

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HUM INDUSTRIAL TECHNOLOGY, INC.,
Petitioner,

v.

AMSTED RAIL COMPANY, INC.,
Patent Owner.

IPR2023-00539

PATENT NO. 9,981,673

ISSUED: MAY 29, 2018

**TITLE: SYSTEM AND METHOD FOR MONITORING
RAILCAR PERFORMANCE**

EXHIBIT 2164

**REPLY DECLARATION OF MICHAEL I. SHAMOS, PH.D.
IN SUPPORT OF PATENT OWNER’S REVISED MOTION TO AMEND**

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

I. INTRODUCTION AND QUALIFICATIONS

2. I have been retained as an expert on behalf of Patent Owner to provide technical analysis and opinions relating to the Petition for *Inter Partes* Review (“Petition,” Paper 1) filed by Hum Industrial Technology, Inc. (“Hum” or “Petitioner”) challenging the validity of Claims 1-18 and 20-32 (the “Challenged Claims”) of U.S. Patent No. 9,981,673 (“the ’673 Patent” or “the Patent”). I have also been asked to provide opinions relating to the Substitute Claims presented in Patent Owner’s Reply in Support of Revised Motion to Amend (“RRMTA,” filed concurrently), which is a reply to “Petitioner’s Opposition to Patent Owner’s Revised Motion to Amend” (“Opp’n,” Paper 37).

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

4. I previously submitted declarations in this matter. The first was entitled, “Declaration of Michael I. Shamos, Ph.D. on Behalf of Patent Owner,” dated May 15, 2023 (EX2001). My background, qualifications and compensation were set forth in ¶¶ 4-14 and 21-22 of EX2001. I then submitted a “Declaration of Michael I. Shamos, Ph.D. in Support Of Patent Owner’s Response” (EX2010) and a

“Declaration of Michael I. Shamos, Ph.D. in Support Of Patent Owner’s Motion to Amend” (EX2158). Most recently, I submitted a “Declaration of Michael I. Shamos, Ph.D. in Support of Patent Owner’s Revised Motion to Amend” (EX2163).

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

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

II. MATERIALS CONSIDERED

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

8. I have also relied on my education, skill, training, and experience in the relevant fields of technology. I have further considered the viewpoint of a person of ordinary skill in the art (“POSITA”) at the time of the invention of the ’673 Patent.

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

III. SUMMARY OF MY OPINIONS

10. The following table summarizes the current grounds of challenge (“Grounds”) to the Substitute Claims raised in the Opp’n.

Grd.	Sec.	References	Challenged Claims
1	§ 103	LeFebvre, Barone, Moretti, Inbarajan, and Betters	23-43
2	§ 103	LeFebvre, Armitage Barone, Moretti, Inbarajan, and Betters	23-43

11. After a review of the Substitute Claims and the alleged prior art asserted by Petitioner, it is my opinion that the Substitute Claims are not invalid under any of the Grounds. My opinions, and the bases therefor, are detailed throughout this Declaration.

12. In this Declaration, I only address issues that are raised in the Opp’n and the RRMTA.

IV. WRITTEN DESCRIPTION SUPPORT FOR THE SUBSTITUTE CLAIMS

A. Claim 23: “mounted on a sidewall of a bearing adapter”

13. Petitioner alleges lack of written description support for the claim 23 limitation requiring the sensor to be “mounted on a sidewall of a bearing adapter.” I note, however, that the ’673 Patent indeed discloses an adapter-mounted sensor unit, and the sidewall is the only adapter mounting location expressly disclosed in the specification. Figures 3 and 3A, referred to be Petitioner, do not limit the sensor device to being only a temperature sensor. Therefore, the specification reasonably conveys to a POSITA that the inventors had possession of the claimed sensor units “mounted on a sidewall of a bearing adapter.”

B. Claim 23: “a plurality of defined severity levels that are each assignable based on respective possible values for a magnitude of the deviations of one or more numeric values from nominal operating conditions for the bearing during operation of the railcar”

14. Petitioner alleges lack of written description support for this claim 23 limitation, basically alleging that the limitation itself does not appear verbatim in the specification. Opp’n at 4-6. I understand that written description does not require an *in haec verba* passage in the disclosure, but instead the test is whether a POSITA would reasonably understand that the inventors has possession of the invention.

