EXHIBIT 1004

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ETN CAPITAL, LLC, d/b/a BEECH LANE

Petitioner

v.

FBA OPERATING CO.,

Patent Owner

Case No. IPR2024-01445

US Patent No. 10,890,925

DECLARATION OF JAMES E. GRIMES

TABLE OF CONTENTS

Lits of Materials Reviewed..... vii

Listing Of Claims ix

I. BACKGROUND 1

II. STANDARDS FOR ANALYSIS 4

III. THE '925 PATENT 6

A. Overview of '925 Patent 6

B. Claim Construction..... 8

IV. GROUNDS ASSERTED IN PETITION 9

V. RV LEVELING BACKGROUND 10

VI. SUMMARY OF PRIOR ART RELIED UPON 14

A. Thorpe (ETN1005) 14

B. Clark (ETN1006)..... 16

C. Garceau (ETN1007) 17

D. TealLevel (ETN1018) 19

VII. ANALYSIS OF GROUNDS 1 & 2 - OBVIOUSNESS OVER THORPE IN VIEW OF CLARK (GROUND 1) OR TEALLEVEL (GROUND 2) AND FURTHER IN VIEW OF GARCEAU 20

A. Summary of Analysis for Grounds 1 and 2..... 20

B. Analysis of Claims 23

1. Claim 1 (Grounds 1 & 2) 23

a) Element [1.0] – leveling system 23

b) Element [1.1] – sensor device 24

c) Elements [1.2], [1.2.1] and [1.2.2] –printed circuit board including a digital accelerometer and a processor 24

d) Element [1.3] – smart device with display 26

e) Element [1.4] –configured to calculate adjustment pairs 27

f) Element [1.5] – configured to display an image representative of the vehicle 28

g) Element [1.6] – configured to simultaneously display adjustment pairs 29

h) Element [1.7] – configured to update display in real-time 32

2. Claim 2 (Grounds 1 & 2) 33

3. Claim 3 (Grounds 1 & 2) 36

4. Claim 4 (Ground 2) 37

5. Claim 5 (Ground 2) 39

6. Claim 6 (Grounds 1 & 2) 40

7. Claim 8 (Grounds 1 & 2) 40

8. Claim 9 (Grounds 1 & 2) 41

9. Claim 10 (Grounds 1 & 2) 42

a) Element [10.0] – method for leveling a recreational vehicle.. 42

b) Element [10.1] – sensing inclination 43

c) Element [10.2] – determining adjustment pairs..... 43

d) Element [10.3] – displaying image representative of vehicle..... 44

e) Element [10.4] – simultaneous displaying adjustment pairs adjacent respective sections of the vehicle 45

f) Element [10.5] – real-time updates..... 47

10. Claim 11 (Grounds 1 & 2)..... 48

11. Claims 12 (Ground 2)..... 49

12. Claim 13 (Grounds 1 & 2)..... 50

13. Claim 15 (Grounds 1 & 2)..... 51

a) Element [15.0] – non-transitory computer readable medium..... 51

b) Element [15.1] – receiving pitch angle measurement and roll angle measurements..... 51

c) Element [15.2] – calculating adjustment pairs 51

d) Element [15.3] – displaying image of vehicle..... 52

e) Element [15.4] – simultaneous display of adjustment pairs... 53

f) Element [15.5] – real-time updates..... 54

14. Claim 16 (Grounds 1 & 2) 56

15. Claim 17 (Ground 2) 56

16. Claim 18 (Ground 2) 57

17. Claim 19 (Grounds 1 & 2) 58

VIII. GROUNDS 3 AND 4-– OBVIOUSNESS OVER THORPE IN VIEW OF CLARK (GROUND 3) OR TEALLEVEL (GROUND 4) AND FURTHER IN VIEW OF GARCEAU AND COMMON KNOWLEDGE 59

IX. GROUND 5 & 6 – OBVIOUSNESS OVER GARCEAU IN VIEW OF TEALLEVEL (GROUND 5) AND FURTHER IN VIEW OF COMMON KNOWLEDGE (GROUND 6) 60

A. Summary of Analysis for Grounds 5 & 6 62

B. Analysis Of Claims 62

1. Claim 1 (Ground 6) 62

a) Element [1.0] – leveling system 62

b) Element [1.1] – sensor device 63

c) Elements [1.2, 1.2.1, and 1.2.2] – printed circuit board including a digital accelerometer and a processor 64

d) Element [1.3] – smart device with display 64

e) Element [1.4] – configured to calculate adjustment pairs 65

f) Element [1.5] –configured to display image representative of vehicle 67

g) Element [1.6] – configured to simultaneously display adjustment pairs 68

h) Element [1.7] – configured to update display in real-time 69

2. Claim 2 (Ground 6) 69

3. Claim 3 (Ground 6) 70

4. Claim 4 (Ground 6) 70

5. Claim 5 (Ground 6) 71

6. Claim 6 (Ground 6) 72

7. Claim 7 (Ground 6) 72

8. Claim 8 (Ground 6) 73

9. Claim 9 (Ground 6) 74

10. Claim 10 (Ground 5) 74

a) Element [10.0] Preamble 74

b) Element [10.1] – sensing inclination 75

c) Element [10.2] – determining adjustment pairs 75

d) Element [10.3] – displaying image representative of vehicle 77

e) Element [10.4] – simultaneously displaying adjustment pairs 77

f) Element [10.5] – real-time updates of graphical display 78

11. Claim 11 (Ground 5) 78

12. Claim 12 (Ground 5) 79

13. Claim 13 (Ground 5) 80

14. Claim 14 (Ground 6) 80

15. Claim 15 (Ground 5) 81

a) Preamble [15.0] – non-transitory computer readable medium 81

b) Element [15.1] - receiving pitch and roll measurements 81

c) Element [15.2] – calculating adjustment pairs 82

d) Element [15.3] - displaying image of vehicle 83

e) Element [15.4] - simultaneously displaying 84

f) Element [15.5] - real-time updates 84

16. Claim 16 (Ground 5) 85

17. Claim 17 (Ground 5) 85

18. Claim 18 (Ground 5) 86

19. Claim 19 (Ground 5) 86

20. Claim 20 (Ground 6) 87

LIST OF MATERIALS REVIEWED

Exhibit No.	Description
1001	U.S. Patent No. 10,890,925 (the '925 Patent)
1002	Prosecution History of the '925 Patent (App. No. 15/619,261)
1003	Prosecution History of the '925 Patent (App. No. 14/961,787)
1005	U.S. Patent Pub. No. 2018/142,769 ("Thorpe")
1006	U.S. Patent No. 7,305,772 ("Clark")
1007	U.S. Patent Pub. No. 2016/0075,311 ("Garceau")
1008	U.S. Provisional App. No. 62/050,590
1010	U.S. Patent No. 7,456,014 ("Wilson")
1011	U.S. Patent No. 5,136,784 ("Marantz")
1012	U.S. Patent No. 7,786,883 ("Davison, III")
1013	U.S. Patent Pub. No. 2018/338,848 ("Park")
1018	TealLevel User's Manual, Version 1.1.0 (Jan 9, 2010)
1051	Niu, X.; Li, Y.; Zhang, H.; Wang, Q.; Ban, Y. Fast Thermal Calibration of Low-Grade Inertial Sensors and Inertial Measurement Units. Sensors 2013, 13, 12192-12217. https://doi.org/10.3390/s130912192
1052	W. -T. Liao, W. . -C. Chou, W. -Y. Lin, K. F. Lei, W. -W. Tsai and M. -Y. Lee, "CORDIC-based inclination sensing algorithm using three-axis accelerometer-based inertial sensors," 2011 4th International Conference on Biomedical Engineering and Informatics (BMEI), Shanghai, China, 2011, pp. 708-712, doi: 10.1109/BMEI.2011.6098459.
1053	X. Yao, G. Sun, W. -Y. Lin, W. -C. Chou, K. F. Lei and M. -Y. Lee, "The design of an in-line accelerometer-based inclination sensing system," *2012 IEEE International Symposium on Circuits and Systems (ISCAS)*, Seoul, Korea (South), 2012, pp. 333-336, doi: 10.1109/ISCAS.2012.6272029.
1054	Fisher, Chrisopher J. (2020). Using an Accelerometer for Inclination Sensing. (Application Note AN-1057). Retrieved from Analog Devices website:
1055	ADXL288 Data Sheet
1056	ADXL345-EP Data Sheet
1057	U.S. Patent Publication 2004/0176032
1058	U.S. Patent Publication 2014/0378056
1059	L. Guo-cheng and Y. Hong-yang, "Design and implementation of a Bluetooth 4.0-based heart rate monitor system on iOS platform," 2013 International Conference on Communications, Circuits and Systems (ICCCAS), Chengdu, China, 2013, pp. 112-115, doi: 10.1109/ICCCAS.2013.6765297.

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1061	Wakerly, John F., Digital Design: Principles and Practices, 2d Ed. Englewood Cliffs: Prentice Hall, 1995
1062	Kaplan, Steven M. Kaplan, "smart." In *Wiley Electrical and Electronics Engineering Dictionary*, Hoboken: John Wily & Sons, 2004
1063	Dictionary.com. "Dictionary.Com | Meanings & Definitions of English Words," September 12, 2024. https://www.dictionary.com/browse/smart.
1064	"Smart Device." In *Wikipedia*, September 12, 2024. https://en.wikipedia.org/w/index.php?title=Smart_device&oldid=1245328011.
1065	Morris, William, Ed., "simultaneous." In American Heritage Dictionary of the English Language, Houghton Mifflin Company: Boston 1973
1066	Anton, Howard, *Elementary Linear Algebra, 2d Edition*. Toronto, Canada: John Wiley & Sons, 1977
1067	"Vector Addition." Accessed September 12, 2024. https://www.grc.nasa.gov/www/k-12/airplane/vectadd.html.
1068	"iPhone 5 (GSM/LTE/AWS/North America) 16, 32, 64 GB Specs (A1428, ME486LL/A*, N/A, iPhone5,1): EveryiPhone.Com." Accessed September 12, 2024. https://everymac.com/systems/apple/iphone/specs/apple-iphone-5-a1428-gsm-lte-aws-tmobile-north-america-specs.html.
1069	"iPhone 6 (GSM/North America/A1549) 16, 32, 64, 128 GB* Specs (A1549, MG4P2LL/A*, 2816*, iPhone7,2): EveryiPhone.Com." Accessed September 12, 2024. https://everymac.com/systems/apple/iphone/specs/apple-iphone-6-a1549-4.7-inch-gsm-north-america-specs.html.

LISTING OF CLAIMS

Claim 1	
[1.0]	A system for leveling a vehicle, the system comprising:
[1.1]	a sensor device secured to a vehicle to sense an inclination of the vehicle in both a pitch direction and a roll direction when the vehicle is parked on an uneven surface of the ground,
[1.2]	the sensor device comprising a printed circuit board that includes:
[1.2.1]	a digital accelerometer that permits calculation in both the pitch direction and roll direction,
[1.2.2]	and a processor to process data collected by the digital accelerator;
[1.3]	and a smart device in wireless communication with the sensor device, the smart device including a display screen;
[1.4]	wherein, based on the inclination of the vehicle as sensed by the sensor device, at least one of the sensor device and smart device is configured to determine adjustment pairs, each adjustment pair including a height adjustment amount and a corresponding adjustment direction needed to level a respective section of the vehicle by movement of the respective section of the vehicle with respect to the uneven surface of the ground by the height adjustment amount in the corresponding adjustment direction;
[1.5]	wherein the display device of the smart device is configured to display at least one image representative of the vehicle and showing the respective sections of the vehicle
[1.6]	and to simultaneously display the height adjustment amount and corresponding adjustment direction of each adjustment pair adjacent to each respective section of the vehicle shown in the at least one image;
[1.7]	and wherein the smart device is further configured to update the display screen, substantially in real time, as one or more of the height adjustment amounts are changed.
Claim 2	
[2.0]	The system according to claim 1, wherein the smart device and the sensor device communicate with each other through a wireless connection and the smart device is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device.
Claim 3	

[3.0]	The system according to claim 1, wherein the adjustment indicators show the adjustments in height to at least one part of a frame of the vehicle located at or near at least one of four wheels of the vehicle.
Claim 4	
[4.0]	The system according to claim 3, wherein the smart device is configured to calculate a first adjustment in height to level the vehicle in the pitch direction and a second adjustment in height to level the vehicle in the roll direction, and wherein the smart device is further configured to calculate the adjustments in height to the at least one part of the frame of the vehicle by adding the first adjustment with the second adjustment.
Claim 5	
[5.0]	The system according to claim 4, wherein:
[5.1]	the at least one part of the frame includes a first part located at or near a front driver-side wheel, a second part located at or near a back driver-side wheel, a third part located at or near a front passenger-side wheel, and a fourth part located at or near a back passenger-side wheel;
[5.2]	an adjustment in height, if any, to the first part includes combining a rearward pitch adjustment of the first adjustment with a right roll adjustment of the second adjustment;
[5.3]	an adjustment in height, if any, to the second part includes combining a forward pitch adjustment of the first adjustment with the right roll adjustment of the second adjustment;
[5.4]	an adjustment in height, if any, to the third part includes combining the rearward pitch adjustment of the first adjustment with a left roll adjustment of the second adjustment;
[5.5]	and an adjustment in height, if any, to the fourth part includes combining the forward pitch adjustment of the first adjustment with the left roll adjustment of the second adjustment.
Claim 6	
[6.0]	The system according to claim 1, wherein the smart device is further configured to display on the display screen near-real-time height adjustments remaining that are needed to level the vehicle when the vehicle is in the process of being leveled.
Claim 7	
[7.0]	The system according to claim 1, further comprising a temperature calibration lookup table, wherein the smart device is configured to correct the height adjustment amounts based on current temperature

	readings and information from the temperature calibration lookup table.
Claim 8	
[8.0]	The system according to claim 1, wherein the vehicle includes four wheels, and wherein at least one of the sensor device and smart device is configured to determine, based on the height needed to level the vehicle in both the pitch direction and the roll direction, adjustments in height to at least one of four parts of a frame of the vehicle, the four parts of the frame located at or near the four wheels of the vehicle.
Claim 9	
[9.0]	The system according to claim 1, wherein the information sensed by the sensor device regarding the inclination of the vehicle in both the pitch direction and the roll direction is processed to determine an amount of adjustment in height to a rear section or front section of the vehicle needed to level the vehicle in the pitch direction and to determine an amount of adjustment in height to a first side section or a second side section of the vehicle needed to level the vehicle in the roll direction.
Claim 10	
[10.0]	A method for leveling a recreational vehicle, the method comprising:
[10.1]	sensing an inclination of the recreational vehicle in both a pitch direction and a roll direction when the recreational vehicle is parked on an uneven surface of the ground;
[10.2]	based on the sensed inclination of the recreational vehicle, determining adjustment pairs, each adjustment pair including a height adjustment amount and a corresponding adjustment direction needed to level a respective section of the recreational vehicle by movement of the respective section of the recreational vehicle with respect to the uneven surface of the ground by the height adjustment amount in the corresponding adjustment direction;
[10.3]	displaying at least one image, representative of the recreational vehicle and showing the respective sections of the recreational vehicle, on a display screen of a smart device;
[10.4]	simultaneously displaying the height adjustment amount and corresponding adjustment direction of each adjustment pair on the display screen adjacent to each respective section of the recreational vehicle in the at least one image;

[10.5]	and updating the display screen, essentially in real time, as the height adjustment amounts are changed.
Claim 11	
[11.0]	The method according to claim 10, wherein the step of sensing the inclination of the recreational vehicle in both a pitch direction and a roll direction is performed by a corresponding sensor device, and wherein the smart device and the corresponding sensor device communicate with each other through a wireless connection, the method further comprising storing a serial number of the corresponding sensor device in the smart device so that the smart device communicates with the corresponding sensor device.
Claim 12	
[12.0]	The method according to claim 10, further comprising:
[12.1]	calculating a first adjustment in height to level the vehicle in the pitch direction;
[12.2]	calculating a second adjustment in height to level the vehicle in the roll direction;
[12.3]	calculating any needed adjustment in height to a first part of the frame located at or near a front driver-side wheel by combining a rearward pitch adjustment of the first adjustment and a right roll adjustment of the second adjustment;
[12.4]	calculating any needed adjustment in height to a second part of the frame located at or near a rear driver-side wheel by combining a forward pitch adjustment of the first adjustment and the right roll adjustment of the second adjustment;
[12.5]	calculating any needed adjustment in height to a third part of the frame located at or near a front passenger-side wheel by combining the rearward pitch adjustment of the first adjustment and a left roll adjustment of the second adjustment;
[12.6]	and calculating any needed adjustment in height to a fourth part of the frame located at or near a rear passenger-side wheel by combining the forward pitch adjustment of the first adjustment and the left roll adjustment of the second adjustment.
Claim 13	
[13.0]	The method according to claim 10, further comprising the step of displaying on the display screen near-real-time height adjustments remaining that are needed to level the vehicle when the vehicle is in the process of being leveled.
Claim 14	

