Nth Solutions, LLC

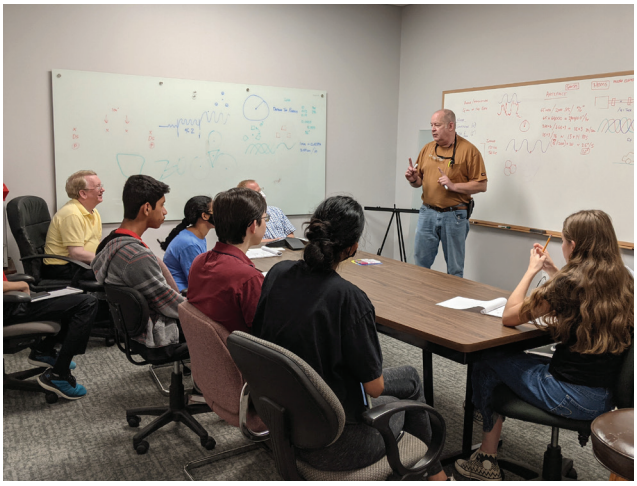
Our Patents

Nth Solutions, LLC
190 W Lincoln Hwy,
Coatesville, PA 19320

IMAGINED HERE
CREATED HERE
MADE HERE

ABOUT US

nth Solutions, LLC



The Company

nth Solutions was founded in 2006 by Susan Springsteen and Eric Canfield. We are a vertically integrated product development & manufacturing company whose design team holds more than 50 commercialized patents. The company's mission—Save Money, Save Lives, and Preserve Natural Resources—has resulted in the creation and distribution of unique products for homes and businesses, all of which are made in the USA.

Concept to Commercialization Under One Roof

In addition to our own product lines, we solve problems for our clients using a proprietary market-driven methodology in order to produce extraordinary products. We develop intellectual property and products which save money, save lives, and preserve natural resources. We use our Concept to Revenue-Ready™ process to solve everyday problems with extraordinary solutions. Our multi-disciplinary team utilizes its internal capabilities at every step of the development process to guide our clients through the best critical path to success. For whichever stage of the process you need our help, we apply our research, creative, and technical expertise to make your project Revenue-Ready™. We go beyond our clients' expectations to find the perfect nth solution.

ABOUT US

Nth Solutions, LLC

Due to a need for additional space for engineering, manufacturing, and general business operations, the Company relocated from Exton, PA, to Coatesville in 2020. The historic Lukens Steel building (pictured left) was built in 1902 but had been a burnt-out shell for more than 20 years before renovations.

The historic building renovations and the newly constructed 20,000 square foot engineering and manufacturing building were specifically designed to accommodate the Company's requirements for developing diverse engineering technologies and products. A large machine shop, IT and server room, advanced manufacturing floor, spray booth, inventory and finished goods storage, loading dock and warehouse were designed by the Company's engineers and built to spec.

ABOUT US

nth Solutions, LLC

Our Internship Program

The Company offers a unique and widely acclaimed multi-year paid internship program for high school students, typically involving 12 to 18 students from 8 or more local high schools and PALCS. The interns work alongside our professional technical staff to develop products for the Company and our clients. They create work product that includes physics and math applications, software development, firmware development, electronic hardware design, mechanical design, prototyping, along with social media and marketing projects. Our program has resulted in over two dozen high school interns being named as co-inventors on commercialized and revenue-generating issued patents.

Product Development and Business Incubation Expertise

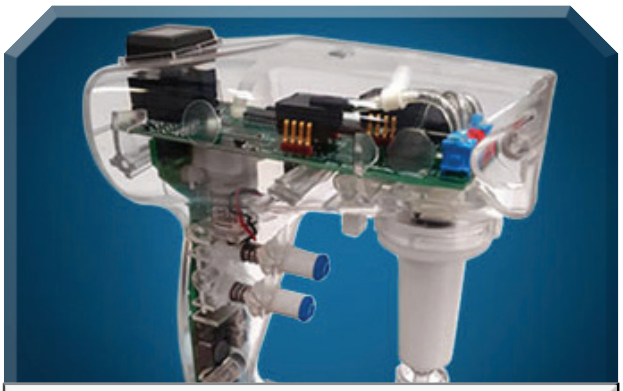
The core competencies, business pedigrees, and technical disciplines of the nth Solutions' team are best explained in the pages that follow. Whether it is designing sporks, sophisticated wireless products, or particle physics (and everything in between), nth Solutions personnel are narrowly focused on dissecting problems and vertically accelerating the concepts to cost-effective solutions.

Nth Solutions, LLC

Select Legacy Products

StormAlertor

Short Range Lightning Detector for Home Use



Elite Pipettor

For Precise Laboratory Liquid Dispensing

NanoDash

Dash-Mounted Preemption

Indoor Stink Bug Trap

Silent Non-Toxic Stinkbug Trap

MULTI SYSTEMS

Breaker Finder
Phase 3
Blaster
Flicker
Pinpoint

Companies Featured

H2O CONNECTED

Priority Green

NVH TECHNOLOGY

BIOFORCE ANALYTICS

TRUTEK

Quantum Pest Management

EZ Grease 'n Go

Along with One-Piece, Lasko, and Harrell.

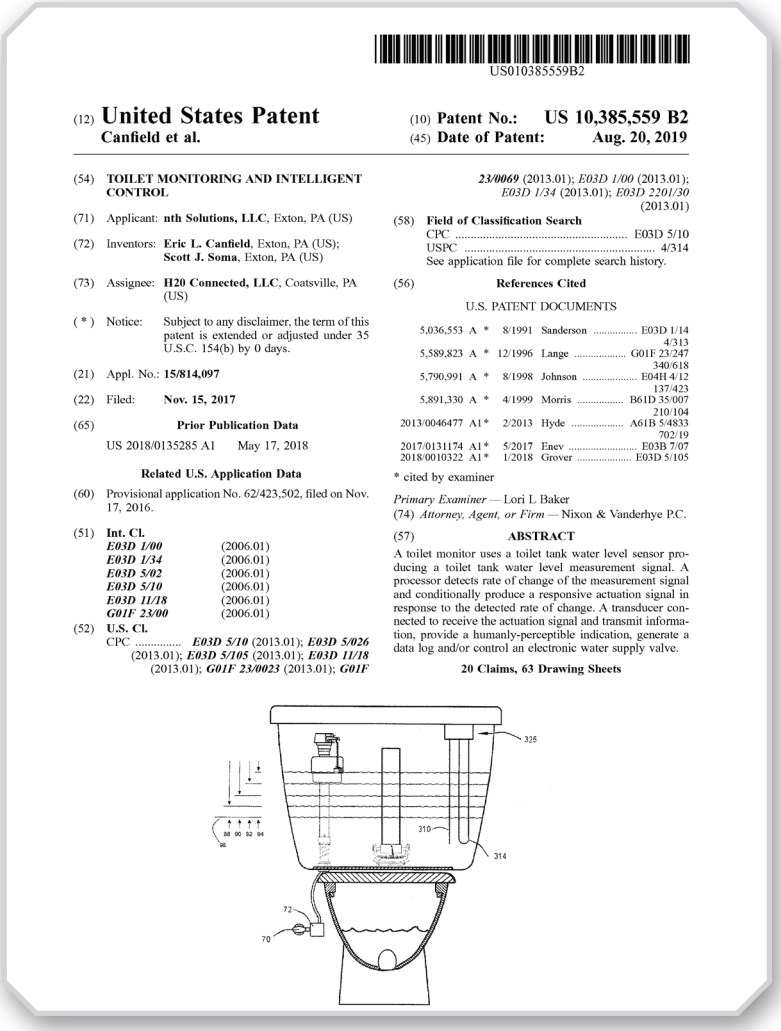
H2O CONNECTED

H2O Connected is a woman co-founded and led company that develops multi-patented water management and monitoring devices. Its award winning LeakAlertor® Wireless PRO System detects, alerts, diagnoses, and qualifies water wasting problems in tank-toilets so that hotel and multi-tenant property managers can save water and save money.

US PATENT 8,362,907

3 Intern Researchers

Detecting Unintended Flush Toilet Water Flow



US010385559B2

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 10,385,559 B2**
(45) **Date of Patent: Aug. 20, 2019**

(54) **TOILET MONITORING AND INTELLIGENT CONTROL**

(71) Applicant: **nth Solutions, LLC**, Exton, PA (US)

(72) Inventors: **Eric L. Canfield**, Exton, PA (US); **Scott J. Soma**, Exton, PA (US)

(73) Assignee: **H20 Connected, LLC**, Coatsville, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/814,097**

(22) Filed: **Nov. 15, 2017**

(65) **Prior Publication Data**

US 2018/0135285 A1 May 17, 2018

Related U.S. Application Data

(60) Provisional application No. 62/423,502, filed on Nov. 17, 2016.

(51) **Int. Cl.**

E03D 1/00	(2006.01)
E03D 1/34	(2006.01)
E03D 5/02	(2006.01)
E03D 5/10	(2006.01)
E03D 11/18	(2006.01)
G01F 23/00	(2006.01)

(52) **U.S. Cl.**

CPC ***E03D 5/10*** (2013.01); ***E03D 5/026*** (2013.01); ***E03D 5/105*** (2013.01); ***E03D 11/18*** (2013.01); ***G01F 23/0023*** (2013.01); ***G01F 23/0069*** (2013.01); *E03D 1/00* (2013.01); *E03D 1/34* (2013.01); *E03D 2201/30* (2013.01)

(58) **Field of Classification Search**

CPC E03D 5/10
USPC 4/314

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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5,891,330	A *	4/1999	Morris	B61D 35/007 210/104
2013/0046477	A1 *	2/2013	Hyde	A61B 5/4833 702/19
2017/0131174	A1 *	5/2017	Enev	E03B 7/07
2018/0010322	A1 *	1/2018	Grover	E03D 5/105

* cited by examiner

Primary Examiner — Lori L Baker
(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye P.C.

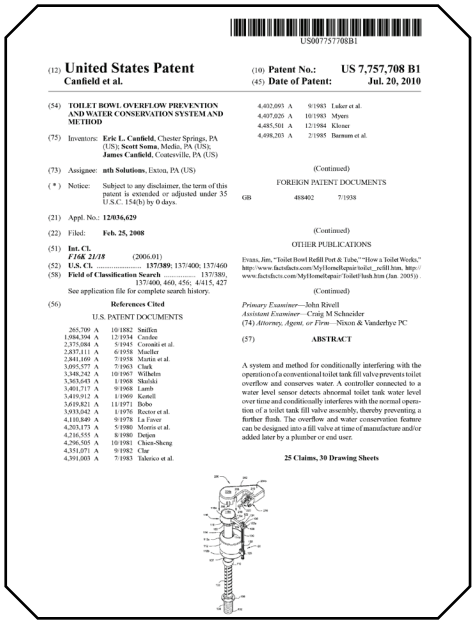
(57) **ABSTRACT**

A toilet monitor uses a toilet tank water level sensor producing a toilet tank water level measurement signal. A processor detects rate of change of the measurement signal and conditionally produce a responsive actuation signal in response to the detected rate of change. A transducer connected to receive the actuation signal and transmit information, provide a humanly-perceptible indication, generate a data log and/or control an electronic water supply valve.

20 Claims, 63 Drawing Sheets

Interested? Learn More:

These patents are the foundation for the ENTIRE H2O Connected line.



US007757708B1

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 7,757,708 B1**
(45) **Date of Patent: Jul. 20, 2010**

(54) **TOILET BOWL OVERFLOW PREVENTION AND WATER CONSERVATION SYSTEM AND METHOD**

(75) Inventors: **Eric L. Canfield**, Chester Springs, PA (US); **Scott Soma**, Media, PA (US); **James Canfield**, Coatesville, PA (US)

(73) Assignee: **nth Solutions**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/036,629**

(22) Filed: **Feb. 25, 2008**

(51) **Int. Cl.**
F16K 21/18 (2006.01)

(52) **U.S. Cl.** **137/389**; 137/400; 137/460

(58) **Field of Classification Search** 137/389, 137/400, 460, 456; 4/415, 427
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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1,984,394	A	12/1934	Cardee
2,375,084	A	5/1945	Coronili et al.
2,837,111	A	6/1958	Mueller
2,841,169	A	7/1958	Martin et al.
3,095,577	A	7/1963	Clark
3,348,242	A	10/1967	Wilhelm
3,363,643	A	1/1968	Skolaki
3,419,912	A	1/1969	Kettell
3,419,821	A	11/1971	Bobo
3,933,042	A	1/1976	Rector et al.
4,110,849	A	9/1978	La Faver
4,203,173	A	5/1980	Morris et al.
4,216,555	A	8/1980	Dotjen
4,296,505	A	10/1981	Chien-Sheng
4,351,071	A	9/1982	Che
4,391,003	A	7/1983	Talesico et al.
4,402,095	A	9/1983	Luker et al.
4,407,026	A	10/1983	Myers
4,485,501	A	12/1984	Kloner
4,498,203	A	2/1985	Barnum et al.

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Evans, Jim, "Toilet Bowl Refill Port & Tube," "How a Toilet Works," http://www.factsfacts.com/MyHomeRepair/toilet_refill.htm, http://www.factsfacts.com/MyHomeRepair/ToiletFlush.htm (Jan. 2003)).

