

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

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**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

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HUM INDUSTRIAL TECHNOLOGY, INC.,  
Petitioner,

v.

AMSTED RAIL COMPANY, INC.,  
Patent Owner.

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IPR2023-00538

PATENT NO. 9,365,223

ISSUED: JUNE 14, 2016

TITLE: SYSTEM AND METHOD FOR MONITORING  
RAILCAR PERFORMANCE

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EXHIBIT 2172

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

AMSTED 2172  
IPR2023-00538

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

## **I. INTRODUCTION AND QUALIFICATIONS**

2. I have been retained as an expert on behalf of Patent Owner to provide technical analysis and opinions relating to the Petition for Inter Partes Review (“Petition,” Paper 2) filed by Hum Industrial Technology, Inc. (“Hum” or “Petitioner”) challenging the validity of Claims 1-10, 13-18, and 20-32 (the “Challenged Claims”) of U.S. Patent No. 9,365,223 (“the ’223 Patent” or “the Patent”). I have also been asked to respond to the arguments made in “Petitioner’s Opposition to Patent Owner’s Revised Motion to Amend (“Opp’n,” Paper 41), challenging Substitute Claims 33-61.

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 four declarations in this matter. The first, “Declaration of Michael I. Shamos, Ph.D. on Behalf of Patent Owner,” was dated May 15, 2023 (“Shamos 1,” EX2001). My background, qualifications and compensation were set forth in ¶¶ 4-14 and 21-22 of Shamos 1. The legal principles I was asked to follow were set forth in ¶¶ 26-33 of Shamos 1. The characterization of a POSITA appears in ¶¶ 42-46 of Shamos 1. The second was a “Declaration of

Michael I. Shamos, Ph.D. in Support Of Patent Owner’s Response,” dated November 3, 2023 (“Shamos 2,” EX2010). The third was a “Declaration of Michael I. Shamos, Ph.D. in Support Of Patent Owner’s Motion to Amend,” dated November 3, 2023 (“Shamos 3,” EX2158). Additional legal principles I was asked to follow were contained in ¶¶ 13-16 of Shamos 3. The fourth was a “Declaration of Michael I. Shamos, Ph.D. in Support of Patent Owner’s Revised Motion to Amend, dated March 8, 2024 (“Shamos 4,” EX2171). The Revised Motion to Amend (Paper 36) is abbreviate herein as “RMTA.”

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

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

## **II. MATERIALS CONSIDERED**

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 ’223 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 grounds of challenge (“Grounds”) raised in the Opp’n:

| <b>Grd.</b> | <b>Sec.</b> | <b>References</b>                                              | <b>Challenged Claims</b> |
|-------------|-------------|----------------------------------------------------------------|--------------------------|
| 1           | § 103       | Armitage in view of LeFebvre, Barone, Moretti, and Brandmeier  | 34-58                    |
| 2           | § 103       | LeFebvre in view of Armitage, Barone, Moretti, and Brandmeier  | 34-58                    |
| 3           | § 103       | Armitage in view of LeFebvre, Denny, Provasnik, and Culbertson | 33, 59–61                |
| 4           | § 103       | LeFebvre in view of Denny, Provasnik, and Culbertson           | 33, 59–61                |

11. Petitioner in the Opp’n also raised indefiniteness, lack of written description, and lack of enablement. 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 Petitioner’s arguments. My opinions, and the bases therefor, are detailed throughout this Declaration.

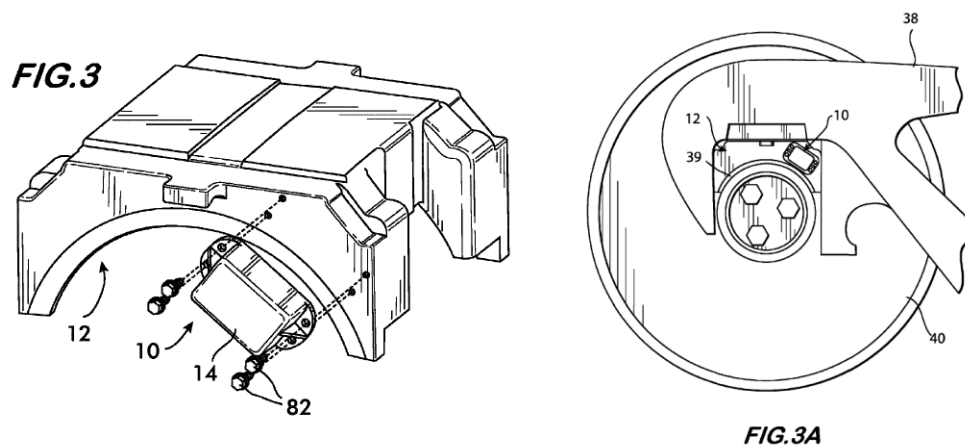
### **IV. WRITTEN DESCRIPTION SUPPORT FOR THE SUBSTITUTE CLAIMS**

12. Petitioner asserts that Substitute Claims 34-58 lack written description. On the contrary, Substitute Claims 34-58 are adequately described.

