IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ARETECH, LLC,
Petitioner,
v.

BIONESS INC.,
Patent Owner.

U.S. Patent No. 10,668,316

DECLARATION OF DAVID REINKENSMEYER, PH.D.

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1. I, David J. Reinkensmeyer, declare as follows:

2. My name is David J. Reinkensmeyer. I am a Professor of Mechanical and Aerospace Engineering at the University of California, Irvine, with joint appointments as a professor in the department of Anatomy and Neurobiology, the department of Biomedical Engineering, and the department of Physical Medicine and Rehabilitation at the same institution.

3. I have prepared this report as an expert witness retained by Aretech, LLC. In this report I give my opinions as to whether certain claims of U.S. Patent No. 10,668,316 ("the '316 patent") are invalid.

4. This report contains statements of my opinions formed to date and the bases and reasons for those opinions. I may offer additional opinions based on further review of materials in this case, including opinions and/or testimony of other expert witnesses. I make this declaration based upon my own personal knowledge and, if called upon to testify, would testify competently to the matters contained herein.

I. BACKGROUND AND QUALIFICATIONS

A. Summary of Relevant Experience and Qualifications

5. I have summarized in this section my educational background, career history, publications, and other relevant qualifications. My full curriculum vitae is attached as Appendix 1 to this declaration.

6. I am an expert in the fields of biomedical and mechanical engineering, with a focus on movement control, neuro-rehabilitation and robotics. I have studied, taught, practiced, and researched in these fields for over thirty-five years. Currently, I am Professor of Computer Science at the University of California, Irvine in Irvine, California, where I have been on the faculty since 1998.

7. I received my Doctor of Philosophy (Ph.D.) degree in the field of Electrical Engineering from the University of California, Berkely, in 1993. I received my Masters of Science (M.S.) degree in Electrical Engineering from the University of California, Berkely, in 1991, and my Bachelor of Science (B.S.) degree in Electrical Engineering from the Massachusetts Institute of Technology in 1988.

8. After receiving my Ph.D. degree, I worked as a researcher and lecturer at Berkeley and Northwestern, until becoming a research assistant professor at Northwestern University Medical School in 1997.

9. I have been involved in biomedical robotics and mechatronics research since 1986. My research has been funded by a variety of governmental agencies, including the National Institute of Health (NIH) and the National Institute of Disability, Independent Living, and Rehabilitation Research (NIDILRR). In addition, I have received government Small Business Innovation Research (SBIR) funding, as well as several industrial grants.

10. Throughout my career, I have received numerous awards and honors for my work in these fields, some of which include: (1) a Training Fellowship from 1994-1995 with the National Institute on Disability and Rehabilitation Research, (2) 1998 Sarah Baskin Award for Excellence in Research at the Rehabilitation Institute of Chicago, (3) 2011 Best Paper of the Journal Award for the IEEE Transactions on Neural Systems and Rehabilitation Engineering Journal, (4) 2012 Most Innovative Technology Award in the 2nd IEEE EMBS Unconference on Rehabilitation Robotics, (5) 2016 UC Irvine Distinguished Mid-Career Award for Research, (6) 2016 Henry Samueli School of Engineering Innovator of the Year Award, (7) 2017 Google Scholar Classic Paper Award for having authored one of ten most-cited articles in Rehabilitation Therapy published ten years earlier, (8) 2019 Elected Fellow, American Institute of Medical and

Biological Engineers. From 2017-2021, I served on the National Advisory Board for Medical Rehabilitation Research, NIH. I am Editor-in-Chief of the Journal of Neuroengineering and Rehabilitation, one of the top journals in the rehabilitation field. I have held this position for eight years.

11. I regularly teach courses in bioengineering (with emphasis in rehabilitative therapy technologies), robotics, and mechatronics at both the undergraduate and graduate level. As an expert in these fields, I am also regularly invited to speak at conferences on these topics. By way of example, (1) I was the keynote speaker at the 2013 IEEE International Conference on Rehabilitation Robotics, (2) I was the keynote speaker at the 2022 Rehabweek Conference (which combines eight societies, including International Conference on Rehabilitation Robotics, International Functional Electrical Stimulation Society, International Society for Virtual Rehabilitation), (3) I was the keynote speaker at the 2009 Dynamic Walking Conference in Vancouver, and I have been invited to speak at over eighty other conferences, symposiums, and seminars as may be seen from my curriculum vitae (Appendix 1).

12. I am the author or co-author of over 200 peer-reviewed journal and conference papers, as identified in my curriculum vitae (Appendix 1). My articles have been published in many reputable journals such as, for example, IEEE Transactions on Neural Systems and Rehabilitation Engineering, Neurorehabilitation and Neural Repair, Neurology, Journal of Neurophysiology, Sensors, and the Journal of Neuroengineering and Rehabilitation. My articles have been cited over 18000 times by other academic writings.

13. I also routinely serve as referee for papers submitted to highly reputable journals such as, for example: Nature Medicine; Science Robotics, Science Translational Medicine; IEEE Transactions on Robotics; IEEE Transactions on Neural Systems and Rehabilitation

Engineering; American Journal of Physical Medicine and Rehabilitation; Journal of Rehabilitation Research and Development; Journal of Applied Physiology; Journal of Biomechanical Engineering; ASME Journal of Medical Devices; Topics in Spinal Cord Injury Rehabilitation; Journal of Neuroscience; Journal of Neurophysiology; Experimental Brain Research; Biological Cybernetics; Annual Review of Biomedical Engineering; and Archives of Physical Medicine and Rehabilitation, among others.

14. I am the lead Editor of two books: Neurorehabilitation Technology, 2nd Edition (2016), and Neurorehabilitation Technology, 3rd Edition (2022). I am also a contributor and author of numerous book chapters, including in the following titles: Robotics Research: The Fourth Int. Symposium (1987); Artificial Intelligence Research at MIT (1990); Neural Networks for Control (1990); Biomechanics and Neural Control of Posture and Movement (2000), Standard Handbook of Biomedical Engineering & Design (2003); Emerging and Accessible Telecommunications; Information and Healthcare Technologies: Engineering Challenges in Enabling Universal Access (2002); Springer Handbook of Robotics (2008); Biomedical Engineering Systems and Technology (2008); Emerging Therapies in Neurorehabilitation Series: Biosystems & Biorobotics (2014); Emerging Therapies in Neurorehabilitation II (2015); Springer Handbook of Robotics, 2nd Edition (2015); Neurorehabilitation Technology, 2nd edition (2016), Neurorehabilitation Technology, 3rd edition (2022), among others. These books and book chapters have been used as references for undergraduate level bioengineering related courses in universities.

15. I have twelve issued U.S. patents that relate to bioengineering, robotics and rehabilitation technologies.

1. Compensation

16. For my efforts in connection with the preparation of this declaration I have been compensated at the rate of $300 per hour for reading and research, and $400 per hour for consultation and drafting. My compensation is in no way contingent on the results of these or any other proceedings relating to the above-captioned patent.

2. Materials and Other Information Considered

17. I have considered information from various sources in forming my opinions. I have reviewed and considered each of the exhibits listed in the attached Appendix 2 (Appendix of Exhibits) in forming my opinions.

II. UNDERSTANDING OF THE LAW

18. I am not an attorney. In forming my opinions in this Declaration, I applied the relevant legal principles provided to me by counsel, which are summarized in Appendix 4. The contents of Appendix 4 represent my understanding of the law that I have applied in forming my opinions in this declaration.

III. THE ’316 PATENT

19. The ’316 patent issued on June 2, 2020 from an application filed on February 14, 2018. *See* Ex-1001. I understand that Petitioner is challenging the validity of claims 1-5, and 7-11 of the ’316 patent in the Petition for *Inter Partes* Review to which this declaration will be attached. Those claims are reproduced in Appendix 3. I understand that Petitioner is not challenging claims 6, or 12-19. While this declaration is directed to the challenged claims, I have considered all claims (1-19) of the ’316 patent, as well as portions of the ’316 patent prosecution history in forming my opinions.

A. Overview of the ’316 Patent

20. The ’316 patent is directed to various methods of using and implementing a body weight support system (“BWS system”) for use in rehabilitative gait therapy routines. As general background, BWS systems have been commonplace for many years. Essentially, BWS systems provide an upward force (sometimes referred to as vertical “unloading” force) to a patient through tether. The tether is normally coupled between a harness worn by a patient, on the one hand, and a support structure of some kind, on the other hand. The support structures known in the field vary widely, with some including an overhead crane or trolley that is movable on a track. When the tether is properly coupled to the harness (usually through one or more couplers or other components), and the harness is properly fitted and attached to be worn by the patient (normally put on by the patient with the guidance/assistance of a therapist) the patient can perform gait training exercises while bearing less than their entire body weight. By experiencing less than full body weight, a patient can often perform movements/exercises that they could not otherwise perform due to their injury (i.e., the injury they are recovering from). This way, they can begin strengthening their muscles by exercising them under relatively easier conditions, and then gradually increase the difficulty (i.e., by reduce the amount of body weight support they are receiving via the BWS system) as they make progress and regain their strength.

21. At the time of the ’316 patent, several different BWS systems were in the marketplace with many well-known features. By the earliest claimed priority date of the ’316 patent (February 14, 2017), many BWS systems in the marketplace were available, and at the least, the following features were commonly understood to be optional in such systems:

- static unloading force being delivered through a tether connected to a patient, e.g., via a harness and one or more couplers (hereafter “Static Unloading”). *See, e.g.,* Ex-1016, 11:27-36, Fig. 5; Ex-1017, 312; Ex-1021, Abstract.

- dynamic unloading force being delivered through a tether connected to a patient, e.g., via a harness and one or more couplers (hereafter "Dynamic Unloading"). *See, e.g.,* Ex-1016, 15:20-45; Ex-1017, 312; Ex-1021, Abstract, 288 (discussing "dynamic BWS"), 296 (Table 3)
- overhead support track that creates a path along which a patient may travel during gait therapy exercises (hereafter, "Overhead Support Track"). *See, e.g.,* Ex-1016, 2:31-44, 2:56-64, 4:36-5:5; Ex-1021, Abstract, Fig. 1 (and related discussion).
- an automated trolley with a motorized drive system that could ride along the overhead support and either: follow the patient, lead the patient, or remain substantially over head relative to the patient (hereafter, "Overhead Trolley Tracking"). *See, e.g.,* Ex-1016, 16:6-52; Ex-1021, Abstract, Fig. 1 (and related discussion),.
- BWS systems configured to support a patient during use on flat stationary surfaces (e.g., the ground), uneven stationary surfaces (e.g., ramps, stairs, etc.), moving surfaces (e.g., treadmills), and/or other surfaces. *See, e.g.,* Ex-1016, Abstract, 5:50-56; Ex-1021, Abstract, Fig. 1 (and related discussion).
- monitoring of patient and BWS system performance during a therapy session, and display of performance metrics/outputs on a display (hereafter "Monitoring and Display"). *See, e.g.,* Ex-1016, 17:26-18:11 Ex-1021, Abstract, Fig. 1 (and related discussion),
- fall detection during a therapy session (hereafter "Fall Detection") by several means, including fall detection criteria such as one or more of:

i. detecting increases in force on the tether (e.g., via any one or more sensors), indicative of a fall. *See, e.g.,* Ex-1011, [0340].

ii. detecting a patient's descent past a predefined fall limit (e.g., via camera sensors observing the patient, via sensors monitoring the rotational position/velocity of the drum that the tether is coiled around, via sensors monitoring feed rate of the tether, and the like), indicative of a fall. *See, e.g.,* Ex-1021, 293(discussing "fall distance" as a metric for detecting patient falls), 296 (same); Ex-1011, [0338]-[0341].

iii. detecting the speed of a patient's descent that is faster than expected for the given application, indicative of a fall. *See, e.g.,* Ex-1011, [0340].

- fall prevention during a therapy session (hereafter "Fall Prevention") by several means, including by providing added support to the patient in response to a fall being detected, up to an including full body weight support by locking the tether from further movement by, e.g., switching to static unloading (Fall Detection together with Fall Prevention, hereafter, "Fall Detection and Prevention"). *See, e.g.,* Ex-1016, 16:53-67, Ex-1011, [0338]-[0341].

22. The basic objective of the '316 patent was to "deliver[] intensive yet safe gait therapy," through a BWS system that includes overhead tracking, active support (commonly referred to as "dynamic" support), and fall detection and prevention features. Ex-1001, 1:30-32. Essentially, the '316 patent describes a BWS system that includes an obvious and straightforward combination of: (1) the prior art Dynamic Unloading feature, with (2) the prior art Overhead Trolley Tracking feature (noted above), with (3) some of the prior art Fall Monitoring and Prevention features (noted above). I discuss each below after a high level

overview of components of the ’316 patent’s BWS system. A block diagram symbolically showing the components of the BWS system is provided in Figure 1.

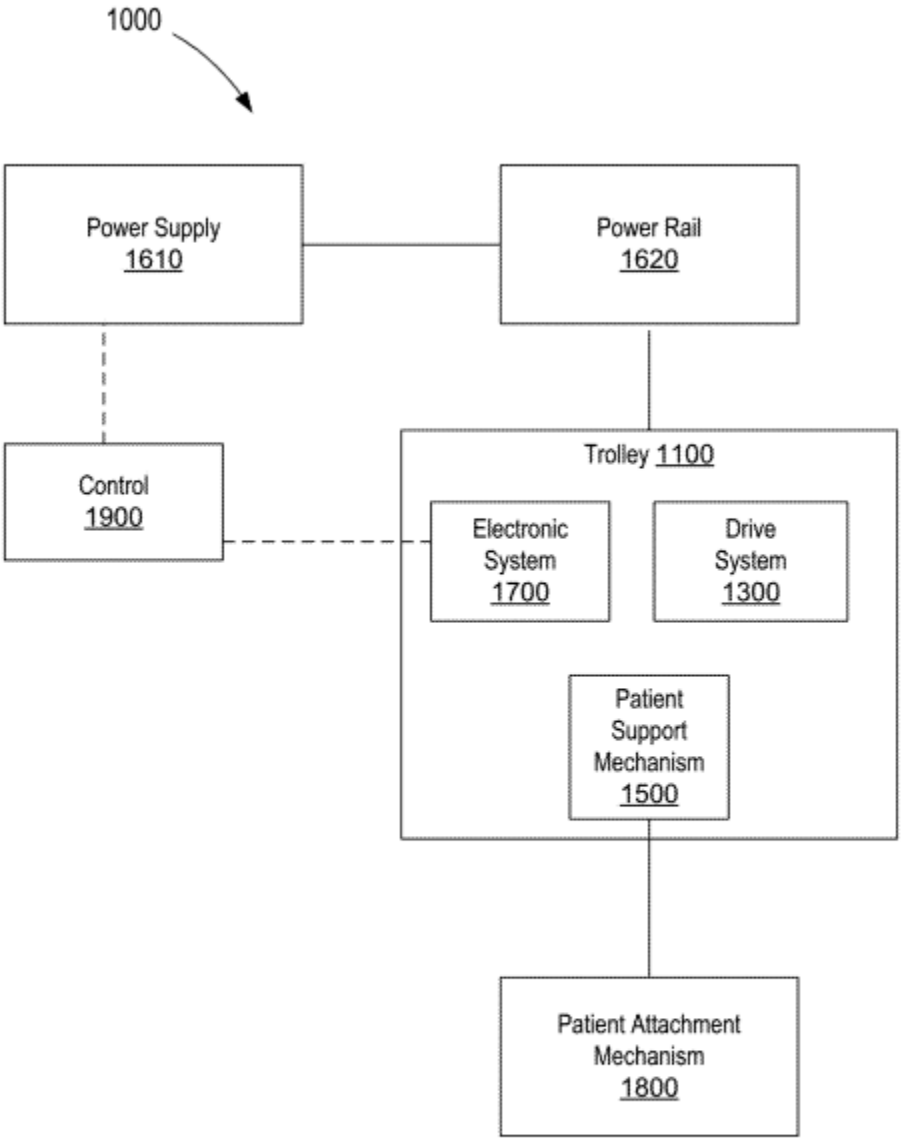


FIG. 1

Ex-1001, Fig. 1; *see also id.,* 3:22-23.