(Continued)

Primary Examiner—John Rivell
Assistant Examiner—Craig M Schneider
(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye PC

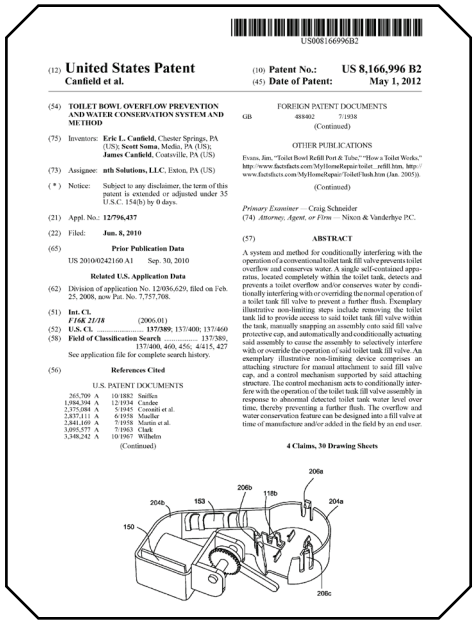
(57) **ABSTRACT**

A system and method for conditionally interfering with the operation of a conventional toilet tank fill valve prevents toilet overflow and conserves water. A controller connected to a water level sensor detects abnormal toilet tank water level over time and conditionally interferes with the normal operation of a toilet tank fill valve assembly, thereby preventing a further flush. The overflow and water conservation feature can be designed into a fill valve at time of manufacture and/or added later by a plumber or end user.

25 Claims, 30 Drawing Sheets

US PATENT 7,757,708

Toilet Bowl Overflow Prevention and Water Conservation System and Method



US008166996B2

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 8,166,996 B2**
(45) **Date of Patent: May 1, 2012**

(54) **TOILET BOWL OVERFLOW PREVENTION AND WATER CONSERVATION SYSTEM AND METHOD**

(75) Inventors: **Eric L. Canfield**, Chester Springs, PA (US); **Scott Soma**, Media, PA (US); **James Canfield**, Coatsville, PA (US)

(73) Assignee: **nth Solutions, LLC**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/796,437**

(22) Filed: **Jun. 8, 2010**

(65) **Prior Publication Data**

US 2010/0242160 A1 Sep. 30, 2010

Related U.S. Application Data

(62) Division of application No. 12/036,629, filed on Feb. 25, 2008, now Pat. No. 7,757,708.

(51) **Int. Cl.**
F16K 21/18 (2006.01)

(52) **U.S. Cl.** **137/389**; 137/400; 137/460

(58) **Field of Classification Search** 137/389, 137/400, 460, 456; 4/415, 427
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

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1,984,394	A	12/1934	Cardee
2,375,084	A	5/1945	Coronili et al.
2,837,111	A	6/1958	Mueller
2,841,169	A	7/1958	Martin et al.
3,095,577	A	7/1963	Clark
3,348,242	A	10/1967	Wilhelm

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GB	488402	7/1938

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Evans, Jim, "Toilet Bowl Refill Port & Tube," "How a Toilet Works," http://www.factsfacts.com/MyHomeRepair/toilet_refill.htm, http://www.factsfacts.com/MyHomeRepair/ToiletFlush.htm (Jan. 2005)).

(Continued)

Primary Examiner — Craig Schneider
(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye PC

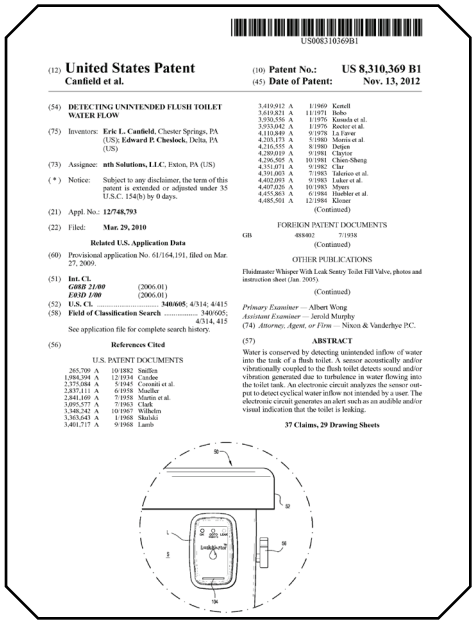
(57) **ABSTRACT**

A system and method for conditionally interfering with the operation of a conventional toilet tank fill valve prevents toilet overflow and conserves water. A single self-contained apparatus, located completely within the toilet tank, detects and prevents a toilet overflow and/or conserves water by conditionally interfering with or overriding the normal operation of a toilet tank fill valve to prevent a further flush. Exemplary illustrative non-limiting steps include removing the toilet tank lid to provide access to said toilet tank fill valve within the tank, manually snapping an assembly onto said fill valve protective cap, and automatically and conditionally actuating said assembly to cause the assembly to selectively interfere with or override the operation of said toilet tank fill valve. An exemplary illustrative non-limiting device comprises an attaching structure for manual attachment to said fill valve cap, and a control mechanism supported by said attaching structure. The control mechanism acts to conditionally interfere with the operation of the toilet tank fill valve assembly in response to abnormal detected toilet tank water level over time, thereby preventing a further flush. The overflow and water conservation feature can be designed into a fill valve at time of manufacture and/or added in the field by an end user.

4 Claims, 30 Drawing Sheets

US PATENT 8,166,996

Toilet Bowl Overflow Prevention and Water Conservation System and Method



US008310369B1

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 8,310,369 B1**
(45) **Date of Patent: Nov. 13, 2012**

(54) **DETECTING UNINTENDED FLUSH TOILET WATER FLOW**

(75) Inventors: **Eric L. Canfield**, Chester Springs, PA (US); **Edward P. Cheslock**, Delta, PA (US)

(73) Assignee: **nth Solutions, LLC**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/748,793**

(22) Filed: **Mar. 29, 2010**

Related U.S. Application Data

(60) Provisional application No. 61/164,191, filed on Mar. 27, 2009.

(51) **Int. Cl.**
G08B 21/00 (2006.01)
E03D 1/00 (2006.01)

(52) **U.S. Cl.** **340/605**; 4/314; 4/415

(58) **Field of Classification Search** 340/605; 4/314, 415
See application file for complete search history.

(56) **References Cited**

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2,841,169	A	7/1958	Martin et al.
3,095,577	A	7/1963	Clark
3,348,242	A	10/1967	Wilhelm
3,363,643	A	1/1968	Skolaki
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3,419,821	A	11/1971	Bobo
3,933,042	A	1/1976	Rector et al.
4,110,849	A	9/1978	La Faver
4,203,173	A	5/1980	Morris et al.
4,216,555	A	8/1980	Dotjen
4,296,505	A	10/1981	Chien-Sheng
4,351,071	A	9/1982	Che
4,391,003	A	7/1983	Talesico et al.
4,402,095	A	9/1983	Luker et al.
4,407,026	A	10/1983	Myers
4,455,863	A	6/1984	Huebler et al.
4,485,501	A	12/1984	Kloner

(Continued)

FOREIGN PATENT DOCUMENTS

GB	488402	7/1938

(Continued)

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(Continued)

Primary Examiner — Albert Wong
Assistant Examiner — Jerold Murphy
(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye P.C.

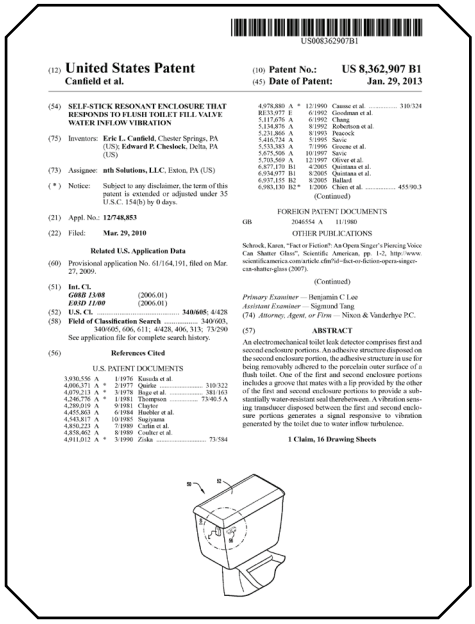
(57) **ABSTRACT**

Water is conserved by detecting unintended inflow of water into the tank of a flush toilet. A sensor acoustically and/or vibrationally coupled to the flush toilet detects sound and/or vibration generated due to turbulence in water flowing into the toilet tank. An electronic circuit analyzes the sensor output to detect cyclical water inflow not intended by a user. The electronic circuit generates an alert such as an audible and/or visual indication that the toilet is leaking.

37 Claims, 29 Drawing Sheets

US PATENT 8,310,369

Detecting Unintended Flush Toilet Water Flow



US008362907B1

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 8,362,907 B1**
(45) **Date of Patent: Jan. 29, 2013**

(54) **SELF-STICK RESONANT ENCLOSURE THAT RESPONDS TO FLUSH TOILET FILL VALVE WATER INFLOW VIBRATION**

(75) Inventors: **Eric L. Canfield**, Chester Springs, PA (US); **Edward P. Cheslock**, Delta, PA (US)

(73) Assignee: **nth Solutions, LLC**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/748,853**

(22) Filed: **Mar. 29, 2010**

Related U.S. Application Data

(60) Provisional application No. 61/164,191, filed on Mar. 27, 2009.

(51) **Int. Cl.**
G08B 13/08 (2006.01)
E03D 11/00 (2006.01)

(52) **U.S. Cl.** **340/605**; 4/428

(58) **Field of Classification Search** 340/603, 340/605, 606, 611; 4/428, 406, 313; 73/290
See application file for complete search history.

(56) **References Cited**

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(Continued)

Primary Examiner — Benjamin C Lee
Assistant Examiner — Sigmund Tang
(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye P.C.

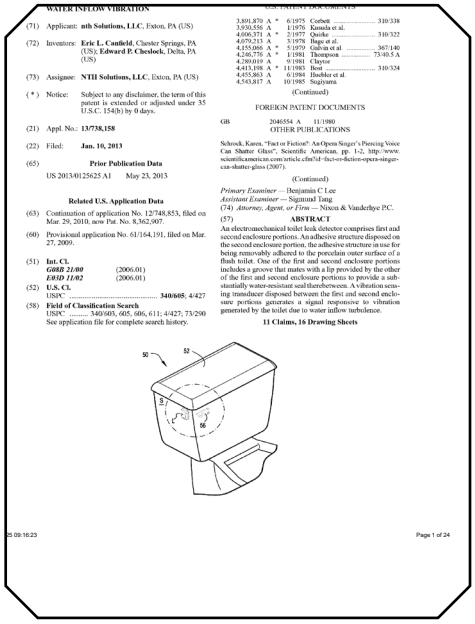
(57) **ABSTRACT**

An electromechanical toilet leak detector comprises first and second enclosure portions. An adhesive structure disposed on the second enclosure portion, the adhesive structure in use for being removably adhered to the porcelain outer surface of a flush toilet. One of the first and second enclosure portions includes a groove that mates with a lip provided by the other of the first and second enclosure portions to provide a substantially water-resistant seal therebetween. A vibration sensing transducer disposed between the first and second enclosure portions generates a signal responsive to vibration generated by the toilet due to water inflow turbulence.

1 Claim, 16 Drawing Sheets

US PATENT 8,362,907

Self-Stick Resonant Enclosure that Responds to Flush Toilet Fill Valve Water Inflow Vibration



WATER INFLOW VIBRATION

(71) Applicant: **nth Solutions, LLC**, Exton, PA (US)

(72) Inventors: **Eric L. Canfield**, Chester Springs, PA (US); **Edward P. Cheslock**, Delta, PA (US)

(73) Assignee: **NTH Solutions, LLC**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/738,158**

(22) Filed: **Jan. 10, 2013**

(65) **Prior Publication Data**

US 2013/0125625 A1 May 23, 2013

Related U.S. Application Data

(63) Continuation of application No. 12/748,853, filed on Mar. 29, 2010, now Pat. No. 8,362,907.

(60) Provisional application No. 61/164,191, filed on Mar. 27, 2009.

(51) **Int. Cl.**
G08B 21/00 (2006.01)
E03D 11/02 (2006.01)

(52) **U.S. Cl.**
USPC **340/605**; 4/427

(58) **Field of Classification Search**
USPC 340/603, 605, 606, 611; 4/427; 73/290
See application file for complete search history.

U.S. PATENT DOCUMENTS

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3,930,556	A	1/1976	Kasuda et al.
4,006,371	A *	2/1977	Quirke 310/322
4,079,213	A *	3/1978	Bago et al.
4,155,085	A *	5/1979	Galvin et al. 367/140
4,246,776	A *	1/1981	Thompson ..... 73/40.5 A
4,280,019	A	9/1981	Claytor
4,413,198	A *	11/1983	Best 310/324
4,455,863	A	6/1984	Huebler et al.
4,543,817	A	10/1985	Sugiyama

(Continued)

FOREIGN PATENT DOCUMENTS

GB	2046554 A	11/1980

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Schrock, Karen, "Fact or Fiction?: An Opera Singer's Piercing Voice Can Shatter Glass", Scientific American, pp. 1-2, http://www.scientificamerican.com/article.cfm?id=fact-or-fiction-opera-singer-can-shatter-glass (2007).

(Continued)

Primary Examiner — Benjamin C Lee
Assistant Examiner — Sigmund Tang
(74) *Attorney, Agent, or Firm* — Nixon & Vanderhye PC.