**A. Claims 34, 42: “mounted to a sidewall of a bearing adapter”**

13. I understand that Petitioner did not challenge written description support for the unamended limitations of claim 34. Support for these claim limitations is present in the specification of both the '223 patent and the '661 Provisional, to which it claims priority. See EX1001 at 2:55-58; 3:48-54; 3:60-63; 4:5-10; 4:39-48; 4:66-5:7; 5:11-23; 5:30-46; 8:7-10; Table spanning cols. 7-12; 11:28-32; 11:39-47; 11:63-12:31; 15:25-30; FIGs. 1, 2, 3, 3A; EX1013 at [00064]-[00076], [00109]-[00131]; FIGs. 3, 9, 8, 8A, 10A; EX1002, 510 (originally filed claim 32); EX1014, [0025].

14. Regarding a sensing unit “mounted to a sidewall of a bearing adapter,” FIGs. 3 and 3A, reproduced below, quite literally show mote 10 (sensor) mounted to the sidewall of bearing adapter 12.



15. The specification states that the sensor “*can be any type of sensor.*” EX1001 at 4:51-52; Table, col. 9. This disclosure, together with the disclosures of

FIGs. 3 and 3a provide support for a mote with a temperature sensor mounted on a sidewall of a bearing adapter. Therefore, the specification does not limit the type of sensor that can be mounted on a sidewall, and thus a POSITA would recognize that the inventors had possession of any type of sensor “mounted to a sidewall of a bearing adapter.”

**B. Claims 34, 42: “numeric values derived from the data”/ “numeric values based on the collected data”**

16. The specification describes a system that monitors the condition of a bearing at a bearing adapter to identify and predict various operational characteristics of the bearing. The specification also discloses that “heuristics may be applied [to sensed data] to determine potential failures based on statistical models and empirical data.” EX1001 at 2:60-62. Further, a table of example heuristics that spans columns 7-12 provides a POSITA with the necessary disclosure to understand that the “one or more numeric values” can be “derived from the data or processed information.” Among the heuristics taught in the referenced table are two bearing fault indicators, one using fast Fourier transforms (FFTs) to isolate dominant modes and shifting or relative amplification of the accelerometer data, and the other calculating kurtosis and calculating a probability density function. A POSITA would understand that both FFTs and kurtosis produce “numeric values based on the collected data.” Therefore, a POSITA would understand that the inventors were in possession of this limitation of claims 34 and 42.

C. **Claims 34, 42: “land-based remote station”/“land-based remote unit”**

17. Petitioner’s argument is based on a complete misreading of the literal words of the specification disclosing that the CMU “is capable of wirelessly collecting data from each of the motes and performing higher-level analysis of the data ... [d]uring such data analysis, heuristics may be applied” and that “CMU 32 ... communicates data and alarms to a remote location, **either** a mobile base station 42 located on the train ... **or to a stationary, land-based station, 44, or both.**” EX1001 at 2:55-3:7, 8:5-7, 11:28-32, 11:39-45. Petitioner ignores this express language to conclude, incorrectly, that there is no disclosure of any embodiment “wherein both the CMU and a ‘land-based remote unit’ perform the claimed steps as required by claim 42 and as expressly encompassed by claim 34.” Opp’n, 5-6. This is just flatly wrong. The written description for this limitation is in black and white in the specification.

D. **Claim 34: “a housing comprising a non-flexible material that is resistant to environmental damage”**

18. The specification discloses that the housing is preferably made of a “hard plastic resistant to environmental damage” and also provides examples (using “e.g.”) of such materials. EX1001 at 4:5-10, Figs. 1-2. To a POSITA, the purpose of the “hard plastic resistant to environmental damage” is to protect the housed sensor from being crushed or exposed to environmental deterioration. A POSITA would

understand that a “non-flexible” material accomplishes the same purpose as a “hard plastic.” Therefore, this limitation of claim 34 has adequate written description given the purpose, the predictability of using non-flexible materials, and the disclosure.

**E. Dependent Claims 35-41 and 43-58**

19. Claims 35-41 and 43-58 satisfy the written description requirement for the reasons discussed above for independent claims 34 and 42.

20. For dependent claims 45 and 46, Petitioner argues that the specification lacks written description of a “vibration sensor or accelerometer configured to sample dynamic vibration data.” Opp’n at 6-7. Petitioner does not recognize that originally filed claim 32 recited both “vibration sensors” and “acceleration sensors.” EX1002 at 31-32, 34, 563; see also RMTA, 16 (disclosing an accelerometer). A POSITA would understand from the disclosure that either a vibration or accelerometer sensor could be placed on the side wall, as shown in Figure 3 and 3A, reproduced at ¶14.