23. As shown in Figure 1, the body weight support system 1000 can include a trolley 1100 (which further includes an electronic system 1700, a drive system 1300, and a patient support mechanism), a patient support mechanism 1500, a patient attachment mechanism 1800, a power supply 1610, a power rail 1620, and a control 1900.

24. The ’316 patent describes that “[t]he support system 1000 can be used, for example, in intensive gait therapy to support patients with walking deficiencies brought on by neurological injuries such as stroke, spinal cord injury, traumatic brain injury, or the like” and “can be used to support at least a portion of the patient's body weight to facilitate the gait therapy.” Ex-1001, 10:11-29; *see also id.*, 11:49-62, 11:63-12:10. In particular, the ’316 patent explains that a patient may be “temporarily coupl[ed]” to the trolley using a “patient support mechanism 1500” (e.g., a “tether”) that couples to a patient attachment mechanism 1800 that couples to a harness worn by the patient. Ex-1001, 11:49-62; *see also id.*, 11:63-12:10. The “support” provided to the patient’s body is optimized through a variety of features, as noted above, each of which was known in the art at the time. *See supra*, ¶¶21, 36-48.

’316 Patent’s Dynamic Unloading Feature

25. The ’316 patent discloses “active” unloading support that makes responsive adjustments to the tether length (coiling it in or uncoiling it out) as the user’s body makes upward and downward movements during their training session. Ex-1001, 12:19-64. The ’316 patent’s “active” unloading essentially maintains constant support of some percentage of the patient’s body weight (e.g., 10-50% of the patient’s body weight) during training. The “active” unloading support of the ’316 patent operates like the prior art Dynamic Unloading features

noted above, and hereafter my reference to the ’316 patent’s Dynamic Unloading feature should be understood to refer to the “active” unloading described herein.

26. The goal of this feature is to provide the same amount of upward lifting support while accounting for upward and downward movements of the user during training so that the user feels the same amount of support regardless of whether they are at the peak or valley of their exercise, or anywhere in-between (assuming those peaks and valleys are within the expected range of movement for the given exercise, e.g., + or - 3 inches from a neutral position). This Dynamic Unloading support is contrasted with Static Support (also noted above), which provides support in an all or nothing fashion relative to the neutral position. Ex-1001, 1:59-2:8.

‘316 Patent’s Overhead Trolley Tracking Feature

27. The BWS system of the ‘316 patent includes a trolley that is movably coupled to (and hung from) an overhead support track. Ex-1001, 10:37-51. The trolley “can perform any suitable function associated with, for example, supporting at least a portion of the body weight of a patient.” Ex-1001, 10:33-34. The trolley includes a “drive system” that moves the trolley along the support track. *Id*.

28. The ’316 patent teaches that a computer controlled drive mechanism is used to maintain the position and movements of trolley in an overhead position (or at least substantially overhead) above the patient to reduce trolley drag and/or to lead the patient to some degree as they traverse either a stationary or moving surface (hereafter, “Overhead Trolley Tracking”). Ex-1001, 34:64-35:44; 2:17-26. By employing the “tracking” feature, the BWS system of the ’316 patent can automatically maintain the body weight supporting trolley in a “substantially overhead” position as the patient moves about during training. *Id*. As noted above, this feature was well-known.

29. The Overhead Trolley Tracking feature maintains a body weight supporting trolley in a "substantially overhead" position as the patient walks along the designated surface (e.g., floor, ground, ramp, stairs, treadmill, etc.) during training. Ex-1001, 72:56-64, 73:33-35, 74:30-36. In connection with the Overhead Trolley Tracking feature, the '316 patent teaches that keeping the trolley positioned overhead (relative to the patient) enables a patient to perform therapeutic exercises without having to "physically drag[] the trolley along the overhead rail during gait therapy." *Id.*, 72:56-64. With the feature successfully implemented, the patient can focus exclusively on their own "balance, posture and walking ability" without having to fight trolley drag as they move about in the body weight support system (along the path of the power rail). *Id.*, 2:17-39.

316 Patent's Fall Detection and Prevention Feature

30. Another feature of the claimed methods in the '316 patent relates to fall-prevention (hereafter, the "Fall Detection and Prevention Feature"). The Fall Detection and Prevention Feature provides methods for catching a patient when they fall so that no further injuries are sustained by the patient. Fall prevention is a common objective in many environments, but particularly so during gait therapy. Indeed, it is often the case that the very reason the patient is there receiving gait therapy is because the issues they face while trying to walk put them at increased risk for falling down. The '316 patent's Fall Detection and Prevention Feature causes the system to provide an increased amount of body support when a fall is detected (i.e., when the patient's descent characteristics cause the tether to extend beyond an expected range (e.g., of distance or speed) and are indicative of a fall).

31. More specifically, the downward force on the tether that is imposed by the patient during a fall causes the tether to satisfy one or more criteria that the BWS system uses to

determine that a fall is occurring. Such criteria relate to the tether extending beyond a predefined distance from an initial position, and/or by extending faster than expected, and/or other criteria determinable from system "state" changes. *See, e.g.*, Ex-1001, 9:59-10:10; 35:35-36:26; 69:46-47. I refer to this feature herein as the "Fall Prevention" feature, which I discuss more below.

32. In my review of the original claims filed with the patent application, as well as the ultimately issued claims, I observed that the claims recited multiple variants of this Fall Detection and Prevention Feature—all common in the art as I demonstrate in this declaration—and each remained in the claims all the way through allowance and issuance.

'316 Patent's Monitoring And Display Feature

33. Another feature of the claimed methods in the '316 patent relates to collecting and displaying data associated with a patient's gait training session (hereafter, "Monitoring And Display"). The 316 discloses that a variety of data related to the operating condition/status of the BWS system itself (including current settings of the system), as well as data related to a gait training session for a particular user, can be displayed on the display of an electronic device. The 316 patent provides:

> As described above, any of the patient support systems and/or body weight support systems described herein can be used to and/or can otherwise facilitate an analysis of a patient's gait while using that system. For example, in some embodiments, the patient support systems can be used with an electronic device (e.g., a personal computer, laptop, tablet, smartphone, controller, remote display, workstation, server, and/or the like) to determine data associated with the patient's gait and graphically and/or alpha-numerically represent that data on a display. The patient support system can include, for example, a trolley tracking and dynamic body weight engine, module, processor, compute device, etc. to determine data such as trolley speed, travelled distance, tether length, cam angle, body weight unloading, elapsed time, and/or any other suitable data set.

Ex-1001, 54:18-32 (annotations added).

In addition, when a patient support system such as those described herein is used with, for example, an electric stimulator system or with any other suitable electric and/or electronic data collection system, the patient support system can be configured to receive signals from and/or send signals to such electric or electronic systems associated with, for example, heel on or off events and/or other gait phases. Thus, in some instances, the patient support systems described herein can calculate and/or determine a step duration, a step length, a walking speed, a symmetry level of gait patterns (left/right), and/or any other suitable gait characteristic. Moreover, the patient support systems described herein can send one or more signals (e.g., via a wired or wireless connection) to, for example, the electronic device to cause a graphical representation, a numeric representation, and/or an alpha-numeric representation of the calculated and/or determined gait characteristics to be presented on a display. In other instances, the patient support system can send data associated with one or more operating conditions of the patient support system to the electronic device. In such instances, the electronic device can calculate and/or define the gait characteristics, based at least in part on the data received from the patient support system. In addition, the electric stimulator can send data associated with the patient's gait, substantially concurrently with the patient support system, to the electric device. In other instances, the electric stimulator can send data associated with the patient's gait to the patient support system and the patient support system (e.g., a processor, module, or compute device included therein) can aggregate the data associated with the patient support system and the data associated with the electric stimulator and, in turn, can send an aggregated data set to the electronic device.

Ex-1001, 54:33-65 (annotations added).

34. The '316 patent provides some screenshots in figures depicting example data that can be displayed on an electronic device associated with the BWS system. Some of these example figures are shown below.

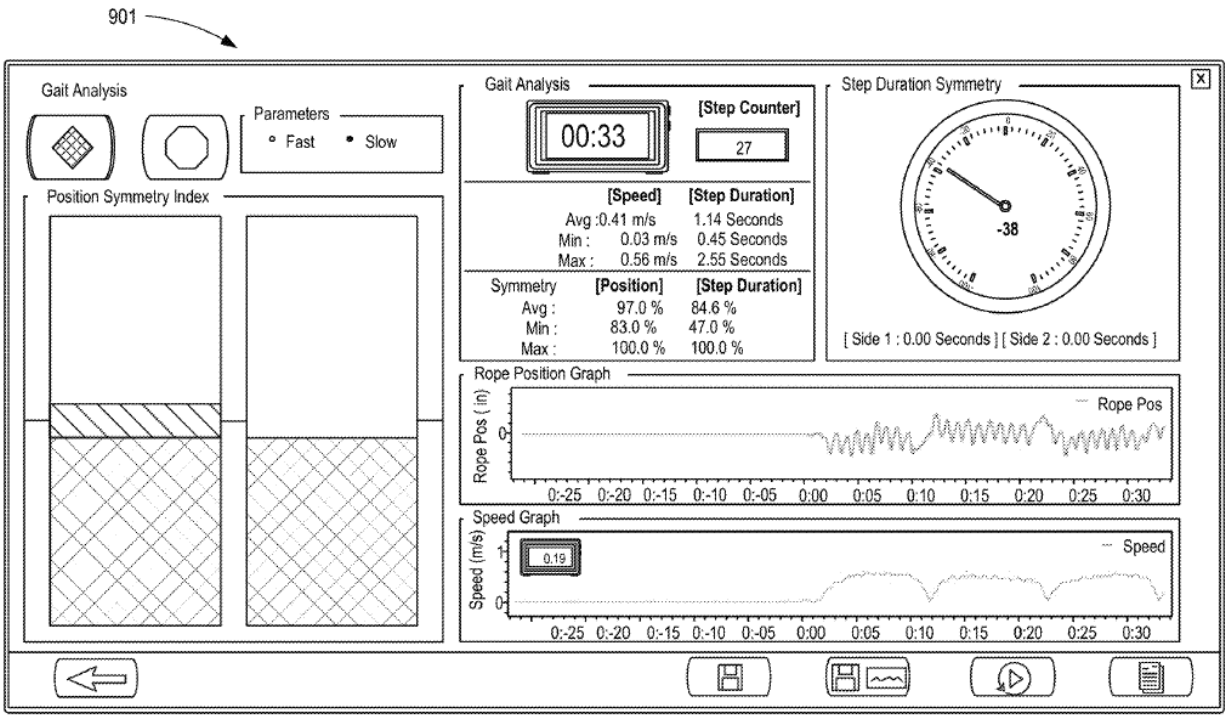


FIG. 56

Ex-1001, Fig. 56.

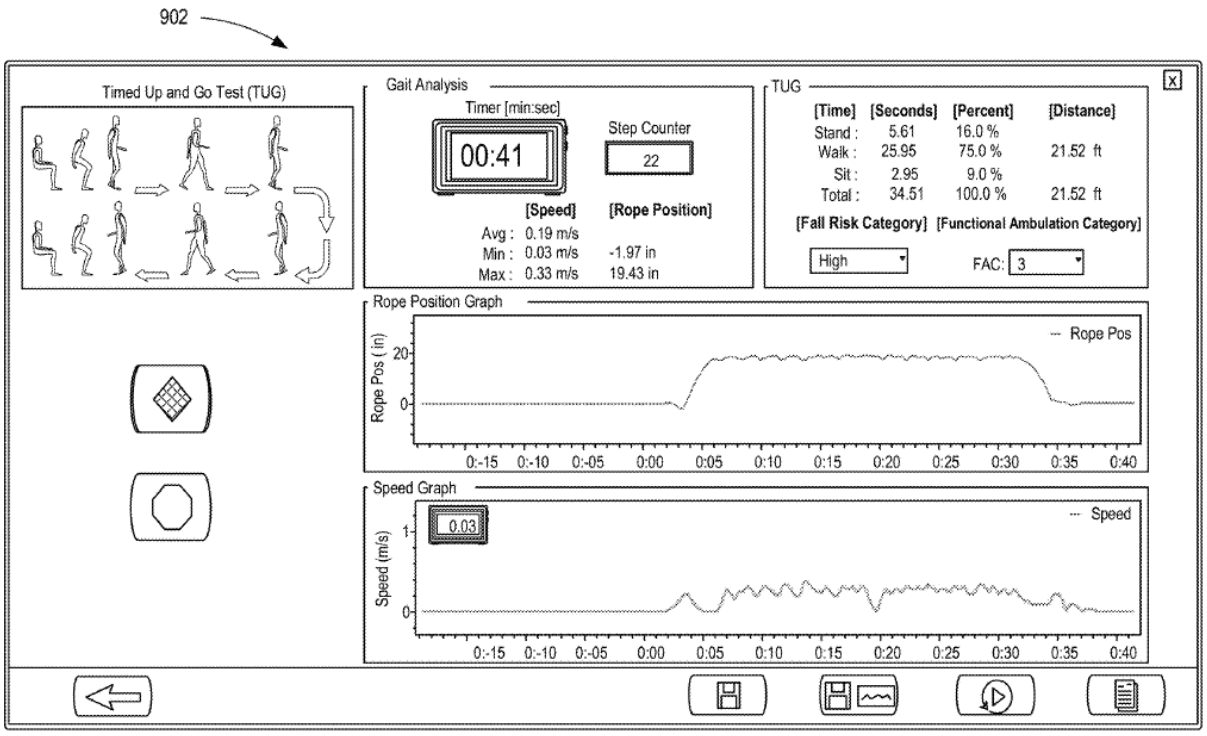


FIG. 57

Ex-1001, Fig. 57.