15. In any case, support for the limitation is found in the Patent’s description of “Leveled Alarms and Responses.” *See* EX1001, 11:59-12:65, 13:30-14:3. It provides a detailed description of assigning severity levels, e.g., at EX1001, 13:30-4:3. The specification explains that severity levels may be triggered by thresholds and ranges based on parameters that are measured and/or compared with other numerical values, with temperature being the example described in the specification. *Id.* Neither Petitioner nor its expert has viewed the specification and claim limitation from the perspective of a POSITA. Had they done so, they should have realize that the disclosure of comparisons between the detected data and the range thresholds would reasonably convey possession of the invention.

C. Claim 23: “numeric values derived from the data or processed information”

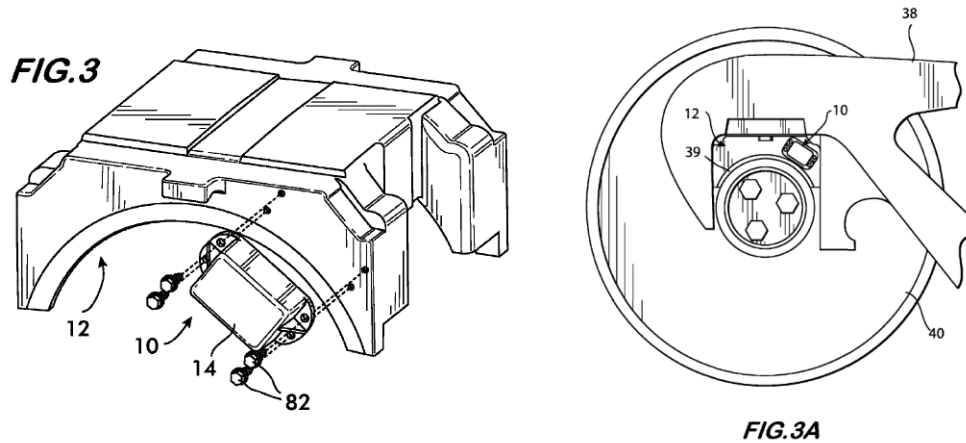
16. Petitioner's position seems to be that the literal words of this limitation do not appear in the specification, a requirement that I understand has no legal basis. Under the correct legal standard, Patent Owner's citations provide written description support because they inform a POSITA that the inventors had possession of the invention.

17. Regarding the "sensed data," the specification discloses that "heuristics may be applied to determine potential failures based on statistical models and empirical data." EX1001, 2:66-3:1. The specification disclose numerous such heuristics. Two of these are bearing fault indicators: one uses the fast Fourier transform (FFT) to isolate dominant modes and shifting or relative amplification of the accelerometer data; a second calculates kurtosis and a probability density function. *See* EX1001, table spanning cols. 7-12; RMTA, 11. A POSITA would have understood that both FFTs and kurtosis involve the calculation of numeric values derived from the data received from the sensors. Indeed, there is no other way to computer FFTs and kurtosis other than numerically. Thus the specification sufficiently conveys to a POSITA that the inventors were in possession of claim 23.

D. Claims 27, 28, 30, and 31: "accelerometer"/"acceleration data"

18. I understand that the fact that a large part of the specification is devoted to a temperature sensor embodiment does not mean that the disclosure is inapplicable to accelerometers. It is necessary to look at the overall teachings of the Patent.

Support is provided for a sensor 10 attached to the sidewall of a bearing adapter 12. See EX1001 at 4:48-56, Table col. 9 (“adapter mounted accelerometer”); Figs. 3, 3A:



19. Further, original claims 17 and 32 of the Patent’s parent application clearly contemplate a sensing unit mounted on a railcar and having an accelerometer. EX2004 at 31-32, 34. This disclosure provides adequate written description support for claims 27, 28, 30, and 31.