(57) **ABSTRACT**

An electromechanical toilet leak detector comprises first and second enclosure portions. An adhesive structure disposed on the second enclosure portion, the adhesive structure in use for being removably adhered to the porcelain outer surface of a flush toilet. One of the first and second enclosure portions includes a groove that mates with a lip provided by the other of the first and second enclosure portions to provide a substantially water-resistant seal therebetween. A vibration sensing transducer disposed between the first and second enclosure portions generates a signal responsive to vibration generated by the toilet due to water inflow turbulence.

11 Claims, 16 Drawing Sheets

US PATENT 8,704,671

Self-Stick Resonant Enclosure that Responds to Flush Toilet Fill Valve Water Inflow Vibration

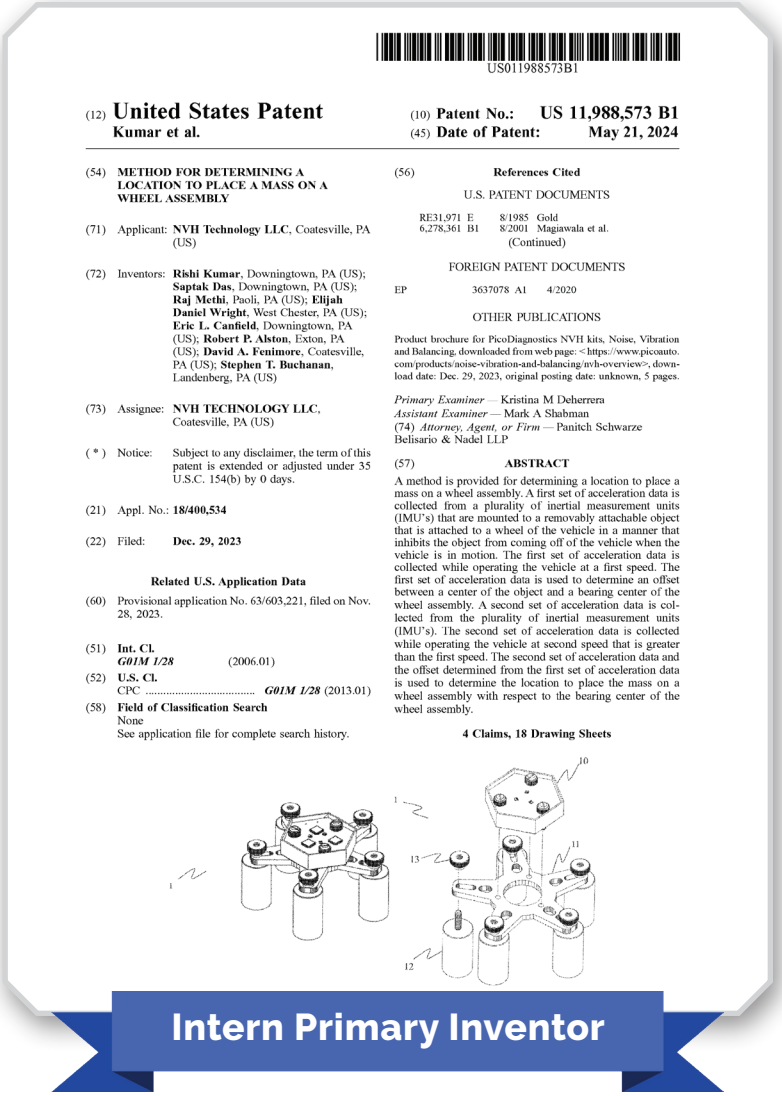
NVH TECHNOLOGY

Introducing a revolutionary engineering technology employing a Three-Axis Force Vector Sensor. Designed to collect data at high speeds, this technology more accurately measures dynamic wheel vibration through highly detailed data, analytics, and repair diagnostics. The result… improved tire life, better handling, a smoother ride, and an overall better driver experience.

US PATENT 8,362,907

12 Intern Co-Inventors

Detecting Unintended Flush Toilet Water Flow



US011988573B1

(12) **United States Patent**
Kumar et al.

(10) **Patent No.: US 11,988,573 B1**
(45) **Date of Patent: May 21, 2024**

(54) **METHOD FOR DETERMINING A LOCATION TO PLACE A MASS ON A WHEEL ASSEMBLY**

(71) Applicant: **NVH Technology LLC**, Coatesville, PA (US)

(72) Inventors: **Rishi Kumar**, Downingtown, PA (US); **Saptak Das**, Downingtown, PA (US); **Raj Methi**, Paoli, PA (US); **Elijah Daniel Wright**, West Chester, PA (US); **Eric L. Canfield**, Downingtown, PA (US); **Robert P. Alston**, Exton, PA (US); **David A. Fenimore**, Coatesville, PA (US); **Stephen T. Buchanan**, Landenberg, PA (US)

(73) Assignee: **NVH TECHNOLOGY LLC**, Coatesville, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **18/400,534**

(22) Filed: **Dec. 29, 2023**

Related U.S. Application Data

(60) Provisional application No. 63/603,221, filed on Nov. 28, 2023.

(51) **Int. Cl.**
G01M 1/28 (2006.01)

(52) **U.S. Cl.**
CPC ***G01M 1/28*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Kristina M Deherrera
Assistant Examiner — Mark A Shabman
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

A method is provided for determining a location to place a mass on a wheel assembly. A first set of acceleration data is collected from a plurality of inertial measurement units (IMU's) that are mounted to a removably attachable object that is attached to a wheel of the vehicle in a manner that inhibits the object from coming off of the vehicle when the vehicle is in motion. The first set of acceleration data is collected while operating the vehicle at a first speed. The first set of acceleration data is used to determine an offset between a center of the object and a bearing center of the wheel assembly. A second set of acceleration data is collected from the plurality of inertial measurement units (IMU's). The second set of acceleration data is collected while operating the vehicle at second speed that is greater than the first speed. The second set of acceleration data and the offset determined from the first set of acceleration data is used to determine the location to place the mass on a wheel assembly with respect to the bearing center of the wheel assembly.

4 Claims, 18 Drawing Sheets

Intern Primary Inventor

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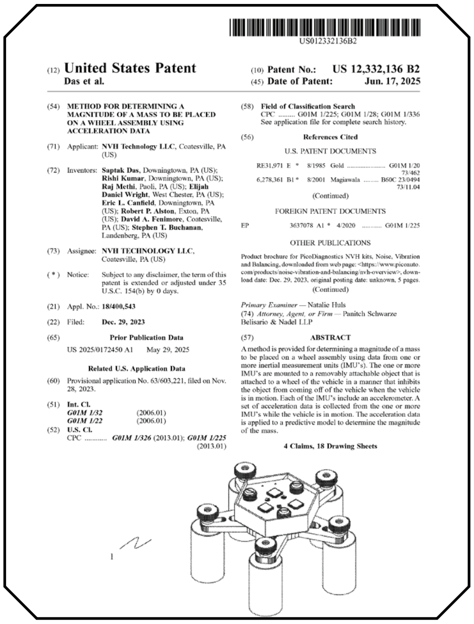
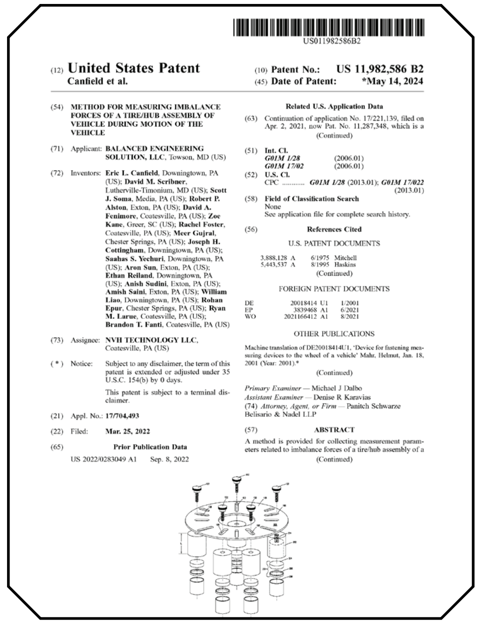


US PATENT 12,332,136

3 Intern Co-Inventors

Method for Determining a Magnitude of Mass to be Placed on a Wheel Assembly using Acceleration Data

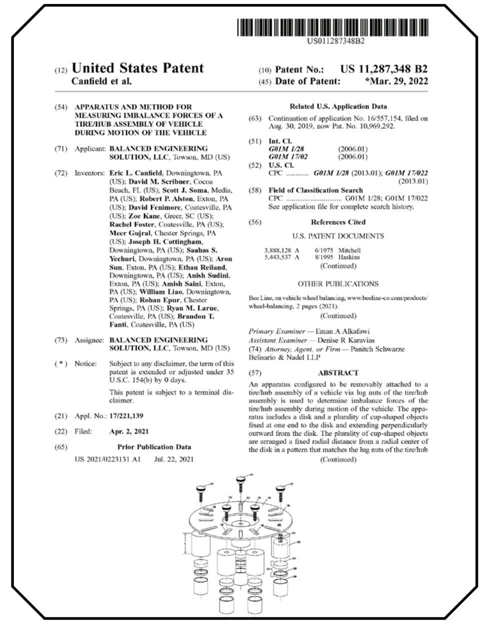
Intern Primary Inventor



US PATENT 11,982,586

12 Intern Co-Inventors

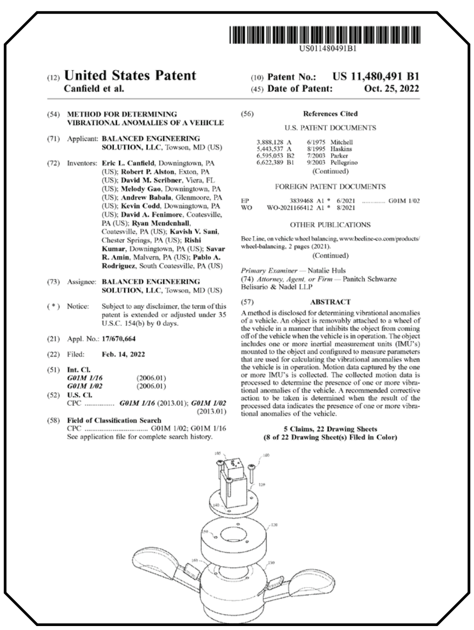
Method for Measuring Imbalance Forces of a Tire/Hub Assembly of Vehicle During Motion of the Vehicle



US PATENT 11,287,348

13 Intern Co-Inventors

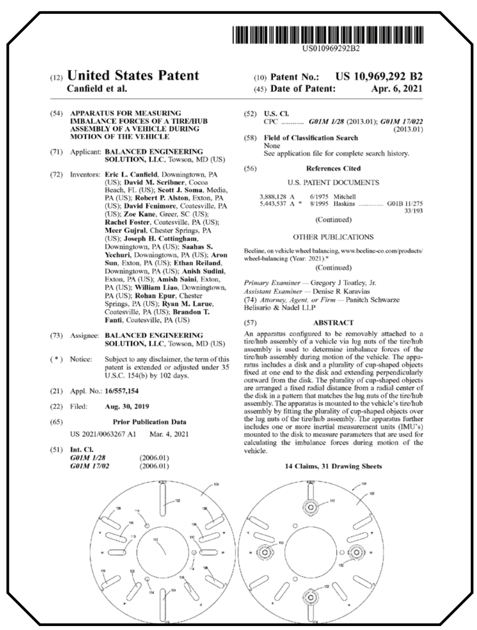
Apparatus and Method For Measuring Imbalance Forces of a Tire/Hub Assembly of Vehicle During Motion of the Vehicle



US PATENT 11,480,491

8 Intern Co-Inventors

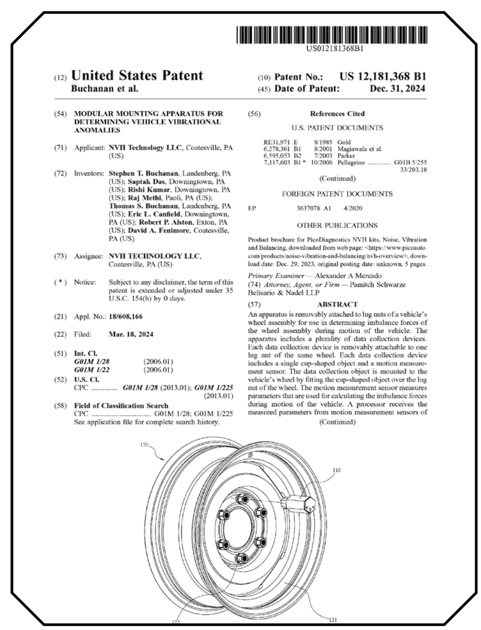
Method for Determining Vibrational Anomalies of a Vehicle



US PATENT 10,969,292

6 Intern Co-Inventors

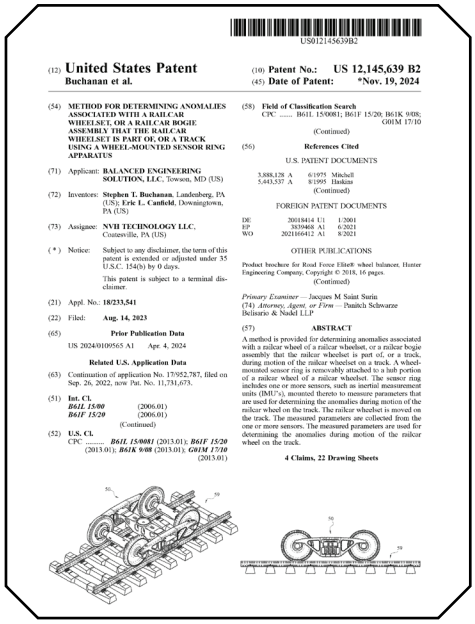
Apparatus For Measuring Imbalance Forces of a Tire/Hub Assembly of a Vehicle During Motion of the Vehicle



US PATENT 12,181,368

3 Intern Co-Inventors

Modular Mounting Apparatus for Determining Vehicle Vibrational Anomalies



US12145639B2

(12) **United States Patent**
Buchanan et al.