[14.0]	The method according to claim 10, further comprising the step of correcting the height adjustment amounts based on current temperature readings and information from a temperature calibration lookup table.
Claim 15	
[15.0]	A non-transitory computer readable medium comprising computer executable instructions that, when executed by a processor of a smart device, control the smart device to perform steps comprising:
[15.1]	receiving a pitch angle measurement and a roll angle measurement of a vehicle from a sensor device secured to the vehicle when the vehicle is parked on an uneven surface of the ground;
[15.2]	based on the pitch angle measurement and roll angle measurement, calculating adjustment pairs, each adjustment pair include a height adjustment amount and a corresponding adjustment direction needed to level the vehicle by movement of the respective section of the vehicle with respect to the uneven surface of the ground by the height adjustment amount in the corresponding adjustment direction;
[15.3]	and displaying, on a display screen of the smart device, at least one image representative of the vehicle and showing the respective sections of the recreational vehicle;
[15.4]	simultaneously displaying, on the display screen of the smart device, the height adjustment amount and corresponding adjustment direction of each adjustment pair adjacent to each respective section of the vehicle in the at least one image;
[15.5]	and updating the display screen of the smart device, essentially in real time, as the height needed to adjust the vehicle to level the vehicle changes.
Claim 16	
[16.0]	The non-transitory computer readable medium according to claim 15, wherein the step of displaying the adjustment in height comprises the step of displaying, on the display screen of the smart device, the needed adjustment in height of at least one portion of a frame of the vehicle at or near at least one wheel position of the vehicle.
Claim 17	
[17.0]	The non-transitory computer readable medium according to claim 15, wherein the computer executable instructions, when executed, further control the smart device to:

[17.1]	calculate a first adjustment in height to level the vehicle in the pitch direction and a second adjustment in height to level the vehicle in the roll direction;
[17.2]	and calculate adjustments in height to each of at least one part of a frame of the vehicle by combining the first adjustment with the second adjustment.
Claim 18	
[18.0]	The non-transitory computer readable medium according to claim 17, wherein the at least one part of the frame includes a first part located at or near a front driver-side wheel, a second part located at or near a back driver-side wheel, a third part located at or near a front passenger-side wheel, and a fourth part located at or near a back passenger-side wheel, and wherein the computer executable instructions, when executed, further control the smart device to:
[18.1]	calculate any needed adjustment in height to the first part by combining a rearward pitch adjustment of the first adjustment with a right roll adjustment of the second adjustment;
[18.2]	calculate any needed adjustment in height to the second part by combining a forward pitch adjustment of the first adjustment with the right roll adjustment of the second adjustment;
[18.3]	calculate any needed adjustment in height to the third part by combining the rearward pitch adjustment of the first adjustment with a left roll adjustment of the second adjustment;
[18.3]	and calculate any needed adjustment in height to the fourth part by combining the forward pitch adjustment of the first adjustment with the left roll adjustment of the second adjustment.
Claim 19	
[19.0]	The non-transitory computer readable medium according to claim 15, wherein the computer executable instructions, when executed, further control the smart device to display, in near real time, height adjustments that are remaining for leveling the vehicle during a vehicle leveling process.
Claim 20	
[20.0]	20. The non-transitory computer readable medium according to claim 15, wherein the computer executable instructions, when executed, further control the smart device to correct the adjustments in height based on current temperature readings and information from a temperature calibration lookup table.

I James E. Grimes, of Ruckersville, Virginia, declare as follows:

I. Background

1. I am a professional engineer and currently work at Neoventus Design Group , LLC in Charlottesville, Virginia (hereinafter "Neoventus"), which I founded in 2005. I am responsible for overall business management, customer interface, and engineering functions that include my own design work and reviewing the work of staff. My curriculum vitae is attached which includes expert testimony within the last four years and publications within the last ten years.

2. Neoventus is comprised of four full-time engineers plus several part-time engineers and support staff. The company provides design and development services in the electronics industry across many applications - medical, industrial, commercial, and space related industries. Services offered focus primarily on embedded computing - system, hardware, and firmware.

3. I earned a Bachelor of Science degree in physics from James Madison University in Harrisburg, Virginia in 1984 and have worked as an engineer for forty (40) years.

4. I worked for Westinghouse Electric in the Oceanic Division in Annapolis , Maryland as a Design Engineer from 1984 through 1987. I was responsible for the design and development of SONAR image processing systems. This includes hardware design of an AMD 2900 bit-slice based Adaptive Time-

Varied Gain (ATVG) processor for image normalization. This also included firmware development across numerous programs for the US Navy. The Oceanic Division has since been purchased by Northrup Grumman.

5. In 1987 and 1988, I worked as a Design Engineer for Westinghouse Electric in the Airborne RADAR Division in Baltimore, Maryland. I was responsible for the design of the Test and Maintenance Interface Unit (TMIU) - Custom VHSIC (Very High Speed Integrated Circuit) for use in the maintenance of the Advanced Tactical Fighter program (ATF) RADAR processor.

6. In 1988, I began working at GE Fanuc in Charlottesville, Virginia as a Principal Engineer, Lead Engineer, and Senior Engineer and worked there until 1999. As Principal and Senior engineer, I was responsible for system level product design as well as detailed processor design with GE Fanuc's PLC lines. Designs included PCB as well as custom integrated circuit design (VHDL). I was also a Lead Engineer responsible for project scheduling and team management (performance reviews, resource planning, etc.) GE Fanuc dissolved and became GE Embedded Platforms, which in-turn was purchased by Emerson.

7. In 1992, while working at GE Fanuc, I received the Engineer of the Year award.

8. I was a named inventor on two U.S. Patents while working at GE Fanuc: U.S. Patent No. 6,964,045 titled Multiple Program Storage within a

Programmable Logic Controller System and U.S. Patent No. 6,047,021 titled Methods and Apparatus for Exchanging Data.

9. From 1999 until 2005, I worked for ADI Engineering in Charlottesville, Virgina as a Principal Engineer. I was responsible for the design and development of electronic systems that included both hardware and firmware. I was actively involved in engineering design and development as well as customer interface. The designs I worked on spanned numerous markets and included reference designs for Intel within their XScale processor family. ADI Engineering has since been purchased and integrated as part of Silicom Connectivity Solutions Ltd.

10. In 2005, I founded Neoventus where I am currently working. Our website is at https://neoventus.com.

11. In November 2021, Neoventus was hired by Petitioner, ETN Capital, LLC d/b/a Beech Lane ("ETN"), to design a vehicle leveling system, which is being sold under the brand name Beech Lane. I was personally involved with the design of the Beech Lane RV leveling system.

12. I have been retained by Coats + Bennett, PLLC on behalf of ETN to provide technical opinions relating to U.S. Patent No. 10,890,925 (the '925 Patent) and prior art. I have reviewed the '925 Patent and relevant portions of the

prosecution history of the ‘925 Patent. I have also reviewed the materials listed above in addition to other materials I cite in my declaration.

13. I do not have a financial interest in ETN or in the outcome of the IPR proceeding. My compensation for this engagement is not contingent upon my performance or the outcome of this proceeding. I am being compensated for my work as an expert on an hourly basis at $145 per hour. I am being reimbursed for my expenses incurred for this engagement.

14. I have personal knowledge of the facts contained in this declaration, am of legal age, and am otherwise competent to testify.

II. Standards For Analysis

15. My analysis of the ‘925 Patent is based on my education and forty (40) years of experience as a design engineer, including my work in the fields of mechanical and electrical engineering, and my experience working with others in those fields.

16. Unless otherwise stated, my analysis of the ‘925 Patent is made from the perspective of a person having ordinary skill in the art (PHOSITA) as of the effective filing date of the ‘925 Patent, which is assumed to be December 5, 2014 (the “Critical Date”).

17. Based on my own experience as a design engineer, a PHOSITA would have been a person having a Bachelor of Science degree in a relevant field of

science or engineering with one to two years of experience as an engineer and a working knowledge of sensor design and application development.

18. For purposes of my analysis, the terms used in the claims have been given their "ordinary and customary" meaning to a PHOSITA as of the effective filing date of the '925 Patent.

19. In preparation of this Declaration, I have reviewed *Graham v. John Deere*, 383 U.S. 1 (1966) and *KSR Int'l Co. v. Teleflex, Inc*. (KSR), 550 U.S. 398 (2007).

20. I understand that a claim is "obvious" under 35 U.S.C. § 103 "if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains." *Graham v. John Deere*, 383 U.S. 1, 13 (1966) I also understand that the time frame for determining obviousness is at the time the application for the patent is filed and that use of hindsight in determining obviousness is improper. That is, obviousness must be determined from the perspective of a PHOSITA at the time the application is filed without benefit of knowledge gained from the patent at issue.

21. I understand that a claim may be rendered obvious by a combination of prior art references. To be obvious, there must be some reason for PHOSITA to

combine the teachings of multiple prior art references to achieve the claimed invention. This reason may come from the reference or references themselves, from the knowledge of a PHOSITA, from the problem to be solved, or from the prior art as a whole. Providing a reason or motivation for combining the teachings of multiple prior art references is important to avoid reliance on hindsight.

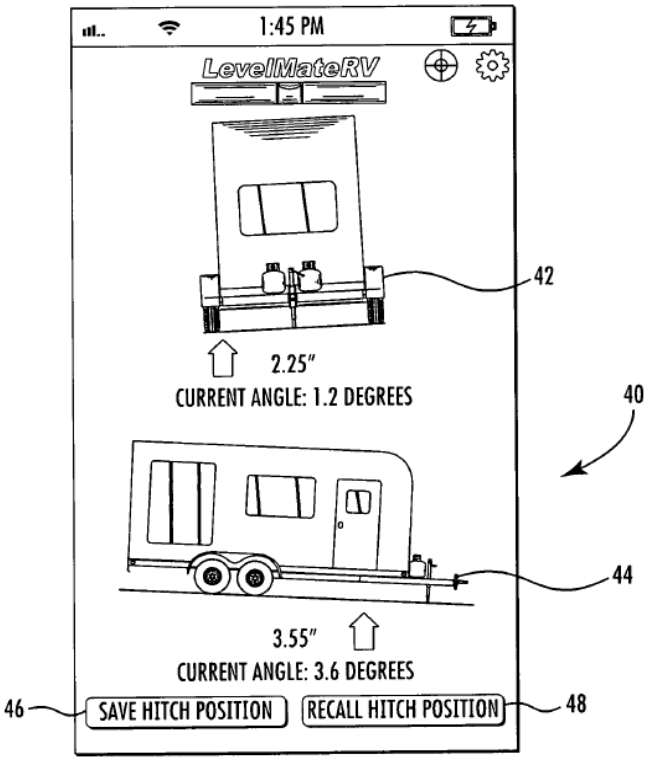
22. I understand that the combination of familiar elements according to known methods is likely to be obvious when the combination does nothing more than yield predictable results.

III. The '925 Patent

A. Overview of '925 Patent

23. The '925 Patent (ETN1001) is directed to a vehicle leveling system that purports to be an improvement of prior art RV leveling systems. The system includes a sensor device functioning as an electronic level that detects an inclination of the vehicle in both a pitch direction (i.e., front-to-rear) and a roll direction (i.e., side-to-side) and a smart device (e.g., smartphone) in communication with the sensor device. ETN1001, 6:47. The smart device includes a display device to display an image representative of the vehicle and to simultaneously display height adjustment amount and direction needed to level the RV to correct for both the pitch and roll of the vehicle. ETN1001, Figure 5A.

24. Figure 5A reproduced below illustrates the graphical interface of the patented RV leveling system.



25. The graphical interface shows two views of the vehicle: an end view and a side view. Each view of the vehicle includes an adjustment pair with a height adjustment amount and a corresponding adjustment direction indicated by an arrow needed to level the vehicle. The end view shows the adjustment needed to correct the roll of the vehicle and the side view shows the adjustment needed to correct the pitch of the vehicle. The graphical display updates in real time as the vehicle is being leveled.

26. The '925 Patent includes twenty claims with claims 1, 10, and 15 being independent. The remaining claims are dependent claims. All of the claims

require the smart device to simultaneously display an image of the vehicle and to the adjustments required to correct for both roll and pitch.

B. Claim Construction

27. For purposes of my analysis, the terms used in the claims have been given their "ordinary and customary" meaning to a PHOSITA as of the effective filing date of the '925 Patent.

28. The claims are directed to a vehicle leveling system including a sensor device and a "smart device." I interpret the term "sensor device" to be a device that senses the inclination of the vehicle. The term "smart" when used in connection with "digital technology" generally means a device with processing and networking capabilities that enable the device to connect to and exchange information with other devices. ETN1062-1064. Therefore, I interpret "smart device" in the context of the claims to mean a device with processing capability that connects to and exchanges information with the sensor device.

29. Independent claim 1 recites a sensor device or smart device "configured to determine 'adjustment pairs.'" Claim 10 and 15 include similar limitations. Claim 10 recites a step of "determining adjustment pairs." Claim 15 recites a step of "calculating adjustment pairs." In all three independent claims, the term "adjustment pairs" is plural. In accordance with the normal rules of grammar,

I have interpreted the term "adjustment pairs" to mean two or more adjustment pairs.

30. Each adjustment pair includes a height adjustment amount and a corresponding adjustment direction needed to level a respective section of the vehicle. ETN1001, Claim 1, 10, and 15. Figures 5A and 5B of the '925 Patent shows the adjustment amount as both a linear distance measurement (e.g., distance in inches or other unit) and a rotational measurement (angle in degrees). I have interpreted the term "height adjustment amount" to mean a linear distance measurement indicating the amount of the adjustment. ETN1003, 496-497.

31. All of the independent claims recite that the smart device "simultaneously [displays] the height adjustment amount and corresponding adjustment direction of each adjustment pair." The ordinary and customary meaning of the term "simultaneously" is "occurring, operating, or done at the same time." "simultaneous.", American Heritage Dictionary of the English Language, 1973. Therefore, I interpret the "simultaneous display" requirement to mean that the adjustment pairs are displayed at the same time on the display screen. ETN1003, 388

IV. Grounds Asserted In Petition

32. It is my understanding that ETN is requesting IPR of claims 1 – 20 of the '925 Patent (See, Listing of Claims) on the grounds set forth in the table below.

Ground	References	Claims	Statute
1	Thorpe + Clark + Garceau	1 -3, 6, 8 - 11, 13, 15, 16, and 19	35 U.S.C. 103
2	Thorpe + TealLevel + Garceau	1 – 6, 8 – 13, and 15 - 19	35 U.S.C. 103
3	Thorpe + Clark + Garceau + common knowledge	7, 14, and 20	35 U.S.C. 103
4	Thorpe + TealLevel + Garceau + common knowledge	7, 14, and 20	35 U.S.C. 103
5	Garceau + TealLevel	10 – 13, and 15 - 19	35 U.S.C. 103
6	Garceau + TealLevel+common knowledge	1 - 9, 14, and 20	35 U.S.C. 103

V. RV Leveling Background

33. Various systems and components within an RV, such as the plumbing system and appliances, do not function properly when the vehicle is not level ETN1011, 1:17-22; ETN1012, 1:17-19; ETN1013, ¶0007. Further, the RV is more comfortable for use when it is properly leveled. ETN1011, 1:28-30; ETN1013, ¶[0007].

34. Some RVs are equipped with hydraulic or electric vehicle leveling systems that automatically level the RV when it is parked. ETN1013, ¶0008. Due to the expense of such systems, many RV owners opt to level the RVs manually using jacks or leveling blocks. ETN1010, 1:14-56; ETN1013, ¶[0008].

35. There are two basic types of RVs: camping trailers that are towed by another vehicle and motor homes.

36. In the case of camping trailers, the axle is generally located near the center of the trailer and the tongue of the trailer includes a jack to raise or lower the front end. In some cases, the trailers may include jacks located near the four corners of the trailer. Leveling the trailer typically involves two steps. First, the trailer is leveled side-to-side to correct the roll, for example, by towing the trailer onto a ramp or blocks. Once the trailer is leveled side-to-side, the front end of the trailer is raised or lowered to level the trailer in the front-to-back direction.

37. Motor homes typically include four wheels that need to be leveled by either blocking the wheels or jacking the frame at the four corners of the vehicle. In this case, four measurements are needed to level the vehicle. Assuming that the vehicle is on a flat but inclined surface, one wheel will be high and the remaining three wheels need to be raised to the level of the highest wheel.

38. Treating the vehicle as a rigid body (i.e., the vehicle frame does not twist or bend), the height adjustment amounts for the three-lowest wheels in a motor home will be related. The height adjustment for the wheel opposite the highest wheel is the roll adjustment and the height adjustment of the wheel on the same of the vehicle is the pitch adjustment. Assuming a flat surface but inclined surface, the height adjustment amount for the wheel diagonally opposite the

highest wheel (i.e., the lowest wheel) is the sum of the roll adjustment and pitch adjustment. This a simple matter of vector addition.

39. Figure 1 below illustrates how pitch and roll measurements are used to calculate height adjustment amounts for a four-wheeled vehicle on a tilted surface. The left side of Figure 1 is a schematic illustration of a four-wheeled vehicle. The corners of the rectangle represent the point of contact between the wheels of the vehicle and the ground. Wheel A is the highest wheel, wheel B is the wheel opposite wheel A, wheel C is the wheel on the same side of the vehicle as wheel A, and wheel D, diagonally opposite the highest wheel, is the lowest wheel. Any of the four wheels could be the highest.

40. Note that the diagrams in Figure 1 are projections onto a horizontal plane including Point A. Points B, C, and D (representing the ground contact points) are below point A. The vertical distances from points B, C, and D to the horizontal plane are the respective height adjustments needed to level the vehicle.