20. Petitioner’s expert states that “[t]he art to which these claims are directed—systems and sensors for monitoring operational parameters of railcars—is predictable, involving simple mechanical components and widely available, off-the-shelf electronic components.” EX1003, ¶¶69, 187. Petitioner simply contends that a POSITA would attach a sensor to a stationary part of the car “because this arrangement is mechanically simple, conventional, and easier to implement.” Petition, 30, 66. However, that fact that a simple arrangement would suggest itself

does not imply that a POSITA would not find that the embodiments described in the Patent require detailed disclosure of how to attach these “predictable, ... simple mechanical components” (e.g., an accelerometer device) to the sidewall as depicted in Fig. 3.

21. For these reasons claims 27, 28, 30, and 31 do find adequate written description.

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

22. For this limitation, Petitioner argues that the disclosure relied on by Patent Owner is “a generic statement” that is not sufficient to support the claim language. On the contrary, the specification expressly states that “[t]he heuristics shown in the chart above may be performed by either mobile base station 42 or land-based base station 44.” EX1001 at 11:51-54. This is by no means “a generic statement.” A land-based station is clearly “remote from said railcar,” and is an explicit disclosure of the location(s) at which the heuristic data analysis can be performed. Thus the specification reasonably conveys to a POSITA that the inventors had possession of claim 30.

F. Claim 33: “calibrated correlations...”

23. A POSITA would have understood that indirect temperature measurements would require correlating the measured temperature to the temperature of the part of genuine interest. See EX1001 at 5:59-62 (“Since the

temperature sensor is not in direct contact with the bearing, but the bearing adapter, the device is calibrated so that the temperature reading is indicative of the bearing temperature.”). A POSITA would have understood that precise correlations and temperatures need not be disclosed in the specification because “different [bearing adapter] models have different sizes and configurations” and calibration information “can be developed with suitable testing.” EX1001, 6:1-4. Further, the specification discloses numerous such correlations, e.g. at least five times in the table beginning at col. 7. These disclosures reasonably convey to POSITA that the inventors possessed this limitation of invention of claim 33.

G. Claim 33: “temperatures”/“temperature value(s)”

24. Here Petitioner argues that limitation 33(c) “introduces a new claim term,” namely “an acceptable range of temperatures,” which is says is “defined in the claim” as “defined range of temperatures expected during normal operation of the railcar.” Petitioner then argues that no such range is disclosed in the specification. Opp’n, 7. This argument is fatuous. Clearly the “defined range of temperatures” depends on the particular component who temperature is being measured, and it would be impossible for the specification to anticipate all such components. Each component, as would be known to a POSITA, must operate within a certain range of temperatures. Too cold is unacceptable and too hot is also unacceptable. The upper and lower limits are dependent on the component.

25. Originally filed claim 47 of the Patent's parent application explicitly recited "an acceptable range of temperatures which provides literal support. EX2004 at 36. Further, a POSITA would have understood that there are multiple recitations of temperature thresholds in the specification, each of which define ranges. *See* RMTA at 18. Petitioner argues, without basis, that thresholds do not disclose ranges. Opp'n, 10. A POSITA would have known that a range is a set of temperatures bounded by an upper and a lower threshold and would have understood that a series of escalating thresholds produces a range. *See* EX1001, 13:30-14:58. Thus, the specification reasonably conveys to a POSITA that the inventors were in possession of this limitation of claim 33.

H. Claim 33: "transmitting an alarm"

26. I understand that limitation 33(d) includes a typographical error that was corrected in the Corrected Claim Appendix that is to be filed with the RRMTA. As corrected, this limitation does not include a requirement for two alarms. For "the specific set of conditions" language of the claim, Petitioner seems to insist, incorrectly, that that phrase must literally appear in the specification. Limitation 33(d) is supported at least as follows. The "Stage 3" alarm is triggered when "any bearing is at a temperature a predetermined amount above ambient." EX1001, 13:49-51. This expressly discloses sending an alarm when the measured value is outside the acceptable range and when it falls within one of the recited severity levels.

Further, example, the “Stage 4” alarm triggers at a predetermined temperature, which is one outside the acceptable range of temperatures and falls within a severity level. EX1001, 14:1-2.