(10) **Patent No.: US 12,145,639 B2**
(45) **Date of Patent: *Nov. 19, 2024**

(54) **METHOD FOR DETERMINING ANOMALIES ASSOCIATED WITH A RAILCAR WHEELSET, OR A RAILCAR BOGIE ASSEMBLY THAT THE RAILCAR WHEELSET IS PART OF, OR A TRACK USING A WHEEL-MOUNTED SENSOR RING APPARATUS**

(71) Applicant: **BALANCED ENGINEERING SOLUTION, LLC**, Towson, MD (US)

(72) Inventors: **Stephen T. Buchanan**, Landenberg, PA (US); **Eric L. Canfield**, Downingtown, PA (US)

(73) Assignee: **NVH TECHNOLOGY LLC**, Coatesville, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **18/233,541**

(22) Filed: **Aug. 14, 2023**

(65) **Prior Publication Data**

US 2024/0109565 A1 Apr. 4, 2024

Related U.S. Application Data

(63) Continuation of application No. 17/952,787, filed on Sep. 26, 2022, now Pat. No. 11,731,673.

(51) **Int. Cl.**
B61L 15/00 (2006.01)
B61F 15/20 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***B61L 15/0081*** (2013.01); ***B61F 15/20*** (2013.01); ***B61K 9/08*** (2013.01); ***G01M 17/10*** (2013.01)

(58) **Field of Classification Search**
CPC B61L 15/0081; B61F 15/20; B61K 9/08; G01M 17/10
(Continued)

(56) **References Cited**

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(Continued)

Primary Examiner — Jacques M Saint Surin
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

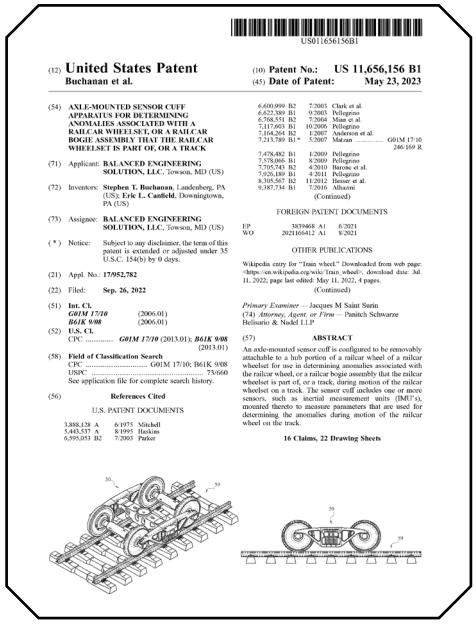
A method is provided for determining anomalies associated with a railcar wheel of a railcar wheelset, or a railcar bogie assembly that the railcar wheelset is part of, or a track, during motion of the railcar wheelset on a track. A wheel-mounted sensor ring is removably attached to a hub portion of a railcar wheel of a railcar wheelset. The sensor ring includes one or more sensors, such as inertial measurement units (IMU's), mounted thereto to measure parameters that are used for determining the anomalies during motion of the railcar wheelset on the track. The railcar wheelset is moved on the track. The measured parameters are collected from the one or more sensors. The measured parameters are used for determining the anomalies during motion of the railcar wheel on the track.

4 Claims, 22 Drawing Sheets

US PATENT 12,145,639

4 Intern Collaborators

Method for Determining Anomalies Associated With a Railcar Wheelset, or a Railcar Bogie Assembly That the Railcar Wheelset is Part of, or a Track Using a Wheel-Mounted Sensor Ring Apparatus



US11656156B1

(12) **United States Patent**
Buchanan et al.

(10) **Patent No.: US 11,656,156 B1**
(45) **Date of Patent: May 23, 2023**

(54) **AXLE-MOUNTED SENSOR CUFF APPARATUS FOR DETERMINING ANOMALIES ASSOCIATED WITH A RAILCAR WHEELSET, OR A RAILCAR BOGIE ASSEMBLY THAT THE RAILCAR WHEELSET IS PART OF, OR A TRACK**

(71) Applicant: **BALANCED ENGINEERING SOLUTION, LLC**, Towson, MD (US)

(72) Inventors: **Stephen T. Buchanan**, Landenberg, PA (US); **Eric L. Canfield**, Downingtown, PA (US)

(73) Assignee: **BALANCED ENGINEERING SOLUTION, LLC**, Towson, MD (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **17/952,782**

(22) Filed: **Sep. 26, 2022**

(51) **Int. Cl.**
G01M 17/10 (2006.01)
B61K 9/08 (2006.01)

(52) **U.S. Cl.**
CPC ***G01M 17/10*** (2013.01); ***B61K 9/08*** (2013.01)

(58) **Field of Classification Search**
CPC G01M 17/10; B61K 9/08
USPC 73/660
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Jacques M Saint Surin
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

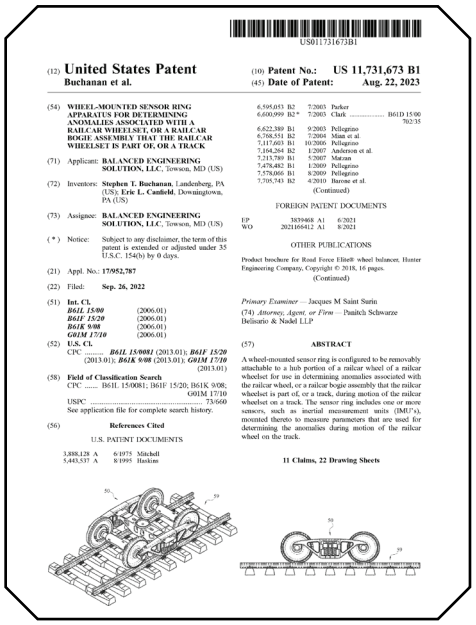
An axle-mounted sensor cuff is configured to be removably attachable to a hub portion of a railcar wheel of a railcar wheelset for use in determining anomalies associated with the railcar wheel, or a railcar bogie assembly that the railcar wheelset is part of, or a track, during motion of the railcar wheelset on a track. The sensor cuff includes one or more sensors, such as inertial measurement units (IMU's), mounted thereto to measure parameters that are used for determining the anomalies during motion of the railcar wheel on the track.

16 Claims, 22 Drawing Sheets

US PATENT 11,656,156

4 Intern Collaborators

Axle-Mounted Sensor Cuff Apparatus for Determining Anomalies Associated With a Railcar Wheelset, or a Railcar Bogie Assembly That the Railcar Wheelset is Part of, or a Track



US11731673B1

(12) **United States Patent**
Buchanan et al.

(10) **Patent No.: US 11,731,673 B1**
(45) **Date of Patent: Aug. 22, 2023**

(54) **WHEEL-MOUNTED SENSOR RING APPARATUS FOR DETERMINING ANOMALIES ASSOCIATED WITH A RAILCAR WHEELSET, OR A RAILCAR BOGIE ASSEMBLY THAT THE RAILCAR WHEELSET IS PART OF, OR A TRACK**

(71) Applicant: **BALANCED ENGINEERING SOLUTION, LLC**, Towson, MD (US)

(72) Inventors: **Stephen T. Buchanan**, Landenberg, PA (US); **Eric L. Canfield**, Downingtown, PA (US)

(73) Assignee: **BALANCED ENGINEERING SOLUTION, LLC**, Towson, MD (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **17/952,787**

(22) Filed: **Sep. 26, 2022**

(51) **Int. Cl.**
B61L 15/00 (2006.01)
B61F 15/20 (2006.01)
B61K 9/08 (2006.01)
G01M 17/10 (2006.01)

(52) **U.S. Cl.**
CPC ***B61L 15/0081*** (2013.01); ***B61F 15/20*** (2013.01); ***B61K 9/08*** (2013.01); ***G01M 17/10*** (2013.01)

(58) **Field of Classification Search**
CPC B61L 15/0081; B61F 15/20; B61K 9/08; G01M 17/10
USPC 73/660
See application file for complete search history.

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(Continued)

Primary Examiner — Jacques M Saint Surin
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

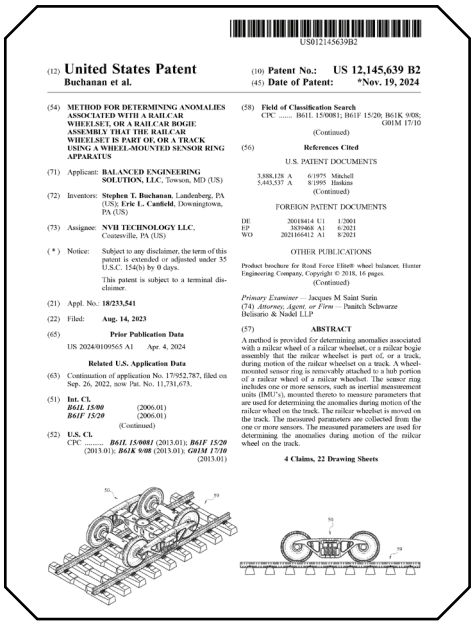
A wheel-mounted sensor ring is configured to be removably attachable to a hub portion of a railcar wheel of a railcar wheelset for use in determining anomalies associated with the railcar wheel, or a railcar bogie assembly that the railcar wheelset is part of, or a track, during motion of the railcar wheelset on a track. The sensor ring includes one or more sensors, such as inertial measurement units (IMU's), mounted thereto to measure parameters that are used for determining the anomalies during motion of the railcar wheel on the track.

11 Claims, 22 Drawing Sheets

US PATENT 11,731,673

4 Intern Collaborators

Wheel-Mounting Sensor Ring Apparatus for Determining Anomalies Associated With a Railcar Wheelset , or a Railcar Bogie Assembly That the Railcar Wheelset is Part of, or a Track



US12145639B2

(12) **United States Patent**
Buchanan et al.

(10) **Patent No.: US 12,145,639 B2**
(45) **Date of Patent: *Nov. 19, 2024**

(54) **METHOD FOR DETERMINING ANOMALIES ASSOCIATED WITH A RAILCAR WHEELSET, OR A RAILCAR BOGIE ASSEMBLY THAT THE RAILCAR WHEELSET IS PART OF, OR A TRACK USING A WHEEL-MOUNTED SENSOR RING APPARATUS**

(71) Applicant: **BALANCED ENGINEERING SOLUTION, LLC**, Towson, MD (US)

(72) Inventors: **Stephen T. Buchanan**, Landenberg, PA (US); **Eric L. Canfield**, Downingtown, PA (US)

(73) Assignee: **NVH TECHNOLOGY LLC**, Coatesville, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **18/233,541**

(22) Filed: **Aug. 14, 2023**

(65) **Prior Publication Data**

US 2024/0109565 A1 Apr. 4, 2024

Related U.S. Application Data

(63) Continuation of application No. 17/952,787, filed on Sep. 26, 2022, now Pat. No. 11,731,673.

(51) **Int. Cl.**
B61L 15/00 (2006.01)
B61F 15/20 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***B61L 15/0081*** (2013.01); ***B61F 15/20*** (2013.01); ***B61K 9/08*** (2013.01); ***G01M 17/10*** (2013.01)

(58) **Field of Classification Search**
CPC B61L 15/0081; B61F 15/20; B61K 9/08; G01M 17/10
(Continued)

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Product brochure for Road Force Elite® wheel balancer, Hunter Engineering Company, Copyright © 2018, 16 pages.
(Continued)

Primary Examiner — Jacques M Saint Surin
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

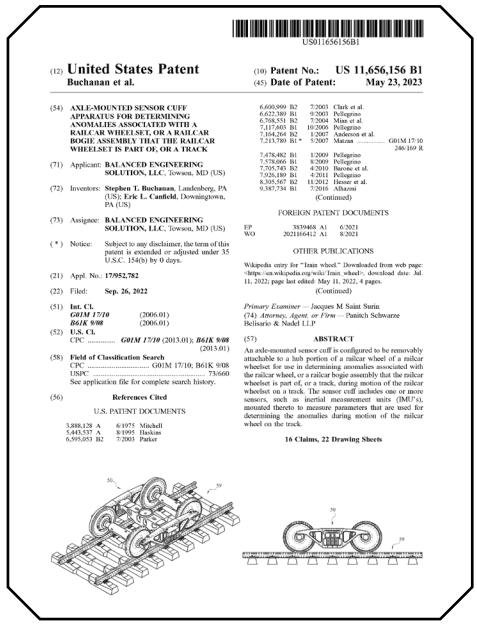
A method is provided for determining anomalies associated with a railcar wheel of a railcar wheelset, or a railcar bogie assembly that the railcar wheelset is part of, or a track, during motion of the railcar wheelset on a track. A wheel-mounted sensor ring is removably attached to a hub portion of a railcar wheel of a railcar wheelset. The sensor ring includes one or more sensors, such as inertial measurement units (IMU's), mounted thereto to measure parameters that are used for determining the anomalies during motion of the railcar wheelset on the track. The railcar wheelset is moved on the track. The measured parameters are collected from the one or more sensors. The measured parameters are used for determining the anomalies during motion of the railcar wheel on the track.