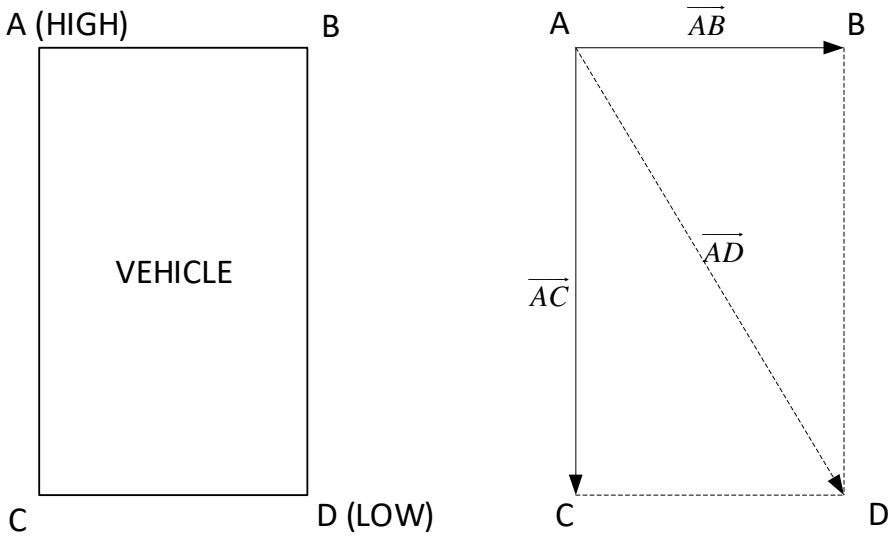


Figure 1

41. The right side of Figure 1 is a vector representation of the pitch and roll. The vector $\overrightarrow{AB}$ represents the roll of the vehicle and the vector $\overrightarrow{AC}$ represents the pitch of the vehicle. The magnitude of $\overrightarrow{AB}$ is equal to the tracking width of the vehicle and the magnitude of vector $\overrightarrow{AC}$ is equal to the wheelbase. The vertical component of roll vector $\overrightarrow{AB}$ ($\overrightarrow{AB_z}$) is the height adjustment amount for wheel B and the vertical component of pitch vector $\overrightarrow{AC}$ ($\overrightarrow{AC_z}$) is the height adjustment amount for wheel C.

42. In linear algebra, the vertical component of the vector $\overrightarrow{AD}$ ($\overrightarrow{AD_z}$) is the sum of the vertical components of vector $\overrightarrow{AB}$ ($\overrightarrow{AB_z}$) and the vertical component of the vector $\overrightarrow{AC}$ ($\overrightarrow{AC_z}$) ETN1066-1067 The relationship of the height adjustment amounts can be expressed mathematically as:

$$\overrightarrow{AD_z} = \overrightarrow{AB_z} + \overrightarrow{AC_z}$$

43. In layman's terms, the height adjustment for the lowest wheel (wheel D) is the sum of the height adjustment for wheel B (roll adjustment) and wheel C (pitch adjustment).

VI. Summary of Prior Art Relied Upon

A. Thorpe (ETN1005)

44. Thorpe discloses a vehicle leveling system for use with recreational vehicles. ETN1005, Abstract. The leveling system comprises a level unit 12 that is placed inside the recreational vehicle and a control unit 14 that wirelessly communicates with the level unit 12. ETN1005, ¶[0037- 0040] Based on information received from the level unit 12, the control unit 14 calculates and displays a roll adjustment and pitch adjustment needed to level the vehicle. ETN1005, ¶[0040]

45. Figure 6 of Thorpe, reproduced below, illustrates how information to correct the roll and pitch of the vehicle is displayed to the user by the control unit 14.

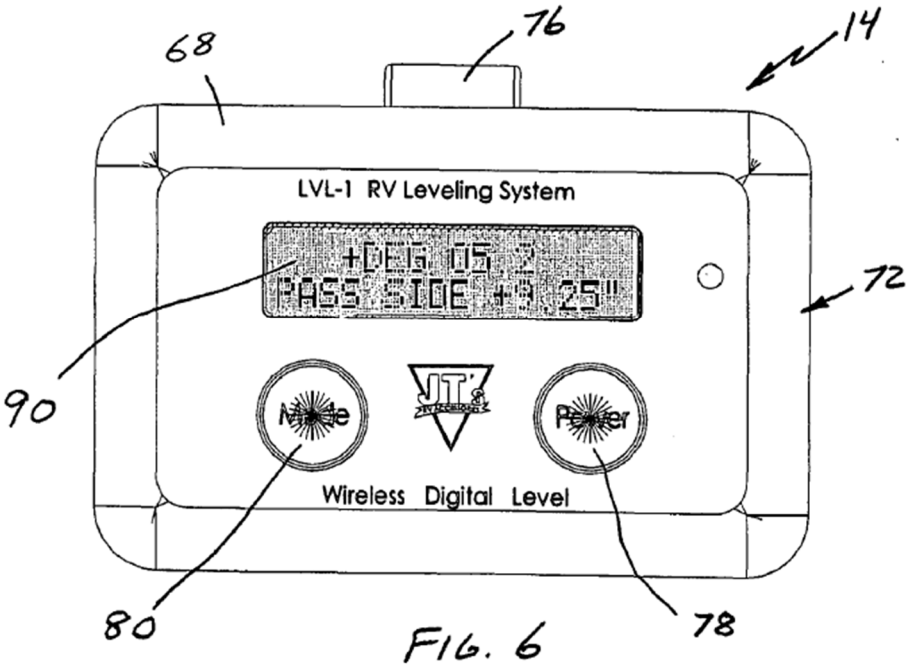


FIG. 6

46. Figure 6 of Thorpe shows the roll adjustment needed to correct the roll of the vehicle. In this example, the display 90 shows the roll adjustment as "PASS SIDE +9.25" " The "+" sign indicates that the passenger side of the vehicle needs to be raised (direction) and the measurement value (9.25") indicates the amount of the adjustment in inches (height adjustment amount).

47. The Figures in Thorpe do not show the pitch adjustment but the text of the applications explains that the pitch adjustment is displayed to the user in the same manner and indicates whether the front or rear of the vehicle needs to be raised. ETN1005, ¶¶[0040, 0044] The mode button (80) on the control unit 14 allows the user to toggle the display to show the roll adjustment and pitch adjustment one at a time. *Id.*

B. Clark (ETN1006)

48. Clark discloses a vehicle leveling system comprising a clinometer mounted on the vehicle in communication with a computer. Abstract; Fig. 1. "The clinometer is configured to measure at least one inclination angle of the vehicle and send an electrical signal representing the at least one inclination angle to the computer." ETN1006, Abstract The clinometer 2 may be permanently or temporarily mounted on or attached anywhere on the vehicle 1 to monitor the levelness or orientation of the vehicle 1 with respect to a selected reference angle. ETN1006, 3:21-22 "The computer is configured to transform the signal back into the at least one inclination angle and present a graphical display." ETN1006, Abstract. The graphical display comprises at least one representation of the vehicle which rotates in real-time as the at least one inclination angle changes." *Id*.

49. Figure 4 of Clark is reproduced below.

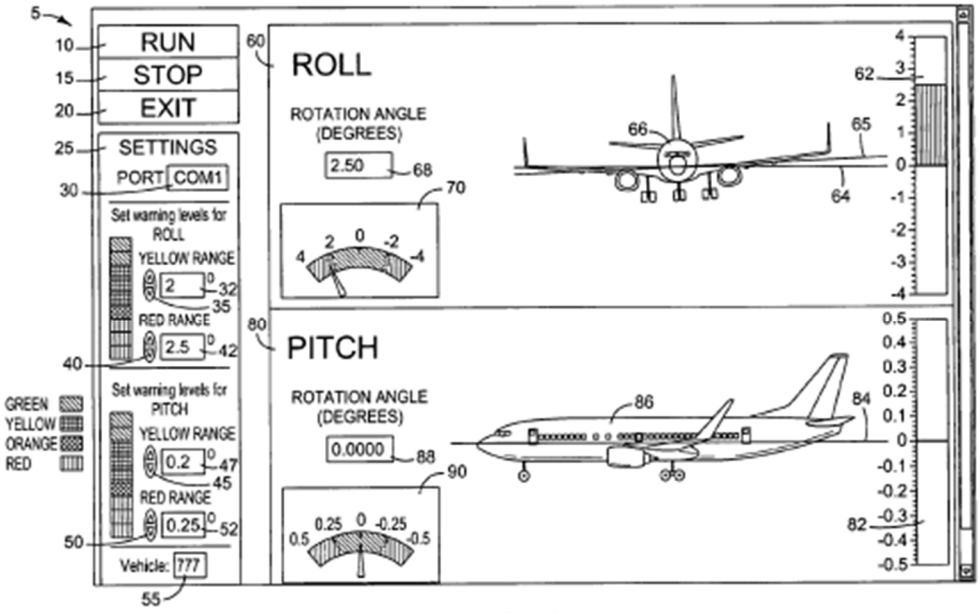


FIG. 4

50. Clark simultaneously displays roll and pitch information on the top and bottom halves of the display screen respectively. The displayed information includes the direction and amount of the roll of the vehicle in degrees and the direction and amount of the pitch of the vehicle in degrees.

C. Garceau (ETN1007)

51. Garceau discloses "[a] leveling assembly and method for analyzing the attitude of a platform or structure such as a motor vehicle …." ETN1007, ¶[0012. "A control system actuates leveling jacks attached to or in contact with the platform or structure using feedback from a multi axis digital sensor." Id. The leveling system is specially designed for leveling a recreational vehicle. ETN1007, ¶[0017]. Figure 1 of Garceau is reproduced below.

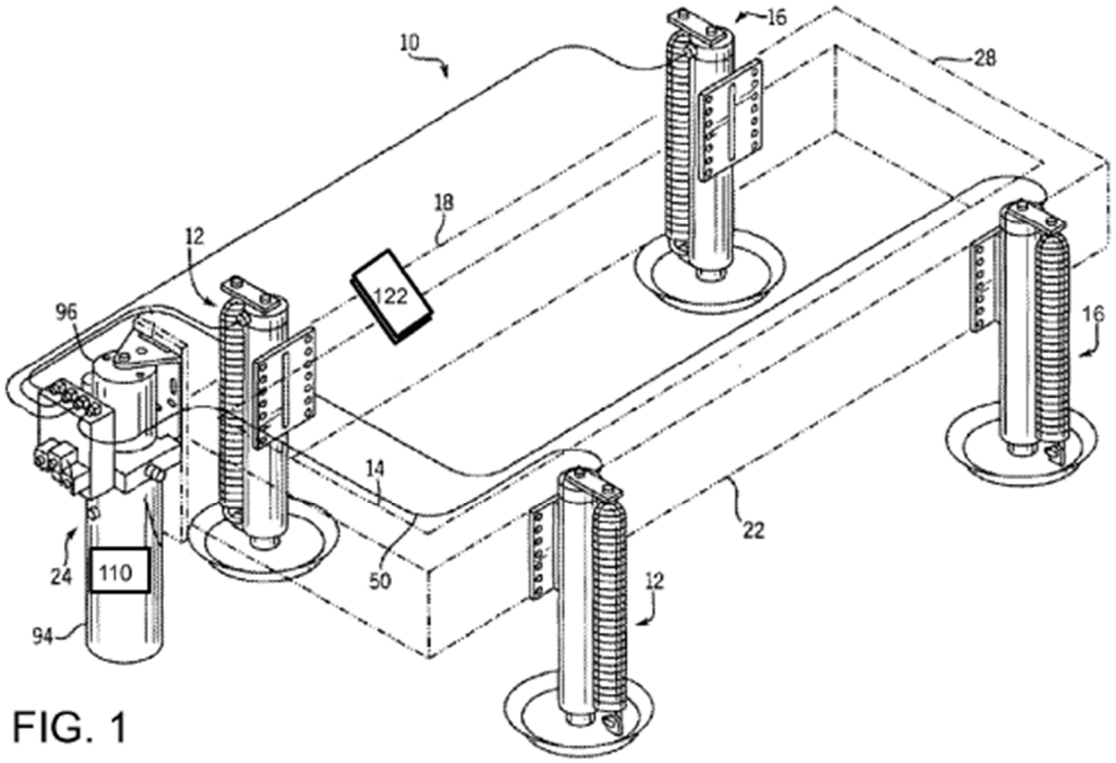


FIG. 1

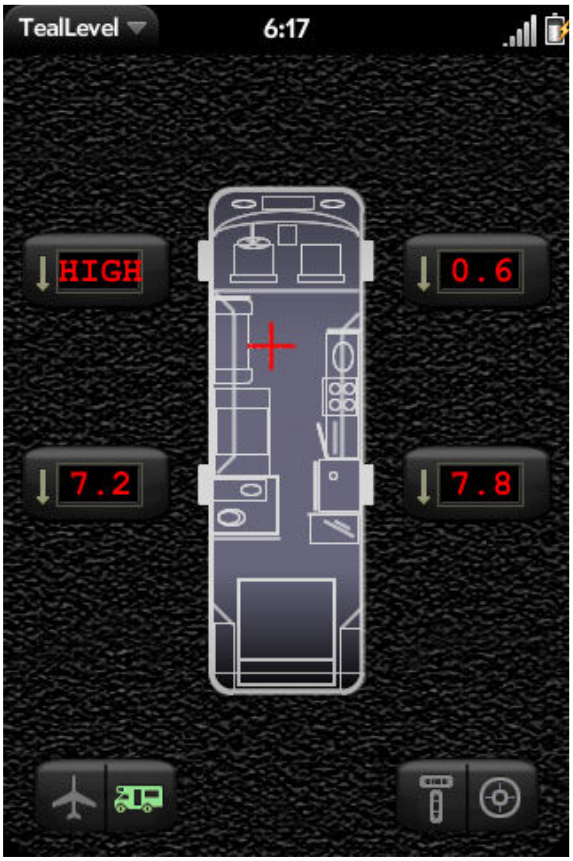
52. The leveling system in Garceau "includes a multi-axis digital sensor 122, which may be mounted to the vehicle in any satisfactory location." ETN1007, ¶[0037] "The multi-axis digital sensor is configured to provide digital signals to the controller representing, for example, the degree of longitudinal pitch and lateral roll of a vehicle to which the multi-axis digital sensor is connected." ETN1007, ¶[0030] "Using data from the gyroscope and accelerometer, the attitude (e.g., pitch, roll, or other relative metrics) of the structure can be calculated…."

53. Garceau discloses a remote unit that communicates wirelessly with the digital sensor (122). ETN1007, ¶[0035] Examples of remote units include computers, cellular telephones and smartphones. *Id.* Using information provided

by the digital sensor 122 "text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static, or in motion." *Id*.

D. TealLevel (ETN1018)

54. TealLevel discloses a vehicle leveling application for Palm devices. In use, the Palm device with the TealLevel application installed is laid flat on the floor of the RV. The TealLevel application calculates a height adjustment amount for the lower three wheels based on the vehicle's track width and wheel base and displays the calculated height adjustment amounts on a graphical display as shown below.



VII. Analysis of Grounds 1 & 2 - Obviousness Over Thorpe In View Of Clark (Ground 1) or TealLevel (Ground 2) and Further In View Of Garceau

A. Summary of Analysis for Grounds 1 and 2

55. Thorpe discloses a vehicle leveling system for use with recreational vehicles (RVs). ETN1005, Abstract. The leveling system in Thorpe comprises a level unit 12 that is placed inside the recreational vehicle and a control unit 14 that wirelessly communicates with the level unit. ETN1005, ¶[0037 - 0040] Based on information received from the level unit 12, the control unit 14 calculates and displays a roll adjustment and pitch adjustment needed to level the vehicle. The display in Thorpe comprises a character-based display that display the height adjustments for leveling the vehicle one at a time. ETN1005, ¶[0040]

56. Garceau teaches a vehicle leveling system including a digital sensor 122 and a remote unit. ETN1007, ¶[0035, 0037] The digital sensor 122 may comprise a digital accelerometer and the control unit 110 may comprise a smart device, such as a computer or smartphone. ETN1007, ¶[0012, 0037]

57. Clark and TealLevel both disclose graphical displays for vehicle leveling systems that display an image of the vehicle and simultaneously display pitch and roll indicators (Clark) or height adjustment amounts for leveling the vehicle (TealLevel) ETN1006, Figure 4; ETN1018, p.3.

58. It would have been obvious to a PHOSITA as of the Critical Date to use a smartphone or computer capable of displaying graphics as a remote unit as taught by Garceau. As described in Garceau, an application installed on a cellular telephone or smartphone can communicate wirelessly with the sensor device in Thorpe and display text or graphics depicting the attitude of the vehicle. ETN1007, ¶[0035]. Apple's iPhone was introduced to the market in 2007 followed by Android devices shortly thereafter. By 2014, smart phones with large and advanced displays were ubiquitous. Sources estimate that about 50% of the U.S. population had smartphones in 2014. A smartphone is essentially a hand-held computer with wireless communication capability. The PHOSITA would have known that a large and growing segment of the population owned smartphones and that the display on a smartphone would have been sufficiently large to implement the graphical display as taught by Clark and TealLevel. Implementing the control unit as an application running on a computer or smartphone with graphical display capabilities avoids the need to design manufacture a special purpose control unit and would reduce costs.

