

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

Case IPR2023-00539
Patent No. 9,981,673

Before JAMES P. CALVE, KEVIN W. CHERRY, and MICHAEL L. WOODS,
Administrative Patent Judges.

**DECLARATION OF STEVEN RICCA
IN SUPPORT OF PETITIONER'S REPLY TO PATENT OWNER'S
RESPONSE**

1. I, Steven Ricca, hereby declare that the following is true and correct. I previously provided a declaration filed as Ex. 1003 in support of Paper No. 1, Petition for *Inter Partes* Review, and my testimony from that first Declaration remains the same. I am competent to make this Declaration based upon my personal knowledge and technical expertise, which I addressed in my first Declaration. If called to testify, I could and would testify honestly, under oath, to the matters set forth herein.

2. 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.

3. In the Decision Granting Institution of *Inter Partes* Review (Paper No. 10) (“Institution Decision”), the Board interpreted the term “nominal operating conditions” to mean “normative or expected conditions based on trends, conditions of other components, ambient conditions, and predetermined values.” Institution Decision, 8. I agree with the Board’s construction, which accurately reflects the meaning of “nominal operating conditions” as that term is used in the ’673 Patent.

4. I disagree with Patent Owner’s expert, Mr. Shamos, that the term “nominal operating conditions” does not include “*normative* operating conditions.” EX2010, ¶ 29. For example, the Board correctly found that “normative operating conditions”

are based on “predetermined values,” as described in the ’673 Patent. For example, see the ’673 Patent, EX1001 at 14:1–3:

Stage 4: “Critical Alarm”: this is the absolute alarm set at
a predetermined bearing temperature
Action: Stop train, remove bearing

The “predetermined bearing temperature” is a *normative* limit, corresponding to the maximum permissible operating temperature of the bearing. If the bearing rises above this temperature, a critical alarm will be triggered and the train must be stopped and the bearing removed.

5. In the Institution Decision, the Board interpreted the term “severity level” as “a type of fault that requires a particular action.” Institution Decision, 8. I agree with the Board’s construction, which accurately reflects the meaning of “severity level” as that term is used in the ’673 Patent.

6. Specifically, the Board’s construction is consistent with the examples provided in the ’673 Patent at col. 13:9–15:46. Each of these examples describes a type of fault that requires a particular action to be taken. For example, with respect to the “Levelled Alarms and Responses” provided at 13:30–14:3:

Type of Fault	Action Required
Stage 1: “Bearing Temp Alarm”	Alarm to base station only Used for trending recommendations and repeat offender identifications
Stage 2: “Axle Differential Alarm”: is the condition any bearing that is a predetermined amount hotter than its axle mate	Action: Stop train, check journal of alarming bearing. Look for any sign that the bearing is “walking off” the

	axle, grease is being purged, or the bearing has been damaged. Proceed at predetermined reduced maximum speed until a stage 2 “alarm clear” message is received ...
Stage 3: “Above Ambient Alarm”: is when any bearing is at a temperature a predetermined amount above ambient	Action: Stop train, check journal of alarming bearing. Look for any signs that the bearing is “walking off” the axle, grease is being purged, or the bearing has been damaged. Proceed at predetermined reduced maximum speed until stage 3 “alarm clear” message is received ...
Stage 4: “Critical Alarm”: this is the absolute alarm set at a predetermined bearing temperature	Action: Stop train, remove bearing

7. In the '673 Patent, the purpose of a “severity level” is to determine whether a given deviation is severe enough to warrant an alarm. For example, the specification states that the system has “the ability to determine the severity of detected conditions to determine *if* immediate alarms should be raised.” EX1001, 2:20–22. This concept would have been familiar to a PHOSITA: high severity faults warrant an alarm and require immediate action, while low severity faults do not.

8. There are at least two examples in the '673 Patent that follow this pattern:

- i. The Level 2 Algorithms (EX1001, 14:10–58) raise an alarm if “at least four of the following five criteria are flagged for the same bearing.” If a bearing meets three or fewer criteria, no alarm is raised.

- ii. Similarly, the Level 3 Algorithms (EX1001, 14:59–15:46) raise an alarm if “a bearing is ranked in the top five percent for at least four of the five criteria.” If a bearing meets three or fewer criteria, no alarm is raised.

In both of these examples, there are only two possible outcomes: (1) an alarm is raised, or (2) an alarm is not raised.