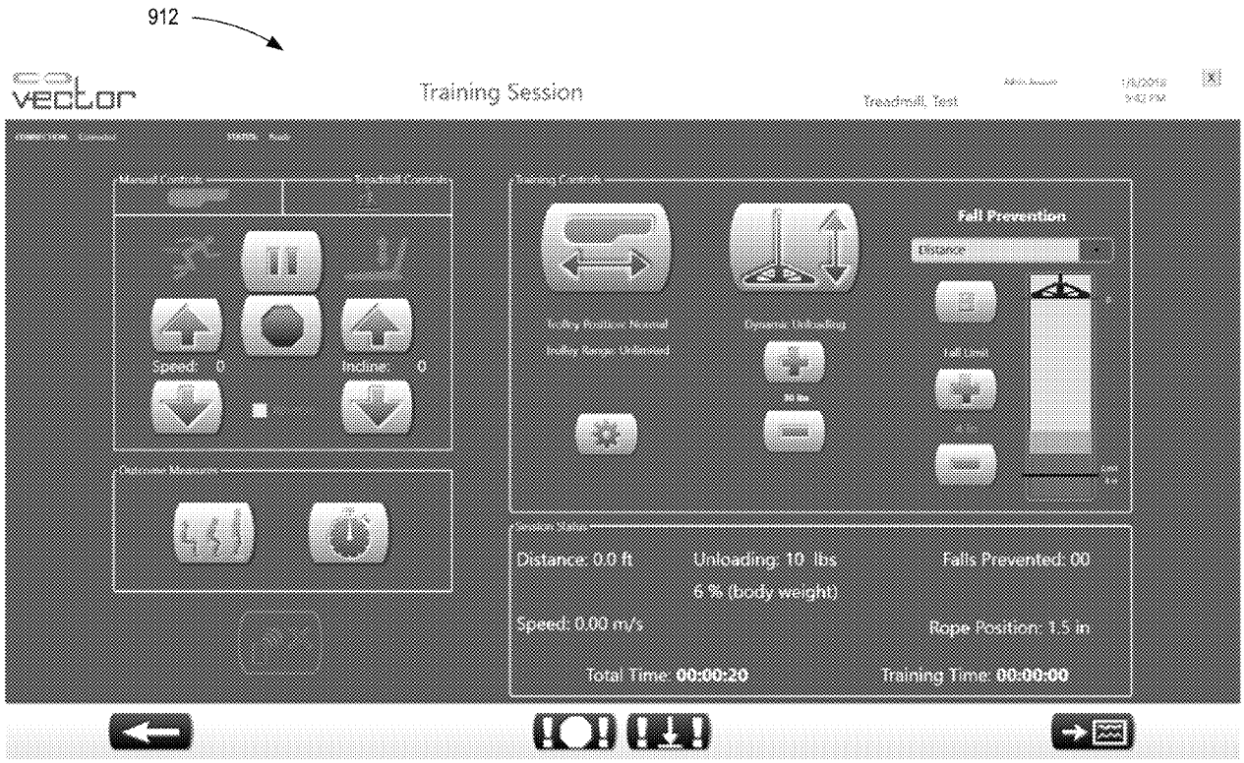


FIG. 66

Ex-1001, Fig. 66.

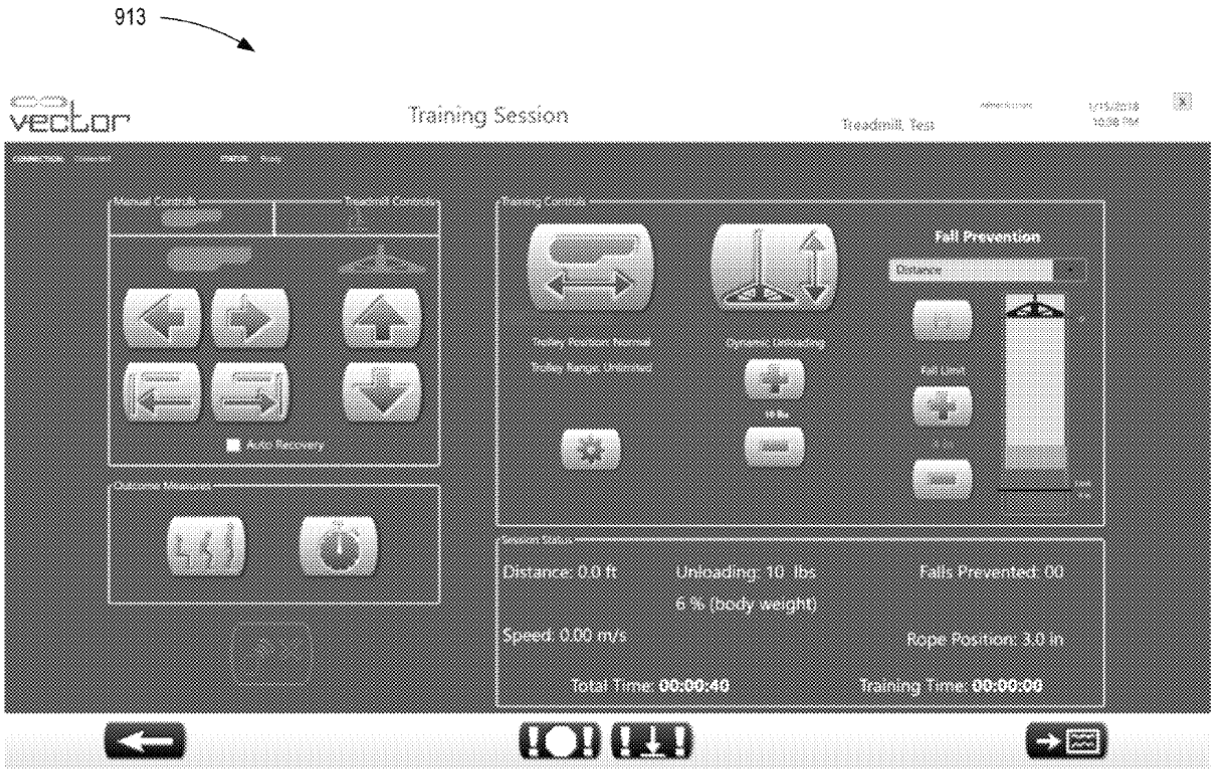


FIG. 67

Ex-1001, Fig. 67.

35. The ’316 patent teaches that this Monitoring and Display feature is useful, in part, to facilitate an “analysis of a patient's gait while using that system.” Ex-1001, 54:18-21.

B. The ’316 Patent in the Context of Body Weight Support Systems as of February 2017

36. It is my opinion that the elements of the alleged invention, individually and collectively – particularly in the context of BWS systems generally – were all well-known to a POSITA by February 2017.

37. As a threshold matter, body weight support systems for gait therapy applications were widely available by February 2017 when the application for the ’316 patent was filed. In fact, BWS systems—including those having Overhead Trolley Tracking using an Overhead Support Track, Dynamic Unloading, Fall Detection & Prevention, and Monitoring & Display

(see supra, ¶20-21)—had been available to users in various forms long before February 2017. The literature regarding this technology was abundant as of February 2017, including both patent literature and non-patent literature.

38. For example, IEEE Transactions on Neural Systems and Rehabilitation published an article in 2006 titled A Novel Mechatronic Body Weight Support System ("Frey"), which included an overview of some of the body weight support systems that existed for gait training over a decade prior to February 2017, including those that incorporated many of the aforementioned features, e.g., Dynamic Unloading. Ex-1017, 311-312 (Section B. Overview of Body Weight Support Systems).

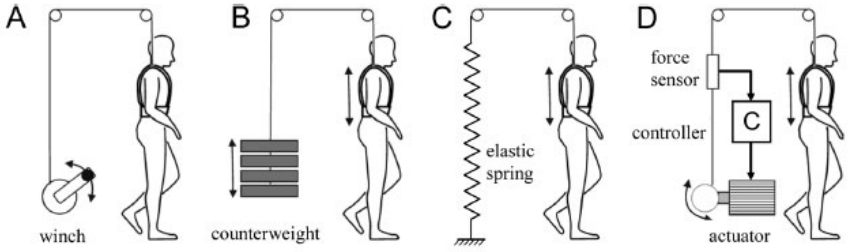


Fig. 1. Illustration of the most common body weight support (BWS) systems. (A) Static BWS with rope and winch. (B) Passive dynamic BWS with adjustable counterweights. (C) Passive dynamic BWS with elastic spring. (D) Active dynamic BWS with force sensor and electric winch.

Ex-1017, Fig. 1; *see also id.*, at 311-312 (Overview of Body Weight Support Systems).

39. Frey recognized the importance of maintaining a constant unloading force on the patient during gait training. Frey taught that such dynamic unloading is a "prerequisite for BWS gait therapy, where it is important to generate physiologically correct segmental dynamics and ground reaction forces." Ex-1017, 312.

C. Objective of This Work

The main mechanism to conserve the energy expenditure during locomotion is the exchange between kinetic and gravitational potential energy within each stride [17]. The percentage of energy recovery reaches about 65% for the optimal walking speed. In this way, the muscle work against gravity to accelerate the center of mass is minimized. This mechanism is wholly preserved if the applied unloading force is constant over the stride period. In this case, the physical work spent against the unloading force is zero. This is similar to walking at reduced gravity.

This is not the case if the unloading force is not constant as the physical work against the unloading force is the integral of the unloading force multiplied by the vertical speed over time. The energy saving mechanism mentioned above may be significantly disturbed. This may affect the time course of the movement, joint moment, and ground reaction forces. However, constancy of unloading force is an important prerequisite for BWS gait therapy, where it is important to generate physiologically correct segmental dynamics and ground reaction forces.

Ex-1017, 312 (highlights added).

40. As evidenced by Frey, as early as 2006, BWS systems delivering Dynamic Unloading so that the patient could experience a constant unloading force even while they move upward and downward during gait training was a very well-known objective, desired in many advanced gait training BWS implementations.

41. Frey's proposed solution also included a body weight support system that provided a variant of Dynamic Unloading for use over a treadmill. *See* Ex-1017 at Abstract, Figs. 1D and 2, below.

A novel mechatronic body weight support system for precise unloading during treadmill walking is presented in this publication. The design goals for the novel BWS system were as follows:

- high force accuracy with a force error clearly lower than the error of alternative BWS systems available on the market;
- full automation with static lifting capacity of up to 150 kg;
- dynamic unloading capacity of up to 80 kg.

The mechanical setup and the closed-loop control system are presented in detail. This is followed by a validation of the device among two different BWS systems currently on the market.

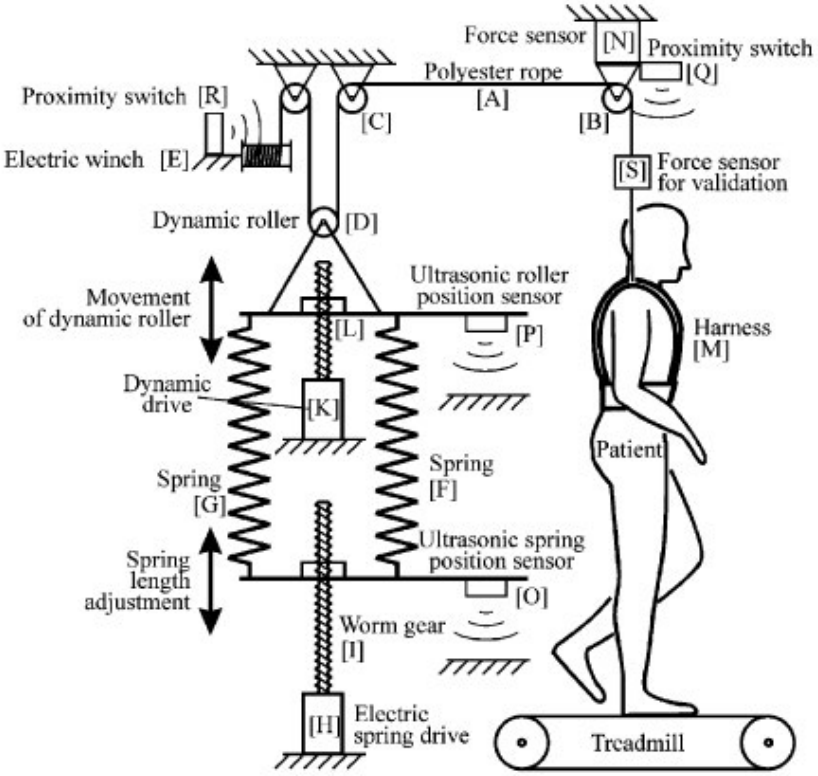


Fig. 2. Sketch of the mechanical setup of the Lokolift system.

Ex-1017, 312.

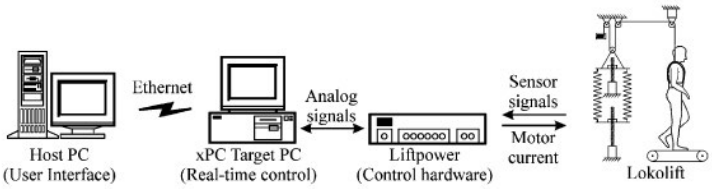


Fig. 3. Control hardware of the Lokolift system. User interface programmed with LabView runs at the host PC. Real-time xPC Target is equipped with analog–digital and digital–analog converter cards. Liftpower module is equipped with servo controllers and electric circuits for signal preprocessing.

42. In another example, U.S. Publication Number 2014/0206503 to James Stockmaster and assigned to Gorbel ("Gorbel"), published in July 2014, described a "body-weight support system" " including many common features including some of those mentioned above in ¶¶20-21, e.g., Dynamic Unloading and Overhead Trolley Tracking. Ex-1014, *passim*.

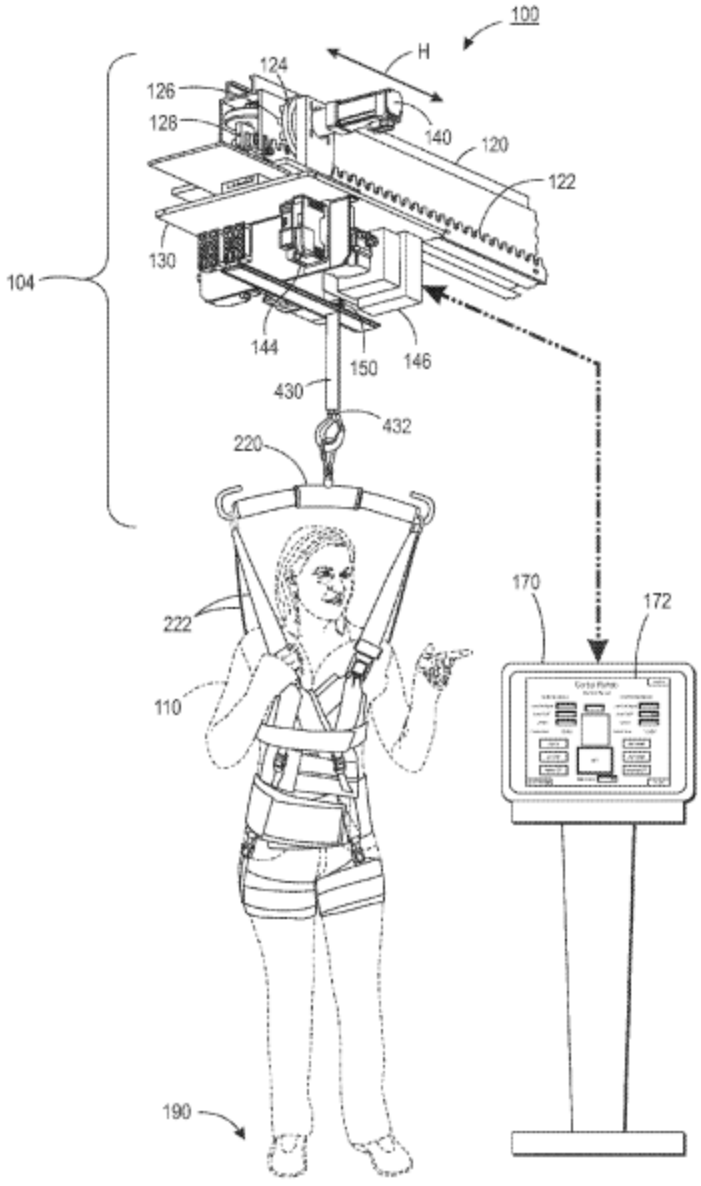


FIG. 1

Ex-1017, Fig. 1.