59. It would also have been obvious to a PHOSITA as of the Critical Date to include a graphical display as taught by Clark or TealLevel that displays an image representative of the vehicle and that simultaneously displays the adjustments for roll and pitch. Clark discloses that the graphical display updates in

real time so that users can immediately see the changes in the attitude of the vehicle when leveling the vehicle. ETN1006, Abstract. Clark explains that the graphical representation of the vehicle that updates in real time provides the user with "an intuitive understanding of the measurements taken by the clinometer 2, such as the roll and pitch conditions of the vehicle 1" and enables the vehicle to be "jacked and leveled with fewer persons and in less time" ETN1006, 3:57-60; 8:66 – 9:2. A PHOSITA would have recognized the desirability of replacing the character-based display of Thorpe with a graphical display that updates in real time as taught by Clark for the reasons stated in Clark.

60. Both digital and analog accelerometers were common at the time the application for the '925 Patent was filed. ETN1007, ¶[0012]; ETN1052-1056 Digital and analog accelerometers are essentially the same, the main difference being that the analog-to-digital conversion in a digital accelerometer is integrated with the sensor components in the same integrated circuit (e.g., "chip"). Both are widely used and it is largely a matter of design choice whether to use an analog or digital accelerometer. Advantages of using a digital versus analog accelerometer include 1) fewer electronic components, and therefore, potentially, smaller product implementation; 2) lower power consumption; 3) increased manufacturing ease and product reliability. The first advantage is realized by the analog-to-digital converter (ADC) being integrated along with the sensor itself, allowing a single

integrated circuit (IC) as opposed to two. The second advantage is realized by the inherent nature of silicon integration – power consumption decreases as adjacent circuits are made closer and their interconnections shorter. The last advantage is obtained by the decrease in the number of IC packages and their associated solder joints – each PCB to IC contact point (a solder joint) requiring attention to detail in manufacturing process and being a potential point of product failure. Thus, it would have been obvious to a PHOSITA to substitute a digital accelerometer as taught by Garceau in place of the analog accelerometer described in Clark.

61. As set forth below, the combination of Thorpe, Clark, and Garceau disclose all of the limitations of claims 1-3, 6, 8 - 11, 13, 16, 16, 18, and 19. The combination of Thorpe, TealLevel, and Garceau disclose all of the limitations of claims 1-6, 8-13, and 15-19.

B. Analysis of Claims

1. Claim 1 (Grounds 1 & 2)

a) Element [1.0] – leveling system

62. Thorpe discloses a "leveling system for use with recreational vehicles having one or more leveling mechanisms to level the vehicle in the side-to-side and front-to-back directions" ETN1005, Abstract. The leveling system comprises a level unit 12 that is placed inside the recreational vehicle and a control unit 14 that wirelessly communicates with the level unit. *Id*; ETN1005, ¶[0035] ("A leveling

system for recreational vehicles …generally comprises a level unit 12 and a separate control unit 14 that is in spaced apart relation to level unit 12.")

b) Element [1.1] – sensor device

63. The level unit 12 in Thorpe constitutes a sensor device as recited in Element [1.1]. The level unit 12 is placed inside a vehicle to sense the inclination of the vehicle. ETN1005, ¶[0043]; claims 7 & 8. The level unit 12 comprises a "housing that encloses a controller, a level sensing means, a power supply and a transceiver mounted on a circuit board." ETN1005, ¶[0012]. "The level sensing means is configured to determine the pitch and the roll of the recreational vehicle so the user can operate the leveling mechanism to place the recreational vehicle in its level condition." *Id*.

c) Elements [1.2], [1.2.1] and [1.2.2] –printed circuit board including a digital accelerometer and a processor

64. Figures 9 - 11 in Thorpe are schematic diagrams showing a printed circuit board (34) of the level unit 12 and control unit 14. The printed circuit board (34) includes "a controller 36 which is operatively connected to a level sensing means 38, power supply 40 and transmitter/receiver or transceiver 42, including antenna 44." ETN1005, ¶[0037].

65. The controller 36 "can be a Nordic Semiconductor model number nRF24E1 2.4 Ghz RF transceiver that is integrated with an 8051 compatible

microcontroller." ETN1005, ¶[0037]. The controller 36 comprises a processor as recited in Element [1.2.2].

66. In a preferred embodiment, the "level sensing means 38 is a dual-axis accelerometer, such as the model number LIS2L02AS4 low-power two-axis linear accelerometer available from ST Microelectronics, that is configured to detect tilting in both the front/back and left/right directions so as to determine the attitude of recreational vehicle 16 relative to a calibrated reference position (i.e., the level condition 20)." ETN1005, ¶[0038] [T]he output from level sensing means 38 goes to one or more analog conversion devices … that convert the analog signal to a linear value that is used by controller 36 to determine the pitch and roll level position relative to the common reference 50." *Id.*

67. The accelerometer used as the level sensing means 38 in Thorpe is an analog device, although digital accelerometers performing the same function were well-known in the art at the time that the '925 Patent was filed. Garceau, for example, discloses a leveling system for a RV or other vehicle that senses inclination using a multi-axis digital sensor (122). ETN1007, ¶[0012] ("[T]he multi-axis digital sensor can be a 6-axis digital sensor. The 6-axis digital sensor can include a 3-axis gyroscope and 3-axis accelerometer and a processor for interpreting motion data from the gyroscope and accelerometer.") It would have been an obvious matter of design choice to substitute the digital sensor of Garceau

in place of the analog accelerometer and A/D conversion devices described in Thorpe.

d) Element [1.3] – smart device with display

68. The control unit 14 in Thorpe is a special-purpose computer with processing capabilities that communicates wirelessly with the level unit 12 to exchange information. ETN1005, ¶[0037] ("The on-board wireless circuitry for ***transceiver 42 on controller 36 provides an integrated WiFi capability that allows level unit 12 to wirelessly communicate with control unit 14***, which as described below also includes transceiver 42.") The control unit 14 includes a controller 36 and a display 90. ETN1005, ¶[[0040](" To communicate information to the operator, control unit 14 includes a display panel 90 that is operatively connected to controller 36. "); ETN1005, ¶[0012](" The control unit also has a display panel for displaying the pitch and roll information received from the level unit…")

69. The control unit 14 in Thorpe constitutes a "smart device" as recited in Element [1.3]. Alternatively, Clark, TealLevel, and Garceau teach that the control unit can be implemented as an application on a computer or smartphone, which also constitute "smart devices." ETN1006, 2:59-64 ;ETN1007,¶[0035]; ETN1018, pp. 3-4

e) Element [1.4] – configured to calculate adjustment pairs

70. The control unit 14 in Thorpe receives pitch and roll data from the level unit 12 and the controller 36 determines "the amount in inches or other measurement units, based on a known length or width of recreational vehicle 16, that one end or side of the recreational vehicle 16 must be raised to place recreational vehicle 16 in level condition 20." ETN1005, ¶[0040]. Alternatively, the final tilt adjustments can be computed by the level unit 12 and transmitted to the control unit 14. ETN1005, ¶[0038]. The adjustment information includes both a height adjustment amount (measurement value in inches) and a direction (+ sign indicating part of vehicle to be raised) to correct for both roll and pitch of the vehicle. The "+" sign in combination with the measurement value constitutes an adjustment pair indicating both the direction and the amount of correction needed to level the vehicle.

71. The control unit 14 calculates adjustment pairs to correct both the pitch and roll of the vehicle. ETN1005, ¶[0040, 0044]

f) Element [1.5] – configured to display an image representative of the vehicle

72. Both Clark and TealLevel disclose a vehicle leveling system with a graphical display that displays an image of the vehicle. ETN1005, Figure 4; ETN1018, p. 3.

73. With respect to Ground 1, the leveling system of Clark can be used with "a vehicle 1 such as an aircraft, automobile, ship, bus, train, ***or recreational vehicle***." ETN1006, 2:51-55. The Abstract in Clark states that the "**graphical display comprises at least one representation of the vehicle which rotates in real-time as the at least one inclination angle changes."** ETN1006, Abstract (emphasis added) Figures 4 – 6 show an exemplary display with front and side views of a vehicle.

74. With respect to Ground 2, TealLevel discloses a "vehicle mode to help level an RV or other vehicle." ETN1007, p.3. The graphical display in the vehicle mode includes a top view of the vehicle showing different sections of the vehicle (e.g., front, rear, driver side, and passenger side). *Id*. The height adjustment amounts are displayed adjacent respective sections of the vehicle. The graphical displays in Clark and TealLevel provide an image representative of the vehicle.

75. Displaying an image of the vehicle in a graphical display as taught by Clark or TealLevel would have been obvious to a PHOSITA as of the Critical Date because visualization of roll and pitch would provide users with "an intuitive understanding of the measurements such as the pitch and roll conditions of the vehicle" and reduce the chances of causing injury to users or damage to the vehicle. ETN1006, 1:31-36; 4:57-62; 9:2-7.

g) Element [1.6] – configured to simultaneously display adjustment pairs

76. Both Clark and TealLevel disclose a vehicle leveling system with a graphical display that displays a plurality of adjustments simultaneously. ETN1005, Figure 4; TealLevel. p. 3.

77. With respect to Ground 1, the graphical interface in Clark simultaneously displays the roll (top half of display) and pitch (bottom half of display) of a vehicle as shown in Figure 4 below.

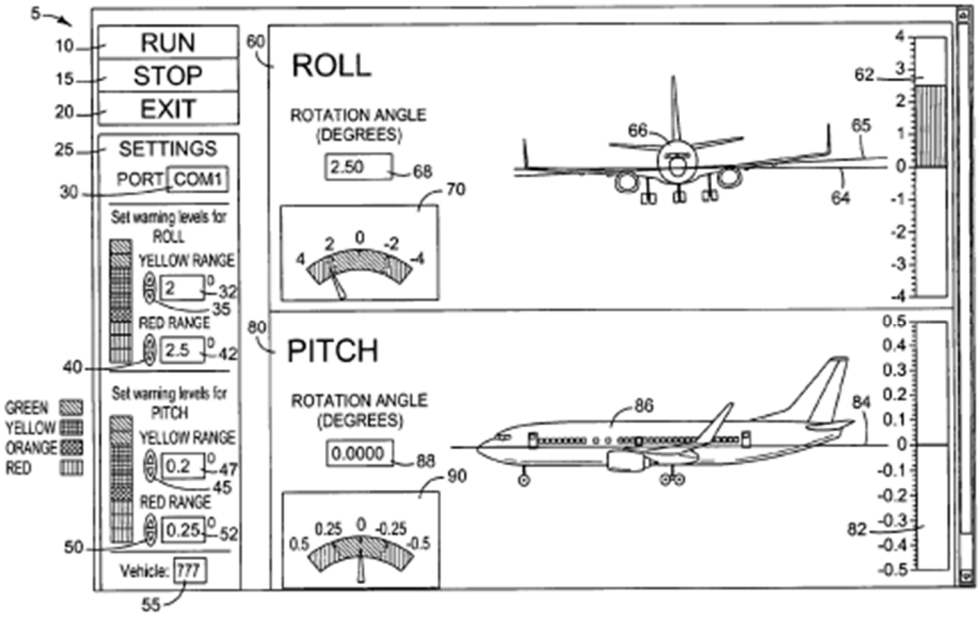
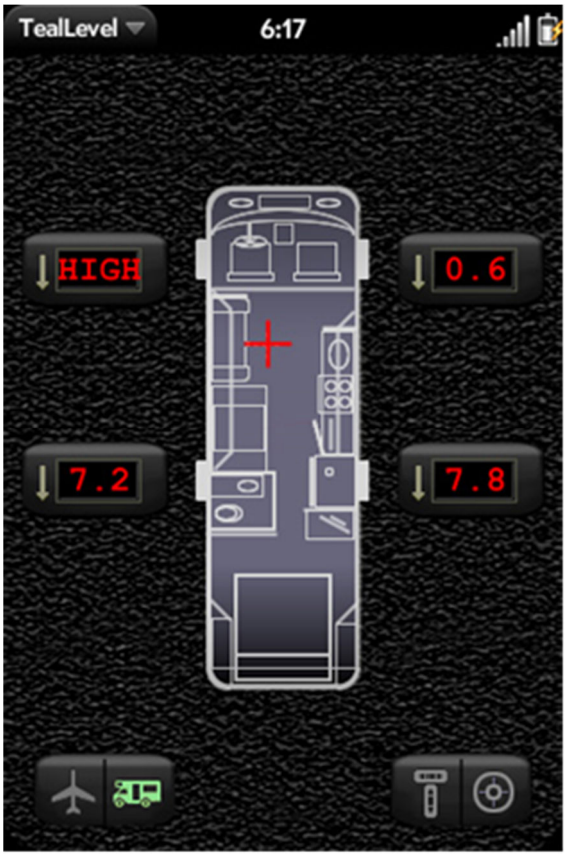


FIG. 4

78. The roll indicators (62, 68, 70) and pitch indicators (82, 88, 90) described in Clark provide both the amount (in degrees) and direction of the pitch and roll. The pitch and roll indicators are displayed adjacent respective sections of the vehicle shown in the image]

79. With respect to Ground 2, TealLevel discloses a graphical display where the height adjustment amounts for the three lowest wheels are displayed adjacent respective sections of the vehicle as shown below. ETN1018, p.3



80. Simultaneously displaying the adjustment pairs in a graphical display as taught by Clark or TealLevel would have been obvious to a PHOSITA as of the Critical Date to enable the user to see the adjustments for all ground contact points at the same time and there are only a finite number of ways to display the measurements: either simultaneously or one at a time. ETN1010, 1:53-56 ("Keeping the above in mind it can easily be seen when a leveling device that gives simultaneous readings for the four corners of a vehicle in inches is greatly needed by motorhome users.")

h) Element [1.7] – configured to update display in real-time

81. While Thorpe does not explicitly state that the display is updated in real time, the description suggests that the display is updated in real time while the user is engaging the leveling mechanism to level the vehicle. For example, in paragraph [0044], the description states that the "operator engages leveling mechanism 18 until the readout on display panel 90 goes to zero, indicating that recreational vehicle 16 is level in the front-to-back direction and, therefore, at its level condition 20. Because control unit 14 is hand-held, this can be accomplished with the operator outside recreational vehicle 14 operating the leveling mechanisms 18." Thorpe also notes that the leveling can be accomplished "with the operator outside the recreational vehicle 14 operating the leveling mechanism 18." *Id.* A PHOSITA would understand these descriptions to indicate real-time update of the display.

82. Even assuming that Thorpe does not teach real-time display, it would have been obvious to a PHOSITA as of the Critical Date to provide real-time updates of a graphical display as taught by Clark and Garceau. Clark states that "[t]he graphical representation and numerical representation may change substantially in real-time to correspond to real-time changes in the roll and pitch, as measured by the clinometer 2" ETN1006, 3:54-57. Clark further states that

"[t]he displayed information may be updated substantially in real-time based on changes in the measurements of the clinometer 2" ETN1006, 4:46-48. Similarly, Garceau states that "text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static, or in motion." ETN1007, ¶[0035]

83. Clark states that "[b]y enabling visualization of roll and pitch measurements in substantially real-time, vehicles 1 or other objects can be jacked and leveled with few persons and in less time" (ETN1006, 8:66 – 9:2), thus providing explicit motivation to provide real time updates of the height adjustment amounts and vehicle image.

2. Claim 2 (Grounds 1 & 2)

84. Claim 2 depends from claim 1 and further recites that the smart device "is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device".

85. Thorpe further teaches that a level unit in communication with the control unit 14 over a wireless communication channel. ETN1005, ¶[0037] ("The on-board wireless circuitry for transceiver 42 on controller 36 provides an integrated WiFi capability that allows level unit 12 to wirelessly communicate with control unit 14, which as described below also includes transceiver 42.") Garceau

teaches that the control unit can communicate with the sensor using Bluetooth, WiFi or other wireless communication standard.

86. There is no reason for a PHOSITA to design from scratch a custom communication protocol. Rather, a PHOSITA would be motivated to use an existing communication protocol because chips and software were commercially available for existing protocols, such as Bluetooth, and using existing protocols, chips and software would reduce costs. Also, almost all smartphones in common use at the time included Bluetooth capabilities. An iphone5 or iphone6 purchased in 2013 or 2014 would have been equipped with Bluetooth 4.0 or Bluetooth 4.2 depending on the date of purchase. ETN1059; ETN1068-1069. The Bluetooth specification is developed and published by a standards body called the Bluetooth Special Interest Group. Manufacturers must meet Bluetooth SIG standards to market it as a Bluetooth device. ETN1009 is copy of relevant portions of the Bluetooth Specification, Version 4.0.

87. In most wireless communication standards, it is necessary for devices to exchange unique device identifiers in order to establish a point-to-point (PTP) connection. In Bluetooth, for example, the devices exchange a unique identifier called the Bluetooth Device Address (BD_ADDR) when establishing a connection. The BD_ADDR is a globally unique 48-bit address assigned to the Bluetooth

device by the manufacturer that uniquely identifies a Bluetooth device. ETN1009, p. 159 (describing Bluetooth Device Address (BD_ADDR))

88. In Bluetooth 4.0, the connection establishment procedure is part of the Bluetooth Low Energy (BLE) protocol, which is designed for low-power communication. ETN1009, pp. 80-83. To establish a BLE connection between the two devices an advertising device, referred to as the peripheral, periodically sends advertising packets while a listening device, referred to as the central, scans for advertisements. ETN1009, p. 81 The advertising packets convey some useful information, such as the Bluetooth Device address (BD_ADDR) of the advertising device, available services, and other relevant data. ETN1009, pp. 300-302. This information can be used by the listening device to establish a connection with the advertiser. When the listening device detects an advertiser it wants to connect with, the listening device can initiates a connection using the information in the advertisement. ETN1009, pp. 82-83. The connection is initiated by sending a connection request (CONNECT_REQ) packet on the same advertising broadcast channel used by the advertiser. *Id*. The connection request includes a control packet data unit (PDU) that contains an Initiator Address (InitA) and an Advertiser Address (AdvA). ETN1009, pp. 303-304. The Initiator Address (InitA) is a 6 octet field containing the address of the listening device and the Advertiser Address (AdvA) is a 6 octet field containing the address of the advertising device.

