenced by the measured accelerations at the data control unit...”).

137. A PHOSITA would have been motivated to include an accelerometer within the communication management unit in view of the disclosure of LeFebvre in combination with the systems of Armitage and Barone. Specifically, a PHOSITA would include the sensor (i.e., accelerometer) in the communication management unit, as disclosed in LeFebvre, because of the efficiency, space, and power

benefits. As previously discussed, Barone emphasizes the importance of a low power system, so by including the sensor within the CMU, a PHOSITA would understand the system saves power by combining the two components into one physical device. EX1007, Abstract, ¶¶ [0026], [0030], [0107], [0116], [0129]. Placing the sensor within the CMU would also save space on the railcar for other components, and also shorten the line of communication between the sensor and CMU, increasing the efficiency and accuracy of data processing.

D. Ground 3: Claims 23 and 26 under 35 U.S.C. § 103(a) in view of Armitage, Barone, and Winfree

138. As I have explained in detail with respect to Ground 1, in Section X.B above, a PHOSITA would have been motivated to include the filter taught by Barone in Armitage's system because the advantage of filtering is to remove unwanted data and/or amplify particularly relevant data. *KSR*, 550 U.S. at 416. Likewise, Winfree teaches a mechanical filter for accelerometers, and a PHOSITA would be motivated to combine the teachings of Armitage and Barone with Winfree to add another layer of filtering—with a mechanical filter—to filter out undesirable accelerations data in the system. As discussed in more detail below, a PHOSITA could have arrived at the claimed solution by combining prior art elements according to known methods to yield predictable results.

1. Dependent Claim 23

a. Limitation 23(a): “The system of claim 1, wherein the one or more filters comprise one or more mechanical filters that include a resilient material configured to filter out undesirable accelerations from the accelerations”

139. As discussed in previous limitations, Armitage in combination with Barone discloses a filter for filtering accelerations—specifically, electronic and digital filters. *See* Limitation 1(d), Section X.B.2.d above, which is incorporated here by reference. While Armitage and Barone do not explicitly disclose a “mechanical filter”, it would have been obvious to modify Armitage in view of Barone to further include the mechanical filter of Winfree. EX1008, Abstract. A PHOSITA would have had a reasonable expectation of success adding the mechanical filter in Winfree with Armitage and Barone.

140. Using mechanical, digital and/or electronic filters in the data collection process was well known in the art. According to Winfree, it is desirable for a mechanical filter to be comprised of a resilient material (i.e., magnesium alloy) to block the transmission of unwanted frequencies during data collection. EX1008, 4:33-41, 5:10-16, Figs. 1, 2. As can be seen below, the similarities between the mechanical filters in Fig. 1 in Winfree and Fig. 4 in the '915 Patent are evident.

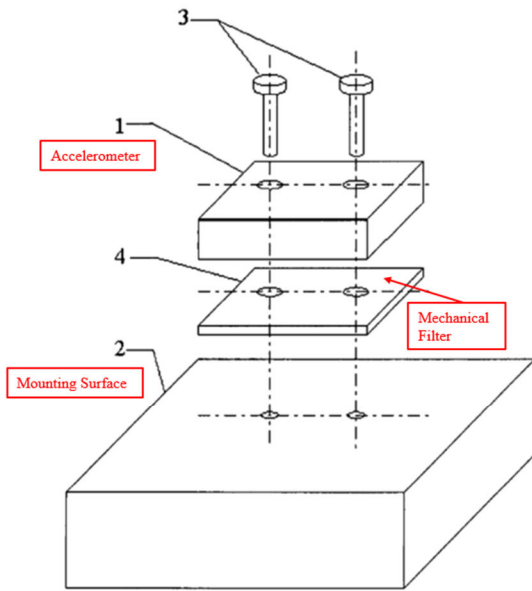


FIG. 1

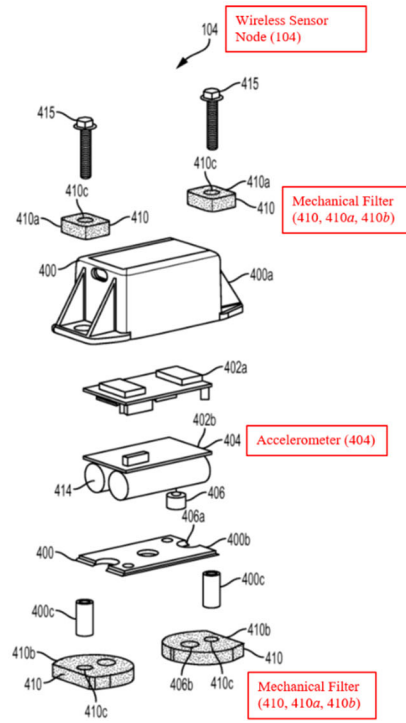


FIG. 4

141. A PHOSITA would have been motivated to use a mechanical filter in combination with an electric or digital filter, because it is typically preferred to “double down” on the filtering of the data with two (or more) filters having different characteristics. EX1008, 5:35-42. An accelerometer mounted on top of a wheel bearing would result in outlier accelerations data due to unwanted vibrations because of where the sensor is mounted; a PHOSITA would understand that, in this situation, a mechanical filter is useful to remove unwanted data and/or amplify particularly relevant data at a first level of filtering. Bracket materials for the mechanical filter, shape, and length can also have large effects on the filtering of data, and can even resonate and add to the signal at certain frequencies or subtract from the signal at other frequencies. Therefore, a PHOSITA would understand that

using a mechanical filter as a first level of filtering the accelerations before sending the data to an electronic or digital filter would be desirable to filter and minimize effects from the physical environment on the data.

b. Limitation 23(b): “wherein the one or more mechanical filters are disposed to remove the undesirable accelerations before the undesirable accelerations reach the one or more sensors that are configured to measure accelerations.”

142. As explained above in Limitation 23(a), Section X.D.1.a above (which is incorporated here by reference), a PHOSITA would understand the well-known benefits of mechanical filters made of resilient material to filter out undesirable accelerations. According to Winfree, it is desirable for a mechanical filter to be comprised of a resilient material (i.e., magnesium alloy) to block the transmission of unwanted frequencies before they even reach the accelerometer. EX1008, 4:33-41, 5:10-16, Figs. 1, 2. Winfree teaches isolating the accelerometer for purposes of minimizing damage to the accelerometer or some other undesirable events. EX1008, 2:30-33.

143. Further, a PHOSITA would understand it would be desirable to remove the undesirable accelerations with the mechanical filter before those accelerations even reach the sensors. As noted in Winfree, this could be for a number of reasons, including: (1) not overloading the processor with unusable data and (2) not wanting to harm or destroy the sensor (i.e., shock absorption). EX1008,

2:30-33. Therefore, Armitage in view of Barone and Winfree renders this claim obvious.