43. As shown below, Gorbel teaches a "movable support unit" (which may also be referred to as a trolley) that is movably "suspended" from a support "track" via "rollers" and a "drive" system. Ex-1014, [0010].

[0010] Further disclosed in embodiments herein is A method for supporting the weight of a person for purposes of rehabilitation therapy, comprising: providing a track, the track including a plurality of extruded members joined end-to-end, and a plurality of electrical rails arranged longitudinally along an interior portion of the track for each portion of track, wherein at least one extruded member includes a generally planar upper surface extending in a longitudinal direction, opposing sides extending longitudinally and downward from each side of the upper surface, and where a combination the upper surface and downward-extending sides form the interior portion of the track; each of said opposing sides further including a shoulder extending in an outward direction therefrom; operatively attaching a movable support unit to the track, the movable support unit being movable along a path defined by the track in a first direction and in a second direction generally opposite to the first direction; moving the support unit along the path defined by the track using a first drive attached to the movable support unit, wherein the first drive is operatively coupled to a surface of the track to control the horizontal position of the support along the track, and where the movable support unit is suspended from rollers

resting on each of the shoulders extending from the opposing sides of the track; controlling the vertical position of the person using an actuator attached to the movable support unit, said actuator including a second drive for driving a rotatable drum, said drum having a first end of a strap attached thereto and the strap wound in an overlapping coil fashion about an outer surface of the drum, and a second end of the strap being coupled to a support harness attached to support the person; detecting a horizontal force applied to the movable support unit via the strap using a first sensor, the first sensor including a strap guide operatively attached to and extending from the movable support unit, the strap guide being attached to a load cell in a manner causing a change in the load cell output when the strap is pulled in a direction forward from or backward from vertical; sensing a vertical force applied to the strap using a second sensor, the second sensor including at least one pulley between the drum and the person supported by the strap, wherein the pulley is connected on one end of a pivoting arm, said arm being pivotally attached near its midsection to a frame member coupled to the movable support, and where an opposite end of said pivoting arm is operatively associated with a load cell such that the load cell is placed only in compression in response to a load suspended on the strap; and providing a control system configured to receive signals from the first and second sensors, and a user interface, and to control the movement of at least the first and second drives to facilitate and support movement of the person, where the control system dynamically adjusts the amount of support provided to the person by moving the moveable support unit horizontally along the track to follow the person.

Ex-1014, [0010] (annotations added).

44. In another example, U.S. Publication Number 2016/0256346A1 (hereafter "Stockmaster") – filed on Feb. 3, 2016 and later published naming James Stockmaster as the first inventor – described a "body-weight support system" including many common features including some of those mentioned above in ¶¶20-21, e.g., Dynamic Unloading, Overhead

Trolley Tracking, Fall Detection and Prevention, and Monitoring and Display. See example figures from Stockmaster below (and related discussion):

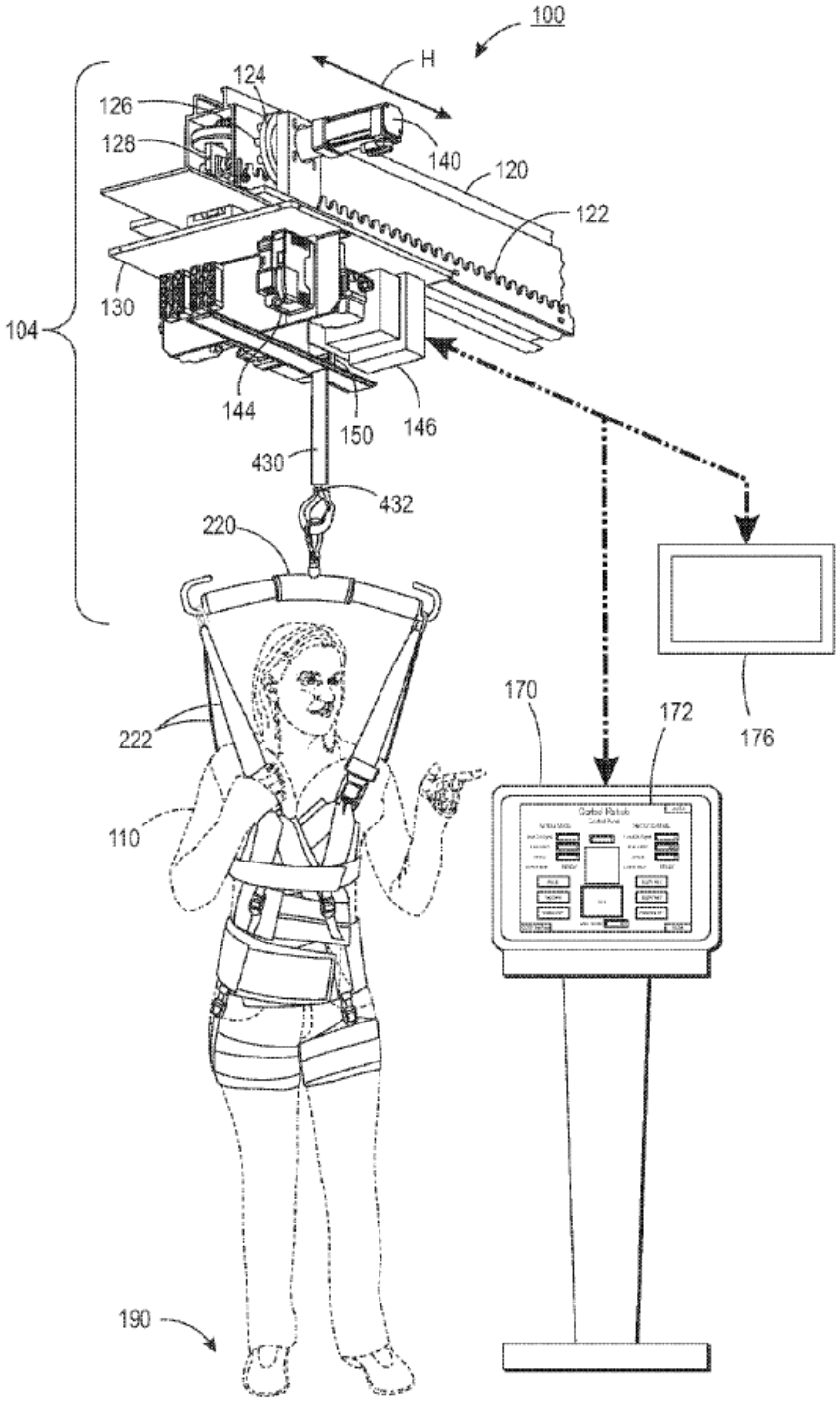


FIG. 1

Ex-1011, Fig. 1 (illustrating the BWS with Overhead Trolley Tracking, as well as a computer station with Monitoring and Display features).

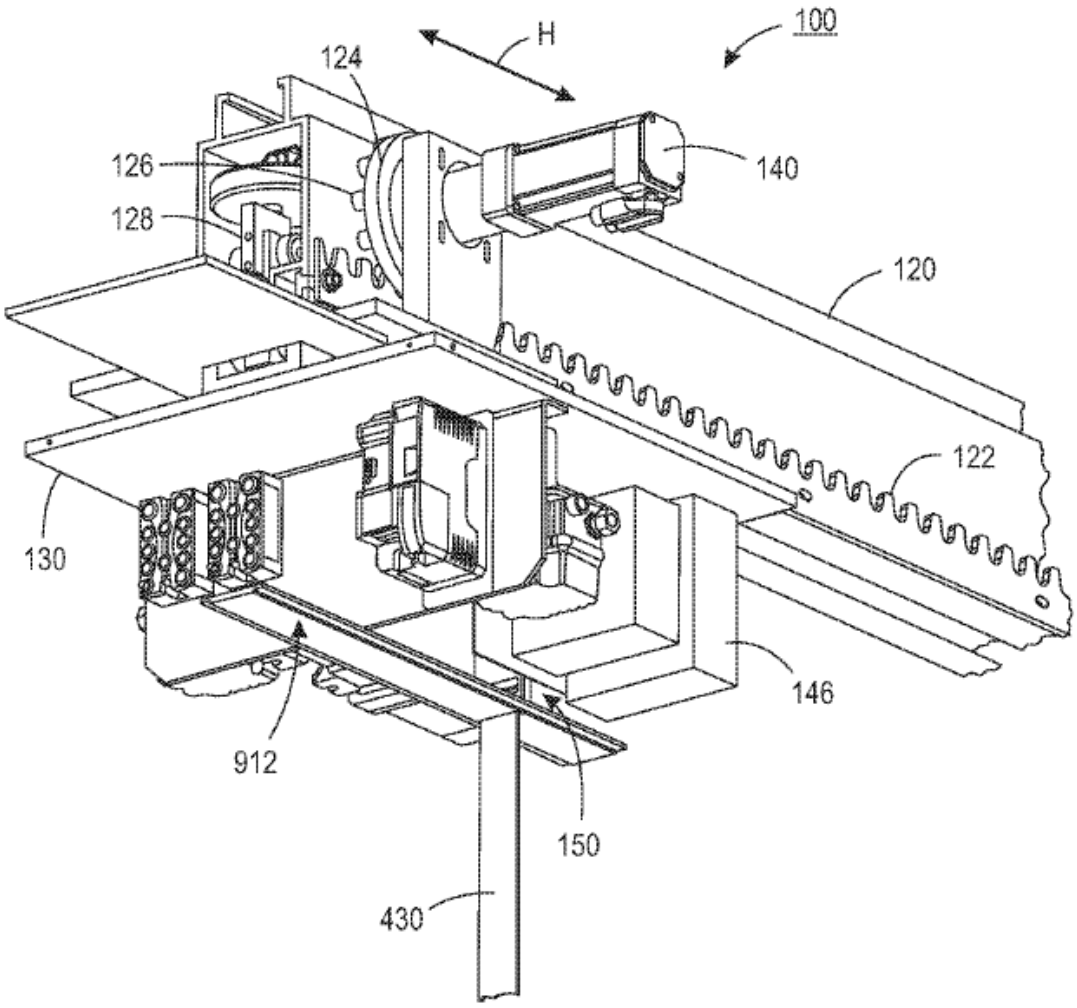


FIG. 3

Ex-1011, Fig. 3 (illustrating components that enable Overhead Trolley Tracking and Dynamic Unloading).

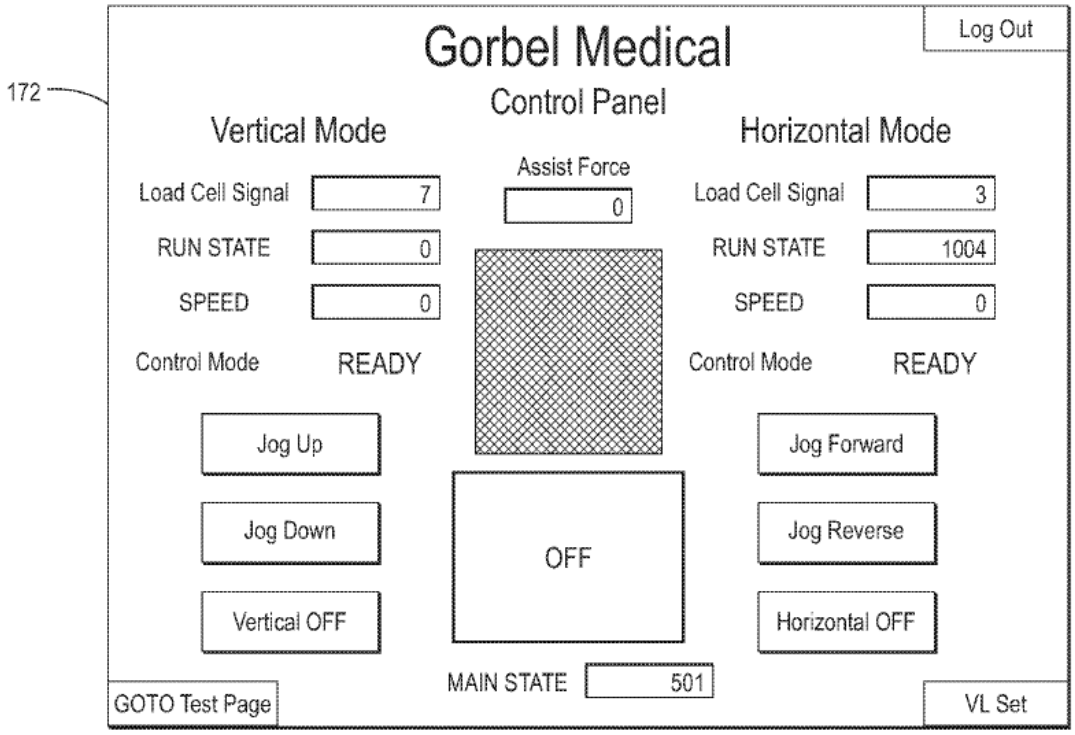


FIG. 20

Ex-1011, Fig. 20 (illustrating the control panel displayed on a computer screen, including information associated with an operating condition of the body weight support system).

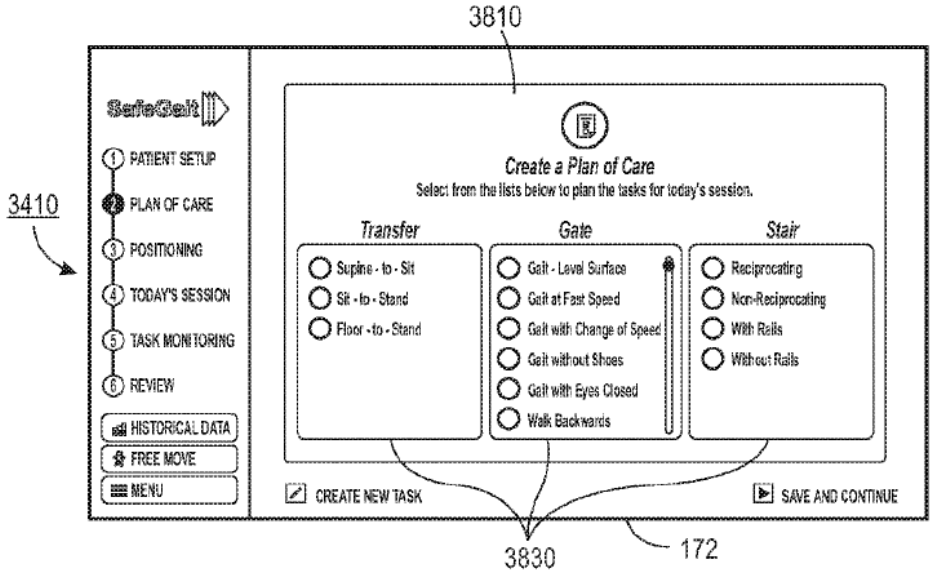


FIG. 38

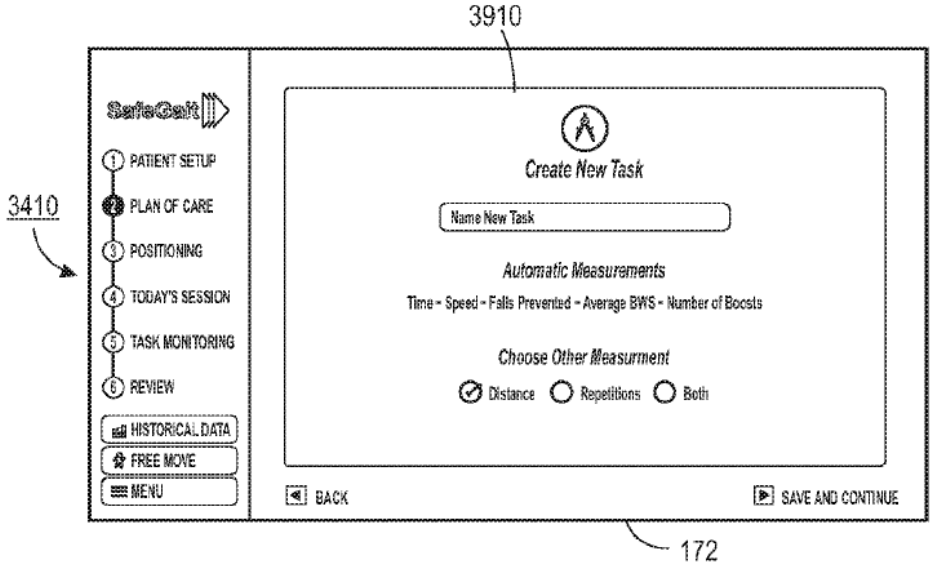


FIG. 39

Ex-1011, Figs. 38-39 (illustrating steps to create a plan of care for a patient).