ETN1009, p. 304. The Initiator Address (InitA) and Advertiser Address (AdvA) comprise Bluetooth Device Addresses (BD_ADDR) that uniquely identify the devices to enable the connection between them initiating the connection.

89. Using the Bluetooth protocol to establish the connection between the sensor device and smart device would have been obvious to a PHOSITA as of the Critical Date because smartphones at that time were equipped with Bluetooth capabilities and had processing capabilities. ETN1059; ETN 1068-1069 It would be logical to have the sensor device advertise its presence so that any smartphone or other smart device would be able to find and connect to the sensor device, assuming that the appropriate application is installed.

90. A serial number is a unique identifier that is assigned to a product or item to distinguish it from others. The BD_ADDR used in Bluetooth constitutes a serial number as recited in Claim 2.

3. Claim 3 (Grounds 1 & 2)

91. Claim 3 depends from claim 1 and further recites that "the adjustment indicators show the adjustments in height to at least one part of a frame of the vehicle located at or near at least one of four wheels of the vehicle." The term "adjustment indicators is interpreted to mean "adjustment pairs."

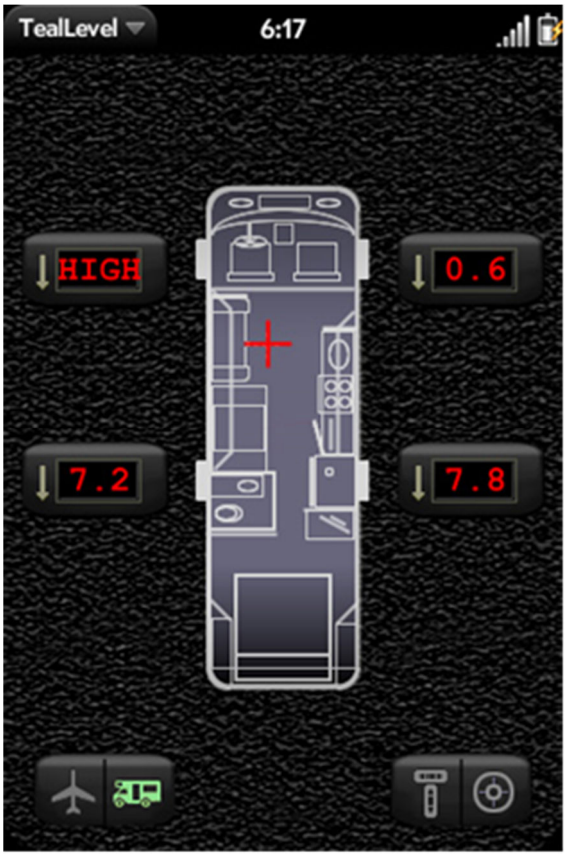
92. Thorpe teaches that the leveling mechanism may comprise a "block type" leveling mechanism where blocks are placed underneath one of the wheels of

the vehicle to raise one part of the vehicle. ETN1005, ¶¶[011, 0035]. The wheel is attached to the frame so raising the wheel raises the frame. Thus, Thorpe teaches raising "at least one part of a frame of the vehicle located at or near at least one of four wheels of the vehicle."

4. Claim 4 (Ground 2)

93. Claim 4 depends from claim 3 and further recites a known mathematical relationship between the height adjustment amount for the three lowest wheels of a four-wheeled vehicle. Specifically, claim 4 recites that the smart device is configured "calculate the adjustments in height to the at least one part of the frame of the vehicle by adding the first adjustment with the second adjustment" where the first adjustment levels the vehicle in the pitch direction and the second adjustment levels the vehicle in the roll direction.

94. TealLevel discloses a vehicle leveling application with a graphical display for a four-wheeled vehicle as shown below.



95. In a four-wheeled vehicle, the height adjustment for the wheel opposite the highest wheel (the front passenger side wheel in this example) is the roll adjustment and the height adjustment of the wheel on the same of the vehicle (the rear driver side wheel in this example) is the pitch adjustment. Assuming a flat but inclined surface where all ground contact points lie on the same plane and that the vehicle is a rigid body, which are both reasonable assumptions, the height adjustment amount for the wheel diagonally opposite the highest wheel (i.e., the lowest wheel) is the sum of the roll adjustment and pitch adjustment. This is a simple matter of vector addition. See, ¶¶38-43. In the example illustrated in

TealLevel, the roll adjustment is 0.6', the pitch adjustment is 7.2" and the height adjustment for the low wheel is 7.8" (the sum of 0.6" and 7.2")

96. Claim 4 simply recites the known mathematical relationship between the height adjustment amounts of the three lowest wheels in a four-wheeled vehicle. The claimed mathematical relationship of the height adjustment amounts is inherent to a four-wheeled vehicle and is disclosed by TealLevel. A person skilled in the art of vehicle leveling systems would have known how to apply the known mathematical relationship to compute the height adjustment amount for the lowest wheel of a four-wheeled vehicle. Claim 5 (Ground 2)

5. Claim 5 (Ground 2)

97. Claim 5 depends from claim 4 and simply recites the same mathematical relationship four times, each recitation depending on which wheel is lowest. Element [5.1] defines parts of the vehicle adjacent each wheel (e.g., first part located near front driver-side wheel) Element [5.2] assumes that the front driver-side wheel is lowest, Element [5.3] assumes that the rear driver-side wheel is lowest, and so forth. Regardless of which wheel is lowest, the formula to calculate the height adjustment amount for the lowest wheel is the same. It is the sum of the height adjustment amount for the pitch and roll directions. The claim simply labels the pitch vector as a forward pitch (front end low) or rearward pitch (back end low) depending on which wheel is assumed to be the lowest. Similarly,

the claim labels the roll vector as a right roll (right side low) or left roll (left side low) depending on which wheel is assumed to be the lowest. The claimed mathematical relationship of the height adjustment amounts is inherent to a four-wheeled vehicle and is disclosed by TealLevel.

6. Claim 6 (Grounds 1 & 2)

98. Claim 6 depends from claim 1 and further recites that the "smart device is further configured to display on the display screen near-real-time height adjustments remaining that are needed to level the vehicle when the vehicle is in the process of being leveled." As previously discussed with respect to Element [1.7] of claim 1, Thorpe, Clark and Garceau disclose updating the height adjustment in real time while the operator is engaged in leveling the vehicle.

7. Claim 8 (Grounds 1 & 2)

99. Claim 8 depends from claim 1 and further recites that the vehicle includes at least four wheels and that one of the sensor device and smart device is configured "to determine, based on the height needed to level the vehicle in both the pitch direction and the roll direction, adjustments in height to at least one of four parts of a frame of the vehicle, the four parts of the frame located at or near the four wheels of the vehicle."

100. With respect to Ground 1, Figure 1 in Thorpe illustrates a vehicle with two axles and four wheels attached to the frame of the vehicle near the center of

the frame. The roll adjustment in Thorpe indicates an amount that one side of the vehicle needs to be raised to level the vehicle in the side-to-side direction. Blocking the wheels one side of the vehicle to correct for roll raises a part of the vehicle frame located at or near two of the wheels.

101. With respect to Ground 2, TealLevel discloses a graphical display including an image of a four-wheeled vehicle. In a four-wheeled vehicle, the height adjustment for the wheel opposite the highest wheel (the front passenger side wheel in this example) is the roll adjustment and the height adjustment of the wheel on the same of the vehicle (the rear drive side wheel in this example) is the pitch adjustment. Assuming a flat surface, the height adjustment amount for the wheel diagonally opposite the highest wheel (i.e., the lowest wheel) is the sum of the roll adjustment and pitch adjustment. In the example illustrated in TealLevel, the roll adjustment is 0.6', the pitch adjustment is 7.2" and the height adjustment for the low wheel is 7.8" (the sum of 0,6" and 7.2") Thus, TealLevel explicitly discloses height adjustment amounts for the parts of the frame located at or near three of the four wheels of the vehicle.

8. Claim 9 (Grounds 1 & 2)

102. Claim 9 depends from claim 1 and further recites that "the information sensed by the sensor device regarding the inclination of the vehicle in both the pitch direction and the roll direction is processed to determine an amount

of adjustment in height to a rear section or front section of the vehicle needed to level the vehicle in the pitch direction and to determine an amount of adjustment in height to a first side section or a second side section of the vehicle needed to level the vehicle in the roll direction. ETN1005, ¶[0011] (Thorpe discloses a "leveling system that communicates to the operator the amount one of the sides and/or one of the ends of the vehicle must be raised to place the vehicle in a level condition.") The adjustment in height needed to level the vehicle is determined by the control unit 14 based on the inclination sensed by the level unit 12 and the known length and width of the vehicle. *Id*. Thorpe discloses the limitations of claim 9.

9. Claim 10 (Grounds 1 & 2)

a) Element [10.0] – method for leveling a recreational vehicle

103. Thorpe discloses a "leveling system for use with recreational vehicles having one or more leveling mechanisms to level the vehicle in the side-to-side and front-to-back directions". ETN1005, Abstract. The leveling system comprises a level unit 12 that is placed inside the recreational vehicle and a control unit 14 that wirelessly communicates with the level unit. *Id*; ETN1005, ¶[0035] ("A leveling system for recreational vehicles …generally comprises a level unit 12 and a separate control unit 14 that is in spaced apart relation to level unit 12.") The preamble limitations are disclosed by Thorpe.

b) Element [10.1] – sensing inclination

104. The leveling system in Thorpe includes level unit 12 with an accelerometer "configured to determine the pitch and roll of the vehicle." ETN1005, Abstract, ¶¶[0012, 0036, 0037].

c) Element [10.2] – determining adjustment pairs

105. The control unit 14 in Thorpe receives pitch and roll data from the level unit 12 and the controller 36 in the control unit 14 and determines "the amount in inches or other measurement units, based on a known length or width of recreational vehicle 16, that one end or side of the recreational vehicle 16 must be raised to place recreational vehicle 16 in level condition 20." ETN1005, ¶¶[0012, 016, 0038, 0040]. The adjustment information includes both a height adjustment amount (measurement value in inches) and a direction (+ sign indicating part of vehicle to be raised) to correct for both roll and pitch of the vehicle. The "+" sign in combination with the measurement value constitutes an adjustment pair indicating both the direction and the amount of correction needed to level the vehicle. The control unit 14 calculates adjustment pairs to correct both the pitch and roll of the vehicle. ETN1005, ¶[0040, 0044]. Element [10.2] is disclosed by Thorpe.

d) Element [10.3] – displaying image representative of vehicle

106. Both Clark and TealLevel disclose a vehicle leveling system with a graphical display that displays an image of the vehicle. ETN1005, Figure 4; TealLevel. p. 3.

107. With respect to ground 1, Clark discloses a system for monitoring the inclination of a vehicle having a graphical display that "at least one representation of the vehicle which rotates in real-time as the at least one inclination angle changes." ETN1006, Abstract, Figure 3 – 6. The graphical display includes front and side views showing different sections of the vehicle. The front view shows the right and left sides of the vehicle and aids in visualizing roll of the vehicle. The side view shows the front and rear of the vehicle and aids in visualizing the pitch of the vehicle.

108. With respect to Ground 2, TealLevel discloses the a "vehicle mode to help level an RV or other vehicle. ETN1007, p.3-4. The graphical display in the vehicle mode includes a top view of the vehicle showing different sections of the vehicle (e.g., front, rear, driver side, and passenger side). The height adjustment amounts are displayed adjacent respective sections of the vehicle. TealLevel discloses Element [10.3]

109. Displaying an image of the vehicle on a graphical display as taught by Clark,TealLevel, or Garceau would have been obvious to a PHOSITA as of the Critical Date because visualization of roll and pitch would provide users with "an intuitive understanding of the measurements such as the pitch and roll conditions of the vehicle" and reduce the chances of causing injury to users or damage to the vehicle. ETN1006, 1:31-36; 4:57-62; 9:2-7.

e) Element [10.4] – simultaneous displaying adjustment pairs adjacent respective sections of the vehicle

110. Thorpe displays the pitch and roll corrections one at a time and provides a mode button to switch the display while Clark and TealLevel disclose a vehicle leveling system with a graphical display that displays a plurality of adjustments simultaneously. ETN1005, Figure 4; TealLevel. p. 3.

111. With respect to Ground 1, the graphical interface in Clark simultaneously displays the roll (top half of display) and pitch (bottom half of display) of a vehicle as shown in Figure 4 below. The roll indicators (62, 68, 70) and pitch indicators (82, 88, 90) described in Clark provide both the amount (in degrees) and direction of the pitch and roll. Thorpe combined with Clark discloses Element [10.4]

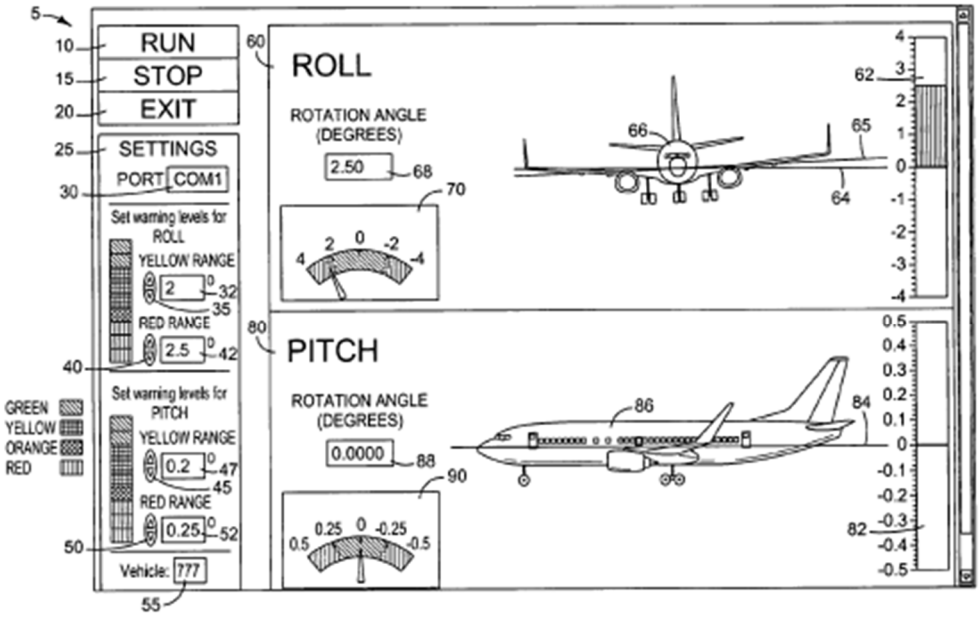


FIG. 4

112. With respect to Ground 2, TealLevel discloses a graphical display where the height adjustment amounts for the three lowest wheels are displayed. The height adjustment amounts are displayed simultaneously. Thorpe combined with TealLevel discloses Element [10.4]

113. There are only a finite number of ways to display the measurements: either simultaneously or one at a time. Modifying Thorpe to simultaneously display the adjustment pairs as taught by Clark or TealLevel would have been obvious to a PHOSITA as of the Critical Date to enable the user to see the adjustments for all ground contact points at the same time and. ETN1010, 1:53-56 ("Keeping the above in mind it can easily be seen when a leveling device that gives simultaneous readings for the four corners of a vehicle in inches is greatly needed by motorhome users.")

f) Element [10.5] – real-time updates

114. Thorpe does not explicitly state that the display is updated in real time, but the description indicates that the display is updated in real time while the user is engaging the leveling mechanism to level the vehicle. For example, in paragraph [0044] the description states that the "operator engages leveling mechanism 18 until the readout on display panel 90 goes to zero, indicating that recreational vehicle 16 is level in the front-to-back direction and, therefore, at its level condition 20. Because control unit 14 is hand-held, this can be accomplished with the operator outside recreational vehicle 14 operating the leveling mechanisms 18." Thorpe also notes that the leveling can be accomplished "with the operator outside the recreational vehicle 14 operating the leveling mechanism 18." *Id*. A PHOSITA would understand these descriptions to indicate real-time update of the display.

115. Even assuming that Thorpe does not teach real-time display, it would have been obvious to a PHOSITA as of the Critical Date to update the display in real-time as taught by Garceau and Clark. Clarks states that "[t]he graphical representation and numerical representation may change substantially in real-time to correspond to real-time changes in the roll and pitch, as measured by the clinometer 2" Clark 3:54-57. Clark further states that "[t]he displayed information may be updated substantially in real-time based on changes in the measurements of

the clinometer 2" ETN1006, 4:46-48. Finally, Similarly, Garceau states that "text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static, or in motion." ETN1007, ¶[0035]

116. Clark states that "[b]y enabling visualization of roll and pitch measurements in substantially real-time, vehicles 1 or other objects can be jacked and leveled with few persons and in less time" (ETN1006, 8:66 – 9:2), thus providing explicit motivation to provide real time updates of the height adjustment amounts and vehicle image.