2. Dependent Claim 26: “The system of claim 1, wherein the one or more filters comprise one or more mechanical filters.”

144. See Limitation 23(a), Section X.D.1.a above, which is incorporated here by reference.

E. Ground 4: Claims 1, 21-22, 25, 27-30, 36, and 37 are unpatentable under 35 U.S.C. § 103(a) in view of LeFebvre and Barone

1. Obviousness in View of LeFebvre and Barone

145. In my opinion, Claims 1, 21-22, 25, 27-30, 36, and 37 would have been obvious to a PHOSITA in view of LeFebvre and Barone. This is because I believe that a PHOSITA, having knowledge of these two sources, would have found it obvious to combine the references to create the technology at issue in this case. LeFebvre and Barone are related to the same field of endeavor (i.e., monitoring components of a railcar in order to predict and/or detect component failure) and describe the same device: a system for monitoring railcar and train consist operational parameters. EX1005, Abstract; EX1007, Abstract. Furthermore, LeFebvre and Barone both use sensors, CMUs, and a wireless network to solve the same problem, namely, to determine anomalous conditions of a railcar in real-time and wirelessly report the anomalous conditions to determine a fault conditions (e.g., degree of wear on wheel bearings of railroad cars). EX1006, Abstract, ¶¶ [0021],[0024], [0025], [0036]-[0037], [0093]; EX1007, Abstract, ¶¶ [0002],

[0006]. *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004); MPEP 2141.01(a).

Moreover, LeFebvre, which shares a named inventor of the '915 Patent, expressly admits that systems with the relevant topology were well-known at least as of 2006 when the application that led to the publication of LeFebvre was filed. *See* EX1005, Abstract, ¶ [0005]. Thus, use of the relevant topology was a known method that would yield predictable results and could be combined with the arrangement disclosed in Barone with relative ease. Therefore, it is my opinion that LeFebvre and Barone are analogous art.

146. Further, LeFebvre discloses the periodic sampling of frequencies from sensors depending on the type of behavior being monitored (i.e., accelerations), which a PHOSITA would understand requires an electronic or digital filter. EX1005, ¶¶ [0034]-[0035]. A PHOSITA would understand it is general knowledge that filtering means excluding or amplifying certain ranges of data (or signals) within a data set—and would require an actual filter to achieve said filtering. To the extent LeFebvre does not explicitly disclose a filter, Barone shows filtering accelerations with an electronic or digital filter was well-known in the art and conventionally used in the field at the time of the invention. EX1007, Fig. 8, ¶¶ [0114]-[0115], [0150], [0172]-[0185]. Barone explicitly discloses filtering data, and a PHOSITA would have been motivated to include the filter taught by Barone with LeFebvre because the advantage of filtering is to remove unwanted data

and/or amplify particularly relevant data, and the purpose of both systems is to analyze data in a train monitoring system to accurately predict anomalous conditions and avoid false or inaccurate data processing. *KSR International Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). Combining the preliminary analysis and sampling of data in LeFebvre using an electronic filter and the filter taught in Barone would have predictably resulted in the electronic or digital filtering of accelerations data.

2. Independent Claim 1

a. Preamble/Limitation 1(a): “A system for detecting operational anomalies on a train consist or railcar comprising”

147. I have been informed by counsel that claim preambles are generally not limiting when the content of the claimed preamble is an “intended use.” I have been informed by counsel that preambles are generally statements of intended use when the body of a claim fully sets forth all the limitations of the claimed invention, and the preamble merely states the purpose or intended use of the invention. Here the preamble merely states a system for detecting operational anomalies on a train consist or railcar. In my opinion, this preamble is entirely a statement of use.

148. Even so, if the preamble was limiting, LeFebvre teaches the entire preamble. Specifically, LeFebvre teaches a system for detecting operational anomalies on a railcar. EX1005, Abstract. Specifically, LeFebvre teaches railcar

monitoring for processing information received from sensors and reporting departures of performance variables. EX1005, Abstract, ¶¶ [0003], [0006].

149. Therefore, it is my opinion that even though the preamble should not be given patentable weight, LeFebvre teaches “a system for detecting operational anomalies on a train consist or railcar.”

b. Limitation 1(b): “one or more communication management units mounted on one or more railcars”

150. LeFebvre teaches a “communications device 24” mounted on a railcar and “data control unit 23” linked by a “cable 23a” to the “communications device 24.” EX1005, ¶¶ [0008], [0024], Fig. 1. The “communications device 24” and “data control unit 23” can be contiguous. EX1005, ¶ [0024], Fig. 1. “Indeed, the two devices may well be combined or their functions shared so that the distinction could become unnecessary.” EX1005, ¶ [0068].

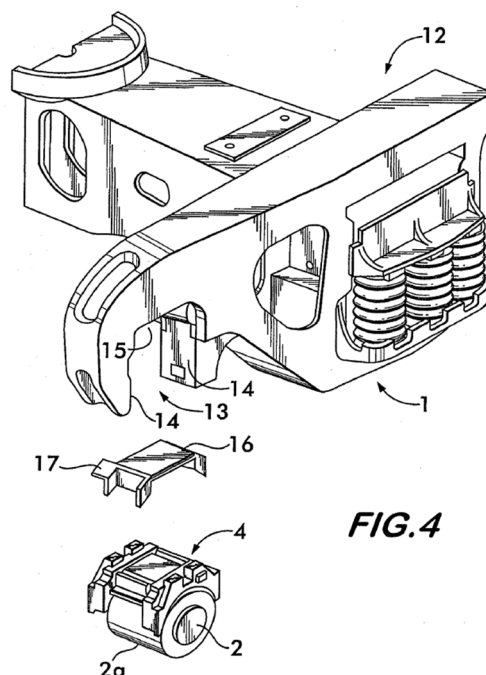
151. The “data control unit 23” communicates with pads on the railcar. EX1005, ¶ [0024]-[0026]. Therefore, LeFebvre discloses one or more communication management units mounted on one or more railcars. EX1005, ¶¶ [0008], [0024]-[0026], [0068].

c. Limitation 1(c): “one or more sensors located on said one or more railcars configured to sense an operational parameter of said one or more railcars, said sensors being in communication with said one or more

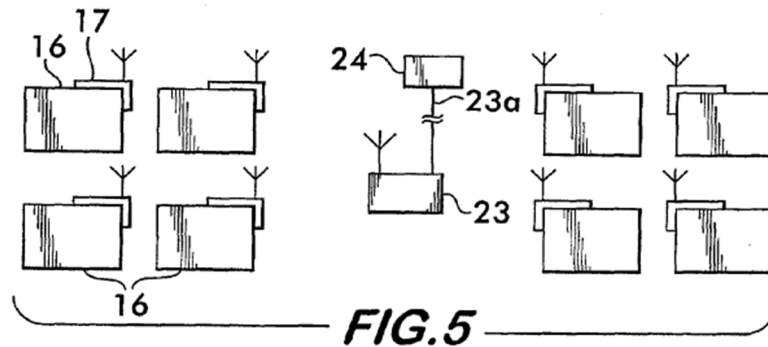
communication management units, wherein the one or more sensors comprise one or more sensors configured to measure accelerations of the railcar”

152. LeFebvre discloses a railcar monitoring system comprising a plurality of “instrumented pads 16”, each of which comprises one or more sensors that measure operational parameters of the railcar. EX1005, ¶¶ [0019], [0023], [0052]. LeFebvre further discloses “a plurality of sensors 5” located on one or more railcars in communication with the “communications device 24” and “data control unit 23.” EX1005, ¶¶ [0021], [0036]. LeFebvre further claims the sensors in the instrumented pads measure accelerations. EX1005, Claims 28, 30.

153. Each “instrumented pad 16” in LeFebvre is a separate device that is mounted on the railcar. Specifically, each pad is mounted upon the upper surface of a wheel bearing adapter 4, as shown in Fig. 4. EX1005, ¶ [0019].