9. I disagree with Mr. Shamos’s statement that a bearing fault “cannot be a ‘severity level’ for the simple reason that different bearing faults may have different levels of severity.” I agree that different types of bearing faults have different levels of severity. It is also obvious that different types of bearing faults will require different actions, depending on how severe the fault is. For example, some types of bearing faults are severe enough to require an alarm, followed by reducing the maximum speed or even halting the train. Other types of bearing faults are less severe—minor defects that do not warrant an alarm, and can be addressed during the next scheduled maintenance window. This is consistent with the Board’s construction of “severity level” as “a type of fault that requires a particular action.”

10. I disagree with Mr. Shamos’s statements that LeFebvre “does not assign a severity level,” EX2010, ¶ 40, “conveys no relative information as to how severe the condition is,” *id.*, ¶ 41, and “does not disclose any assignment indicating the

seriousness of the measured unsatisfactory behavior.” *Id.*, ¶ 42. Each of these statements is factually incorrect.

11. In LeFebvre’s system, data collected from a sensor unit could indicate any of the following conditions for a given component:

1. A high-severity deviation from normal operating conditions, which warrants an alarm;
2. A low-severity deviation from normal operating conditions, which does not warrant an alarm; or
3. Nominal operating conditions (i.e., no deviation).

In other words, as I explained in my previous declaration, LeFebvre distinguishes between (1) large deviations that *are* severe enough to raise an alarm; and (2) small deviations that *are not* severe enough to raise an alarm, which is all that claim 1 requires. *See* EX1003, ¶¶ 80–83. In my experience, small deviations from nominal operating conditions that do not warrant an alarm would be considered “low severity” deviations, while large or critical deviations that warrant an alarm would be considered “high severity” deviations. I do not agree with Mr. Shamos that every “severity level” must necessarily result in an alarm.

12. Mr. Shamos argues that LeFebvre does not disclose the temperature monitoring limitations of claim 10 because “if all the bearings on a car are running hot, [LeFebvre’s] system may miss a hot temperature reading because it does not deviate sufficiently from the car average.” EX2010, ¶ 50. I respectfully disagree.

First, the scenario described by Mr. Shamos (“all the bearings on a car are running hot”) is unlikely to occur in practice. Mr. Shamos does not dispute that the monitoring technique disclosed in paragraph [0058] of LeFebvre would be effective to monitor temperatures under the vast majority of real-world scenarios (e.g., one or two failing bearings on a railcar). Second, LeFebvre states at ¶ [0033] that the instrumented pads “carry temperature sensors to give an indication of the temperature of the associated bearing, since it is important for safety that a bearing does not become overheated.” In other words, LeFebvre’s system monitors the temperature of each individual bearing associated with an instrumented pad, which means that LeFebvre’s system would successfully detect the overheating bearings even in Mr. Shamos’s contrived scenario.

13. Additionally, the same temperature monitoring technique that Mr. Shamos criticizes (comparing temperature readings taken from different bearings) is expressly disclosed in the ’673 Patent. For example:

- Stage 2: “Axle Differential Alarm”: is the condition any bearing that is a predetermined amount hotter than its axle mate (13:37–39)
- Criteria 3—Deviation from Wagon Average Analysis: Calculate the average bearing temperature and standard deviation of each bearing compared to the average of bearing temperatures for the rest of the wagon (14:31–34) (identical disclosure at 15:15–18)
- Criteria 4—Deviation from Fleet Average Analysis: Calculate the average bearing temperature and standard deviation of each bearing compared to the average of bearing temperatures for the rest of the fleet (14:40–43) (identical disclosure at 15:26–29)

In other words, the critiques Mr. Shamos directs at LeFebvre and Armitage are also applicable to the '673 Patent.

14. I disagree with Mr. Shamos's argument that LeFebvre fails to "predict potential or imminent failures based on a statistical analysis of said received data" as required by claim 14. Mr. Shamos incorrectly states that, in LeFebvre's system, "no statistical sampling takes place because all the sensors are considered."

EX2010, ¶ 55. LeFebvre expressly discloses that its sensor units engage in statistical sampling. EX1005, ¶¶ [0034]–[0035]:

"The rationale for the choice of sampling frequencies and the selection of sensors to be read is based on the type of behavior being monitored and the particular application. Sampling should be at a frequency several times the highest frequency to be detected from the data. More frequent sampling will gain no further intelligence but increase power consumption. The periodicities of sampling and reporting are controlled by the data control unit 23. . . ."

The principle discussed in paragraph [0034], that beyond a certain point "more frequent sampling will gain no further intelligence," is based on the Nyquist–Shannon sampling theorem and would have been well-known to a PHOSITA.