4 Claims, 22 Drawing Sheets

US PATENT 12,145,639

4 Intern Collaborators

Method for Determining Anomalies Associated With a Railcar Wheelset, or a Railcar Bogie Assembly That the Railcar Wheelset is Part of, or a Track Using a Wheel-Mounted Sensor Ring Apparatus



US11656156B1

(12) **United States Patent**
Buchanan et al.

(10) **Patent No.: US 11,656,156 B1**
(45) **Date of Patent: May 23, 2023**

(54) **AXLE-MOUNTED SENSOR CUFF APPARATUS FOR DETERMINING ANOMALIES ASSOCIATED WITH A RAILCAR WHEELSET, OR A RAILCAR BOGIE ASSEMBLY THAT THE RAILCAR WHEELSET IS PART OF, OR A TRACK**

(71) Applicant: **BALANCED ENGINEERING SOLUTION, LLC**, Towson, MD (US)

(72) Inventors: **Stephen T. Buchanan**, Landenberg, PA (US); **Eric L. Canfield**, Downingtown, PA (US)

(73) Assignee: **BALANCED ENGINEERING SOLUTION, LLC**, Towson, MD (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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(51) **Int. Cl.**
G01M 17/10 (2006.01)
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(52) **U.S. Cl.**
CPC ***G01M 17/10*** (2013.01); ***B61K 9/08*** (2013.01)

(58) **Field of Classification Search**
CPC G01M 17/10; B61K 9/08
USPC 73/660
See application file for complete search history.

(56) **References Cited**

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Primary Examiner — Jacques M Saint Surin
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

An axle-mounted sensor cuff is configured to be removably attachable to a hub portion of a railcar wheel of a railcar wheelset for use in determining anomalies associated with the railcar wheel, or a railcar bogie assembly that the railcar wheelset is part of, or a track, during motion of the railcar wheelset on a track. The sensor cuff includes one or more sensors, such as inertial measurement units (IMU's), mounted thereto to measure parameters that are used for determining the anomalies during motion of the railcar wheel on the track.

16 Claims, 22 Drawing Sheets

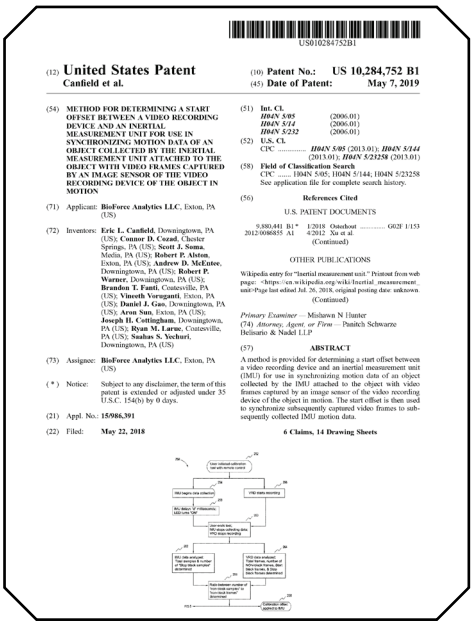
US PATENT 11,656,156

4 Intern Collaborators

Axle-Mounted Sensor Cuff Apparatus for Determining Anomalies Associated With a Railcar Wheelset, or a Railcar Bogie Assvembly That the Railcar Wheelset is Part of, or a Track

BIOFORCE ANALYTICS

The EduForce™ Module contains an Inertial Measurement Unit (IMU) with nine degrees of freedom. The compact device offers maximum capability in three dimensions to measure acceleration, angular velocity, and magnetic field strength



US010284752B1

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 10,284,752 B1**
(45) **Date of Patent: May 7, 2019**

(54) **METHOD FOR DETERMINING A START OFFSET BETWEEN A VIDEO RECORDING DEVICE AND AN INERTIAL MEASUREMENT UNIT FOR USE IN SYNCHRONIZING MOTION DATA OF AN OBJECT COLLECTED BY THE INERTIAL MEASUREMENT UNIT ATTACHED TO THE OBJECT WITH VIDEO FRAMES CAPTURED BY AN IMAGE SENSOR OF THE VIDEO RECORDING DEVICE OF THE OBJECT IN MOTION**

(71) Applicant: **BioForce Analytics LLC**, Exton, PA (US)

(72) Inventors: **Eric L. Canfield**, Downingtown, PA (US); **Connor D. Cozad**, Chester Springs, PA (US); **Scott J. Soma**, Media, PA (US); **Robert P. Alston**, Exton, PA (US); **Andrew D. McEntee**, Downingtown, PA (US); **Robert P. Warner**, Downingtown, PA (US); **Brandon T. Fanti**, Coatesville, PA (US); **Vineeth Vorugunti**, Exton, PA (US); **Daniel J. Gao**, Downingtown, PA (US); **Aron Sun**, Exton, PA (US); **Joseph H. Cottingham**, Downingtown, PA (US); **Ryan M. Larue**, Coatesville, PA (US); **Saahas S. Yechuri**, Downingtown, PA (US)

(73) Assignee: **BioForce Analytics LLC**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/986,391**

(22) Filed: **May 22, 2018**

(51) **Int. Cl.**
H04N 5/05 (2006.01)
H04N 5/14 (2006.01)
H04N 5/232 (2006.01)

(52) **U.S. Cl.**
CPC ***H04N 5/05*** (2013.01); ***H04N 5/144*** (2013.01); ***H04N 5/23258*** (2013.01)

(58) **Field of Classification Search**
CPC H04N 5/05; H04N 5/144; H04N 5/23258
See application file for complete search history.

(56) **References Cited**

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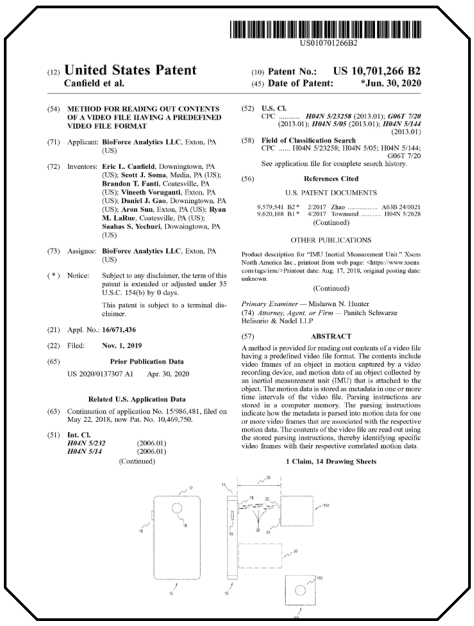
(Continued)

Primary Examiner — Mishawn N Hunter
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

A method is provided for determining a start offset between a video recording device and an inertial measurement unit (IMU) for use in synchronizing motion data of an object collected by the IMU attached to the object with video frames captured by an image sensor of the video recording device of the object in motion. The start offset is then used to synchronize subsequently captured video frames to subsequently collected IMU motion data.

6 Claims, 14 Drawing Sheets



US010701266B2

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 10,701,266 B2**
(45) **Date of Patent: *Jun. 30, 2020**

(54) **METHOD FOR READING OUT CONTENTS OF A VIDEO FILE HAVING A PREDEFINED VIDEO FILE FORMAT**

(71) Applicant: **BioForce Analytics LLC**, Exton, PA (US)

(72) Inventors: **Eric L. Canfield**, Downingtown, PA (US); **Scott J. Soma**, Media, PA (US); **Brandon T. Fanti**, Coatesville, PA (US); **Vineeth Vorugunti**, Exton, PA (US); **Daniel J. Gao**, Downingtown, PA (US); **Aron Sun**, Exton, PA (US); **Ryan M. LaRue**, Coatesville, PA (US); **Saahas S. Yechuri**, Downingtown, PA (US)

(73) Assignee: **BioForce Analytics LLC**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/671,436**

(22) Filed: **Nov. 1, 2019**

(65) **Prior Publication Data**

US 2020/0137307 A1 Apr. 30, 2020

Related U.S. Application Data

(63) Continuation of application No. 15/986,481, filed on May 22, 2018, now Pat. No. 10,469,750.

(51) **Int. Cl.**
H04N 5/232 (2006.01)
H04N 5/14 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04N 5/23258*** (2013.01); ***G06T 7/20*** (2013.01); ***H04N 5/05*** (2013.01); ***H04N 5/144*** (2013.01)

(58) **Field of Classification Search**
CPC H04N 5/23258; H04N 5/05; H04N 5/144; G06T 7/20
See application file for complete search history.

(56) **References Cited**

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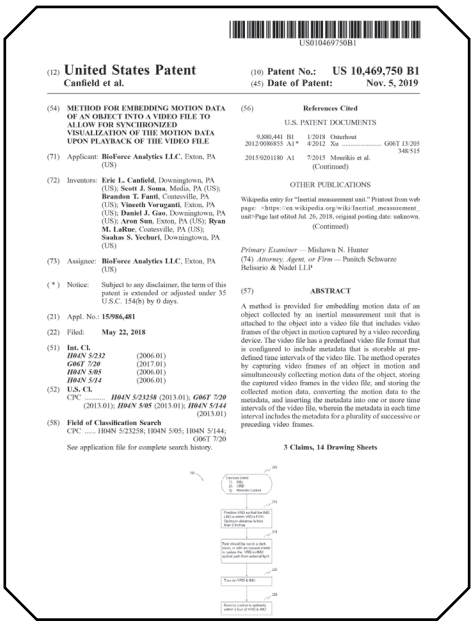
(Continued)

Primary Examiner — Mishawn N. Hunter
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

A method is provided for reading out contents of a video file having a predefined video file format. The contents include video frames of an object in motion captured by a video recording device, and motion data of an object collected by an inertial measurement unit (IMU) that is attached to the object. The motion data is stored as metadata in one or more time intervals of the video file. Parsing instructions are stored in a computer memory. The parsing instructions indicate how the metadata is parsed into motion data for one or more video frames that are associated with the respective motion data. The contents of the video file are read out using the stored parsing instructions, thereby identifying specific video frames with their respective correlated motion data.

1 Claim, 14 Drawing Sheets



US010469750B1

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 10,469,750 B1**
(45) **Date of Patent: Nov. 5, 2019**

(54) **METHOD FOR EMBEDDING MOTION DATA OF AN OBJECT INTO A VIDEO FILE TO ALLOW FOR SYNCHRONIZED VISUALIZATION OF THE MOTION DATA UPON PLAYBACK OF THE VIDEO FILE**

(71) Applicant: **BioForce Analytics LLC**, Exton, PA (US)

(72) Inventors: **Eric L. Canfield**, Downingtown, PA (US); **Scott J. Soma**, Media, PA (US); **Brandon T. Fanti**, Coatesville, PA (US); **Vineeth Vorugunti**, Exton, PA (US); **Daniel J. Gao**, Downingtown, PA (US); **Aron Sun**, Exton, PA (US); **Ryan M. LaRue**, Coatesville, PA (US); **Saahas S. Yechuri**, Downingtown, PA (US)

(73) Assignee: **BioForce Analytics LLC**, Exton, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/986,481**

(22) Filed: **May 22, 2018**

(51) **Int. Cl.**
H04N 5/232 (2006.01)
G06T 7/20 (2017.01)
H04N 5/05 (2006.01)
H04N 5/14 (2006.01)

(52) **U.S. Cl.**
CPC ***H04N 5/23258*** (2013.01); ***G06T 7/20*** (2013.01); ***H04N 5/05*** (2013.01); ***H04N 5/144*** (2013.01)

(58) **Field of Classification Search**
CPC H04N 5/23258; H04N 5/05; H04N 5/144; G06T 7/20
See application file for complete search history.

(56) **References Cited**

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(Continued)

Primary Examiner — Mishawn N. Hunter
(74) *Attorney, Agent, or Firm* — Panitch Schwarze Belisario & Nadel LLP

(57) **ABSTRACT**

A method is provided for embedding motion data of an object collected by an inertial measurement unit that is attached to the object into a video file that includes video frames of the object in motion captured by a video recording device. The video file has a predefined video file format that is configured to include metadata that is storable at predefined time intervals of the video file. The method operates by capturing video frames of an object in motion and simultaneously collecting motion data of the object, storing the captured video frames in the video file, and storing the collected motion data, converting the motion data to the metadata, and inserting the metadata into one or more time intervals of the video file, wherein the metadata in each time interval includes the metadata for a plurality of successive or preceding video frames.