154. Figure 5 of LeFebvre depicts an exemplary embodiment with a plurality of instrumented pads 16, where each instrumented pad is attached to a different wheel bearing adapter. EX1005, ¶ [0039], Fig. 5.



155. Each instrumented pad 16 communicates wirelessly with a data control unit 23, which is mounted on the railcar body. EX1005, ¶ [0024]; Fig. 5. LeFebvre’s data control unit therefore is in communication with and receives information from the instrumented pads (i.e., sensors), as required by Limitation 1(c). The data control unit also performs steps (d)–(f) of claim 1, as will be discussed below.

d. Limitation 1(d): “one or more filters configured to filter at least a portion of the accelerations”

156. LeFebvre teaches filtering at both the sensor and CMU level for purposes of identifying “essential indicative information” from a large data set. EX1005, ¶ [0053]. First, LeFebvre discloses a “preliminary analysis” performed by the “microprocessor” within the instrumented pad which samples frequencies from sensors depending on the type of behavior being monitored (i.e., accelerations).

EX1005, ¶¶ [0034]-[0036]. A PHOSITA would understand LeFebvre’s preliminary analysis equates to filtering at least a portion of accelerations.

157. Second, LeFebvre teaches the microprocessors within the instrumented pads and the “data control unit 23” serve the important functions of processing and filtering the raw data so to only send “essential indicative information.” EX1005, ¶ [0053]. A PHOSITA would understand LeFebvre’s processing of data in order to identify and send essential indicative information equates to filtering at least a portion of accelerations.

158. For the same reasons I have explained in Section X.B.2.d above, which is incorporated here by reference, filtering data was well-known in the art and a PHOSITA would have understood the LeFebvre system filters sensor data. A PHOSITA would have understood the meaning of filtering is excluding some portion of a data set, and it is desirable to include a filter in any data collection and processing system to get rid of unwanted data, and/or to identify and amplify particularly relevant data. In this field, filtering data can be accomplished by choice of the sensor that has a specific range or resolution, through physical methods (i.e., mechanical filtering), electronic filtering, or digital filtering. Electronic filtering is a type of filtering which utilizes electrical circuits to process signals (i.e., analog signals), and includes a number of different types of filters. Mechanical filtering is another type of signal processing filtering, that relies on

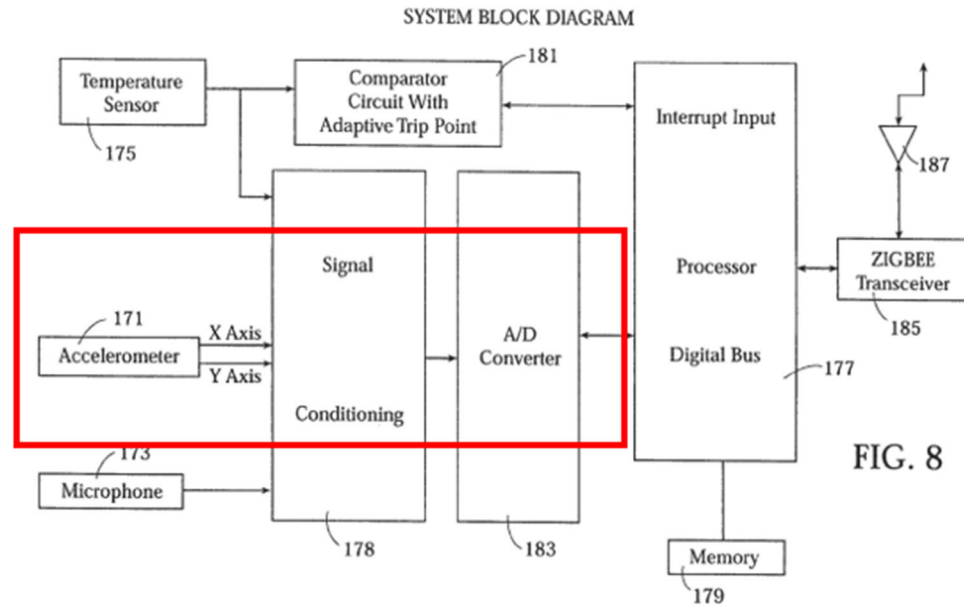
physical parameters in order to remove unwanted high and low frequencies from a signal of interest. Digital filtering uses software to manipulate and filter data in order to decrease noise and increase signals from a particular area of interest.

159. All three types of filters (electronic, mechanical, digital) have been commonplace in the art for decades and would have been well-understood by a PHOSITA. *See, e.g.*, EX1009 (“There are times when you should build the filter with analog hardware and times when it is appropriate to implement it with a controller or processor in firmware.”). In summary, in any data collection analysis, data is almost always filtered in some manner, and the system can utilize the various types of filters alone or in combination to achieve the most effective filtering of data to achieve more accurate and/or targeted data analysis for detection of fault conditions. A PHOSITA would understand that LeFebvre’s teachings of conducting a preliminary analysis and identifying essential indicative information equates to filtering data in the ’915 Patent.

160. To the extent LeFebvre does not explicitly require a “filter”, Barone shows filtering accelerations was well-known in the art and conventionally used in the field at the time of the invention.; EX1007, Fig. 8, ¶¶ [0114]-[0115], [0150], [0172]-[0185]. Specifically, Barone explicitly teaches output of an “accelerometer 171” being transmitted to “signal conditioning 178”, where the analog signals are amplified and/or filtered as appropriate (electronic filter), and then routed to analog

to digital (A/D) converters for wide bandwidth calculations and data manipulations (digital filter). EX1007, ¶¶ [0114]-[0115], Fig. 8. The filtering in Barone occurs in the sensor. EX1007, ¶¶ [0114]-[0115], Fig. 8. A PHOSITA would have understood filtering of data can take place anywhere in the system—including in either the CMU or sensor. A PHOSITA would understand various considerations impact where the filtering takes place in a data processing system. For example, Barone emphasizes the importance of a low power system, so a PHOSITA would understand power consumption could impact where filtering takes place. EX1007, Abstract, ¶¶ [0026], [0030], [0107], [0116], [0129].

161. Barone further teaches the use of a high-pass, low-pass, and/or band-pass filters, all of which can utilize both electronic and digital filters. EX1007, ¶¶ [0172]-[0185]. Barone explicitly discloses filtered data (both digital and electronic), which shows filtering accelerations was well-known in the art and a PHOSITA would be motivated to include the filtering taught by Barone to remove unwanted data and/or amplify particularly relevant accelerations data. Again, filtering could occur at various points within the system.



162. Because Barone explicitly discloses filtering data, a PHOSITA would have been motivated to include the filtering taught by Barone with LeFebvre because the advantage of filtering is to remove unwanted data and/or amplify particularly relevant data, and the purpose of both the LeFebvre and Barone systems is to analyze data in a train monitoring system to accurately predict anomalous conditions and avoid false or inaccurate data processing. *KSR*, 550 U.S. at 416. Combining the filtering at both the sensor and CMU level to identify “essential indicative information” in LeFebvre with the electronic and digital filtering taught in Barone would have predictably resulted in the filtering of accelerations data. Therefore, it is my opinion that LeFebvre and Barone render this limitation obvious.

e. Limitation 1(e): “wherein said communication management units perform the functions of: (i) collecting data regarding said one or more railcar operational parameters”

163. LeFebvre teaches a “data control unit 23” and “communications device 24” (which can be contiguous). EX1005, ¶¶ [0024], [0036]. The “data control unit 23” (CMU) compares information it receives from the instrumented pads regarding one or more railcar operational parameters to determine the status of the railcar. EX1005, ¶¶ [0024], [0036]. Therefore, LeFebvre discloses a communication management unit for collecting data regarding said one or more railcar operational parameters. EX1005, ¶¶ [0024], [0036].

f. Limitation 1(f): “(ii) analyzing said collected data for trends or events indicative of an anomalous operational condition”

164. The system in LeFebvre processes raw sensor data to look for anomalous operational conditions—with analysis occurring in the “data control unit 23” to recognize faults. EX1005, ¶¶ [0024], [0036], [0053]. In LeFebvre’s system, the data control unit acts as an “aggregator of information,” collecting data from each of the instrumented pads on the railcar. EX1005, ¶¶ [0036], [0056], [0095]. And as discussed above, each of the instrumented pads contains one or more sensors that collect data about the railcar.