27. Therefore, claim 33 finds written description support in the specification.

V. ADDITIONAL §112 ISSUES

A. Alleged indefiniteness

1. Claims 33, 34, 35: “temperatures”/“temperature value(s)”

28. Petitioner argues that the terms “temperatures” and “temperature values” are indefinite. Opp’n, 12. I cannot image a POSITA (or even any adult human being) who would not understand what a “temperature” is or that “temperature value” is a number representing a temperature. I therefore cannot understand what could possibly be indefinite about a claim that uses those terms.

B. Alleged lack of enablement

29. I am informed that the enablement requirement is met with respect to as claim if the specification enables any mode of making and using the invention of a claim.

1. Claim 23: “determining the condition of the bearing by applying a heuristic”

30. Petitioner argues that this limitation is not enabled because “[c]aim 23 is not limited to any particular technique for correlating any particular type of

measurement ... with the condition of the bearing.” Opp’n, 13-14. However, the specification discloses various heuristics in the table beginning at col. 7 that a POSITA would be able to implement without undue experimentation, including heuristics applied to values of temperature and vibration.

2. Claim 23: “assigning a severity level”

31. A POSITA would know how to assign a severity level to a deviation from normality. Which specific level should be assign, as a POSITA would know, depends on the specific requipment being deployed. For example, a beairng made of a new material might be able to withstand higher temperatures than its predecessor material and would not fail at the same temperature. Indeed, some experimentation would be needed to determine the severity associated with temperature X. But this is not undue experimentation, *nor is it even experimentation to determine how to to implement the invention*. It is experimentation to determine specific values of a parameter to plug into an existing implementation. If the severity levels are known for any temperature values of any known part (or even just how to determine such severity levels), then the limitation is perforce enabled. A POSITA would know how to determine a correlation between bearing vibrations of a particular magnitude and frequency by examining a bearing exhibiting that behavior. Such experimentation is specifically called for in the Patent at 6:2-4: “Calibration

information for use by the circuitry 26, such as a calibration algorithm, can be developed with suitable testing.” Therefore, the experimentation is not “undue.”

3. **Claims 27, 28, 30, and 31: “accelerometer”/“acceleration data”**

32. As I explained above, the specification of the ’673 Patent discloses multiple examples of heuristics for analyzing acceleration, including bearing acceleration with “an adapter mounted accelerometer. *See* EX1001, Table spanning cols. 7-12. *See* ¶¶18-21. A POSITA would only need to engage in routine experimentation to determine how to implement these heuristics.

4. **Claim 33: “calibrated correlations”**

33. Here Petitioner raises the same “undue experimentation” argument already dealt with above in ¶31. Even Petitioner’s expert concedes that the relevant art “is predictable, involving simple mechanical components and widely available, off-the-shelf electronic components.” EX1003, ¶¶69, 187. Researchers at UTGRV, under the direction of the inventors, engaged in the normal experimentation that would be expected of a POSITA.

5. **Claim 33: “temperatures/temperature values”**

34. *See* ¶¶24, 28.

6. **Claims 36, 42: “determine a condition of the bearing,”
“assign/assigning a severity level”**

35. *See* ¶¶14-15, 26, 31.

VI. PRIOR ART ARGUMENTS

36. Petitioner adopts the untenable position that claims 33 and 42 are meaningless as indefinite, but somehow are sufficiently understandable that they are obvious in light of prior art. Even if Petitioner is able to wriggle out of this contradiction, it has not made an adequate showing of obviousness.

A. LeFebvre, Armitage, and Barone

37. I previously analyzed the shortcomings of LeFebvre, Armitage, and Barone in earlier declarations relative to the limitations challenged now. *See* EX2001, ¶¶82-87 (“applying a heuristic”), 95 (“acceptable range of temperatures”), 103-104 (motivation to combine Armitage and Barone), 105-109 (motivation to combined Armitage and LeFebvre). *See also* EX2158, ¶¶28-45, EX2163, ¶¶37-59.