3 Claims, 14 Drawing Sheets

US PATENT 10,284,752

10 Intern Co-Inventors

Method for Determining a Start Offset Between a Video Recording Device and an Inertial Measurement Unit for use in Synchronizing Motion Data of an Object Collected by the Inertial Measurement Unit Attached to the Object with Video Frames Captured by an Image Sensor of the Video Recording Device of the Object in Motion

US PATENT 10,701,266

6 Intern Co-Inventors

Method for Reading out Contents of a Video File Having a Predefined Video File Format

US PATENT 10,469,750

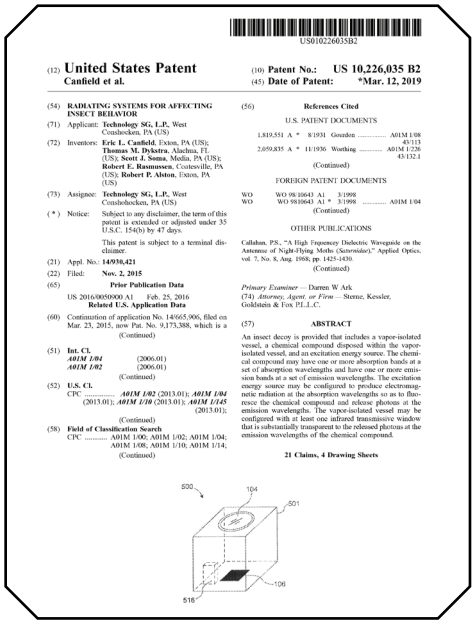
6 Intern Co-Inventors

Method for Embedding Motion Data of an Object Into a Video File to Allow for Synchronized Visualization of the Motion Data Upon Playback of the Video File

TBD

Quantum Pest Management

Nth Legacy Product



US010226035B2

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 10,226,035 B2**
(45) **Date of Patent: *Mar. 12, 2019**

(54) **RADIATING SYSTEMS FOR AFFECTING INSECT BEHAVIOR**

(71) Applicant: **Technology SG, L.P.**, West Conshohocken, PA (US)

(72) Inventors: **Eric L. Canfield**, Exton, PA (US); **Thomas M. Dykstra**, Alachua, FL (US); **Scott J. Soma**, Media, PA (US); **Robert E. Rasmussen**, Coatesville, PA (US); **Robert P. Alston**, Exton, PA (US)

(73) Assignee: **Technology SG, L.P.**, West Conshohocken, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 47 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/930,421**

(22) Filed: **Nov. 2, 2015**

(65) **Prior Publication Data**

US 2016/0050900 A1 Feb. 25, 2016

Related U.S. Application Data

(60) Continuation of application No. 14/665,906, filed on Mar. 23, 2015, now Pat. No. 9,173,388, which is a (Continued)

(51) **Int. Cl.**
A01M 1/04 (2006.01)
A01M 1/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***A01M 1/02*** (2013.01); ***A01M 1/04*** (2013.01); ***A01M 1/10*** (2013.01); ***A01M 1/145*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC A01M 1/00; A01M 1/02; A01M 1/04; A01M 1/08; A01M 1/10; A01M 1/14;
(Continued)

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(Continued)

Primary Examiner — Darren W Ark
(74) *Attorney, Agent, or Firm* — Sterne, Kessler, Goldstein & Fox P.L.L.C.

(57) **ABSTRACT**

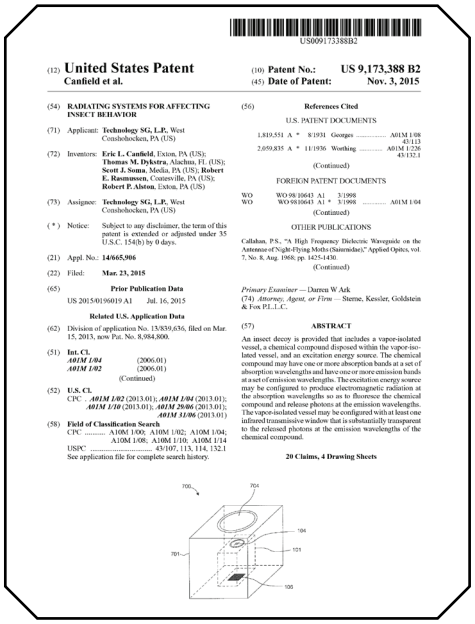
An insect decoy is provided that includes a vapor-isolated vessel, a chemical compound disposed within the vapor-isolated vessel, and an excitation energy source. The chemical compound may have one or more absorption bands at a set of absorption wavelengths and have one or more emission bands at a set of emission wavelengths. The excitation energy source may be configured to produce electromagnetic radiation at the absorption wavelengths so as to fluoresce the chemical compound and release photons at the emission wavelengths. The vapor-isolated vessel may be configured with at least one infrared transmissive window that is substantially transparent to the released photons at the emission wavelengths of the chemical compound.

21 Claims, 4 Drawing Sheets

US PATENT 10,226,035

4 Intern Collaborators

Radiating Systems for Affecting Insect Behavior



US009173388B2

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 9,173,388 B2**
(45) **Date of Patent: Nov. 3, 2015**

(54) **RADIATING SYSTEMS FOR AFFECTING INSECT BEHAVIOR**

(71) Applicant: **Technology SG, L.P.**, West Conshohocken, PA (US)

(72) Inventors: **Eric L. Canfield**, Exton, PA (US); **Thomas M. Dykstra**, Alachua, FL (US); **Scott J. Soma**, Media, PA (US); **Robert E. Rasmussen**, Coatesville, PA (US); **Robert P. Alston**, Exton, PA (US)

(73) Assignee: **Technology SG, L.P.**, West Conshohocken, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/665,906**

(22) Filed: **Mar. 23, 2015**

(65) **Prior Publication Data**

US 2015/0196019 A1 Jul. 16, 2015

Related U.S. Application Data

(62) Division of application No. 13/839,636, filed on Mar. 15, 2013, now Pat. No. 8,984,800.

(51) **Int. Cl.**
A01M 1/04 (2006.01)
A01M 1/02 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***A01M 1/02*** (2013.01); ***A01M 1/04*** (2013.01); ***A01M 1/10*** (2013.01); ***A01M 29/06*** (2013.01); ***A01M 31/06*** (2013.01)

(58) **Field of Classification Search**
CPC A10M 1/00; A10M 1/02; A10M 1/04; A10M 1/08; A10M 1/10; A10M 1/14
USPC 43/107, 113, 114, 132.1
See application file for complete search history.

(56) **References Cited**

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(Continued)

Primary Examiner — Darren W Ark
(74) *Attorney, Agent, or Firm* — Sterne, Kessler, Goldstein & Fox P.L.L.C.

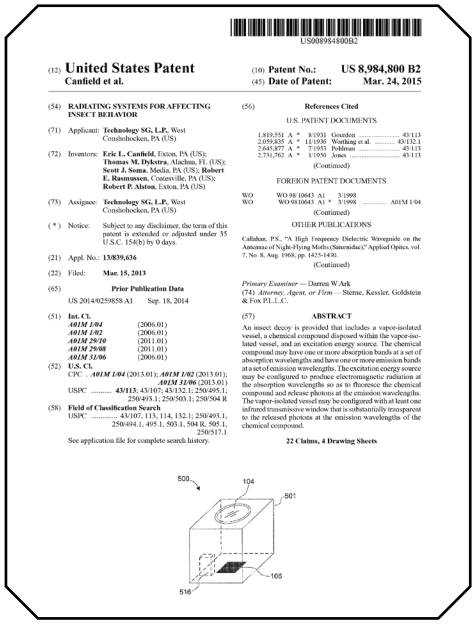
(57) **ABSTRACT**

An insect decoy is provided that includes a vapor-isolated vessel, a chemical compound disposed within the vapor-isolated vessel, and an excitation energy source. The chemical compound may have one or more absorption bands at a set of absorption wavelengths and have one or more emission bands at a set of emission wavelengths. The excitation energy source may be configured to produce electromagnetic radiation at the absorption wavelengths so as to fluoresce the chemical compound and release photons at the emission wavelengths. The vapor-isolated vessel may be configured with at least one infrared transmissive window that is substantially transparent to the released photons at the emission wavelengths of the chemical compound.

20 Claims, 4 Drawing Sheets

US PATENT 9,173,388

Radiating Systems for Affecting Insect Behavior



US008984800B2

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 8,984,800 B2**
(45) **Date of Patent: Mar. 24, 2015**

(54) **RADIATING SYSTEMS FOR AFFECTING INSECT BEHAVIOR**

(71) Applicant: **Technology SG, L.P.**, West Conshohocken, PA (US)

(72) Inventors: **Eric L. Canfield**, Exton, PA (US); **Thomas M. Dykstra**, Alachua, FL (US); **Scott J. Soma**, Media, PA (US); **Robert E. Rasmussen**, Coatesville, PA (US); **Robert P. Alston**, Exton, PA (US)

(73) Assignee: **Technology SG, L.P.**, West Conshohocken, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **13/839,636**

(22) Filed: **Mar. 15, 2013**

(65) **Prior Publication Data**

US 2014/0259858 A1 Sep. 18, 2014

(51) **Int. Cl.**
A01M 1/04 (2006.01)
A01M 1/02 (2006.01)
A01M 29/10 (2011.01)
A01M 29/08 (2011.01)
A01M 31/06 (2006.01)

(52) **U.S. Cl.**
CPC ***A01M 1/04*** (2013.01); ***A01M 1/02*** (2013.01); ***A01M 31/06*** (2013.01)
USPC ..... **43/113**; 43/107, 43/132.1; 250/495.1; 250/493.1; 250/503.1; 250/504 R

(58) **Field of Classification Search**
USPC ..... 43/107, 113, 114, 132.1; 250/493.1, 250/494.1, 495.1, 503.1, 504 R, 505.1, 250/517.1
See application file for complete search history.

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Callahan, P.S., "A High Frequency Dielectric Waveguide on the Antennae of Night-Flying Moths (Saturniidae)," Applied Optics, vol. 7, No. 8, Aug. 1968, pp. 1425-1430.
(Continued)

Primary Examiner — Darren W Ark
(74) *Attorney, Agent, or Firm* — Sterne, Kessler, Goldstein & Fox P.L.L.C.

(57) **ABSTRACT**

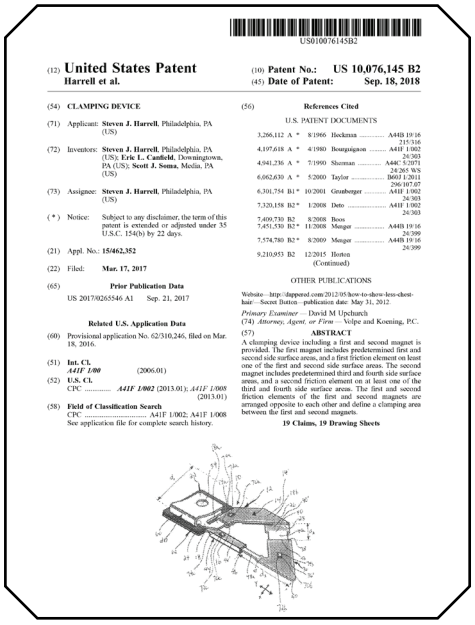
An insect decoy is provided that includes a vapor-isolated vessel, a chemical compound disposed within the vapor-isolated vessel, and an excitation energy source. The chemical compound may have one or more absorption bands at a set of absorption wavelengths and have one or more emission bands at a set of emission wavelengths. The excitation energy source may be configured to produce electromagnetic radiation at the absorption wavelengths so as to fluoresce the chemical compound and release photons at the emission wavelengths. The vapor-isolated vessel may be configured with at least one infrared transmissive window that is substantially transparent to the released photons at the emission wavelengths of the chemical compound.

22 Claims, 4 Drawing Sheets

US PATENT 8,984,800

Radiating Systems for Affecting Insect Behavior

ADDITIONAL PATENTS



US PATENT 10,076,145

Clamping Device

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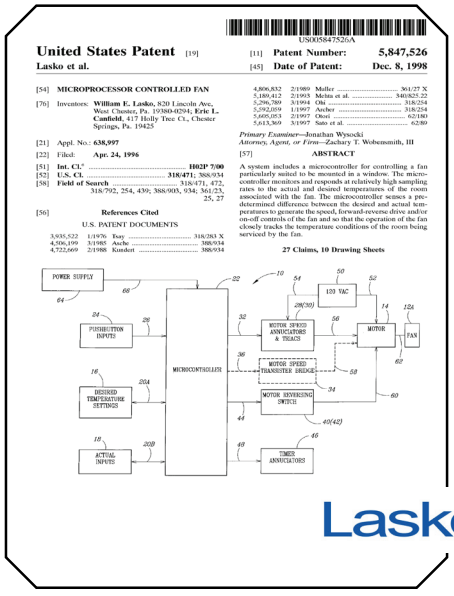
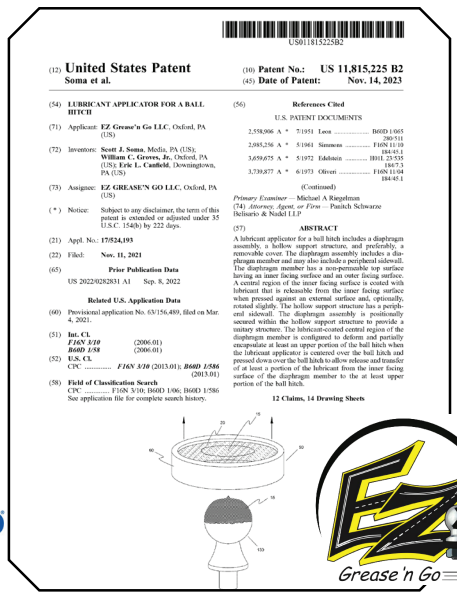