10. Claim 11 (Grounds 1 & 2)

117. Claim 11 depends from claim 1 and further recites "storing a serial number of the corresponding sensor device in the smart device so that the smart device communicates with the corresponding sensor device".

118. Thorpe discloses a vehicle leveling system including a senor device that communicates wirelessly with a control unit. Garceau teaches that the remote unit can communicate with the digital sensor using Bluetooth, WiFi or other wireless communication standard.

119. For reasons discussed in the analysis of claim 2 above (Section VII.B.2.), a smartphone or other smart device implementing the Bluetooth standard would inherently store, at least temporarily, the BD_ADDR of the sensor device

while engaged in communication with the sensor device. BD_ADDR of the paired device would be stored in a more persistent memory.

120. A serial number is a unique identifier that is assigned to a product or item to distinguish it from others. The BD_ADDR in Bluetooth constitutes a serial number as recited in Claim 11.

11. Claims 12 (Ground 2)

121. As discussed in the analysis of claims 4 and 5 above (Sections VII.B.4-5), claim 12 simply recites a known mathematical algorithm for computing the height adjustment of the lowest wheel in a four-wheeled vehicle based on a known mathematical relationship. TealLevel explicitly discloses this mathematical relationship.

122. Element [12.1] and [12.2] recite, respectively, calculating the height adjustment to level the vehicle in the pitch and roll directions. In a four-wheeled vehcile, the pitch adjustment is the height adjustment for the wheel on the same side of the vehicle (wheel C) as the highest wheel (wheel A). The roll adjustment is the height adjustment for the wheel opposite the highest wheel (wheel B).

123. Elements [12.3]-[12.6] recite the mathematical formula to compute the height adjustment for the wheel diagonally opposite the highest wheel (i.e., the lowest wheel) assuming a flat surface and that the vehicle is a rigid body. The

calculations recited in Elements [12.3]-[12.6] are stated in the alternative, assuming that different wheels are the lowest.

124. Using the known mathematical relationship between the adjustment heights of different wheels to calculate the height adjustment amount for the lowest wheel in a four-wheeled vehicle would have been obvious to a PHOSITA as of the Critical Date.

12. Claim 13 (Grounds 1 & 2)

125. Claim 13 depends from claim 10 and further recites "displaying on the display screen near-real-time height adjustments remaining that are needed to level the vehicle when the vehicle is in the process of being leveled." As previously discussed with respect to Element [1.7] of claim 1 and Element [10.5] of claim 10, Thorpe, Clark and Garceau disclose real-time update of the display while the operator is engaged in leveling the vehicle.

126. Updating the height adjustment amounts in real-time while the vehicle is being leveling would have been obvious to a PHOSITA as of the Critical Date because "visualization of roll and pitch measurements in substantially real-time" would reduce the amount of time and number of persons it takes to level the vehicle. ETN1006, Clark 8:66 – 9:2.

13. Claim 15 (Grounds 1 & 2)

a) Element [15.0] – non-transitory computer readable medium

127. The control unit 14 in Thorpe includes a flash memory chip 60 to store program code. Thorpe [¶[0039]("The circuit board 34 shown in the figures also includes a memory chip connector 62 for programming the flash memory chip 60 with the manufacturer's computer control code…"). The flash memory constitutes a non-transitory computer-readable medium comprising computer executable instructions. The control unit 14 is a smart device. Alternatively, Clark, TealLevel, and Garceau teach that the control unit can be implemented as an application on a computer or smartphone, which also constitute "smart devices." ETN1006, 2:59-64 ;ETN1007,¶[0035]; ETN1018, pp. 3-4

b) Element [15.1] – receiving pitch angle measurement and roll angle measurements

128. In Thorpe, pitch and roll information is transmitted wirelessly from the level unit 14 to the control unit 14. ETN1005, ¶¶[0012, 0038] Element [15.1] is disclosed by Thorpe.

c) Element [15.2] – calculating adjustment pairs

129. After receiving the pitch and roll measurements from the level unit 12, the control unit 14 determines "the amount in inches or other measurement units,

based on a known length or width of recreational vehicle 16, that one end or side of the recreational vehicle 16 must be raised to place recreational vehicle 16 in level condition 20." ETN1005, ¶[0040]. The adjustment information includes both a height adjustment amount in inches and a direction. This calculation is made for each of the pitch and roll directions to enable leveling of the vehicle. ETN1005, ¶[0044]. The roll adjustment indicates the side of the vehicle to be raised (direction) and the amount of the adjustment in inches. The pitch adjustment indicates the end of the vehicle to be raised (direction) and the amount of the adjustment in inches.

d) Element [15.3] – displaying image of vehicle

130. Both Clark and TealLevel disclose a vehicle leveling system with a graphical display that displays an image of the vehicle. ETN1005, Figure 4; TealLevel. p. 3.

131. With respect to Ground 1, Clark discloses a system for monitoring the inclination of a vehicle having a graphical display that includes "at least one representation of the vehicle …" ETN1006, Abstract, Figure 3 – 6. The graphical display includes front and side views of the vehicle showing different sections of the vehicle. The front view shows the right and left sides of the vehicle to indicate roll. The side view shows the front and back of the vehicle to indicate pitch.

132. With respect to Ground 2, TealLevel discloses the a "vehicle mode to help level an RV or other vehicle. ETN1007, p.3-4. The graphical display in the vehicle mode includes a top view of the vehicle showing different sections of the vehicle (e.g., front driver side, front passenger side, etc.). The height adjustment amounts are displayed adjacent respective sections of the vehicle.

133. Displaying an image of the vehicle in a graphical display as taught by Clark or TealLevel would have been obvious to a PHOSITA for reasons explained in Section VII.A. and VII.B.1.f above.

e) Element [15.4] – simultaneous display of adjustment pairs

134. Thorpe displays the pitch and roll corrections one at a time and provides a mode button to switch the display while Clark and TealLevel disclose a vehicle leveling system with a graphical display that displays a plurality of adjustments simultaneously. ETN1005, Figure 4; TealLevel. p. 3.

135. With respect to Ground 1, the graphical interface in Clark simultaneously displays the roll (top half of display) and pitch (bottom half of display) of a vehicle as shown in Figure 4 below. The roll indicators (62, 68, 70) and pitch indicators (82, 88, 90) described in Clark provide both the amount (in degrees) and direction of the pitch and roll. Modifying Thorpe to simultaneously display the adjustment pairs as taught by Clark would have been obvious to a

PHOSITA as of the Critical Date to enable the user to see the adjustments for all ground contact points at the same time.

136. With respect to Ground 2, TealLevel discloses a graphical display where the height adjustment amounts for the three lowest wheels are displayed. The height adjustment amounts are displayed. Thorpe combined with TealLevel discloses Element [15.4]

137. Simultaneously displaying the adjustment pairs as taught by Clark or TealLevel would have been obvious to a PHOSITA as of the Critical Date to enable the user to see the adjustments for all ground contact points at the same time and there are only a finite number of ways to display the measurements: either simultaneously or one at a time. ETN1010, 1:53-56 ("Keeping the above in mind it can easily be seen when a leveling device that gives simultaneous readings for the four corners of a vehicle in inches is greatly needed by motorhome users.")

f) Element [15.5] – real-time updates

138. Thorpe does not explicitly state that the display is updated in real time, but the description indicates that the display is updated in real time while the user is engaging the leveling mechanism to level the vehicle. For example, in paragraph [0044] the description states that the "operator engages leveling mechanism 18 until the readout on display panel 90 goes to zero, indicating that recreational vehicle 16 is level in the front-to-back direction and, therefore, at its

level condition 20. Because control unit 14 is hand-held, this can be accomplished with the operator outside recreational vehicle 14 operating the leveling mechanisms 18." Thorpe also notes that the leveling can be accomplished "with the operator outside the recreational vehicle 14 operating the leveling mechanism 18." *Id*. A PHOSITA would understand these descriptions to indicate real-time update of the display.

139. Even assuming that Thorpe does not teach real-time display, this aspect is explicitly taught by Clark. Clarks states that "[t]he graphical representation and numerical representation may change substantially in real-time to correspond to real-time changes in the roll and pitch, as measured by the clinometer 2" Clark 3:54-57. Clark further states that "[t]he displayed information may be updated substantially in real-time based on changes in the measurements of the clinometer 2" ETN1006, 4:46-48.

140. Clark states that "[b]y enabling visualization of roll and pitch measurements in substantially real-time, vehicles 1 or other objects can be jacked and leveled with few persons and in less time" (ETN1006, 8:66 – 9:2) thus providing explicit motivation to provide real time updates of the height adjustment amounts and vehicle image

14. Claim 16 (Grounds 1 & 2)

141. Claim 16 depends from claim 15 and recites that "displaying the adjustment in height comprises the step of displaying, on the display screen of the smart device, the needed adjustment in height of at least one portion of a frame of the vehicle at or near at least one wheel position of the vehicle"

142. Thorpe teaches a "leveling system that communicates to the operator the amount one of the sides and/or one of the ends of the vehicle must be raised to place the vehicle in a level condition." ETN1005, ¶[0011] Thorpe states that the "operator engages leveling mechanism 18 until the readout on display panel 90 goes to zero, indicating that recreational vehicle 16 is level in the front-to-back direction and, therefore, at its level condition 20." ETN1005, ¶[0044]. The leveling mechanism may comprise a "block type" leveling mechanism where blocks are placed underneath one of the wheels of the vehicle to raise one side of the vehicle. ETN1005, ¶¶[0011, 0035]. Blocking the wheels one side of the vehicle to correct for roll raises a part of the frame of the vehicle at or near two of the wheels.

15. Claim 17 (Ground 2)

143. Element [17.1] recites calculating first and second height adjustments to level the vehicle in the pitch and roll directions respectively. Element [17.2]

generically recites combining the first and second adjustments to get a third adjustment for one part of the vehicle.

144. As discussed in the analysis of claim 4 above (Section VII.B.4), the height adjustment of the lowest wheel in a four-wheeled vehicle can be obtained by adding (combining) the pitch and roll adjustments. Using the known mathematical relationship between the adjustment heights of different wheels to calculate the height adjustment amount for the lowest wheel in a four-wheeled vehicle would have been obvious to a PHOSITA as of the Critical Date.

16. Claim 18 (Ground 2)

145. Element [18.0] defines the different parts of a four-wheeled vehicle frame relative to the vehicle wheels.

146. Elements [18.1]-[18.4] recite a mathematical algorithm to compute the height adjustment for the wheel diagonally opposite the highest wheel (i.e., the lowest wheel) assuming a flat surface and that the vehicle is a rigid body. The calculations recited in Elements [18.1]-[18.4] are stated in the alternative, assuming that different wheels are the lowest.

147. Using the known mathematical relationship between the height adjustment amounts for different wheels to compute the height adjustment amount for the lowest wheel on a four-wheeled vehicle would have been obvious to a PHOSITA as of the Critical Date.

17. Claim 19 (Grounds 1 & 2)

148. Claim 19 depends from claim 15 and recites that the instructions "further control the smart device to display, in near real time, height adjustments that are remaining for leveling the vehicle during a vehicle leveling process." As previously discussed with respect to Element [1.7] of claim 1, Thorpe, Clark and Garceau disclose updating the height adjustment in real time while the operator is engaged in leveling the vehicle.

VIII. Grounds 3 and 4-– Obviousness Over Thorpe In View Of Clark (Ground 3) or TealLevel (Ground 4) and Further In View Of Garceau and Common Knowledge

149. Thorpe, Clark or TealLevel, and Garceau as applied to claims 1, 10, and 15 is discussed in Section VII above. Claims 7, 14 and 20 depend respectively from claims 1, 10 and 15 and add limitations related to temperature compensation. Claim 7 recites "a temperature calibration lookup table' and states that "the smart device is configured to correct the height adjustment amounts based on current temperature readings and information from the temperature calibration lookup table." Claim 14 recites a step of "correcting the height adjustment amounts based on current temperature readings and information from a temperature calibration lookup table." Claim 20 recites a instructions to "control the smart device to correct the adjustments in height based on current temperature readings and information from a temperature calibration lookup table." The crux of these claims is using a lookup table to compensate the height adjustment based on a current temperature.

150. Garceau discloses a leveling system including "temperature compensation to ensure maximum resolution and stability over a wide range of temperature conditions." ETN1007, ¶[0031] Garceau does not specifically disclose using a lookup table for temperature compensation. However, it was well-

known as of the Critical Date to use a look up table for temperature calibration of an accelerometer or tilt sensor. Niu et al, *Fast Thermal Calibration of Low-Grade Inertial Sensors and Inertial Measurement Unit*s, Sensors 2013, 13, 12192-12217; doi:10.3390/s130912192. A PHOSITA would understand that there are only a finite number of ways to implement temperature compensation: by using a known mathematical relationship between the measured temperature and the error correction amount to calculate the error correction or by using a lookup table to lookup the error correction for a given temperature measurement. The late option may involve interpolation. The limitations of claims 7, 14, and 20 would be within the knowledge of a PHOSITA.

IX. Ground 5 & 6 – Obviousness Over Garceau In View of TealLevel (Ground 5) and Further In View of Common Knowledge (Ground 6)

A. Summary of Analysis for Grounds 5 & 6

151. Garceau teaches a vehicle leveling system including a digital sensor 122 and a control unit 110. ETN1007, ¶[0035, 0037] The digital sensor 122 may comprise a digital accelerometer and the control unit 110 may comprise a smart device, such as a computer or smartphone. ETN1007, ¶[0012, 0037] An application installed on a cellular telephone or smartphone can communicate wirelessly with the digital sensor and display text or graphics depicting the attitude of the vehicle in real time while the vehicle is being leveled. ETN1007, ¶[0035].

152. TealLevel discloses a graphical display for an application on a smartphone that displays an image of the vehicle and simultaneously displays a plurality of height adjustment amounts for leveling the vehicle adjacent respective sections of the vehicle. ETN1018, p.3

153. Combining the graphical display as taught by TealLevel with the vehicle leveling system as taught by Garceau would have been obvious to a PHOSITA as of the Critical Date. Clark teaches that the graphical representation of the vehicle on the display provides the user with "an intuitive understanding of the measurements taken by the clinometer 2, such as the roll and pitch conditions of the vehicle 1" and enables the vehicle to be "jacked and leveled with few persons and in less time" ETN1006, 3:57-60; 8:66 – 9:2. Wilson states that "a leveling device that gives simultaneous readings for the four corners of a vehicle in inches is greatly needed by motorhome users." ETN1010, 1:54-57.

154. A PHOSITA would have recognized the desirability of a graphical display including an image representative of the vehicle for the reasons stated in Clark. A PHOSITA would have also recognized the desirability of providing simultaneous display of the height adjustment amounts for all four wheels of a vehicle for the reasons stated in Wilson. TealLevel provides both. Thus, it would have been obvious to PHOSITA at the time the '925 Patent was filed to provide a graphical display that includes an image of the vehicle and that simultaneously

displays the height adjustment amount and direction for multiple ground contact points (e.g., the three lowest wheels of a four-wheeled vehicle as taught by TealLevel).

155. The combination of Garceau and TealLevel disclose all of the limitations of claim 10 – 13 and 15 – 19. The combination of Garceau, TealLevel and common knowledge discloses all of the limitations of claims 1 – 9, 14 and 20.

B. Analysis Of Claims

1. Claim 1 (Ground 6)

a) Element [1.0] – leveling system

156. Garceau discloses "[a] leveling assembly and method for analyzing the attitude of a platform or structure such as a motor vehicle …." ETN1007, ¶[0012. "A control system actuates leveling jacks attached to or in contact with the platform or structure using feedback from a multi axis digital sensor." *Id*. The leveling system is specially designed for leveling a recreational vehicle. ETN1007, ¶[0017]. Figure 1 of Garceau is reproduced below. Element [1.0] is disclosed by Garceau.