165. The data control unit then uses “inference engine techniques” (i.e., “drawing inferences”) to analyze the collected data. EX1005, ¶¶ [0036], [0056], [0095]. “As an aggregator of information, it is programmed to compare

information from all of the trucks on the railcar and draws inferences from them as to the status of the car, for example, the data control unit uses inference engine techniques to identify unsatisfactory behavior such as swaying, bouncing or even partial derailment.” EX1005, ¶ [0036]. “Given that more than one instrumented pad may report misbehavior, then the components of the inference engine in the data control unit take responsibility for making assessments for the whole truck and ultimately for the freight car.” EX1005, ¶ [0056]. “When serious trouble is inferred, then messages are sent via the communications link **23a, 24** to the locomotive, etc.” EX1005, ¶ [0056]; *see also* EX1005, ¶ [0095].

166. The “inference engine” techniques used by the data control unit include, for example, statistical analysis of the collected data. EX1005, ¶¶ [0058]–[0066]. For example, the data control unit may detect a wheel derailment condition by looking for a high frequency, periodically repeating load and “a similar signal from both wheels in the wheel set.” EX1005, ¶¶ [0060]–[0061]. Similarly, the data control unit may detect track defects by “monitoring the vertical loads in the instrumented pads and comparing these between wheel sets.” EX1005, ¶ [0066].

167. The data control unit is ultimately responsible for determining the presence of an alarm condition that relates to the railcar as a whole. EX1005, ¶ [0095]. If an alarm condition is present, the data control unit is responsible for

sending an alarm message upstream (i.e., to the locomotive and/or a remote data handling location). *Id.*

g. Limitation 1(g): “(iii) communicating a message to a remote receiver when said trend or event is detected.”

168. LeFebvre discloses, “the data control unit 23 passes messages on to the communications device 24 for onward transmission to the locomotive or to other remote receivers.” EX1005, ¶ [0038]. For communication with remote sources, the communications device may comprise, for example, “a cellular or satellite radio system.” EX1005, ¶ [0025]. The remote receiver may be, for example, a “remote data handling service” (EX1005, ¶ [0052]) or a “central data handling location” (*id.*, ¶ [0095]).

169. In LeFebvre, the data control unit is ultimately responsible for determining whether an alarm message should be generated:

The data control unit then performs the assessments described above for the inference engine to check if the freight car, its trucks or wheels or axles are behaving *sufficiently poorly* that a report to the central data handling location or owner or operator or locomotive is needed. If so, then the report can be sent.

EX1005, ¶ [0095] (emphasis added).

170. If the detected condition is sufficiently severe that an alarm is warranted, the data control unit will send an alarm message upstream (i.e., to the locomotive and/or a remote data handling location). EX1005, ¶ [0095]; *see also*

EX1005, ¶ [0056] (“When serious trouble is inferred, then messages are sent via the communications link **23a, 24** to the locomotive, etc.”).

3. Dependent Claim 21: “The system of claim 1 wherein at least one of said communication management units includes at least one of said sensors.”

171. LeFebvre discloses a “data control unit 23” (i.e., communication management unit) which can include a “triaxial accelerometer” (i.e., sensor).

EX1005, ¶¶ [0037] (“the data control units 23 or the communications device 24 may contain a triaxial accelerometer...”), [0093] (“The commands can be influenced by the measured accelerations at the data control unit...”).

4. Dependent Claim 22: “The system of claim 1, further comprising a powered wireless gateway configured to control a train-based network that includes said powered wireless gateway and a plurality of said communication management units.”

172. A PHOSITA would have been motivated to modify LeFebvre’s system to include the “network coordinator” disclosed by Barone in order to meet all limitations of this claim. The system in Barone includes a “network coordinator” in the locomotive. EX1007, ¶¶ [0087]-[0089], [0267]-[0278], [0280]. This qualifies as a “powered wireless gateway,” because Barone’s “network coordinator” supports long-rang communications (i.e., cellular or satellite communications) for communicating railcar status and data to a remote system. EX1007, ¶¶ [0087]-[0089]. A PHOSITA would understand Barone’s network coordinator is a gateway because it connects the sensors to a remote system off of the train. By definition, a

gateway is an entry and exit point for a network through which all data must pass through before being routed to, for example, a remote system. Further, a PHOSITA would understand the benefit of Barone's "network coordinator" enables the entire train to use a *single* communications link with the outside world, which is more cost efficient. Therefore, LeFebvre in combination with Barone renders this claim obvious.

5. Dependent Claim 25

a. Limitation 25(a): "The system of claim 1, further comprising one or more wireless sensor nodes in communication with at least one of the communication management units"

173. See Limitation 1(c), Section X.E.2.c above, and Limitation 24(a) Section X.F.1.a below, both of which are incorporated here by reference.

174. LeFebvre discloses a railcar monitoring system comprising a plurality of "instrumented pads 16." EX1005, ¶¶ [0019], [0023], [0052]. Each "instrumented pad 16" in LeFebvre is a separate device that is mounted on the railcar. Id. Specifically, each pad is mounted upon the upper surface of a wheel bearing adapter 4, as shown in Fig. 4. EX1005, ¶ [0019], Fig. 4. Each "instrumented pad 16" communicates wirelessly with a "data control unit 23", which is mounted on the railcar body. EX1005, ¶ [0024]; Fig. 5. LeFebvre's data control unit therefore is in communication with and receives information from the instrumented pads (i.e., sensors).

b. Limitation 25(b): “wherein the one or more sensors form part of the one or more wireless sensor nodes”

175. LeFebvre discloses a plurality of “instrumented pads 16,” each of which comprises one or more sensors that measure operational parameters of the railcar. EX1005, ¶¶ [0019], [0023], [0052]. The “plurality of sensors 5” located within the instrumented pads are located on one or more railcars and are configured to sense “a variety of car body motions” in communication with the “communications device 24” and “data control units 23.” EX1005, ¶¶ [0021], [0036], [0037], [0093]. LeFebvre further claims the sensors in the instrumented pads measure accelerations. EX1005, Claims 28, 30. Each instrumented pad 16 communicates wirelessly with a data control unit 23, which is mounted on the railcar body. EX105, ¶ [0024]; Fig. 5.

c. Limitation 25(c): “wherein one or more of the wireless sensor nodes comprises a microprocessor configured to execute firmware to control operation of the one or more of the wireless sensor nodes”

176. Lefebvre discloses the “instrumented pad 16” (wireless sensor node) having a “microprocessor” which controls the sensors within the instrumented pad. EX1005, ¶¶ [0021], [0024], [0034], [0036], [0039]-[0041]. A PHOSITA would understand that firmware’s purpose is to control hardware within a device (i.e., sensors). A PHOSITA would therefore understand that the microprocessor contained in LeFebvre’s instrumented pad executes firmware to control operation of the instrumented pad. Alternatively, it would have been obvious to incorporate

firmware into the instrumented pad. Firmware is a standard and essential component of a modern computing device that software developers would expect to be present.