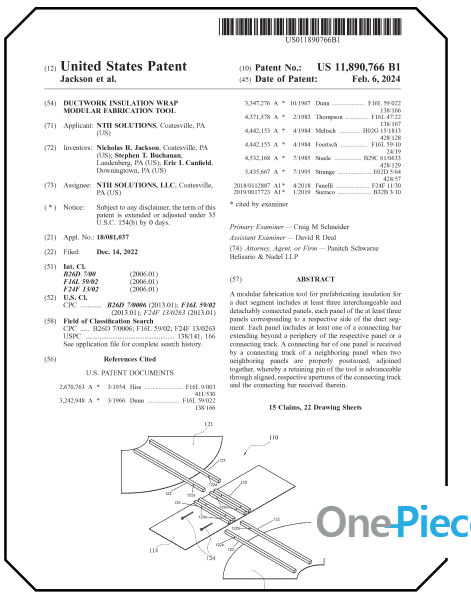
US PATENT 5,847,526

Microprocessor Controlled Fan



US PATENT 11,815,225

Lubricant Applicator for a Ball Hitch



US PATENT 11,890,766

Ductwork Insulation Wrap Modular Fabrication Tool

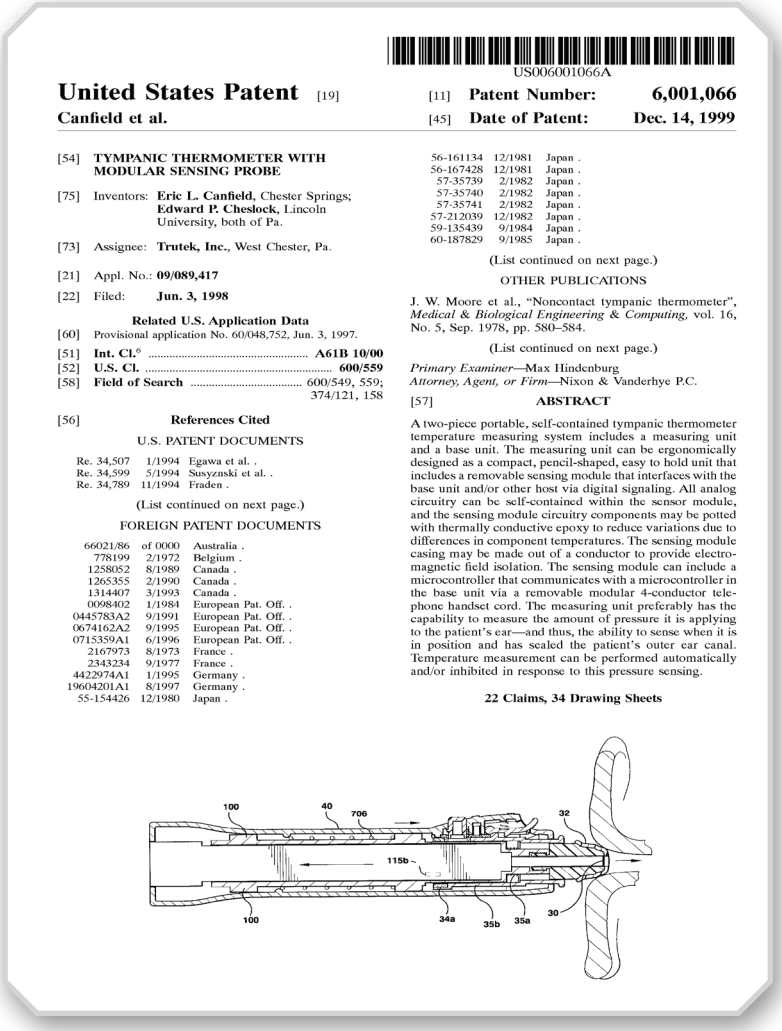
TruTek

This tympanic temperature measurement technology and the associated patents paved the way for several medical products widely used by doctors and hospitals worldwide.

US PATENT 6,001,066

Tympanic Thermometer with Modular Sensing Probe

nth Legacy Product



US006001066A

United States Patent [19]

Canfield et al.

[11] **Patent Number: 6,001,066**

[45] **Date of Patent: Dec. 14, 1999**

[54] **TYMPANIC THERMOMETER WITH MODULAR SENSING PROBE**

[75] Inventors: **Eric L. Canfield**, Chester Springs; **Edward P. Cheslock**, Lincoln University, both of Pa.

[73] Assignee: **Trutek, Inc.**, West Chester, Pa.

[21] Appl. No.: **09/089,417**

[22] Filed: **Jun. 3, 1998**

Related U.S. Application Data

[60] Provisional application No. 60/048,752, Jun. 3, 1997.

[51] **Int. Cl.**[6] **A61B 10/00**

[52] **U.S. Cl.** **600/559**

[58] **Field of Search** 600/549, 559; 374/121, 158

[56] **References Cited**

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Primary Examiner—Max Hindenburg
Attorney, Agent, or Firm—Nixon & Vanderhye P.C.

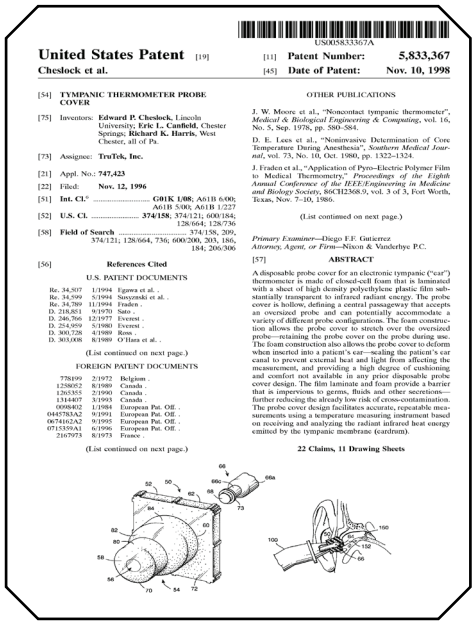
[57] **ABSTRACT**

A two-piece portable, self-contained tympanic thermometer temperature measuring system includes a measuring unit and a base unit. The measuring unit can be ergonomically designed as a compact, pencil-shaped, easy to hold unit that includes a removable sensing module that interfaces with the base unit and/or other host via digital signaling. All analog circuitry can be self-contained within the sensor module, and the sensing module circuitry components may be potted with thermally conductive epoxy to reduce variations due to differences in component temperatures. The sensing module casing may be made out of a conductor to provide electromagnetic field isolation. The sensing module can include a microcontroller that communicates with a microcontroller in the base unit via a removable modular 4-conductor telephone handset cord. The measuring unit preferably has the capability to measure the amount of pressure it is applying to the patient's ear—and thus, the ability to sense when it is in position and has sealed the patient's outer ear canal. Temperature measurement can be performed automatically and/or inhibited in response to this pressure sensing.

22 Claims, 34 Drawing Sheets

Interested? Learn More:

TBD



US005833367A

United States Patent [19]
Cheslock et al.

[11] **Patent Number: 5,833,367**
[45] **Date of Patent: Nov. 10, 1998**

[54] **TYMPANIC THERMOMETER PROBE COVER**

[75] Inventors: **Edward P. Cheslock**, Lincoln University; **Eric L. Canfield**, Chester Springs; **Richard K. Harris**, West Chester, all of Pa.

[73] Assignee: **TruTek, Inc.**

[21] Appl. No.: **747,423**

[22] Filed: **Nov. 12, 1996**

[51] **Int. Cl.**[6] **G01K 1/08**; A61B 6/00; A61B 5/00; A61B 1/227

[52] **U.S. Cl.** **374/158**; 374/121; 600/184; 128/664; 128/736

[58] **Field of Search** 374/158, 209, 374/121; 128/664, 736; 600/200, 203, 186, 184; 206/306

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D. 254,959	5/1980	Everest .	
D. 300,728	4/1989	Ross .	
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Primary Examiner—Diego F.F. Gutierrez
Attorney, Agent, or Firm—Nixon & Vanderhye P.C.

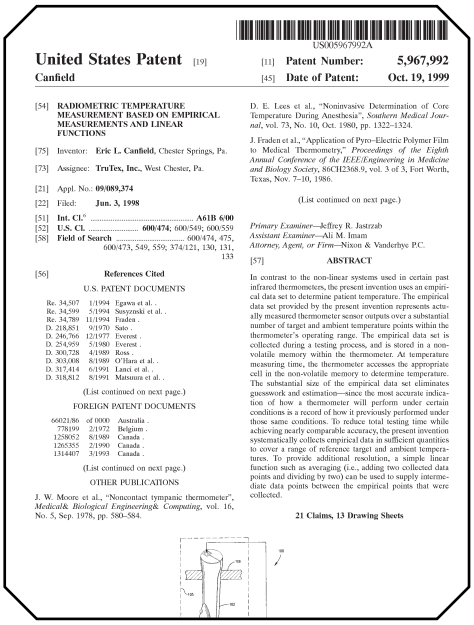
[57] **ABSTRACT**

A disposable probe cover for an electronic tympanic ("ear") thermometer is made of closed-cell foam that is laminated with a sheet of high density polyethylene plastic film substantially transparent to infrared radiant energy. The probe cover is hollow, defining a central passageway that accepts an oversized probe and can potentially accommodate a variety of different probe configurations. The foam construction allows the probe cover to stretch over the oversized probe—retaining the probe cover on the probe during use. The foam construction also allows the probe cover to deform when inserted into a patient's ear—sealing the patient's ear canal to prevent external heat and light from affecting the measurement, and providing a high degree of cushioning and comfort not available in any prior disposable probe cover design. The film laminate and foam provide a barrier that is impervious to germs, fluids and other secretions—further reducing the already low risk of cross-contamination. The probe cover design facilitates accurate, repeatable measurements using a temperature measuring instrument based on receiving and analyzing the radiant infrared heat energy emitted by the tympanic membrane (eardrum).

22 Claims, 11 Drawing Sheets

US PATENT 5,833,367

Tympanic Thermometer Probe Cover



US005967992A

United States Patent [19]
Canfield

[11] **Patent Number: 5,967,992**
[45] **Date of Patent: Oct. 19, 1999**

[54] **RADIOMETRIC TEMPERATURE MEASUREMENT BASED ON EMPIRICAL MEASUREMENTS AND LINEAR FUNCTIONS**

[75] Inventor: **Eric L. Canfield**, Chester Springs, Pa.

[73] Assignee: **TruTex, Inc.**, West Chester, Pa.

[21] Appl. No.: **09/089,374**

[22] Filed: **Jun. 3, 1998**

[51] **Int. Cl.**[7] **A61B 6/00**

[52] **U.S. Cl.** **600/474**; 600/549; 600/559

[58] **Field of Search** 600/474, 475, 600/473, 549, 559; 374/121, 130, 131, 133

[56] **References Cited**

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D. 254,959	5/1980	Everest .	
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D. 317,414	6/1991	Lanzi et al. .	
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J. Fraden et al., "Application of Pyro–Electric Polymer Film to Medical Thermometry," *Proceedings of the Eighth Annual Conference of the IEEE/Engineering in Medicine and Biology Society*, 86CH2368.9, vol. 3 of 3, Fort Worth, Texas, Nov. 7–10, 1986.

(List continued on next page.)

Primary Examiner—Jeffrey R. Jastrzab
Assistant Examiner—Ali M. Imam
Attorney, Agent, or Firm—Nixon & Vanderhye P.C.

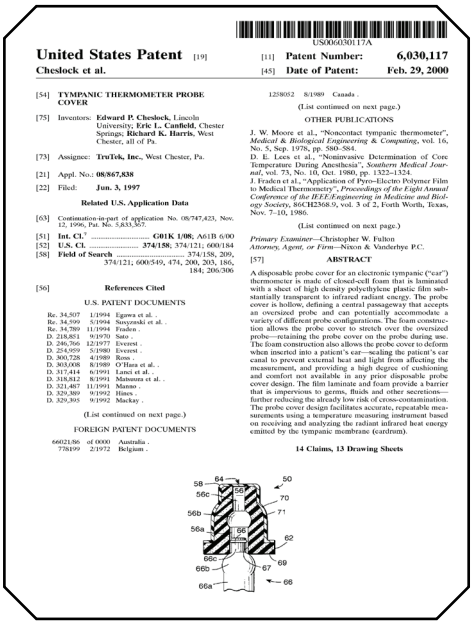
[57] **ABSTRACT**

In contrast to the non-linear systems used in certain past infrared thermometers, the present invention uses an empirical data set to determine patient temperature. The empirical data set provided by the present invention represents actually measured thermometer sensor outputs over a substantial number of target and ambient temperature points within the thermometer's operating range. The empirical data set is collected during a testing process, and is stored in a non-volatile memory within the thermometer. At temperature measuring time, the thermometer accesses the appropriate cell in the non-volatile memory to determine temperature. The substantial size of the empirical data set eliminates guesswork and estimation—since the most accurate indication of how a thermometer will perform under certain conditions is a record of how it previously performed under those same conditions. To reduce total testing time while achieving nearly comparable accuracy, the present invention systematically collects empirical data in sufficient quantities to cover a range of reference target and ambient temperatures. To provide additional resolution, a simple linear function such as averaging (i.e., adding two collected data points and dividing by two) can be used to supply intermediate data points between the empirical points that were collected.

21 Claims, 13 Drawing Sheets

US PATENT 5,967,992

Radiometric Temperature Measurement Based On Empirical Measurements and Linear Functions



US006030117A

United States Patent [19]
Cheslock et al.

[11] **Patent Number: 6,030,117**
[45] **Date of Patent: Feb. 29, 2000**

[54] **TYMPANIC THERMOMETER PROBE COVER**

[75] Inventors: **Edward P. Cheslock**, Lincoln University; **Eric L. Canfield**, Chester Springs; **Richard K. Harris**, West Chester, all of Pa.

[73] Assignee: **TruTek, Inc.**, West Chester, Pa.

[21] Appl. No.: **08/867,838**

[22] Filed: **Jun. 3, 1997**

Related U.S. Application Data

[63] Continuation-in-part of application No. 08/747,423, Nov. 12, 1996, Pat. No. 5,833,367.