38. Further, Petitioner seems to equate “heuristic” with “calculations.” The two are not the same. While the disclosed heuristics do involve numerical calculations, not all calculations constitute heuristics. For example, adding up a list of numbers is a calculation, but is not a heuristic. The heuristics in the Patent implement rules of thumb to correlate measured quantities with the state of a railcar part. This is not taught by the applied references.

B. Moretti, Inbarajan, and Betters

39. Petitioner now relies on patchwork combinations of five references (Ground 1) or six references (Ground 2) motivated only by hindsight. Opp’n, 17-18. Even so, these combinations do not render obvious any of the Substitute Claims.

40. Petitions asserts that a POSITA would combine Armitage, LeFebvre, Barone, and Moretti because they are in the same field of art as the ’673 Patent. I understand that merely being in the same field does not by itself provide a motivation to combine, and particularly not the sort of cherry-picking (both of references and limitations) engaged in by Petitioner.

41. Petitioner cites Moretti as supposedly teaching to mount a vibration sensor at a position that is “vertically aligned with the axis of rotation of the bearing” and to use an “alarm signal” from a temperature sensor. Opp’n, 19-21. It is elusive what the significance of such a teaching might be, as Moretti is simply cumulative of the insufficient disclosures of Armitage, LeFebvre, and Barone.

42. Inbarajan and Betters are not even in the same field as the invention, and neither has the same purpose. Inbarajan teaches sending an email to a car owner to warn of various events, such as reaching a certain mileage or a notification of low oil. EX1036, Abstract; 3:25-50. This is an impractical way of transmitting real-time notifications because the recipient is unlikely to review emails while driving (or operating a train). A POSITA would understand that the claimed real-time

notification system in the '673 Patent requires transmission of alerts in a manner commensurate with the determined severity level. While email or website notifications may be sufficient for low level alerts that are not sent to a locomotive crew, a POSITA would understand that email and website notification would not be sufficient for high severity alerts warning of imminent failure and requiring immediate action to avoid catastrophic failures such as derailment. For example, the '673 Patent discloses that “alarm levels that require the crew to take action are typically transmitted to the crew” and a POSITA would understand that a locomotive crew is unlikely to be reviewing, or even have access to, email and the World-Wide Web. EX1001, 12:52-53. Betters deals with using aircraft removal data for preventive maintenance. EX1037, 2:50-53. Data is “removed” from an aircraft after-the-fact, that is, not while the aircraft is in operation. *See e.g. id.*, 12:55-57 (disclosing example in which the database “may receive the aircraft removal data from ‘X Airlines’ from their CMC's every other day on a fleet of 6 aircraft”). The data is stored in a database, and reports are produced that can be used for preventive maintenance while the aircraft is grounded. No alarms are disclosed, for the simple reason that data is not being processed in real-time as the data is collected. The disclosure in Betters regarding “real-time” information refers to receiving the reports as they are created by a human actor. *See id.*, 13:58-65 (real-time receipt of report after an “expert” analyses the data); 14:21-31 (“virtual posting via the World-Wide-

Web ... [o]nce the expert ... analyzes the aircraft removal data.”). By contrast, the ’673 Patent continuously monitors a railcar and issues alarms in real-time as problems are detected. Combining the other references with Betters would only allow information to be processed after a train has completed its journey, far too late to avoid a possibly fatal accident.

43. Further, Inbajaran and Betters deal with single-vehicle monitoring. A train can have multiple consists and can include hundreds of cars, all of which must be monitored in a manner far beyond those of Inbajaran and Betters. A POSITA would not have consulted Inbarjaran or Betters when seeking real-time notification systems such as those disclosed in the ’673 Patent

VII. CONCLUDING STATEMENT

44. Relying on my education, experience, skill, and training in the relevant field of art, and after reviewing the materials identified above, it is my opinion that the Substitute Claims find adequate written description and are enabled. Further, the Substitute Claims are patentable over the prior art applied in the Opp’n.

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

examination remotely within the United States during the time allotted for such cross-examination at a time and place agreed by counsel.

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

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

Executed April 25, 2023 at Columbus, Ohio.


Michael I. Shamos