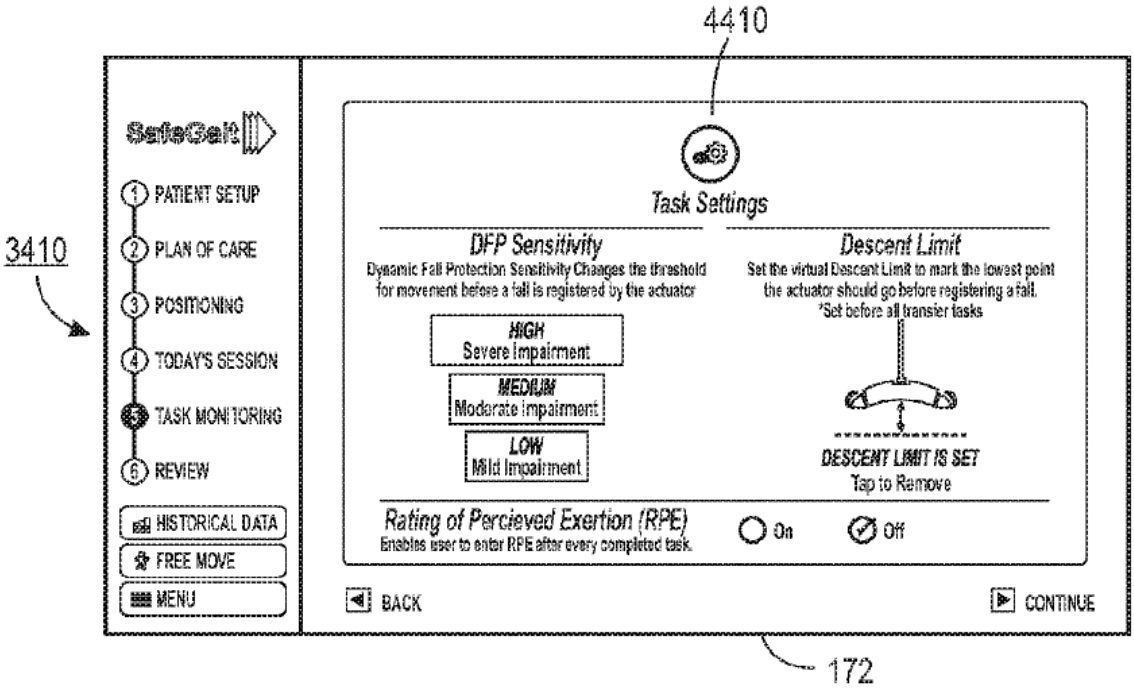


FIG. 44

Ex-1011, Fig. 44 (illustrating an example settings interface where a user may input their

preferences for how Stockmaster's Fall Detection & Prevention feature, which Stockmaster calls Dynamic Fall Protection)

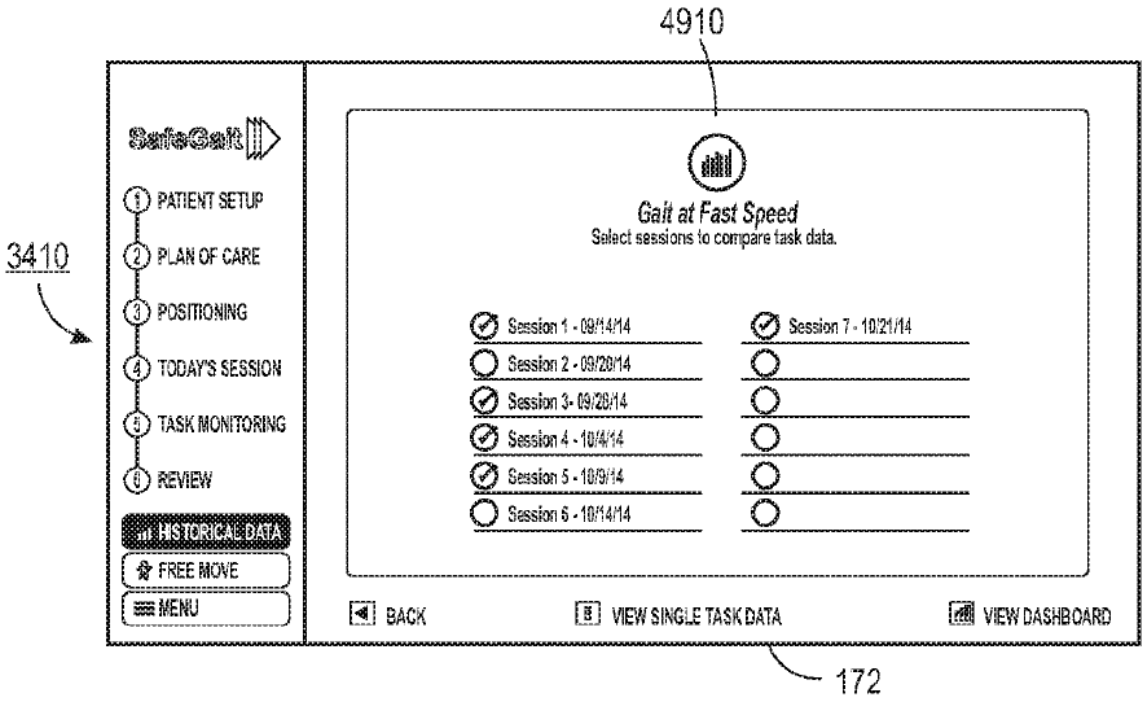


FIG. 49

Ex-1011, Fig. 44 (illustrating an example interface for displaying historical data associated with a user's gait training).

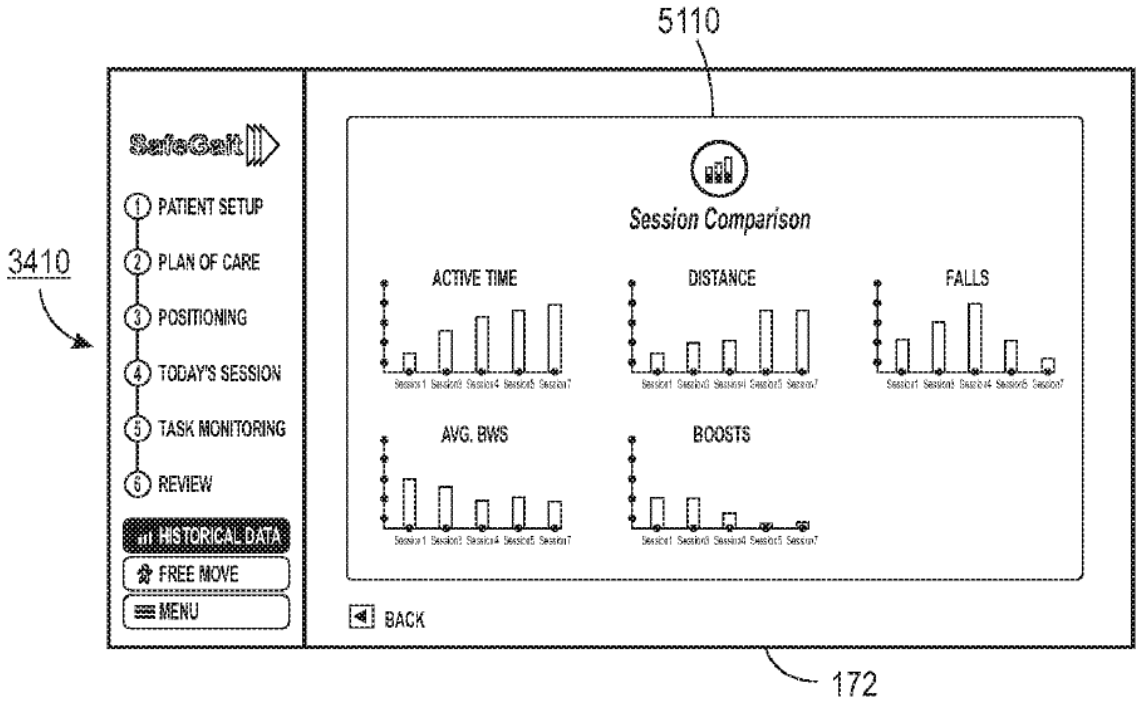


FIG. 51

Ex-1011, Fig. 44 (illustrating an example interface for displaying historical data associated with a user's gait training).

45. In another example BWS system, Patent Owner's very own BWS system embodying the claimed features of the '316 patent was available well before the 2017 priority date of the '316 patent. In particular, Patent Owner's Vector Elite body weight support system included and rendered obvious all of the features claimed (in the form of a method): Dynamic Unloading, Overhead Trolley Tracking via an Overhead Support Track, Fall Detection and Prevention, and Monitoring and Display.

46. Patent Owner's Vector Elite system confirms that the claimed features (discussed more below) were well known in the public domain at least as early as 2015, and certainly well before the 2017 priority date of the '316 patent. Voluminous materials were published by the

Patent Owner about the Vector Elite BWS system by 2017 – including several videos published on Patent Owner's YouTube channel in 2015 and earlier – discussing these features.

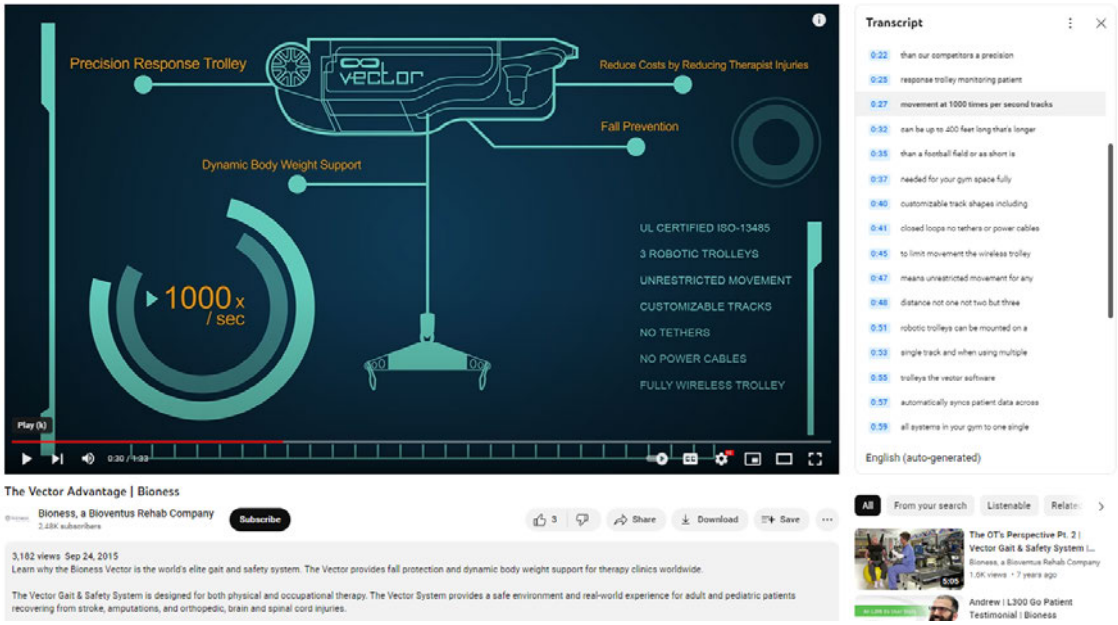
47. For example, the below publicly available screenshots concerning Patent Owner's Vector Elite System are from a video uploaded to Youtube in 2015:



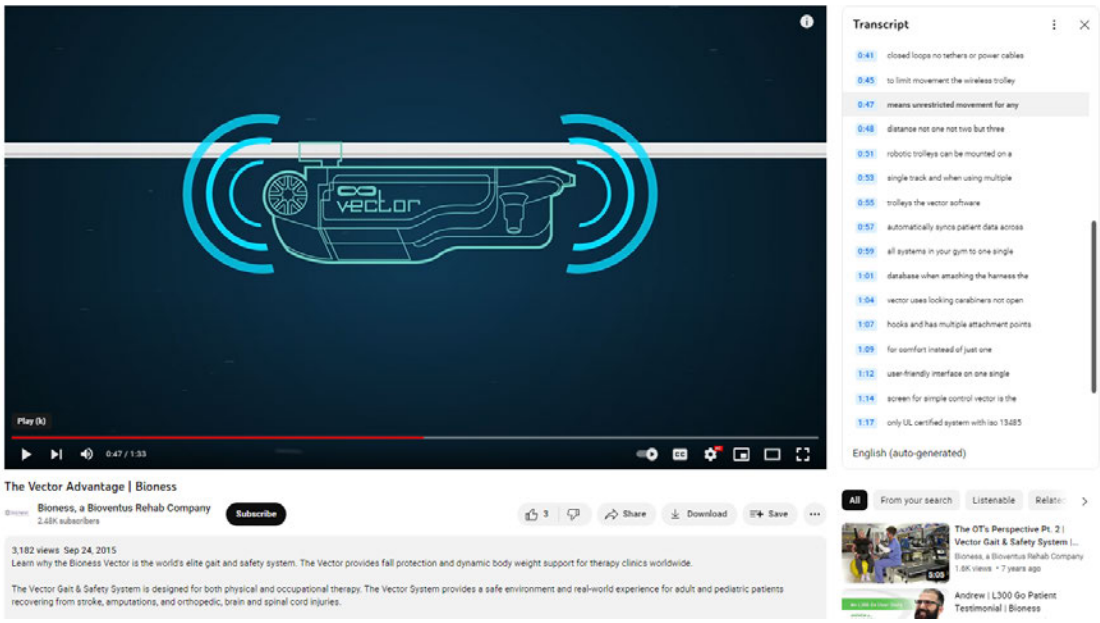
See https://www.youtube.com/watch?v=1OWXwpaq9U4, at 0:03.