21. For dependent claim 48, Petitioner appears to insist that the literal words of the claim must appear verbatim in the specification, which I understand is not the law. Opp’n at 7. Petitioner fails to response to any of Patent Owner’s citations to the specification, including literal written description of temperature and alarm thresholds, which are defined parameter value ranges associated with a bearing.

EX1001, 4:66-5:7, 6:1-7, 6:35-38, 11:61-12:38, 13:23-24, 13:41-42. Therefore, these limitations are adequately supported.

**V. DEFINITENESS AND ENABLEMENT OF THE SUBSTITUTE CLAIMS**

**A. Definiteness**

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

22. Petitioner seems to confuse indefiniteness with written description support regarding these limitations. *See* Opp’n, 7. As discussed at ¶16, there are ample disclosures in the specification providing written description support for these claim terms phrases. Neither Petitioner nor its expert explain in any way how a POSITA would find the phrases “numeric values derived from the data” or “numeric values based on the data” in any way indefinite, especially because the heuristics for calculating these numeric values are disclosed in the specification. These terms and their usage in claims 34 and 42 take their plain meaning and reasonably convey the scope of the respective claims to a POSITA.

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

23. Petitioner does not even begin to explain what could possibly be indefinite about this term, which a POSITA would readily understand to take its plain and ordinary meaning. The specification uses the word “flexible” at 4:20-22

to describe the compound urethane, and at 6:29-33 to describe PVC (polyvinyl chloride), both of which a POSITA would recognize as flexible. The Patent also explains the “demanding environment in which railroad trains operate,” which reasonably informs a POSITA as to the type of environmental damage the material must be resistant to. EX1001, 2:36-38, 4:14-19 (“harsh railroad environment” includes “harsh weather, UV exposure, humidity, vibration, mechanical impact, thermal shock, and abrasion”). Therefore, this claim phrase is not indefinite.

**B. Enablement**

**1. Claims 34, 42: “correlate one or more numeric values derived from the data to the condition of the bearing,” “determine a severity of the condition of the bearing”**

24. Petitioner asserts that the Patent does not disclose any correlations that would enable a POSTIA to practice these claim limitations. Opp’n, 8-10. On the contrary, the specification discloses specific heuristics that a POSITA would be able to implement without undue experimentation, including correlations to temperature and vibration. See EX1001, Table spanning cols. 7-12; EX2171, ¶18. Implementing these heuristics would require merely routine experimentation to determine how various level of temperature elevation and vibration would affect a railcar component. Such testing is expressly called for in the specification at 5:55-57: “Calibration information for use by the circuitry 26, such as a calibration algorithm, can be developed with suitable testing.”

**VI. PETITIONER HAS NOT ESTABLISHED THAT SUBSTITUTE  
CLAIMS 33-61 ARE UNPATENTABLE OVER THE ART OF  
RECORD**

25. I point out the clear contradiction in Petitioner's positions that claims 34 and 42 are invalid for indefiniteness, yet are sufficiently understandable as to be obvious.

26. For claims 34-58, Petitioner attempts to cure the deficiencies in its prior asserted Grounds by appealing to two more references: Moretti (EX1029) and Brandmeier (EX1031). Petitioner simply asserts, in hindsight fashion, that both Moretti and Brandmeier are analogous art to the other references relied on, but they are not. Petitioner does not explain why a POSITA would be motivated to combine any of the five asserted references, let alone why a POSITA would combine them in the fashion detailed by Petitioner. Petitioner further does to explain why Brandmeier, which is directed to a sensor for a motor vehicle, is analogous art when it is from a different field.

27. Brandmeier is not reasonably pertinent because it utilizes a noise sensor in a two-piece housing (including a jacket and cover) in a car engine to trigger a passenger protection system. EX1031, [0002-0003, 0027]. Monitoring railcars, as claimed in the '223 Patent, differs because, among other things, railcars are serially connected and are tethered together to move together along a track in a "demanding environment." This requires monitoring every railcar to allow for prompt and

accurate prediction and identification of any cars that “can damage the track infrastructure and lead to derailments.” EX1001, 1:26-29, 1:39-44, 2:36-44, 4:14-19.

## **VII. CONCLUDING STATEMENT**

28. 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 written description support in the '223 Specification and the '661 Provisional and are enabled and not indefinite. Further, the Substitute Claims are patentable over the prior art applied in the Opp'n.

29. 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.

30. 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.

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

Executed May 10, 2024 at Pittsburgh, PA.

  
Michael I. Shamos