177. To the extent LeFebvre does not explicitly disclose a microprocessor within the wireless sensor node with firmware to control the wireless sensor node, a PHOSITA would be motivated to combine the teachings of LeFebvre with Barone. Barone discloses a “microprocessor” within the sensor nodes, which analyzes information in order to control the sensor nodes. EX1007, ¶¶ [0024]-[0026]. Specifically, Barone discloses the following:

The microprocessor has memory storing software configured to cause the microprocessor to analyze the electrical signals and derive therefrom bearing condition data corresponding to a degradation condition of bearings of the associated wheel axle assembly. A rotation sensor is operatively associated with the circuitry and supplies thereto a rotation frequency signal corresponding to the rate of rotation of the wheel. **The circuitry is configured to assemble the node into a network communicating wirelessly via the low-power transceiver wherein the network is made up of nodes traveling in a train together with a locomotive node to which the nodes transmit the bearing condition data, and the nodes are retained in the network only if the rotation rate of the associated wheel is consistent with the railcars moving together in the train.**

EX1007, ¶ [0026]. LeFebvre, in view of Barone, therefore renders obvious this element of Claim 25.

d. Limitation 25(d): “wherein the firmware comprises one or more software filters configured to isolate one or more types of accelerations.”

178. As noted above in Limitation 25(c), Section X.E.5.c above (which is incorporated here by reference), LeFebvre discloses a microprocessor and firmware. Further, LeFebvre in combination with Barone discloses filtering accelerations—including the use of a digital filter. *See* Limitation 1(d), Section X.E.2.d above, which is incorporated here by reference.

179. In my opinion, a PHOSITA would understand firmware and software have different purposes and functions, but that both can execute the filtering of accelerations data. As discussed in Limitation 1(d), LeFebvre discloses filtering in the instrumented pad, which a PHOSITA would understand requires a microprocessor and firmware in order to execute. A PHOSITA would understand firmware is often considered to be more closely related to the hardware (or physical components) of a system (i.e., making a measurement or detecting a switch position), while software is the layer of programming evaluating rules and making complex decisions. One type of filtering firmware can execute is identifying and isolating certain types of data—in this case, accelerations data. In contrast, software is described as programming that acts on the data; in other words, software performs post data collection algorithms—which is different from the functions of firmware. A PHOSITA would understand a function of filtering data by a software filter can be isolating or excluding certain types of accelerations data

(i.e., “essential indicative information”) - based on programming that would be present in the software filter. Therefore, a PHOSITA would understand that LeFebvre in combination with Barone discloses this limitation.

6. Dependent Claim 27: “The system of claim 1, wherein the one or more filters comprise one or more electronic filters.”

180. *See* Limitation 1(d), Section X.E.2.d above, and Limitation 25(d), Section X.E.5.d above, both of which are incorporated here by reference.

7. Dependent Claim 28: “The system of claim 1, wherein the one or more filters comprise one or more digital filters.”

181. *See* Limitation 1(d), Section X.E.2.d above; Limitation 25(d), Section X.E.5.d above; and Dependent Claim 27, Section X.E.6 above; each of which is incorporated here by reference.

8. Dependent Claim 29: “The system of claim 1 wherein said remote receiver is located off-train.”

182. *See* Limitation 1(g), Section X.E.2.g above, which is incorporated here by reference .

9. Independent Claim 30

a. Preamble/Limitation 30(a): “A method for detecting operational anomalies on a train consist or railcar comprising the steps of:”

183. *See* Limitation 1(a), Section X.E.2.a above, which is incorporated here by reference .

184. It is my opinion that LeFebvre teaches a method for detecting operational anomalies on a train consist or railcar.

b. Limitation 30(b): “sensing, by one or more sensors located on one or more railcars, one or more operational parameters of the one or more railcars, wherein the one or more operational parameters comprise one or more accelerations of the one or more railcars”

185. *See* Limitation 1(c), Section X.E.2.c above, which is incorporated here by reference.

c. Limitation 30(c): “filtering, by one or more filters, at least a portion of the accelerations; and”

186. *See* Limitation 1(d), Section X.E.2.d above, which is incorporated here by reference.

d. Limitation 30(d): “by one or more communication management units associated with the one or more railcars: collecting data regarding said one or more railcar operational parameters”

187. *See* Limitation 1(e), Section X.E.2.e above, which is incorporated here by reference.

e. Limitation 30(e): “analyzing said collected data for trends or events indicative of an anomalous operational condition; and”

188. *See* Limitation 1(f), Section X.E.2.f above, which is incorporated here by reference.

f. Limitation 30(f): “communicating a message to a remote receiver when said trend or event is detected.”

189. *See* Limitation 1(g), Section X.E.2.g above, which is incorporated here by reference.

10. Independent Claim 36

a. Preamble/Limitation 36(a): “A system for detecting operational anomalies on a railcar that is part of a train consist comprising:”

190. *See* Limitation 1(a), Section X.E.2.a above, which is incorporated here by reference.

b. Limitation 36(b): “(a) at least one communication management unit (CMU) mounted on the [a] railcar in said train consist”

191. *See* Limitation 1(b), Section X.E.2.b above, which is incorporated here by reference.

c. Limitation 36(c): “(b) at least two sensors located on the said railcar for configured to sense operational parameters of the railcar, said sensors being in communication with said communication management unit, wherein the one or more sensors comprise one or more sensors configured to measure accelerations of the railcar; and”

192. *See* Limitation 1(c), Section X.E.2.c above, which is incorporated here by reference.

d. Limitation 36(d): “(c) one or more filters configured to filter at least a portion of the accelerations”

193. *See* Limitation 1(d), Section X.E.2.d above, which is incorporated here by reference.

e. Limitation 36(e): “wherein said communication management unit performs the following functions: (i) receiving data from said sensors;”

194. *See* Limitation 1(e), Section X.E.2.e above, which is incorporated here by reference.

f. Limitation 36(f): “(ii) drawing inferences from the data received from at least two of the sensors regarding the performance of the railcar; and”

195. See Limitation 1(f), Section X.E.2.f above, which is incorporated here by reference.

g. Limitation 36(g): “(iii) communicating a message to a remote receiver when an anomaly is detected.”