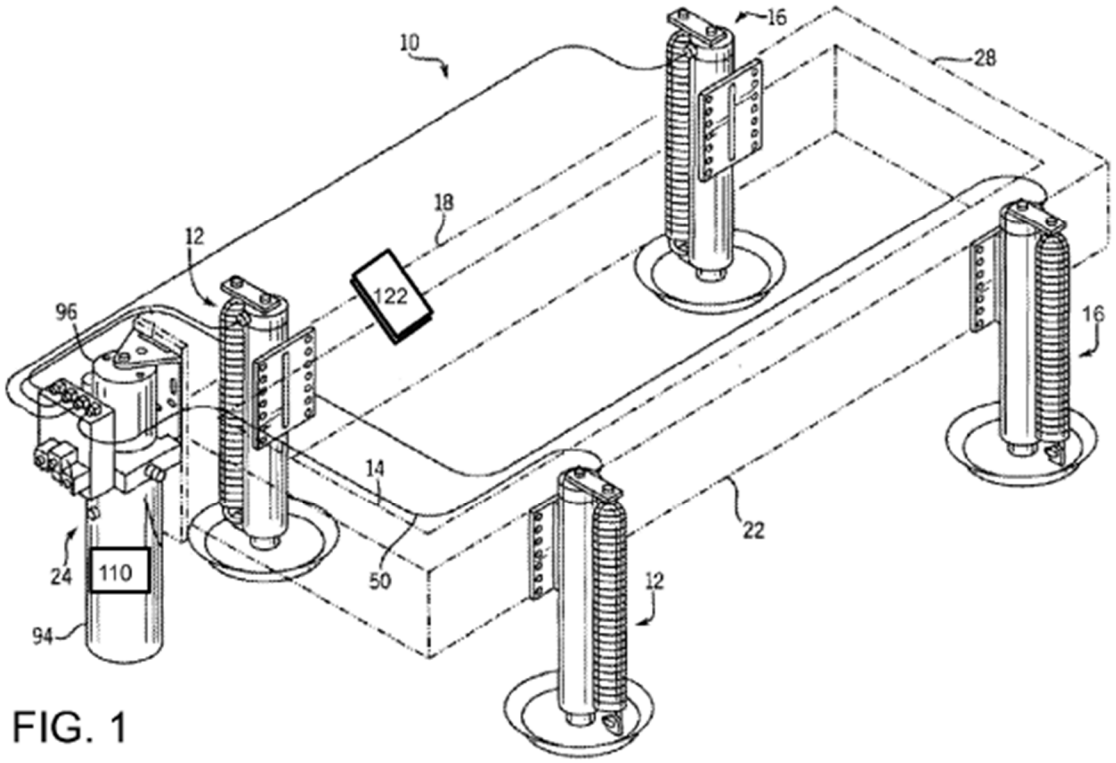


FIG. 1

b) Element [1.1] – sensor device

157. The leveling system in Garceau "includes a multi-axis digital sensor 122, which may be mounted to the vehicle in any satisfactory location." ETN1007, ¶¶[0012, 0037] "Using data from the gyroscope and accelerometer, the attitude (e.g., pitch, roll, or other relative metrics) of the structure can be calculated…." ETN1007, ¶[0012] "The multi-axis digital sensor is configured to provide digital signals to the controller representing, for example, the degree of longitudinal pitch and lateral roll of a vehicle to which the multi-axis digital sensor is connected." ETN1007, ¶[0030]

c) Elements [1.2], [1.2.1] and [1.2.2] – printed circuit board including a digital accelerometer and a processor

158. The multi-axis digital sensor 122 in Garceau "can include a 3-axis gyroscope and 3-axis accelerometer and a processor for interpreting motion data from the gyroscope and accelerometer." ETN1007, ¶[0012]" Garceau does not explicitly state that these components are on a printed circuit board, however, realization of a system comprising integrated circuits (ICs) as described by Garceau is nearly impossible without the use of printed circuit board technology. It would be common knowledge to a PHOSITA that implementation of the sensor components (e.g., digital sensor and processor) in Garceau would require a printed circuit board to mount and interconnect these components. ETN1060-1061; See also, ETN1005, ¶[0037] & Figures 9-11 (disclosing use of printed circuit board to mount sensor components in a vehicle leveling system)

d) Element [1.3] – smart device with display

159. Garceau discloses a remote unit that communicates wirelessly with the digital sensor (122). ETN1007, ¶[0035] Examples of remote units include computers, cellular telephones and smartphones. *Id*. Garceau explains:

> For example, a cellular telephone or smart phone "app" can be installed to communicate with a controller and/or the six-axis digital sensor (e.g., wirelessly through BlueTooth™ or WiFi™, wirelessly through the Internet where the controller is internet-enabled, wired through USB, or others). The app can transmit information to and receive information from the controller and/or six-axis digital sensor.

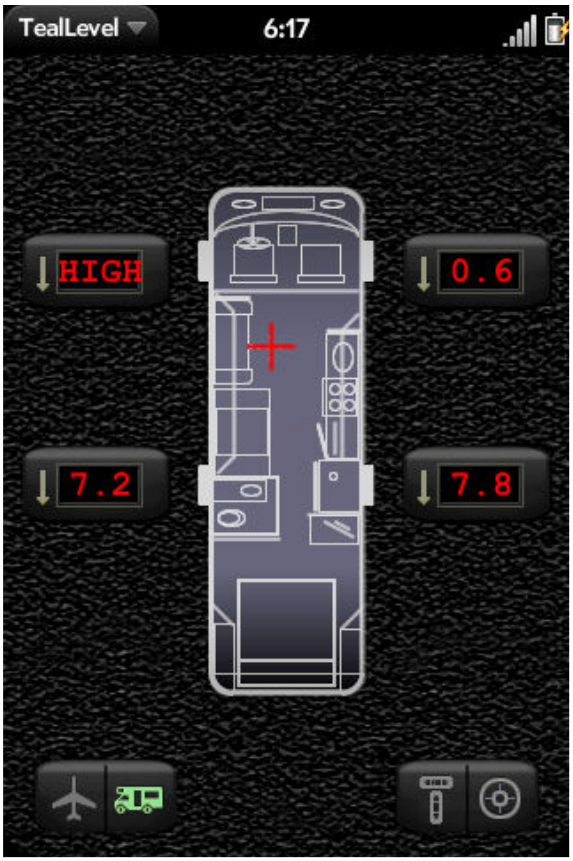
> With information received from the controller and/or the six-axis digital sensor, **text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion**.

Id. A PHOSITA would understand that the computer or smartphone (smart device) would necessarily include a display provide the "text and graphics depicting the attitude of the structure." ETN1007, ¶[0035] Further, Garceau explicitly teaches that the controller could include "display devices". ETN1007, ¶[0016]

e) Element [1.4] – configured to calculate adjustment pairs

160. Garceau discloses that the processor associated with the digital sensor can use "data from the gyroscope and accelerometer" to calculate "the attitude (e.g., pitch, roll, or other relative metrics) of the structure …" ETN1007, ¶[0012] Garceau further states that "**text or graphics depicting the attitude of the structure** can be provided in real-time when the structure is static or in motion" ETN1007, ¶[0035]

161. TealLevel discloses a graphical display for an RV leveling application running on a smart device (e.g., Palm Pre). The graphical display for the TealLevel application is shown below.



162. The text associated with the graphical display states:

> Use vehicle mode to help level an RV or other vehicle. Simply lay the phone flat in a vehicle and it will calculate how high the three lower wheels must be raised.

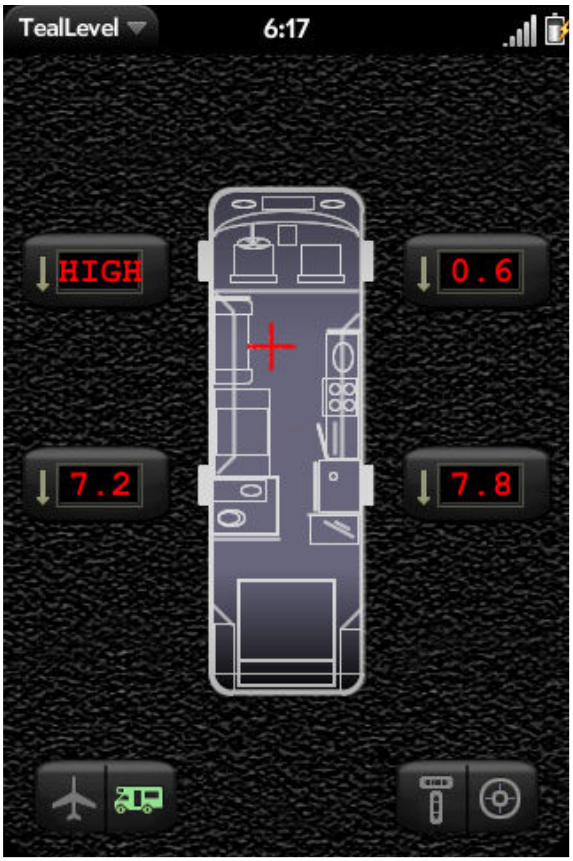
ETN1018, p.3.

163. The graphical display in TealLevel provides both text and graphics depicting the attitude of the vehicle. The text and graphics show which wheel of the RV is high and "how high the three lower wheels must be raised" to level the vehicle. A PHOSITA would understand that the processor in the Palm device running the TealLevel application would necessarily calculate the height adjustment amounts for the three lowest wheels displayed on the display.

164. Calculating and displaying the height adjustments adjustment pairs for a plurality of ground contact points is taught by TealLevel..

f) Element [1.5] – configured to display image representative of vehicle

165. Garceau teaches that a smart device can provide "text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion." ETN1007, ¶[0035]. TealLevel discloses a graphical display for a vehicle leveling application running on a smart device (e.g. Palm Pre). The graphical display for the TealLevel, shown below, includes an image of the vehicle and shows multiple sections of the vehicle (e.g., front, rear, driver side, passenger side, etc.). Displaying an image of the vehicle in a graphical display as taught by Clark or TealLevel would have been obvious to a PHOSITA as of the Critical Date because visualization of roll and pitch would provide users with "an intuitive understanding of the measurements such as the pitch and roll conditions of the vehicle" and reduce the chances of causing injury to users or damage to the vehicle. ETN1006, 1:31-36; 4:57-62; 9:2-7.



g) Element [1.6] – configured to simultaneously display adjustment pairs

166. The graphical display in TealLevel displays the height adjustment amounts and direction for each wheel simultaneously. The TealLevel application indicates which wheels need to be raised (direction) and the amount that each wheel needs to be raised to level the vehicle. The height adjustment amounts are displayed adjacent respective wheels on the display. Simultaneously displaying the adjustment pairs in a graphical display as taught by TealLevel would have been obvious to a PHOSITA as of the Critical Date to enable the user to see the adjustments for all ground contact points at the same time and there are only a

finite number of ways to display the measurements: either simultaneously or one at a time. ETN1010, 1:53-56 ("Keeping the above in mind it can easily be seen when a leveling device that gives simultaneous readings for the four corners of a vehicle in inches is greatly needed by motorhome users.")

h) Element [1.7] – configured to update display in real-time

167. Garceau teaches that "[w]ith information received from the controller and/or the six-axis digital sensor, text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion. ETN1007, ¶[0035]. "In motion" in this context means while the vehicle is being leveled. The leveling system would not be used while the vehicle is being driven.

2. Claim 2 (Ground 6)

168. Claim 2 depends from claim 1 and further recites that the smart device "is configured to receive a serial number of the sensor device so that the smart device communicates with the particular sensor device." Garceau teaches that the smartphone or other smart device can communicate with the sensor using Bluetooth, WiFi or other wireless communication standard.

169. For reasons discussed in the analysis of claim 2 in Grounds 1 & 2 (Section VII.B.2), a smartphone or other smart device implementing the Bluetooth

standard would inherently store, at least temporarily, the BD_ADDR of the sensor device while engaged in communication with the sensor device.

170. A serial number is a unique identifier that is assigned to a product or item to distinguish it from others. The BD_ADDR constitutes a serial number as recited in Claim 2. Therefore, Garceau discloses the limitations of claim 2.

3. Claim 3 (Ground 6)

171. Claim 3 depends from claim 1 and further recites that "the adjustment indicators show the adjustments in height to at least one part of a frame of the vehicle located at or near at least one of four wheels of the vehicle".

172. TealLevel discloses an application for a Palm device that is used to level a motor home having four wheels proximate the four corners of a generally rectangular frame. The TealLevel application "**calculates the necessary jacking or blocking heights for each tire**" and displays the results on the display of the Palm device. The height adjustment amounts are displayed adjacent respective wheels.

4. Claim 4 (Ground 6)

173. For reasons discussed in the analysis of claim 4 in Grounds 1 & 2 (Section VII.B.4), the height adjustment of the lowest wheel in a four-wheeled vehicle can be obtained by adding (combining) the pitch and roll adjustments. This relationship of the height adjustment amounts is disclosed in TealLevel.

ETN1018, p. 3. The example shown in TealLevel indicates that the front driver side wheel is high. The height adjustment amounts are given as 0.6" for the front passenger side wheel (the roll adjustment), 7.2" for the rear driver side wheel (the pitch adjustment), and 7.8" for the rear passenger side wheel (the lowest wheel). The height adjustment for the lowest wheel is the sum of roll adjustment and pitch adjustment.

174. A PHOSITA would have knowledge of the mathematics used in leveling systems and would know how to compute the height adjustment for the lowest wheel. This is simply an exercise of applying known laws of mathematics to solve a known mathematical problem.

5. Claim 5 (Ground 6)

175. As discussed in the analysis of claim 5 in Grounds 1 & 2 (Section VII.B.5), claim 5 simply recites a mathematical relationship between the height adjustment amounts for different wheels assuming a flat surface and that the vehicle is a rigid body. Each recitation assumes a different wheel is the lowest. Regardless of which wheel is lowest, the relationship of the three lowest wheels is the same. It is the sum of the height adjustment amount for the pitch and roll directions as shown in TealLevel. TealLevel, p.3

6. Claim 6 (Ground 6)

176. Claim 6 depends from claim 1 and further recites that the "smart device is further configured to display on the display screen near-real-time height adjustments remaining that are needed to level the vehicle when the vehicle is in the process of being leveled." Garceau states that "[w]ith information received from the controller and/or the six-axis digital sensor, text or graphics depicting the attitude of the structure can be provided **in real-time** when the structure is static or in motion. ETN1007, ¶[0035] "in motion" in this context means while the vehicle is being leveled.

7. Claim 7 (Ground 6)

177. Claim 7 depends from claim 1 and further recites a "temperature calibration lookup table" to correct height adjustments amounts based on temperature. Garceau discloses a leveling system including "temperature compensation to ensure maximum resolution and stability over a wide range of temperature conditions." ETN1007, ¶[0031] Garceau does not specifically disclose using a lookup table for temperature compensation. However, it is well-known to use a look up table for temperature calibration of an accelerometer or tilt sensor. Niu et al, *Fast Thermal Calibration of Low-Grade Inertial Sensors and Inertial Measurement Units,* Sensors 2013, 13, 12192-12217; doi:10.3390/s130912192. A PHOSITA would understand that there are only a

finite number of ways to implement temperature compensation: by using a known mathematical relationship between the measured temperature and the error correction amount to calculate the error correction or by using a lookup table to lookup the error correction for a given temperature measurement. The latter option may involve interpolation. The limitations of Claim 7 would be within the knowledge of a PHOSITA.

8. Claim 8 (Ground 6)

178. Claim 8 depends from claim 1 and further recites that the vehicle has four wheels and that the adjustment in height to at least one part of the frame located near one of the four wheels is determined based on the height needed to level the vehicle in both the pitch and roll directions. The subject matter of claim 8 is similar to claim 4 but expressed differently. As explained in the discussion of claim 4 above (Section IX.B.4), the height adjustment for the lowest wheel is determined by adding the height adjustment for the wheel opposite the highest wheel (roll adjustment) and the height adjustment for the wheel on the same side as the highest wheel (pitch adjustment) to obtain the height adjustment amount for the lowest wheel. Using a known mathematical relationship of the height adjustment amounts shown in TealLevel to calculate the height adjustment amount for the lowest wheel is within the knowledge of a PHOSITA.

9. Claim 9 (Ground 6)

179. Claim 9 depends from claim 1 and further recites that "the information sensed by the sensor device regarding the inclination of the vehicle in both the pitch direction and the roll direction is processed to determine an amount of adjustment in height to a rear section or front section of the vehicle needed to level the vehicle in the pitch direction and to determine an amount of adjustment in height to a first side section or a second side section of the vehicle needed to level the vehicle in the roll direction."

180. Garceau states that the leveling system uses data from the accelerometer to calculate the pitch and roll of the vehicle. ETN1007, ¶[0012]. TealLevel also calculates and displays a roll adjustment (wheel opposite the highest wheel) and pitch adjustment (wheel on same side as highest wheel). ETN1018, p. 3.

10. Claim 10 (Ground 5)

a) Element [10.0] Preamble

181. Garceau discloses "[a] leveling assembly **and method** for analyzing the attitude of a platform or structure such as a motor vehicle …." Garceau, ¶[0012. "A control system actuates leveling jacks attached to or in contact with the platform or structure using feedback from a multi axis digital sensor." *Id*. The

leveling system is specially designed for leveling a recreational vehicle. ETN1007, ¶[0017]. Element [10.1] is disclosed by Garceau.

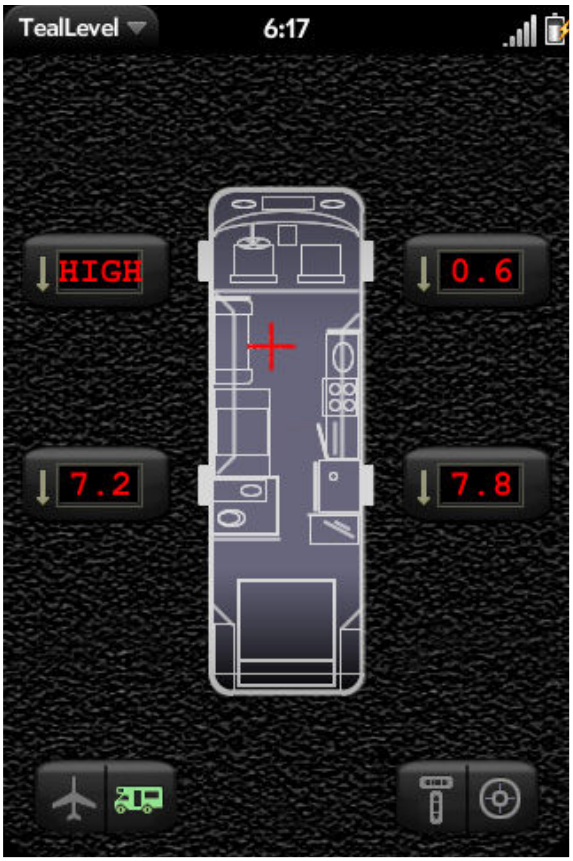
b) Element [10.1] – sensing inclination

182. The leveling system in Garceau "includes a multi-axis digital sensor 122, which may be mounted to the vehicle in any satisfactory location." ETN1007, ¶[0037] "Using data from the gyroscope and accelerometer, the attitude (e.g., pitch, roll, or other relative metrics) of the structure can be calculated…." ETN1007, ¶[0012]. The multi-axis digital sensor is configured to sense an inclination of the vehicle in both a pitch direction and a roll direction. ETN1007, ¶[0035].

c) Element [10.2] – determining adjustment pairs

183. Garceau discloses that the processor associated with the digital sensor can use "data from the gyroscope and accelerometer" to determine "the attitude (e.g., pitch, roll, or other relative metrics) of the structure …" ETN1007, ¶[0012] Garceau further states that "text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion" ETN1007, ¶[0035]

184. TealLevel discloses a graphical display for an RV leveling application running on a smart device (e.g., Palm Pre). The graphical display for the TealLevel application is shown below.