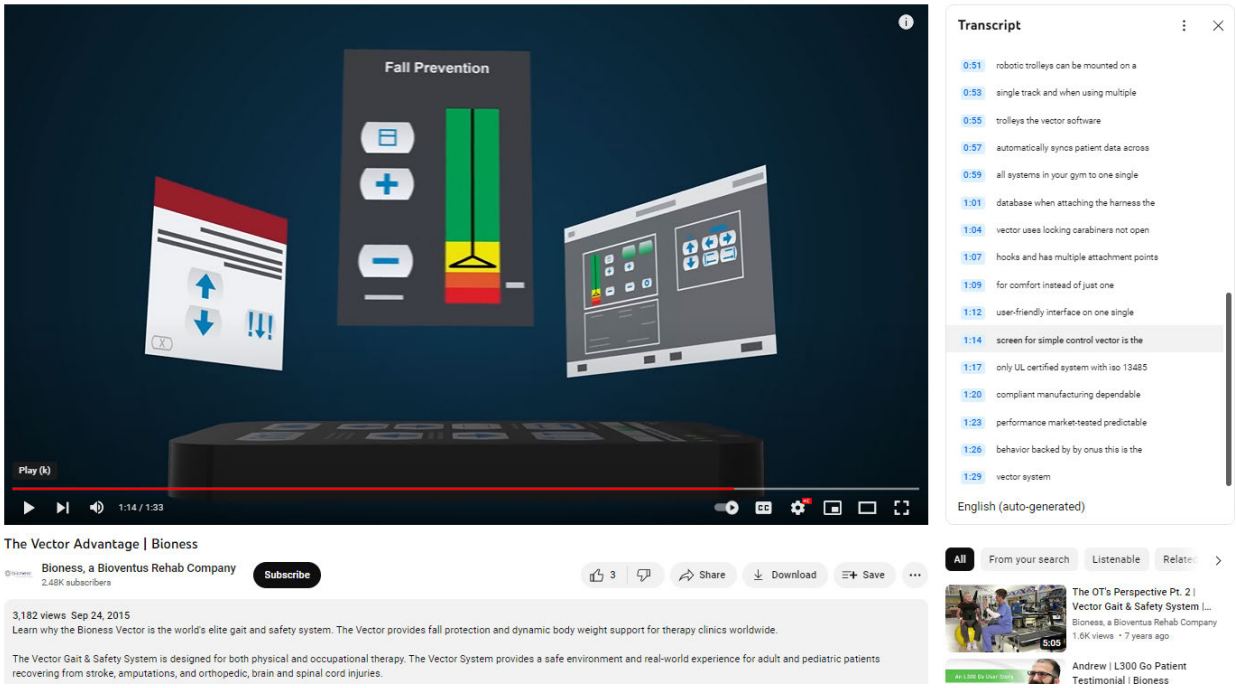
See https://www.youtube.com/watch?v=1OWXwpaq9U4, at 0:22.



See https://www.youtube.com/watch?v=1OWXwpaq9U4, at 0:30.



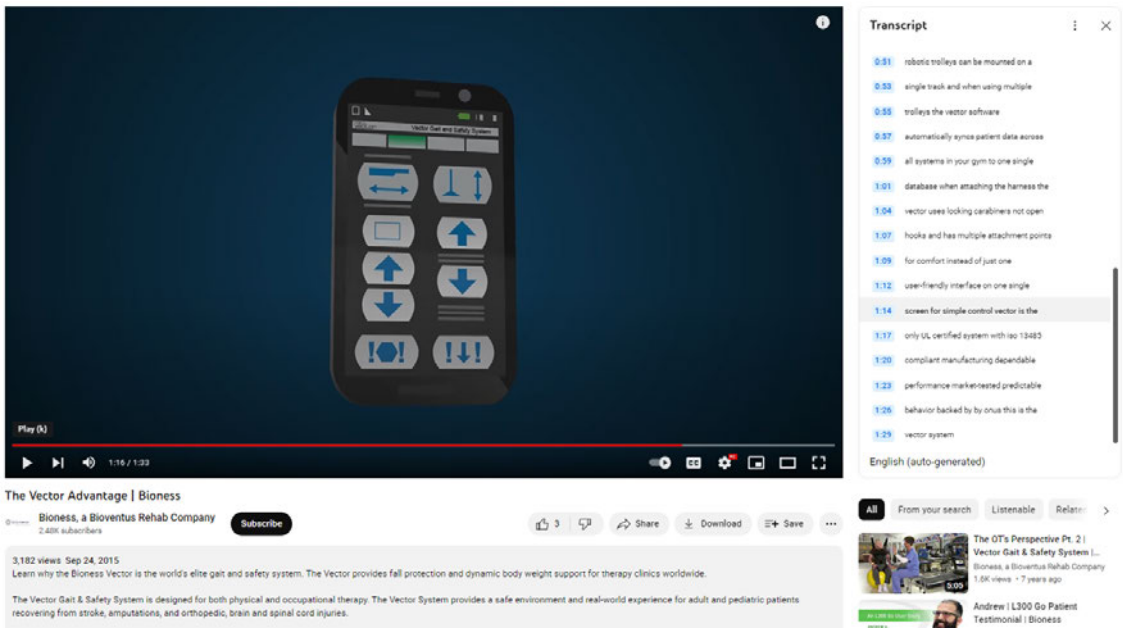
See https://www.youtube.com/watch?v=1OWXwpaq9U4, at 0:47.



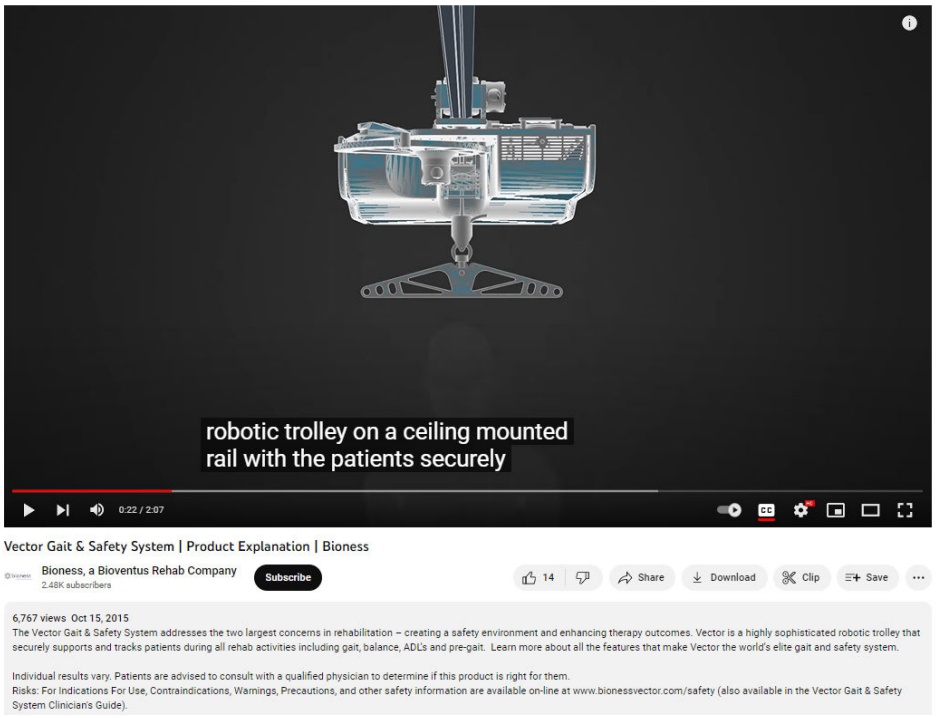
See https://www.youtube.com/watch?v=1OWXwpaq9U4, at 1:14.



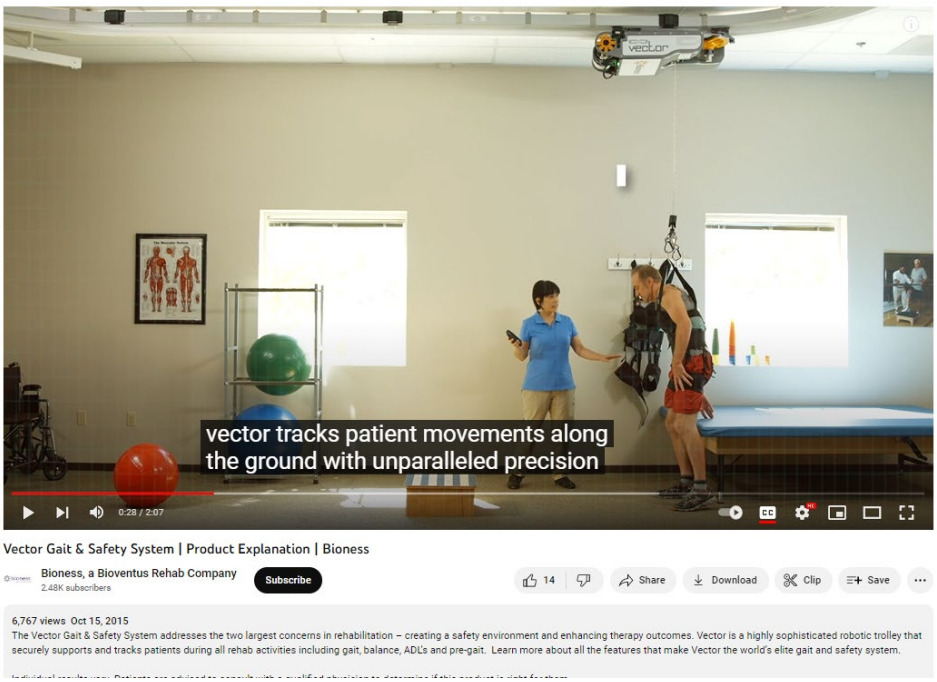
See https://www.youtube.com/watch?v=1OWXwpaq9U4, at 1:15.



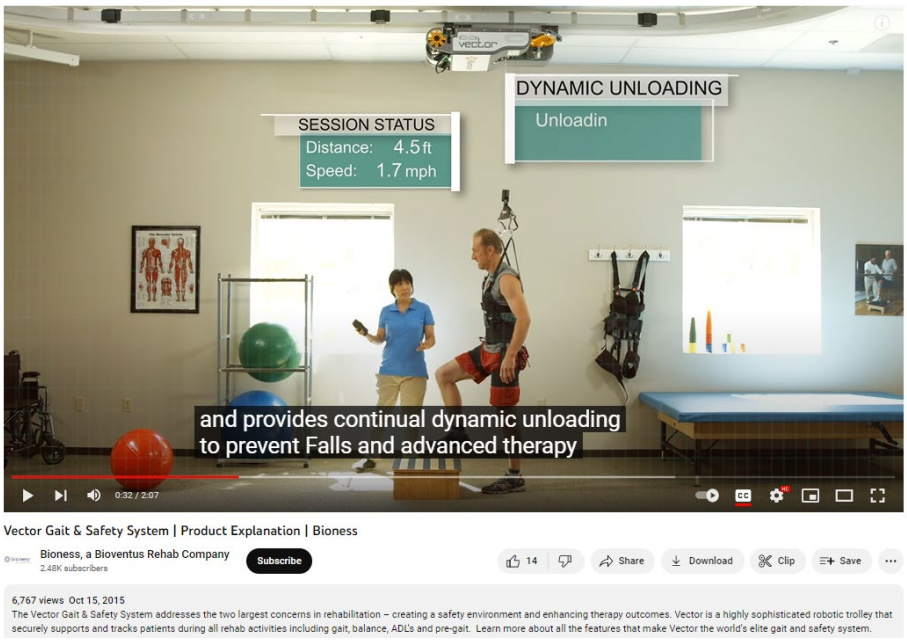
See https://www.youtube.com/watch?v=1OWXwpaq9U4, at 1:16.



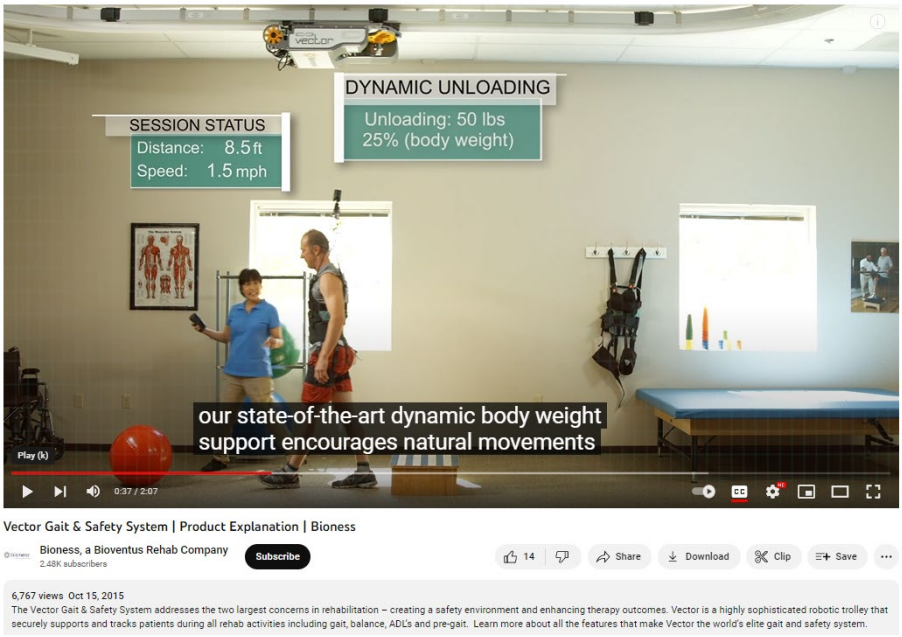
See https://www.youtube.com/watch?v=1FW8___gUlc, 0:22.



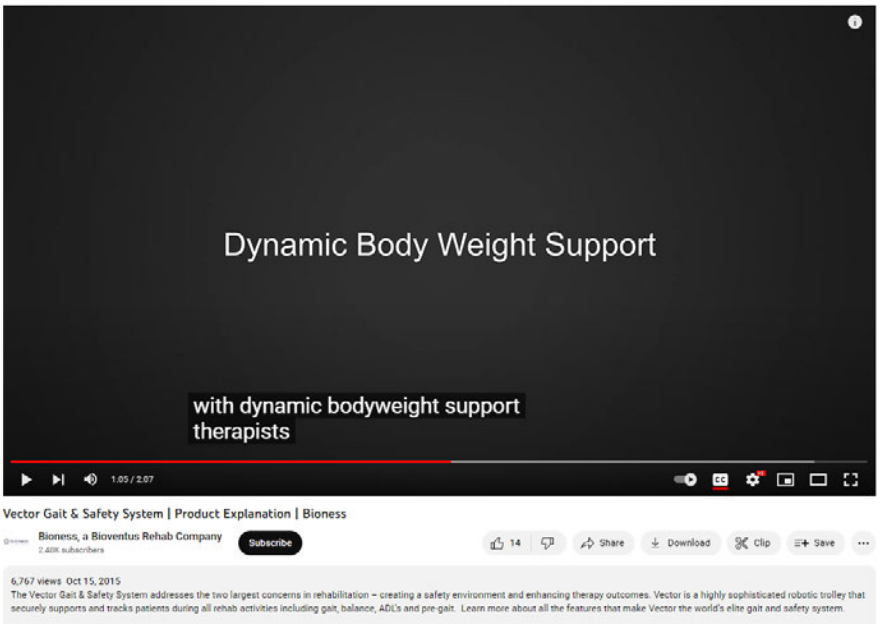
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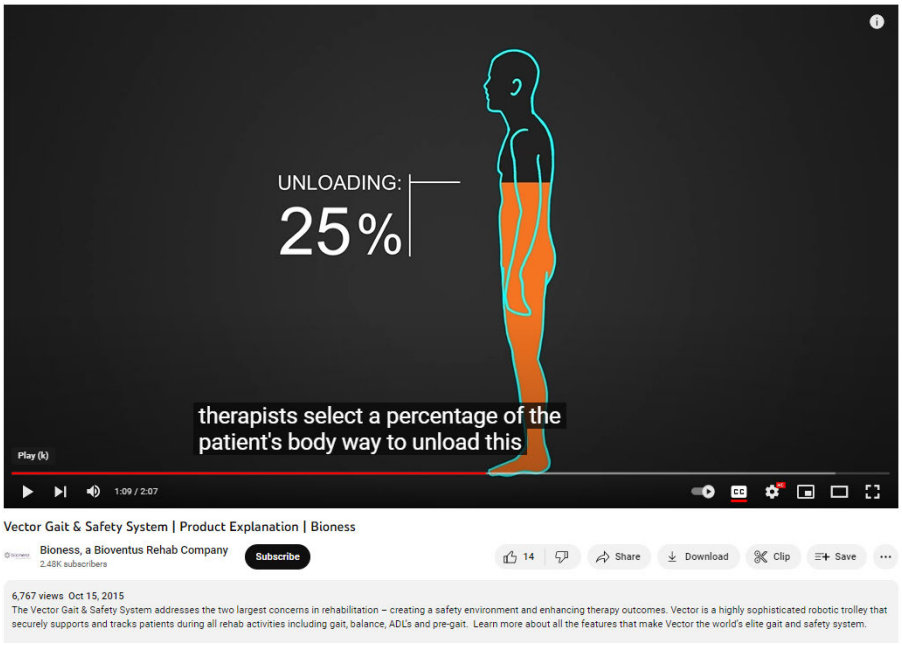
See https://www.youtube.com/watch?v=1FW8 gUlc, 0:32.