196. See Limitation 1(g), Section X.E.2.f above, which is incorporated here by reference.

11. Dependent Claim 37

a. Limitation 37(a): “The system of claim 36,”

197. See Limitation 1(a), Section X.E.2.a above, which is incorporated here by reference..

b. Limitation 37(b): “wherein said sensors comprise accelerometers positioned at different locations of the railcar,”

198. See Limitation 1(c), Section X.E.2.c above, which is incorporated here by reference.

c. Limitation 37(c): “wherein said step of drawing inferences comprises the comparison of data from two or more of said accelerometers,”

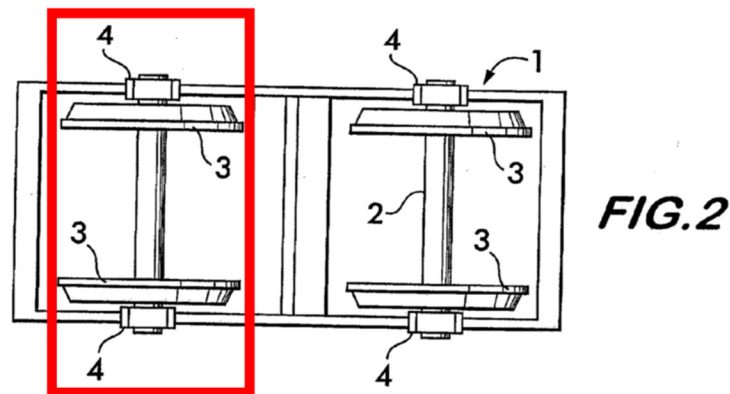
199. See Limitation 1(f), Section X.E.2.f above, which is incorporated here by reference. Specifically, LeFebvre’s data control unit “is programmed to *compare information* from all of the trucks on the railcar.” EX1005, ¶ [0036]. Each truck comprises one or more instrumented pads (i.e., sensors). See, e.g., EX1005, ¶ [0062], Fig. 2.

d. Limitation 37(d)-(g): “wherein said accelerometers are positioned on the railcar to provide data for carrying out one or more of the following functions:”, “i) compare accelerations from one railcar wheel with that of another railcar wheel on the same axle but opposite side of the railcar,”, “ii) compare accelerations from one railcar wheel with that of at least one other wheel on the same side of said railcar, and”, “iii) compare accelerations from one railcar wheel with that of at least one other railcar wheel on the same side of said one railcar wheel and which other wheel is on another railcar of the same train consist.”

200. LeFebvre discloses a railcar monitoring system comprising a plurality of “instrumented pads 16”, each of which comprises one or more sensors that measure operational parameters of the railcar. EX1005, ¶¶ [0019], [0023], [0052]. LeFebvre further discloses “a plurality of sensors 5” located on one or more railcars in communication with the “communications device 24” and “data control units 23.” EX1005, ¶¶ [0021], [0036]. LeFebvre further claims the sensors in the instrumented pads measure accelerations. EX1005, Claims 28, 30. Each instrumented pad 16 communicates wirelessly with a data control unit 23, which is mounted on the railcar body. EX1005, ¶ [0024]; Fig. 5. This limitation precedes the next three limitations (Limitations 37(e), (f), and (g)), and only requires one of the three following limitations to be met in order to satisfy the claim. *See* EX1001, Claim 37 (...wherein said accelerometers are positioned on the railcar to provide data **for carrying out one or more of the following functions...**”).

(1) Limitation 37(e)

201. For Limitation 37(e), LeFebvre teaches the comparing of data from accelerometers of each of the wheel sets (i.e., wheels on the same axle) for determining wheel derailment. EX1005, ¶ [0061], Fig. 2. Annotated Figure 2 from LeFebvre shows the orientation of a “wheel set”:



Paragraph 61 of LeFebvre states:

Wheel derailment. Using the same instrumentation as for the Wheel Condition, but **looking for a higher frequency and a similar signal from both wheels in the wheel set**. Identifying when a wheel set has derailed prevents a possible full derailment and possible catastrophic consequences.

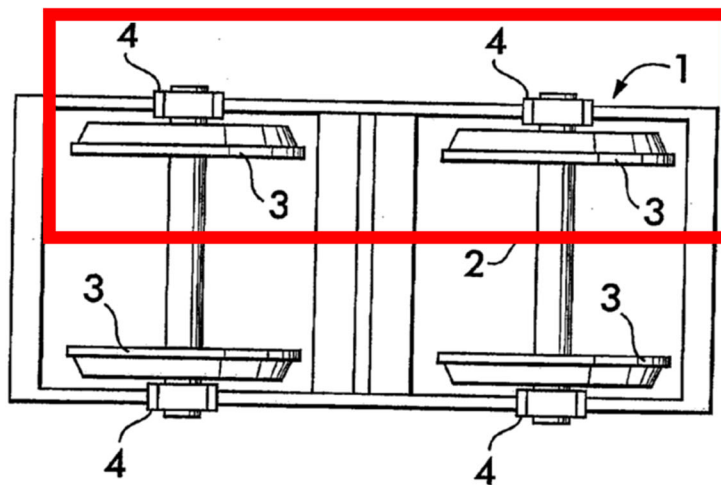
EX1005, ¶ [0061]. Because LeFebvre discloses the comparison of data across both wheels in a wheel set, it would be obvious to a PHOSITA to compare the accelerations data from one railcar wheel on one side of the axle, with the wheel on the other side of the railcar.

(2) Limitations 37(f)-(g)

202. Paragraph 62 of LeFebvre discloses both Limitations 37(f) and 37(g):

Truck Hunting. **Using load sensors mounted in the instrumented pad so as to detect longitudinal, lateral and yawing forces**, monitor rapidly changing loads (and hence the angle of attack of the wheel set) indicative of axle or truck hunting. **By analyzing such loads monitored from both wheel sets on a truck**, and both trucks on a car, truck and axle hunting as well as truck warp can be identified. **Additionally by assessing the angle of attack of wheel sets on each truck, high rotational friction caused by binding side bearings or dry center bowls can be identified.** Identifying these conditions helps to prevent damage to freight car trucks and lading as well as to the track infrastructure.

EX1005, ¶ [0062]. For Limitation 37(f), LeFebvre teaches the comparison of data from accelerometers of different wheel sets on the same side of the railcar for determining truck hunting. EX1005, ¶ [0062], Fig. 2. Therefore, a PHOSITA would understand LeFebvre's teachings of comparing accelerations data from wheels across both wheel sets would include comparing data from an accelerometer on a railcar wheel within a first wheel set with at least one other wheel on the same side of the railcar but within the second wheel set.



203. With respect to limitation 37(g), paragraph 66 of LeFebvre also teaches the comparison of data across multiple wheel sets. (“**Monitoring the vertical loads in the instrumented pads and comparing these between wheel sets** gives car owners insight into track defects that may cause damage to freight cars or their lading.”). EX1005, ¶ [0066]. A PHOSITA would understand that, for the purpose of detecting track defects, comparing data collected from wheel sets on *different* railcars would be particularly useful, because a track defect would be expected to affect *all* railcars in a similar way as they pass over the section of track having the defect. Accordingly—to the extent LeFebvre does not expressly disclose comparing accelerations from one railcar wheel with accelerations from another railcar wheel on the same side of the track, but on a different railcar—doing so would have been obvious to a PHOSITA at least for the purpose of detecting track defects. *Id.*. Therefore, LeFebvre meets each of Limitations 37(e)-(g) and renders all of Claim 37 obvious.

F. Ground 5: Claims 24 and 37 are unpatentable under 35 U.S.C. § 103(a) Over LeFebvre in View of Barone and Armitage

204. As previously discussed, LeFebvre, Barone, and Armitage all teach monitoring components of a railcar in order to predict and/or detect component failure and describe a system for monitoring railcar and train consist operational parameters. Therefore, they are analogous art.

1. Dependent Claim 24

a. Limitation 24(a): “The system of claim 1, further comprising one or more wireless sensor nodes in communication with at least one of the communication management units”

205. *See* Limitation 1(c), Section X.E.2.c above, and Limitation 25(a), Section X.E.5.a above, both of which are incorporated here by reference.