[51] **Int. Cl.**[7] **G01K 1/08**; A61B 6/00

[52] **U.S. Cl.** **374/158**; 374/121; 600/184

[58] **Field of Search** 374/158, 209, 374/121; 600/549, 474, 200, 203, 186, 184; 206/306

[56] **References Cited**

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J. Fraden et al., "Application of Pyro–Electric Polymer Film to Medical Thermometry," *Proceedings of the Eighth Annual Conference of the IEEE/Engineering in Medicine and Biology Society*, 86CH2368.9, vol. 3 of 3, Fort Worth, Texas, Nov. 7–10, 1986.

(List continued on next page.)

Primary Examiner—Christopher W. Fulton
Attorney, Agent, or Firm—Nixon & Vanderhye P.C.

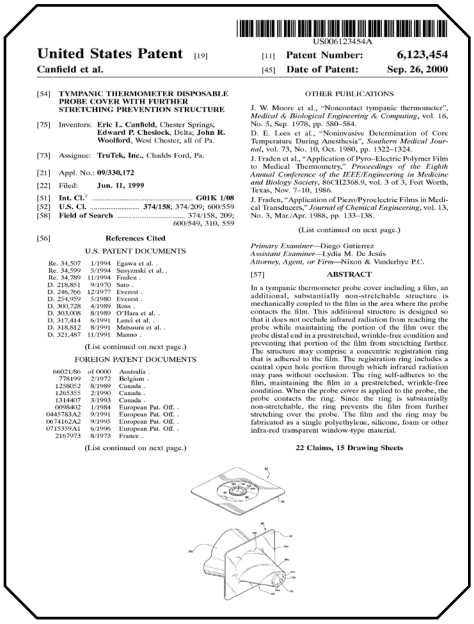
[57] **ABSTRACT**

A disposable probe cover for an electronic tympanic ("ear") thermometer is made of closed-cell foam that is laminated with a sheet of high density polyethylene plastic film substantially transparent to infrared radiant energy. The probe cover is hollow, defining a central passageway that accepts an oversized probe and can potentially accommodate a variety of different probe configurations. The foam construction allows the probe cover to stretch over the oversized probe—retaining the probe cover on the probe during use. The foam construction also allows the probe cover to deform when inserted into a patient's ear—sealing the patient's ear canal to prevent external heat and light from affecting the measurement, and providing a high degree of cushioning and comfort not available in any prior disposable probe cover design. The film laminate and foam provide a barrier that is impervious to germs, fluids and other secretions—further reducing the already low risk of cross-contamination. The probe cover design facilitates accurate, repeatable measurements using a temperature measuring instrument based on receiving and analyzing the radiant infrared heat energy emitted by the tympanic membrane (eardrum).

14 Claims, 13 Drawing Sheets

US PATENT 6,030,117

Tympanic Thermometer Probe Cover



US006123454A

United States Patent [19]
Canfield et al.

[11] **Patent Number: 6,123,454**
[45] **Date of Patent: Sep. 26, 2000**

[54] **TYMPANIC THERMOMETER DISPOSABLE PROBE COVER WITH FURTHER STRETCHING PREVENTION STRUCTURE**

[75] Inventors: **Eric L. Canfield**, Chester Springs; **Edward P. Cheslock**, Delta; **John R. Woodford**, West Chester, all of Pa.

[73] Assignee: **TruTek, Inc.**, Chadds Ford, Pa.

[21] Appl. No.: **09/330,172**

[22] Filed: **Jun. 11, 1999**

[51] **Int. Cl.**[7] **G01K 1/08**

[52] **U.S. Cl.** **374/158**; 374/209; 600/559

[58] **Field of Search** 374/158, 209; 600/549, 310, 559

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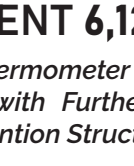
(List continued on next page.)

Primary Examiner—Diego Gutierrez
Assistant Examiner—Lydia M. De Jesús
Attorney, Agent, or Firm—Nixon & Vanderhye P.C.

[57] **ABSTRACT**

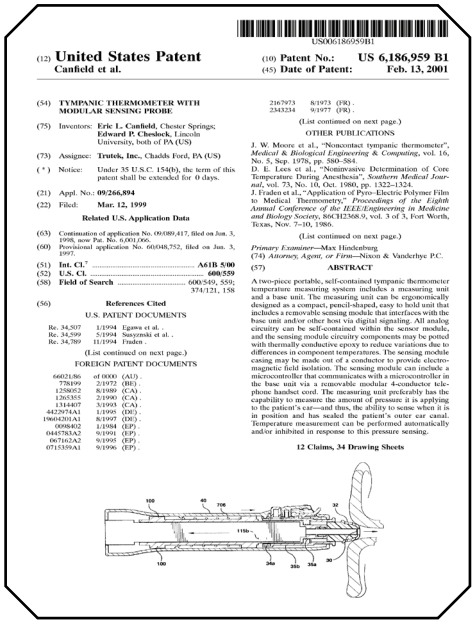
In a tympanic thermometer probe cover including a film, an additional, substantially non-stretchable structure is mechanically coupled to the film in the area where the probe contacts the film. This additional structure is designed so that it does not exclude infrared radiation from reaching the probe while maintaining the portion of the film over the probe distal end in a prestretched, wrinkle-free condition and preventing that portion of the film from stretching further. The structure may comprise a concentric registration ring that is adhered to the film. The registration ring includes a central open hole portion through which infrared radiation may pass without occlusion. The ring self-adheres to the film, maintaining the film in a prestretched, wrinkle-free condition. When the probe cover is applied to the probe, the probe contacts the ring. Since the ring is substantially non-stretchable, the ring prevents the film from further stretching over the probe. The film and the ring may be fabricated as a single polyethylene, silicone, foam or other infra-red transparent window-type material.

22 Claims, 15 Drawing Sheets



US PATENT 6,123,454

Tympanic Thermometer Disposable Probe Cover with Further Stretching Prevention Structure



US006186959B1

(12) **United States Patent**
Canfield et al.

(10) **Patent No.: US 6,186,959 B1**
(45) **Date of Patent: Feb. 13, 2001**

(54) **TYMPANIC THERMOMETER WITH MODULAR SENSING PROBE**

(75) Inventors: **Eric L. Canfield**, Chester Springs; **Edward P. Cheslock**, Lincoln University, both of PA (US)

(73) Assignee: **Trutek, Inc.**, Chadds Ford, PA (US)

(*) Notice: Under 35 U.S.C. 154(b), the term of this patent shall be extended for 0 days.

(21) Appl. No.: **09/266,894**

(22) Filed: **Mar. 12, 1999**

Related U.S. Application Data

(63) Continuation of application No. 09/089,417, filed on Jun. 3, 1998, now Pat. No. 6,001,066.

(60) Provisional application No. 60/048,752, filed on Jun. 3, 1997.

(51) **Int. Cl.**[7] **A61B 5/00**

(52) **U.S. Cl.** **600/559**

(58) **Field of Search** 600/549, 559; 374/121, 158

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J. Fraden et al., "Application of Pyro–Electric Polymer Film to Medical Thermometry," *Proceedings of the Eighth Annual Conference of the IEEE/Engineering in Medicine and Biology Society*, 86CH2368.9, vol. 3 of 3, Fort Worth, Texas, Nov. 7–10, 1986.

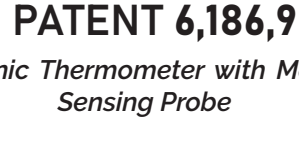
(List continued on next page.)

Primary Examiner—Max Hindenburg
(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye P.C.

(57) **ABSTRACT**

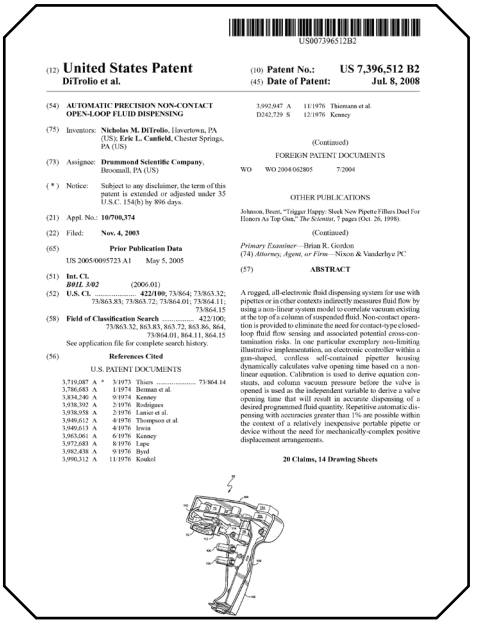
A two-piece portable, self-contained tympanic thermometer temperature measuring system includes a measuring unit and a base unit. The measuring unit can be ergonomically designed as a compact, pencil-shaped, easy to hold unit that includes a removable sensing module that interfaces with the base unit and/or other host via data signaling. All analog circuitry can be self-contained within the sensor module, and the sensing module circuitry components may be potted with thermally conductive epoxy to reduce variations due to differences in component temperatures. The sensing module casing may be made out of a conductor to provide electromagnetic field isolation. The sensing module can include a microcontroller that communicates with a microcontroller in the base unit via a removable modular 4-conductor telephone handset cord. The measuring unit preferably has the capability to measure the amount of pressure it is applying to the patient's ear—and thus, the ability to sense when it is in position and has sealed the patient's outer ear canal. Temperature measurement can be performed automatically and/or inhibited in response to this pressure sensing.

12 Claims, 34 Drawing Sheets



US PATENT 6,186,959

Tympanic Thermometer with Modular Sensing Probe



US007396512B2

(12) **United States Patent**
DiTrolio et al.

(10) **Patent No.: US 7,396,512 B2**
(45) **Date of Patent: Jul. 8, 2008**

(54) **AUTOMATIC PRECISION NON-CONTACT OPEN-LOOP FLUID DISPENSING**

(75) Inventors: **Nicholas M. DiTrolio**, Havertown, PA (US); **Eric L. Canfield**, Chester Springs, PA (US)

(73) Assignee: **Drummond Scientific Company**, Broomall, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 896 days.

(21) Appl. No.: **10/700,374**

(22) Filed: **Nov. 4, 2003**

(65) **Prior Publication Data**

US 2005/0095723 A1 May 5, 2005

(51) **Int. Cl.**
B01L 3/02 (2006.01)

(52) **U.S. Cl.** **422/100**; 73/864; 73/863.32; 73/863.83; 73/863.72; 73/864.01; 73/864.11; 73/864.15

(58) **Field of Classification Search** 422/100; 73/863.32, 863.83, 863.72, 863.86, 864, 73/864.01, 864.11, 864.15

See application file for complete search history.

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Primary Examiner—Brian R. Gordon
(74) *Attorney, Agent, or Firm*—Nixon & Vanderhye PC

(57) **ABSTRACT**

A rugged, all-electronic fluid dispensing system for use with pipettes or in other contexts indirectly measures fluid flow by using a non-linear system model to correlate vacuum existing at the top of a column of suspended fluid. Non-contact operation is provided to eliminate the need for contact-type closed-loop fluid flow feedback, and automated control errors contamination risks. In one particular exemplary non-limiting illustrative implementation, an electronic controller within a gun-shaped, cordless self-contained pipetter housing dynamically calculates valve opening time based on a non-linear equation. Calibration is used to derive equation constants, and column vacuum pressure before the valve is opened is used as the independent variable to derive a valve opening time that will result in accurate dispensing of a desired programmed fluid quantity. Repetitive automatic dispensing with accuracies greater than 1% are possible within the context of a relatively inexpensive portable pipette or device without the need for mechanically-complex positive displacement arrangements.

20 Claims, 14 Drawing Sheets

US PATENT 7,396,512

Automatic Precision Non-Contact Open-Loop Fluid Dispensing

nth Solutions, LLC

and Eric Canfield

Happily Surrounded by Model Trains, Wires, a Booming Sound System, and Pocket Protectors.

Eric has over 30 years' experience in product development and business management. From 1981 through 1987 he worked as an engineer and engineering manager at General Electric, Rumsey Electric, and The Eastern Specialty Company. As co-founder and President of Multi-Systems Corporation and then nth Solutions, he is the author of more than two dozen patents and patents pending, including commercialized products. He received the Technology & Product of the Year award from Popular Science for the Storm Alert™; and recognition for several other technologies, products, and business accomplishments.

Proudly Rocking his Expoxied Dollar Tree Glasses.

In Process

Eric's Cool Stuff

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Nth Solutions, LLC

and Susan Springsteen

Susan spent nearly 30 years as an investment advisor to individuals and the organizations they influence. Combining her expertise in sales, marketing and wealth management, she built financial advisory practices at four investment firms, where she and her team were recognized as "The Best Wealth Management Group on the Main Line." Susan is involved in many other aspects of the Chester County area business community. She was a board member of the Chester County Chamber of Business and Industry, Chester County Futures, and a trustee for Magee Rehabilitation Hospital in Philadelphia.

In Process

Sue's Cool Stuff

EGGS 4 ALL

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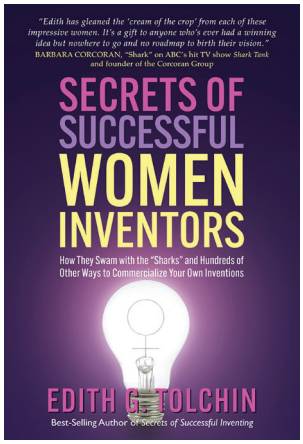

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