15. Mr. Shamos also argues that "Petitioner fails to point to any disclosure in LeFebvre that discloses a method utilizing statistical analysis for the simple reason that no such disclosure exists." EX2010, ¶ 57. Again, Mr. Shamos is incorrect. In my experience, the plain and ordinary meaning of "statistical analysis" is quite

broad: it is a branch of mathematics dealing with the collection, analysis, interpretation, and presentation of masses of numerical data. A PHOSITA would understand that many of LeFebvre's disclosed methods involve statistical analysis. For example, paragraph [0058] of LeFebvre describes monitoring "long term trends to link to bearing condition." A PHOSITA would understand that "long term trends" are generated using statistical techniques. In fact, I am unaware of any method that could be used to generate a "trend" from a large collection of data points *without* the use of statistics. Similarly, paragraph [0060] of LeFebvre describes detecting high amplitude loads that repeat periodically. A PHOSITA would understand that, starting with a large collection of data points, repeating or periodic signals can be identified using statistical techniques. Again, I am unaware of any method that could be used to identify repeating periodic signals in a large collection of data points *without* the use of statistics.

16. I also disagree with Mr. Shamos's argument that "Frequency Spectrum Analysis" "does not refer to a statistical analysis." EX2010, ¶ 58. Frequency Spectrum Analysis is used to identify repeating patterns or trends in a set of collected data points, and is therefore statistical in nature. More generally, a PHOSITA would understand that in the course of performing Frequency Spectrum Analysis, statistical methods are used that expose minimums, maximums, mean values, degrees of deviation, and rates of change from previous data. While the

capturing of the data has many forms, vibration analysis in particular relies heavily on statistical methods to decipher complex signal processing.

17. Mr. Shamos argues that Armitage does not disclose “applying a heuristic to said received data to determine deviations from nominal operating conditions” because “a value that Armitage may regard as acceptable (because it is consistent with other sensor values) can be wildly out of a nominal range.” EX2010, ¶ 75. This is a rehash of Mr. Shamos’s argument against LeFebvre, and it is incorrect for the same reasons. The dynamic monitoring technique disclosed by Armitage would be expected to work reliably under the vast majority of real-world conditions. A PHOSITA would also understand that Armitage’s dynamic monitoring could—and in practice, likely would—be combined with individual sensor thresholds (e.g., alarming if an individual sensor reading exceeds 250°F).

18. With respect to claim 10, Mr. Shamos argues that Armitage fails to disclose the limitations of “(a) sensing the temperature of a part of the railcar other than the desired part by use of a temperature sensor in thermal communication with said other part; and (b) determining the temperature of the desired part by use of the temperature sensed in step (a).” Specifically, Mr. Shamos argues at EX2010, ¶ 89:

“Because the temperature of the desired part is directly measured, there is no need in Armitage for transforming or otherwise using the temperature of another part (e.g., a wheel or bracket) to obtain the temperature of the undercarriage element (e.g., the bearing).”

I disagree; that is not how a PHOSITA would understand the disclosure of Armitage. A PHOSITA would understand that, on a railcar, it would be difficult and unwieldy to attach a sensor directly to a bearing, which is not directly accessible from the exterior of the railcar. For those reasons, sensors are commonly attached to exterior surfaces of bearing boxes or other components in close thermal contact with a bearing, rather than directly to a bearing itself. For example, temperature sensors are often ‘indirectly’ connected to the item to be measured; a small calibration factor can be applied to account for any temperature differences, which are typically minor (for example, the interior bearing temperature may be 10°F hotter than a convenient, nearby measurement point). Accelerometers are typically mounted in a convenient location close to the component to be measured (for example, on a rigid exterior surface in close proximity to the rolling elements in a bearing). Recognizing these well-known principles, Armitage discloses a sensor node that measures bearing temperature and is preferably attached to a “non-rotating structure,” such as a bearing mount. EX1006, ¶ [0034].

19. Finally, I disagree with the argument presented in paragraph 101 of Mr. Shamos’s declaration:

“LeFebvre discloses that a sensor goes to sleep ‘until it has to perform its next tasks,’ not waking up periodically. A POSITA would appreciate that ‘periodically’ and ‘until [sic] it has to perform its next tasks’ are two different concepts.”

I do not agree that these concepts are mutually exclusive. If a sensor periodically awakens to collect data, and enters a low-power sleep state between its collection windows, then it will “periodically collect data” and *also* save power.

* * *

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

Executed on: January 11, 2024



STEVEN RICCA