206. LeFebvre discloses a railcar monitoring system comprising a plurality of “instrumented pads 16”, each of which comprises one or more sensors that measure operational parameters of the railcar. EX1005, ¶¶ [0019], [0023], [0052]. LeFebvre further discloses “a plurality of sensors 5” located on one or more railcars in communication with the “communications device 24” and “data control units 23.” EX1005, ¶¶ [0021], [0036]. LeFebvre further claims the sensors in the instrumented pads measure accelerations. EX1005, Claims 28, 30. Each instrumented pad 16 communicates wirelessly with a data control unit 23, which is mounted on the railcar body. EX1005, ¶ [0024]; Fig. 5.

b. Limitation 24(b): “wherein the one or more sensors form part of the one or more wireless sensor nodes”

207. *See* Limitation 25(b), Section X.E.5.b above, which is incorporated here by reference.

208. LeFebvre’s “instrumented pads 16” comprise one or more sensors that measure operational parameters of the railcar. EX1005, ¶¶ [0019], [0023], [0052].

c. Limitation 24(c): “wherein one or more of the wireless sensor nodes comprise a protective housing”

209. The instrumented pad in LeFebvre “is preferably comprised of a cast or injected molded *elastomeric polymer*,” in other words, a PHOSITA would understand that the instrumented pad is mounted within a protective housing. EX1005, ¶¶ [0019].

d. Limitation 24(d): “wherein the one or more sensors are mounted within the protective housing”

210. See Limitation 24(c), Section X.F.1.c above, which is incorporated here by reference.

e. Limitation 24(e): “wherein the protective housing comprises potting material configured to tune the wireless sensor nodes by absorbing at least a portion of undesirable accelerations.”

211. See Limitation 1(d), Section X.E.2.d above, and Limitation 24(c), Section X.F.1.c above, both of which are incorporated here by reference.

212. As noted above, LeFebvre’s instrumented pad has a protective housing comprised of an elastomeric polymer. LeFebvre teaches that the elastomeric polymer “allow[s] for limited relative movement between the bearing and the pedestal pocket and provid[es] *damping of shock and abrasion*.” EX1005, Claim 12. A PHOSITA that an “elastomeric polymer” *is* a commonly used type of “potting material.” Elastomeric polymers are commonly used in potting applications for precisely the reason that LeFebvre states—namely, the ability to dampen shock and vibration. A PHOSITA would therefore understand that

LeFebvre’s instrumented pad (i.e., wireless sensor node) comprises a protective housing that comprises (i.e., is made from) a “potting material” as required by Limitation 24(e).

213. To whatever extent LeFebvre does not disclose a wireless sensor node comprising a potting material, Armitage teaches “sensor nodes” being encased in a “potted” enclosure. EX1006, ¶¶ [0015], [0034]. A PHOSITA would understand the “potted” enclosure in Armitage would equate to a protective housing comprising potting material to absorb undesirable accelerations.

214. As I have explained in detail in Section X.B.4.e above, which is incorporated here by reference, potting materials and thin layer conformal coatings are commonly used to protect circuit board and electronic components—such as sensors. *See, e.g.*, EX1010. Potting has been used for decades to isolate components, keep wires from vibrating until they break, as well as provide environmental isolation. Potting material is frequently used in conjunction with mechanical and electrical filters to ensure the data is properly filtered and absorbs unwanted data. *Id.* Electrical filters benefit from potting because it helps the circuits stay dry and clean to avoid corrosion. For mechanical filters, potting can help absorb physical signals so less “noise” gets to the sensor. Therefore, a PHOSITA would understand that potting material could be placed within a housing that encases sensors (i.e., accelerometers) to tune said sensors by absorbing

undesirable accelerations, as it is the nature of potting material to protect components of an electrical or mechanical system by absorbing unwanted outside factors.

2. Dependent Claim 37

a. Limitation 37(a): “The system of claim 36,”

215. *See* Limitation 1(a), Section X.B.2.a above (with respect to Armitage and Barone) and Section X.E.2.a above (with respect to LeFebvre and Barone), both of which are incorporated here by reference.

b. Limitation 37(b): “wherein said sensors comprise accelerometers positioned at different locations of the railcar,”

216. *See* Limitation 1(c), Section X.B.2.c above (with respect to Armitage and Barone) and Section X.E.2.c above (with respect to LeFebvre and Barone), both of which are incorporated here by reference.

c. Limitation 37(c): “wherein said step of drawing inferences comprises the comparison of data from two or more of said accelerometers,”

217. *See* Limitation 1(f), Section X.B.2.f above (with respect to Armitage and Barone) and Section X.E.2.f above (with respect to LeFebvre and Barone), both of which are incorporated here by reference.

d. Limitation 37(d)-(g): “wherein said accelerometers are positioned on the railcar to provide data for carrying out one or more of the following functions:”, “i) compare accelerations from one railcar wheel with that of another railcar wheel on the same axle but opposite side of the railcar,”, “ii) compare accelerations from one railcar wheel with that of at least one other wheel on the same side of said railcar, and”, “iii) compare accelerations from one railcar wheel with that of at least one other railcar wheel on the same side

of said one railcar wheel and which other wheel is on another railcar of the same train consist.”

218. *See* Limitations 37(d)-(g), Section X.B.11.d above (with respect to Armitage and Barone) and Section X.E.11.d above (with respect to LeFebvre and Barone), both of which are incorporated here by reference.

219. As discussed previously, both Armitage and LeFebvre disclose Limitation 37(d). This limitation precedes the next three limitations (Limitations 37(e), (f), and (g)), and only requires one of the three following limitations to be met in order to satisfy the claim. *See* EX1001, Claim 37 (...wherein said accelerometers are positioned on the railcar to provide data **for carrying out one or more of the following functions...**”).

(1) Limitation 37(e)-(f)

220. *See* Limitation 37(e), Section X.B.11.d(1) above (with respect to Armitage and Barone) and Section X.E.11.d(1) above (with respect to LeFebvre and Barone); and Limitation 37(f), Section X.B.11.d(1) above (with respect to Armitage and Barone) and Section X.E.11.d(2) above (with respect to LeFebvre and Barone); each of which is incorporated here by reference.

221. To the extent LeFebvre does not explicitly disclose these limitations, a PHOSITA would be motivated to combine the teachings of LeFebvre with Armitage. Specifically, Armitage teaches “where two outliers occur for the same wheel assembly, then a failure of the entire wheel assembly could be

determined...”; EX1006, ¶ [0042]; *see* Section X.B.11.d(1) above. A PHOSITA would understand, based on the disclosure in Armitage, that comparing data to determine outliers for the same wheel assembly would equate to comparing accelerations from one railcar wheel with that of another railcar wheel on the same axle but opposite side of the railcar.

222. Additionally, Armitage teaches “outliers for sensor nodes on an entire side of railway car 310 could indicate a cornering failure, or an off-track condition.” EX1006, ¶ [0042]; *see* Section X.B.11.d(1) above. A PHOSITA would understand, based on the disclosure in Armitage, that comparing data to determine outliers on the same side of a railway car would equate to comparing accelerations from one railcar wheel with that of at least one other wheel on the same side of said railcar. Therefore, Armitage discloses all elements of Limitations 37(e) and 37(f), therefore, renders the entirety of Claim 37 obvious.