185. The text associated with the graphical display states:

> Use vehicle mode to help level an RV or other vehicle. Simply lay the phone flat in a vehicle and it will calculate how high the three lower wheels must be raised.

ETN1018, p.3.

186. The graphical display in TealLevel provides both text and graphics depicting the attitude of the vehicle. The text and graphics show which wheel of the RV is high and "how high the three lower wheels must be raised" to level the vehicle. A PHOSITA would understand that the processor in the Palm device running the TealLevel application would necessarily calculate the height adjustment amounts displayed on the display.

187. Calculating and displaying the height adjustments adjustment pairs for a plurality of ground contact points as is taught by TealLevel would have been obvious to a PHOSITA as of the Critical Date.

d) Element [10.3] – displaying image representative of vehicle

188. Garceau teaches that a smart device can provide "text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion." ETN1007, ¶[0035]. TealLevel discloses a graphical display for a vehicle leveling application running on a smart device (e.g. Palm Pre). The graphical display for the TealLevel application includes an image representative of the vehicle. TealLevel, p.3. Displaying an image of the vehicle in a graphical display as taught by Clark or TealLevel would have been obvious to a PHOSITA as of the Critical Date for reasons set forth in the discussion of Element [1.5] of Ground 6. See, Section IX.B.1.f.

e) Element [10.4] – simultaneously displaying adjustment pairs

189. The graphical display in TealLevel displays the height adjustment amounts and direction for each wheel simultaneously. The TealLevel application indicates which wheels need to be raised (direction) and the amount that the wheel needs to be raised to level the vehicle. TealLevel, p.3. Simultaneously displaying

an image of the vehicle in a graphical display as taught by TealLevel would have been obvious to a PHOSITA as of the Critical Date for reasons set forth in the discussion of Element [1.6] of Ground 6. See, Section IX.B.1.g.

f) Element [10.5] – real-time updates of graphical display

190. Garceau teaches that,"[w]ith information received from the controller and/or the six-axis digital sensor, text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion. ETN1007, ¶[0035]. "In motion" in this context means while the vehicle is being leveled. The leveling system would not be used while the vehicle is being driven.

11. Claim 11 (Ground 5)

191. Claim 11 depends from claim 1 and further recites "storing a serial number of the corresponding sensor device in the smart device so that the smart device communicates with the corresponding sensor device."

192. Garceau teaches an application for a computer or smartphone that communicates with the digital sensor using Bluetooth, WiFi or other wireless communication standard.

193. For reasons discussed in the analysis of claim 2 in Grounds 1 & 2 (Section VII.B.2), a smartphone or other smart device implementing the Bluetooth standard would inherently store, at least temporarily, the BD_ADDR of the sensor

device while engaged in communication with the sensor device. In this case, the BD_ADDR of the paired device would be stored in a more persistent memory.

194. A serial number is a unique identifier that is assigned to a product or item to distinguish it from others. The BD_ADDR constitutes a serial number as recited in Claim 11.

12. Claim 12 (Ground 5)

195. As discussed in the analysis of claims 4 and 5 in Grounds 1 & 2 above (Sections VII.B.4-5), claim 12 simply recites a known mathematical algorithm for computing the height adjustment of the lowest wheel in a four-wheeled vehicle based on a known mathematical relationship. TealLevel explicitly discloses this mathematical relationship.

196. Element [12.1] and [12.2] recite, respectively, calculating the height adjustment to level the vehicle in the pitch and roll directions. In a four-wheeled vehcile, the pitch adjustment is the height adjustment for the wheel on the same side of the vehicle (wheel C) as the highest wheel (wheel A). The roll adjustment is the height adjustment for the wheel opposite the highest wheel (wheel B).

197. Elements [12.3]-[12.6] recite the mathematical formula to compute the height adjustment for the wheel diagonally opposite the highest wheel (i.e., the lowest wheel) assuming a flat surface and that the vehicle is a rigid body. The

calculations recited in Elements [12.3]-[12.6] are stated in the alternative, assuming that different wheels are the lowest.

198. Using the known mathematical relationship between the adjustment heights of different wheels to calculate the height adjustment amount for the lowest wheel in a four-wheeled vehicle would have been obvious to a PHOSITA as of the Critical Date.

13. Claim 13 (Ground 5)

199. Claim 13 depends from claim 10 and further recites "displaying on the display screen near-real-time height adjustments remaining that are needed to level the vehicle when the vehicle is in the process of being leveled." As discussed with respect to Element [10.5] of claim 10 (Section IX.B.10.f), Garceau discloses a real-time display while the operator is engaged in leveling the vehicle.

14. Claim 14 (Ground 6)

200. Claim 14 depends from claim 10 and further recites a "temperature calibration lookup table" to correct height adjustments amounts based on temperature. As discussed in the analysis of claim 7, Garceau discloses a leveling system including "temperature compensation to ensure maximum resolution and stability over a wide range of temperature conditions." Using a lookup table to perform calibration is within the knowledge of a PHOSITA.

15. Claim 15 (Ground 5)

a) Preamble [15.0] – non-transitory computer readable medium

201. Garceau and TealLevel both disclose vehicle leveling applications running on smart devices, such as computer, cellular telephones and smart phones. ETN1007, ¶[0035]; ETN1018. Such devices inherently include memory to store the application code. Paragraph [0016] of Garceau acknowledges t the vehicle leveling system includes memory, such as RAM or storage. ETN1007, ¶[0016]

b) Element [15.1] - receiving pitch and roll measurements

202. Garceau discloses an application for a smart device that receives pitch and roll information from the digital sensor (122). ETN1007, ¶[0035] Garceau states:

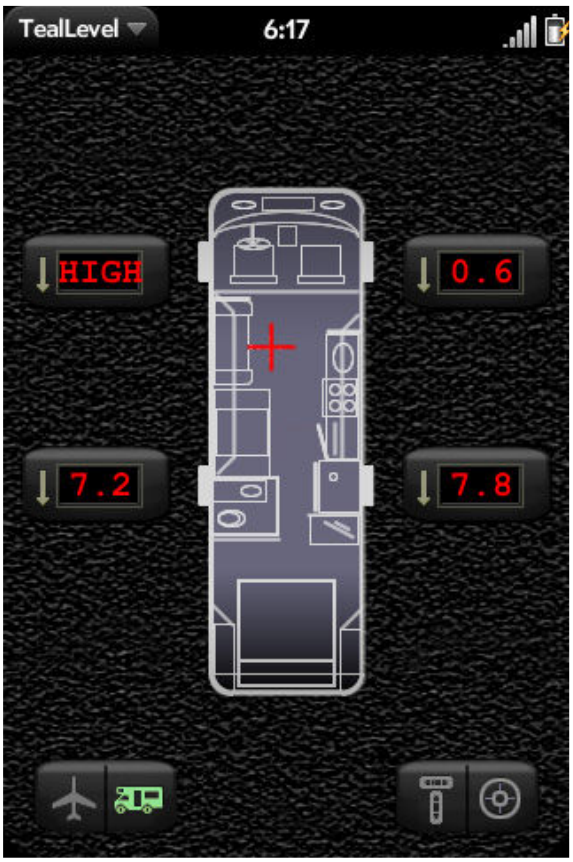
> "Control aspects herein can be implemented using remote devices, including through use of leveling control or visualization applications installed on computers or mobile devices. For example, a cellular telephone or smart phone "app" can be installed to communicate with a controller and/or the six-axis digital sensor (e.g., wirelessly through BlueTooth™ or WiFi™, wirelessly through the Internet where the controller is internet-enabled, wired through USB, or others). The app can transmit information to **and receive information from the controller and/or six-axis digital sensor.** "With information received from the controller and/or the six-axis digital sensor, text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion"

ETN1007, ¶[0035]. Element [15.0] is disclosed by Garceau.

c) Element [15.2] – calculating adjustment pairs

203. Garceau discloses that the processor associated with the digital sensor can use "data from the gyroscope and accelerometer" to calculate "the attitude (e.g., pitch, roll, or other relative metrics) of the structure …" ETN1007, ¶[0012] Garceau further state that "**text or graphics depicting the attitude of the structure** can be provided in real-time when the structure is static or in motion" ETN1007, ¶[0035]

204. TealLevel discloses a graphical display for a RV leveling application running on a smart device (e.g., Palm Pre). The graphical display for the TealLevel application is shown below.



205. The text associated with the graphical display states;

> Use vehicle mode to help level an RV or other vehicle. Simply lay the phone flat in a vehicle and it will calculate how high the three lower wheels must be raised.

ETN1018, p.3.

206. The graphical display in TealLevel provides both text and graphics depicting the attitude of the vehicle. The text and graphics show which wheel of the RV is high and the "how high the three lower wheels must be raised" to level the vehicle. A PHOSITA would understand that the processor in the Palm device running the TealLevel application would necessarily calculate the height adjustment amounts displayed on the display.

207. Calculating and displaying the height adjustments adjustment pairs for a plurality of ground contact points on a graphical display is taught by TealLevel.

d) Element [15.3] - displaying image of vehicle

208. Garceau teaches that a smart device can provide "text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion." ETN1007, ¶[0035]. TealLevel discloses a graphical display for a vehicle leveling application running on a smart device (e.g. Palm Pre). The graphical display for the TealLevel application includes an image of the vehicle. TealLevel, p.3. Displaying an image of the vehicle in a graphical

display as taught by TealLevel would have been obvious to a PHOSITA for reasons explained in Element [1.5] of Ground 6. See, Section IX.B.1.f above.

e) Element [15.4] - simultaneously displaying

209. The graphical display in TealLevel displays the height adjustment amounts and direction for each wheel simultaneously. TealLevel, p. 3. The TealLevel application indicates which wheels need to be raised (direction) and the amount that the wheel needs to be raised to level the vehicle. TealLevel, p.3. Simultaneously displaying an image of the vehicle in a graphical display as taught by TealLevel would have been obvious to a PHOSITA as of the Critical Date for reasons set forth in the discussion of Element [1.6] of Ground 6. See, Section IX.B.1.g.

f) Element [15.5] - real-time updates

210. Garceau teaches that,"[w]ith information received from the controller and/or the six-axis digital sensor, text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion. ETN1007, ¶[0035]. "In motion" in this context means while the vehicle is being leveled. The leveling system would not be used while the vehicle is being driven.

16. Claim 16 (Ground 5)

211. Claim 16 depends from claim 15 and further recites displaying the adjustments in height of at least one part of a frame of the vehicle located at or near at least one of four wheels of the vehicle.

212. TealLevel discloses an application for a Palm device that is used to level a motor home having four wheels proximate the four corners of a generally rectangular frame. The TealLevel application calculates a height adjustment amount for the lower three wheels based on the vehicle's track width and wheel base and displays the calculated height adjustment amounts on a graphical display. TealLevel, p.3. Each height adjustment amount shows the level correction needed to raise the frame proximate a respective wheel, by either blocking the wheel or jacking the frame.

17. Claim 17 (Ground 5)

213. As discussed in the analysis of claim 4 in Grounds 1 & 2 above (Section VII.B.4), claim 17 simply recites a known mathematical algorithm for computing the height adjustment of the lowest wheel in a four-wheeled vehicle based on a known mathematical relationship. See, ¶¶38-41. TealLevel explicitly discloses this mathematical relationship. TealLevel, p.3.

214. Using the known mathematical relationship between the adjustment heights of different wheels to calculate the height adjustment amount for the lowest

wheel in a four-wheeled vehicle would have been obvious to a PHOSITA as of the Critical Date.

18. Claim 18 (Ground 5)

215. As discussed in the analysis of claim 5 in Grounds 1 & 2 above (Section VII.B.5), claim 18 simply recites, four times, the mathematical algorithm for computing the height adjustment of the lowest wheel in a four-wheeled vehicle based on a known mathematical relationship. Element [18.0] defines the different parts of the vehicle frame relative to the vehicle wheels. Elements [18.1] –[18.3] recite the mathematical relationship between the height adjustment amounts for the three lowest wheels, with each recitation of the mathematical algorithm depending on a different wheel being the lowest. [add ref]

216. Using the known mathematical relationship between the height adjustment amounts for different wheels to compute the height adjustment amount for the lowest wheel on a four-wheeled vehicle would have been obvious to a PHOSITA as of the Critical Date.

19. Claim 19 (Ground 5)

217. Claim 19 depends from claim 15 and recites that the instructions "further control the smart device to display, in near real time, height adjustments that are remaining for leveling the vehicle during a vehicle leveling process." Garceau teaches that "[w]ith information received from the controller and/or the

six-axis digital sensor, text or graphics depicting the attitude of the structure can be provided in real-time when the structure is static or in motion. ETN 1007, ¶[0035]. "In motion" in this context means while the leveling is being leveled. The leveling system would not be used while the vehicle is being driven.

20. Claim 20 (Ground 6)

218. Claim 20 depends from claim 15 and further recites a "temperature calibration lookup table" to correct height adjustments amounts based on temperature. Garceau discloses a leveling system including "temperature compensation to ensure maximum resolution and stability over a wide range of temperature conditions." As discussed in the analysis of claim 7 (Section IX.B.7), Garceau discloses a leveling system including "temperature compensation to ensure maximum resolution and stability over a wide range of temperature conditions." Using a lookup table to perform calibration is within the knowledge of a PHOSITA.

Pursuant to 28 U.S.C. § 1746, I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing statements made in this declaration are true and correct.

Executed on: September 13, 2024____

James E. Grimes

ATTACHMENT

Professional Biography

James E. Grimes (Jim)
2505 Frays Mill Rd
Ruckersville, VA 22968
(434)974-6199 (office)
jim.grimes@neoventus.com

1984 – 2024: BS Physics, followed by 40 years, 5 companies, and 7 roles within the electronics industry

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'2005 - Present … *Neoventus Design Group, LLC [1], Charlottesville VA* – President & CEO (Founder, owner)

- Responsible for overall business management, customer interface, and engineering functions – both designing and reviewing the designs of staff.
- Neoventus is comprised of 4 full-time engineers plus several part-time engineers and support staff. The company provides design and development services in the electronics industry across many applications – medical, industrial, commercial, and space related industries. Services offered focus primarily on embedded computing – system, hardware, and firmware.

'1999 - 2005 … *ADI Engineering [2], Charlottesville VA* – Principal Engineer

- Responsible for the design and development of electronic systems - hardware and firmware.
- Provided engineering design and development as well as customer interface. While designs spanned numerous markets, notable where reference designs for Intel within their XScale processor family.

'1988 - 1999 … *GE Fanuc [3], Charlottesville VA* – Principal Engineer (Senior Engineer, Lead Engineer)

- As Principal and Senior engineer, responsible for system level product design as well as detailed processor design with GE Fanuc's PLC lines. Designs included PCB as well as custom integrated circuit design (VHDL).
- As lead engineer, responsible for project scheduling and team management (performance reviews, resource planning).
- Awarded *Engineer of the Year,* 1992
- Patents:
  6964045 ... *Multiple Program Storage with a Programmable Logic Controller System*
  6047021 ... *Methods and Apparatus for Exchanging Data*

'1987 - 1988 … *Westinghouse Electric, Airborne RADAR Division , Baltimore MD* – Design Engineer

- Responsible for the design of the Test and Maintenance Interface Unit (TMIU) - Custom VHSIC (Very High Speed Integrated Circuit) for use in the maintenance of the Advanced Tactical Fighter program (ATF [4]) RADAR processor.

'1984 - 1987 … *Westinghouse Electric, Oceanic Division [5], Annapolis, MD* – Design Engineer

- Responsible for the design and development of SONAR image processing systems. Hardware design included AMD 2900 bit-slice based Adaptive Time-Varied Gain (ATVG) processor for image normalization. Firmware development across numerous programs for the US Navy.

'1980 - 1984 … *James Madison University, Harrisonburg VA*

- BS Physics award August 1984

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[1] https://neoventus.com/
[2] ADI Engineering has since been purchased and integrated as part of Silicom Connectivity Solutions Ltd https://www.silicom-usa.com/
[3] GE Fanuc dissolved and became GE Embedded Platforms, which in-turn was purchased by Emerson https://en.wikipedia.org/wiki/GE_Automation_%26_Controls
[4] https://en.wikipedia.org/wiki/Advanced_Tactical_Fighter
[5] Westinghouse Oceanic has since been purchased by Northrup Grumman https://www.northropgrumman.com/careers/northrop-grumman-in-annapolis-maryland

Publications Authored

- None within the last 10 years.

Prior Expert Witness Testimony

- None within the last 10 years.