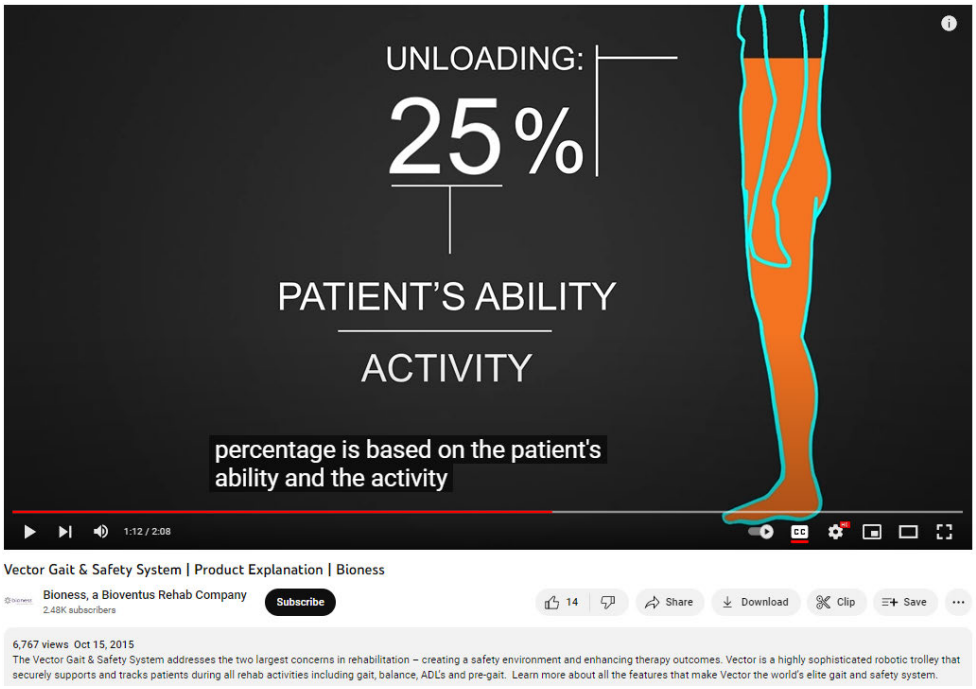
See https://www.youtube.com/watch?v=1FW8 gUlc, 0:37.



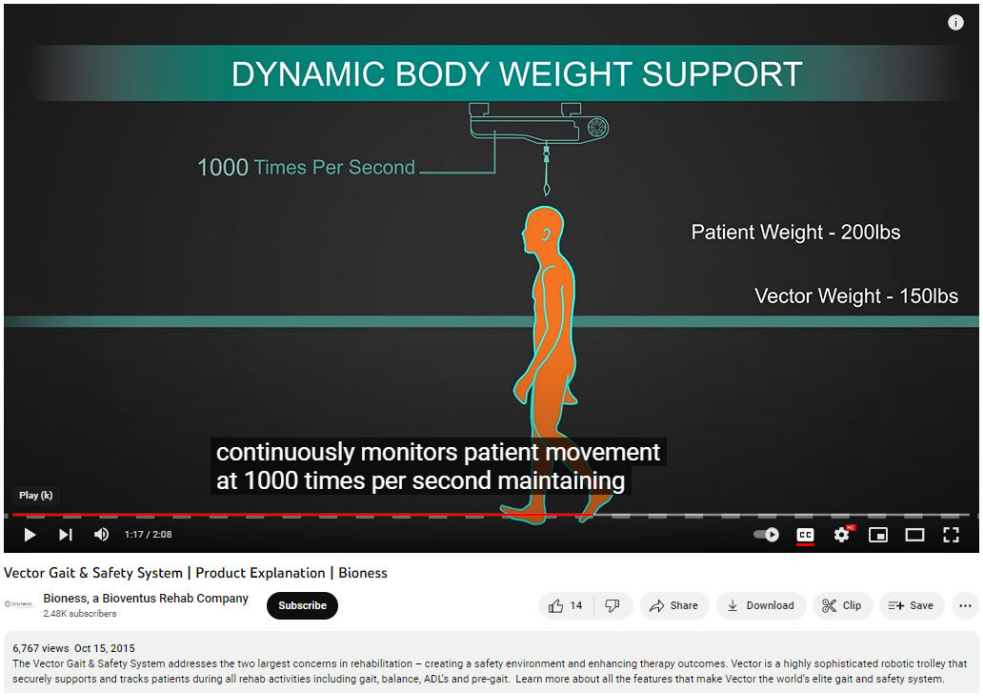
See https://www.youtube.com/watch?v=1FW8___gUlc, 1:05.



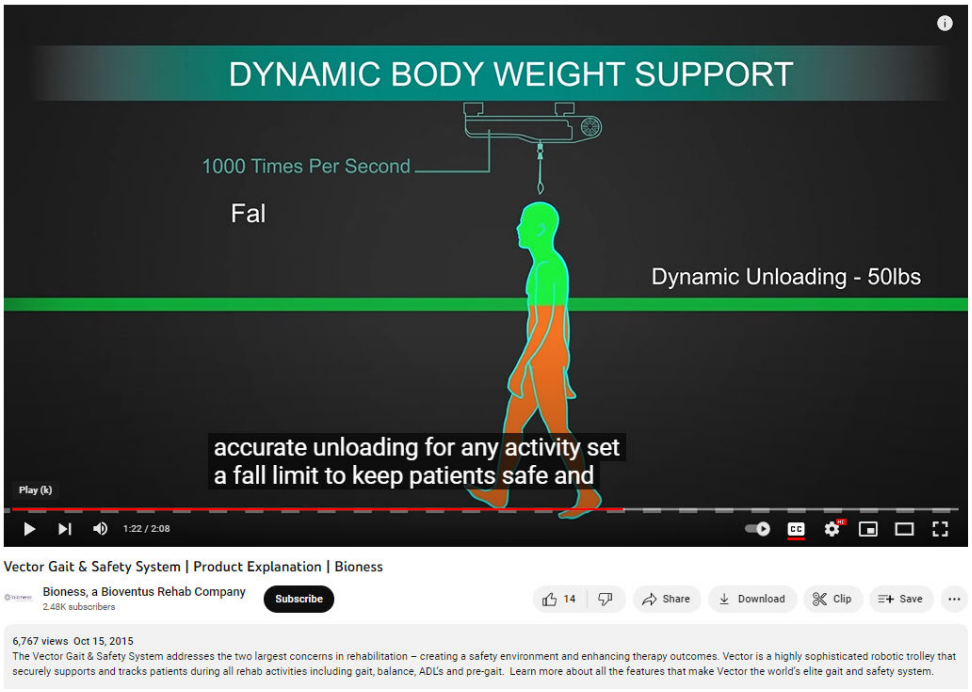
See https://www.youtube.com/watch?v=1FW8___gUlc, 1:09.



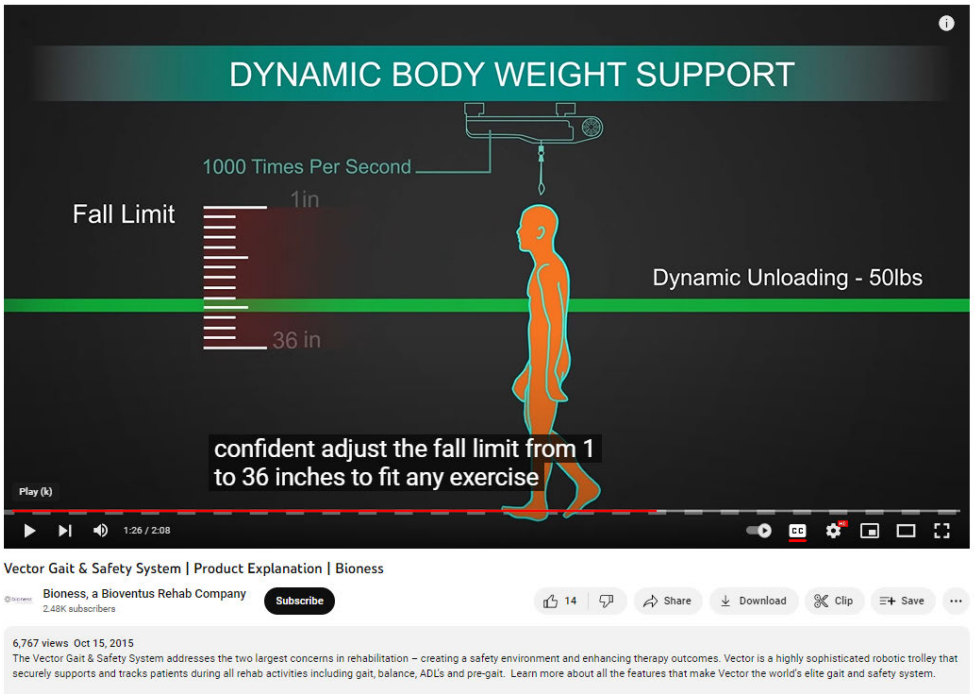
See https://www.youtube.com/watch?v=1FW8___gUlc, 1:12.



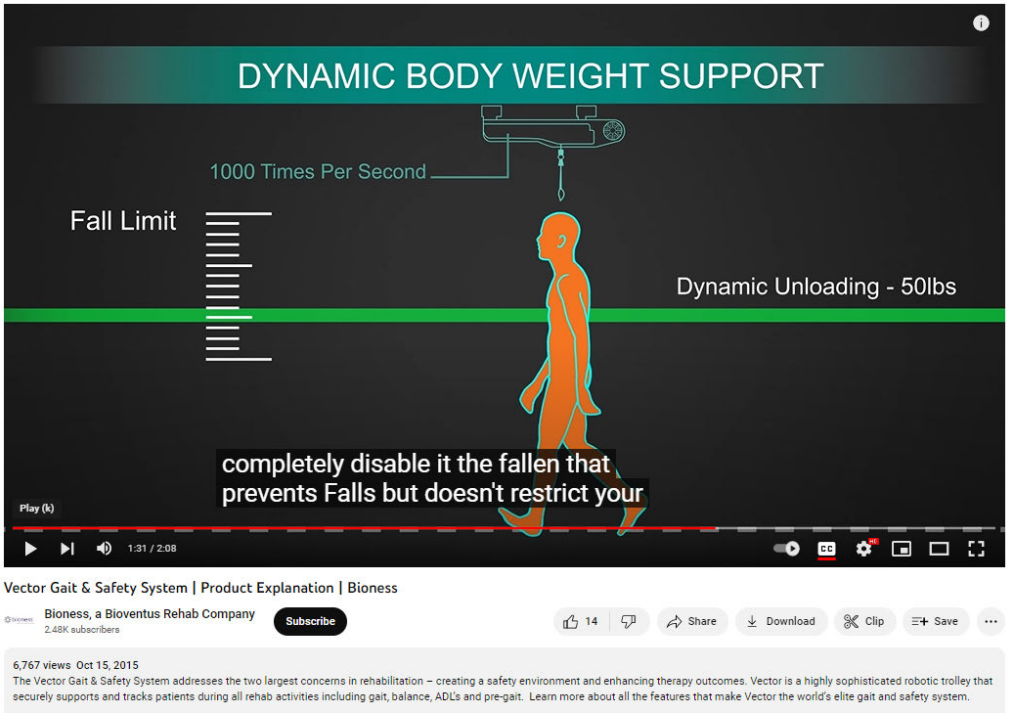
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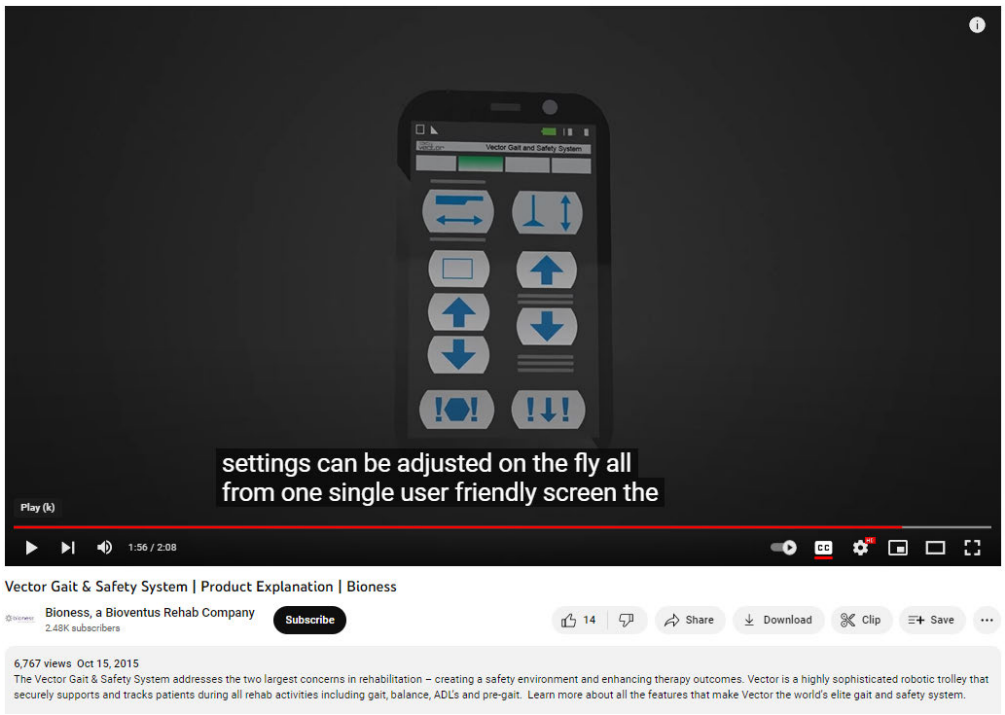
See https://www.youtube.com/watch?v=1FW8___gUlc, 1:22.