(2) Limitations 37(g)

223. *See* Limitation 37(g), Section X.B.11.d(2) above (with respect to Armitage and Barone) and Section X.E.11.d(2) above (with respect to LeFebvre and Barone), both of which are incorporated here by reference.

224. To the extent LeFebvre does not explicitly disclose this limitation, a PHOSITA would be motivated to combine the teachings of LeFebvre with Armitage. Armitage teaches the “[c]ontrol node 130 could process the sensor

information to determine anomalies from an average, such as an anomaly *from a running average of the temperature of all wheels on railway car 110*”, and further, notes that a “dynamic threshold” could be determined as conditions change (i.e., accelerations) across a railcar. EX1006, ¶ [0029]; Section X.B.11.d(2) above, which is incorporated here by reference. For reasons discussed *supra*, a PHOSITA would understand sensors located on the same side of the railcar wheels and/or axles, but on different railcars, could be used to compare accelerations data and determine railcar status and events. *See* Section X.B.11.d(2) above. Therefore, LeFebvre in combination with Armitage meets each of Limitation 37(e)-(g) and renders all of Claim 37 obvious.

G. Ground 6: Claims 23 and 26 are unpatentable under 35 U.S.C. § 103(a) Over LeFebvre in View of Barone and Winfree

225. As explained in detail in Ground 4, Section X.E above, a PHOSITA would have been motivated to include the filter taught by Barone in LeFebvre’s system because the advantage of filtering is to remove unwanted data and/or amplify particularly relevant data. *KSR*, 550 U.S. at 416. Likewise, Winfree (EX1008) teaches a mechanical filter for accelerometers, and a PHOSITA would be motivated to combine the teachings of LeFebvre and Barone with Winfree to add an additional filter step—with a mechanical filter—to filter out undesirable accelerations data in the system. A PHOSITA could have arrived at the claimed

solution by combining prior art elements according to known methods to yield predictable results.

1. Dependent Claim 23

a. Limitation 23(a): “The system of claim 1, wherein the one or more filters comprise one or more mechanical filters that include a resilient material configured to filter out undesirable accelerations from the accelerations”

226. As previously discussed *supra*, LeFebvre in combination with Barone meets all limitations of independent claim 1. Also previously discussed, LeFebvre in combination with Barone discloses a filter for filtering accelerations—specifically, electronic and digital filters. *See* Limitation 1(d), Section X.E.2.d above, which is incorporated here by reference. While LeFebvre and Barone do not explicitly disclose a “mechanical filter”, it would have been obvious to modify LeFebvre in view of Barone to further include the mechanical filter of Winfree. EX1008, Abstract. A PHOSITA would have had a reasonable expectation of success adding the mechanical filter in Winfree with LeFebvre and Barone.

227. Using mechanical, digital and/or electronic filters in the data collection process was well known in the art. According to Winfree, it is desirable for a mechanical filter should be comprised of a resilient material (i.e., magnesium alloy) to block the transmission of unwanted frequencies during data collection. EX1008, 4:33-41, 5:10-16, Figs. 1, 2. As can be seen below, the similarities

between the mechanical filter in Fig. 1 of Winfree and Fig. 4 in the '915 Patent are evident.

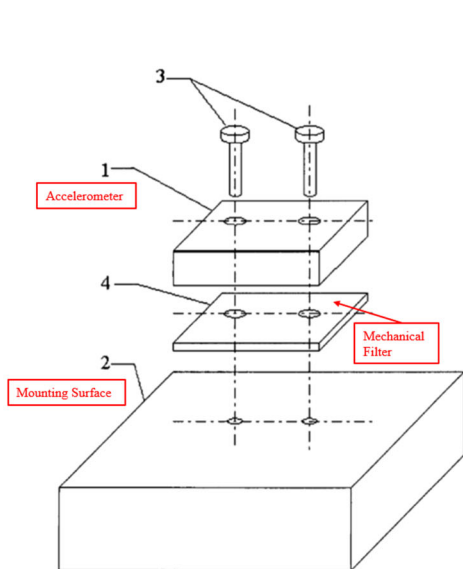


FIG. 1

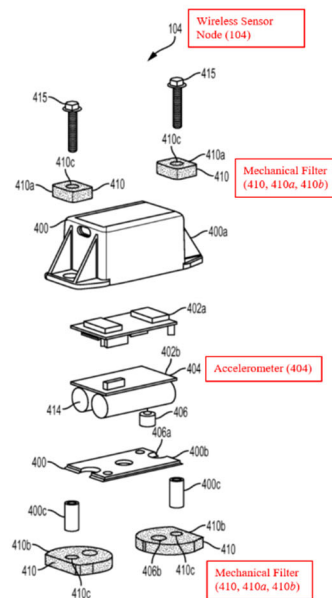


FIG. 4

228. For the same reasons I have explained in Section X.D.1.a above, which is incorporated here by reference, a PHOSITA would have been motivated to use a mechanical filter in combination with an electric or digital filter, because it is typically preferred to “double down” on the filtering of the data with two (or more) filters having different characteristics. EX1008, 5:35-42. An accelerometer mounted on top of a wheel bearing would result in outlier accelerations data due to unwanted vibrations because of where the sensor is mounted; a PHOSITA would understand that, in this situation, a mechanical filter is useful to remove unwanted data and/or amplify particularly relevant data at a first level of filtering. Bracket materials for the mechanical filter, shape, and length can also have large effects on

the filtering of data, and can even resonate and add to the signal at certain frequencies or subtract from the signal at other frequencies. Therefore, a PHOSITA would understand that using a mechanical filter as a first level of filtering the accelerations before sending the data to an electronic or digital filter would be desirable to filter and minimize effects from the physical environment on the data.

b. Limitation 23(b): “wherein the one or more mechanical filters are disposed to remove the undesirable accelerations before the undesirable accelerations reach the one or more sensors that are configured to measure accelerations.”

229. As explained above with respect to Limitation 23(a) in Sections X.D.1.a and X.G.1.a above, both of which are incorporated here by reference, a PHOSITA would have been motivated to use a mechanical filter made of resilient material to filter out undesirable accelerations. According to Winfree, it is desirable for a mechanical filter to be comprised of a resilient material (i.e., magnesium alloy) to block the transmission of unwanted frequencies before they even reach the accelerometer. EX1008, 4:33-41, 5:10-16, Figs. 1, 2. Winfree teaches isolating the accelerometer for purposes of minimizing damage to the accelerometer or some other undesirable events. EX1008, 2:30-33.

230. Further, a PHOSITA would understand it would be desirable to remove the undesirable accelerations with the mechanical filter before those accelerations even reach the sensors. As noted in Winfree, this could be for a number of reasons, including: (1) not overloading the processor with unusable data

or (2) not wanting to harm or destroy the sensor (i.e., shock absorption). EX1008, 2:30-33. Therefore, LeFebvre in view of Barone and Winfree renders this claim obvious.

2. Dependent Claim 26: “The system of claim 1, wherein the one or more filters comprise one or more mechanical filters.”

231. See Limitation 23(a), Section X.G.1.a above, which is incorporated here by reference.

XI. CONCLUSION

For the aforementioned reasons, it is my opinion that Claims 1, 21-30, 36, and 37 of the '915 Patent are unpatentable.

* * *

I understand that this 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 understand that I may be subject to cross-examination concerning this declaration, and I will appear for cross-examination, if required of me, during the time allotted for cross-examination.

I hereby declare that all of the 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 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.

January 31, 2023



STEVEN RICCA