See https://www.youtube.com/watch?v=1FW8___gUlc, 1:26.



See https://www.youtube.com/watch?v=1FW8___gUlc, 1:31.



See https://www.youtube.com/watch?v=1FW8___gUlc, 1:56.

48. As reflected by the various example references above, the features of the ’316 patent that appear in the claims— related to Dynamic Unloading, Overhead Trolley Tracking, Fall Detection and Prevention, and Monitoring and Display—were already well-known and understood by POSITAs long before the application for the Critical Date of the ’316 patent.

C. Prosecution History

49. I understand that the ’316 patent issued from U.S. Patent Application No. 15/896,731 (the “’731 Application”), the face of which identifies that it was filed on February 14, 2018 and claims priority to U.S. Provisional Patent Application No. 62/458,648. Based on the file history, I understand that U.S. Provisional Patent Application No. 62/458,648 was filed on February 14, 2017. *See* Ex-1001, Ex-1003. I understand that for purposes of evaluating the validity of the ’316 patent, February 14, 2017 is treated as the applicable priority date of the ’316 Patent (hereafter, the “Critical Date”). Thus, for purposes of this declaration, I have assumed a priority date of February 14, 2017, but my opinions as set forth herein would not change if the priority date were up to one year earlier.

50. Based on the file history, I understand that on August 8, 2019, the Examiner issued an Office Action concerning the ’731 Application. Ex-1005. The Examiner indicated that claims 14-20 were allowable as written but rejected application claims 1-4 and 6-13.[1] The Examiner found that claims 1-4 and 6-7 were obvious over Mehr (Ex. 1035) in view of Lifewaves (Ex. 1028), and that claims 8-13 were anticipated by Vallery (Ex. 1036). In addition to claims 14-16, the Examiner noted that application claim 1 would be allowable if re-written to include the overhead trolley tracking feature found in application claim 5:

[1] Application claims 14-20 correspond to claims 14-20 of the ’316 patent, which are not among the Challenged Claims.

> 5. The method of claim 4, wherein the body weight support system includes a drive assembly configured to moveably suspend the body weight support system from a support track, the drive assembly configured to move the body weight support system relative to the support track in response to the user moving relative to the surface such that the body weight support system is maintained in a substantially overhead position relative to the user.

51. In response, Applicants amended independent claims 1 and 8 (later renumbered as claim 7) to include the trolley tracking feature from application claim 5 (as shown below). *See* Ex-1006.

1. (Currently Amended) A method of using a body weight support system to provide body weight support during gait training, the body weight support system including a drive assembly configured to movably suspend the body weight support system from a support track and a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system, the method comprising:

defining a reference length of the tether when the attachment device is in an initial position;

defining a threshold length of the tether;

providing a first amount of body weight support during the gait training as the user moves relative to a surface and the length of the tether is less than the threshold length of the tether;

providing a second amount of body weight support during the gait training as the user moves relative to the surface and the length of the tether is greater than the threshold length of the tether, the drive assembly configured to move the body weight support system relative to the support track to maintain the body weight support system in a substantially overhead position relative to the user as the user moves relative to the surface; and

displaying data associated with the gait training on a display of an electronic device included in the body weight support system.

Ex-1006, p. 2.

8. (Currently Amended) A method of using a body weight support system to provide body weight support during gait training, the body weight support system including a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system, the method comprising:

defining a reference length of the tether when the attachment device is in an initial position;

defining a first criterion associated with a change in a length of the tether;

defining a second criterion associated with a change in a length of the tether;

defining an amount of the body weight support to provide in response to the user falling during the gait training;

maintaining the body weight support system in a substantially overhead position relative to the user as the user moves relative to a surface;

determining a fall has occurred based on the first criterion and the second criterion being satisfied; and

providing the amount of body weight support in response to the first criterion and the second criterion being satisfied.

Ex-1006, p. 3-4.

52. Following the amendments, I understand that the Examiner issued a Notice of Allowance on January 10, 2020. Ex-1007.

IV. SUMMARY OF THE PRIOR ART APPLIED TO THE CHALLENGED CLAIMS

A. Erturk

53. I have reviewed the Erturk reference (Ex-1009). Based on the face of the Erturk publication itself, I understand that Erturk is a publication of a patent filing that Patent Owner submitted back on March 26, 2014, and which published on July 24, 2014.

54. Based on my review of the file history of the ’316 patent, I understand that Erturk was cited in an Information Disclosure Statement (“IDS”) filed by the Patent Owner, among 130

references. I also understand that the Examiner did not rely upon Erturk to issue a rejection during prosecution.

55. I understand that Erturk is prior art to the ’316 patent under at least 35 U.S.C. § 102(a)(1) because Erturk was published on July 24, 2014, more than one year before the filing date of the ‘316 patent (Feb. 14, 2018). Even if the ’316 patent is accorded the benefit of priority to its provisional application which was filed on February 14, 2017, and even if the Patent Owner qualifies for a one year grace period under 35 U.S.C. § 102(b)(1), giving a date of February 14, 2016, I understand that Erturk is still prior art under at least pre-AIA § 102(a)(1) because it was published more than one year before February 14, 2016. *See* Ex-1009 (field 22).

56. In my opinion, Erturk is analogous prior art to the ’316 patent because both Erturk and the ’316 patent are directed to overhead gait therapy BWS systems. Moreover, Erturk includes several paragraphs of disclosure that are identical or substantially the same as the disclosures in the ’316 patent.

57. Just like the 316 patent, Erturk is directed toward (1) methods for supporting a patient’s body weight in a safe and controlled manner during gait therapy training, and (2) the BWS systems configured to practice those methods. *See*, e.g., Ex-1001 at Abstract (“A **body weight support system** includes a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system. A method of **providing gait training** includes defining a reference length of the tether when the attachment device is in an initial position and defining a threshold length of the tether. A first amount of **body weight support is provided during the gait training** as the user moves relative to a surface and the length of the tether is less than the threshold length”), 1:25-29 (“The embodiments described herein relate to apparatus and methods for supporting the body weight of a user. More

particularly, the embodiments described herein relate to **apparatus and methods for supporting the body weight of a user during gait therapy**."), 2:59-61 ("Thus, a need exists for improved apparatus and methods for supporting the body-weight of a patient during gate therapy."); *compare* Ex-1009, [0002] ("The embodiments described herein relate to apparatus and methods for Supporting the body weight of a patient. More particularly, the embodiments described herein relate to apparatus and methods for supporting the body weight of a patient during gait therapy."), [0011] ("Thus, a need exists for improved apparatus and methods for supporting the body-weight of a patient during gate therapy.").

58. Additionally, in my opinion, Erturk is from the same field as the '316 patent (intelligent gait therapy systems and methods), and is reasonably pertinent to the problems allegedly addressed by the '316 patent (methods for providing intelligent overhead trolley tracking, dynamic support, and fall prevention during gait therapy). In fact, other than swapping the word "patient" out in favor of the word "user," the background of Erturk (which describes the alleged weaknesses of prior art technologies that Erturk intends improve upon) is word-for-word identical to the background of the '316 patent describing the same. *See* below (differences shown in red):

Erturk, [0002]-[0011]	**'316 patent, 1:25-2:61**
The embodiments described herein relate to apparatus and methods for supporting the body weight of a patient. More particularly, the embodiments described herein relate to apparatus and methods for supporting the body weight of a patient during gait therapy. Successfully delivering intensive yet safe gait therapy to individuals with significant walking deficits can present challenges to skilled therapists. In the acute stages of many neurological injuries such as stroke, spinal	The embodiments described herein relate to apparatus and methods for supporting the body weight of a user. More particularly, the embodiments described herein relate to apparatus and methods for supporting the body weight of a user during gait therapy. Successfully delivering intensive yet safe gait therapy to individuals with significant walking deficits can present challenges to skilled therapists. In the acute stages of many

cord injury, traumatic brain injury, or the like individuals often exhibit highly unstable walking patterns and poor endurance, making it difficult to safely practice gait for both the patient and therapist. Because of this, rehabilitation centers often move over-ground gait training to a treadmill where body-weight support systems can help minimize falls while raising the intensity of the training.	neurological injuries such as stroke, spinal cord injury, traumatic brain injury, or the like individuals often exhibit highly unstable walking patterns and poor endurance, making it difficult to safely practice gait for both the user (e.g., patient) and therapist. Because of this, rehabilitation centers often move over-ground gait training to a treadmill where body-weight support systems can help minimize falls while raising the intensity of the training.
In some instances, body-weight supported treadmill training can promote gains in walking ability similar to or greater than conventional gait training. Unfortunately, there are few systems for transitioning patients from training on a treadmill to safe, weight-supported over-ground gait training. Furthermore, since a primary goal of most individuals with walking impairments is to walk in their homes and in their communities rather than on a treadmill, it is often desirable that therapeutic interventions targeting gait involve over-ground gait training (e.g., not on a treadmill).	In some instances, body-weight supported treadmill training can promote gains in walking ability similar to or greater than conventional gait training. Unfortunately, there are few systems for transitioning patients from training on a treadmill to safe, weight-supported over-ground gait training. Furthermore, since a primary goal of most individuals with walking impairments is to walk in their homes and in their communities rather than on a treadmill, it is often desirable that therapeutic interventions targeting gait involve over-ground gait training (e.g., not on a treadmill).
Some known support systems involve training individuals with gait impairments over smooth, flat surfaces. In some systems, however, therapists may be significantly obstructed from interacting with the patient, particularly the lower legs of the patient. For patients that require partial assistance to stabilize their knees and/or hips or that need help to propel their legs, the systems present significant barriers between the patient and the therapist.	Some known support systems involve training individuals with gait impairments over smooth, flat surfaces. In some systems, however, therapists may be significantly obstructed from interacting with the patient, particularly the lower legs of the patient. For patients that require partial assistance to stabilize their knees and/or hips or that need help to propel their legs, the systems present significant barriers between the patient and the therapist.
Some known gait support systems are configured to provide static unloading to a patient supported by the system. That is, under static unloading, the length of shoulder straps that support the patient are set to a fixed length such that the patient either bears substantially all of their weight when the straps are slack or substantially no weight	Some known gait support systems are configured to provide static unloading to a patient supported by the system. That is, under static unloading, the length of shoulder straps that support the patient are set to a fixed length such that the patient either bears

when the straps are taught. Static unloading systems have been shown to result in abnormal ground reaction forces and altered muscle activation patterns in the lower extremities. In addition, static unloading systems may limit the vertical excursions of a patient that prevent certain forms of balance and postural therapy where a large range of motion is necessary. As a result, some known systems may not be able to raise a patient from a wheelchair to a standing position, thereby restricting the use of the system to individuals who are not relegated to a wheelchair (e.g., those patients with minor to moderate gait impairments). In some known static support systems, there may be a limitation on the amount of body-weight support. In such a system, the body-weight support cannot be modulated continuously, but rather is adjusted before the training session begins and remains substantially fixed at that level during training. Furthermore, the amount of unloading cannot be adjusted continuously since it requires the operator to manually adjust the system. In other known systems, a patient may be supported by a passive trolley and rail system configured to support the patient while the patient physically drags the trolley along the overhead rail during gait therapy. While the trolley may have a relatively small mass, the patient may feel the presence of the mass. Accordingly, rather than being able to focus on balance, posture, and walking ability, the patient may have to compensate for the dynamics of the trolley. For example, on a smooth flat surface, if the subject stops abruptly, the trolley may continue to move forward and potentially destabilize the subject, thereby resulting in an abnormal compensatory gait strategy that could persist when the subject is removed from the device.	substantially all of their weight when the straps are slack or substantially no weight when the straps are taught. Static unloading systems have been shown to result in abnormal ground reaction forces and altered muscle activation patterns in the lower extremities. In addition, static unloading systems may limit the vertical excursions of a patient that prevent certain forms of balance and postural therapy where a large range of motion is necessary. As a result, some known systems may not be able to raise a patient from a wheelchair to a standing position, thereby restricting the use of the system to individuals who are not relegated to a wheelchair (e.g., those patients with minor to moderate gait impairments). In some known static support systems, there may be a limitation on the amount of body-weight support. In such a system, the body-weight support cannot be modulated continuously, but rather is adjusted before the training session begins and remains substantially fixed at that level during training. Furthermore, the amount of unloading cannot be adjusted continuously since it requires the operator to manually adjust the system. In other known systems, a patient may be supported by a passive trolley and rail system configured to support the patient while the patient physically drags the trolley along the overhead rail during gait therapy. While the trolley may have a relatively small mass, the patient may feel the presence of the mass. Accordingly, rather than being able to focus on balance, posture, and walking ability, the patient may have to compensate for the dynamics of the trolley. For example, on a smooth flat surface, if the subject stops abruptly, the trolley may continue to move forward and potentially destabilize the subject, thereby resulting in an abnormal

Some known over-ground gait support systems include a motorized trolley and rail system. In such known systems, the motorized trolley can be relatively bulky, thereby placing height restrictions on system. For example, in some known systems, there may be a maximum suitable height for effective support of a patient. In some known systems, a minimum ceiling height may be needed for the system to provide support for patients of varying height. While the trolley is motorized and programmed to follow the subject's movement, the mechanics and overall system dynamics can result in significant delays in the response of the system such that the patient has the feeling that they are pulling a heavy, bulky trolley in order to move. Such system behavior may destabilize impaired patients during walking. Moreover, some known motorized systems include a large bundle of power cables and/or control cables to power and control the trolley. Such cable bundles present significant challenges in routing and management as well as reducing the travel of the trolley. For example, in some known systems, the cable bundle is arranged in a bellows configuration such that the cable bundle collapses as the trolley moves towards the power supply and expands as the trolley moves away from the power supply. In this manner, the travel of the trolley is limited by the space occupied by the collapsed cable bundle. In some instances, the bundle of cables can constitute a varying inertia which presents significant challenges in the performance of control systems and thus, reduces the efficacy of the overall motorized support system. Thus, a need exists for improved apparatus and methods for supporting the body-weight of a patient during gate therapy.	compensatory gait strategy that could persist when the subject is removed from the device. Some known over-ground gait support systems include a motorized trolley and rail system. In such known systems, the motorized trolley can be relatively bulky, thereby placing height restrictions on system. For example, in some known systems, there may be a maximum suitable height for effective support of a patient. In some known systems, a minimum ceiling height may be needed for the system to provide support for patients of varying height. While the trolley is motorized and programmed to follow the subject's movement, the mechanics and overall system dynamics can result in significant delays in the response of the system such that the patient has the feeling that they are pulling a heavy, bulky trolley in order to move. Such system behavior may destabilize impaired patients during walking. Moreover, some known motorized systems include a large bundle of power cables and/or control cables to power and control the trolley. Such cable bundles present significant challenges in routing and management as well as reducing the travel of the trolley. For example, in some known systems, the cable bundle is arranged in a bellows configuration such that the cable bundle collapses as the trolley moves towards the power supply and expands as the trolley moves away from the power supply. In this manner, the travel of the trolley is limited by the space occupied by the collapsed cable bundle. In some instances, the bundle of cables can constitute a varying inertia that presents significant challenges in the performance of control systems and thus, reduces the efficacy of the overall motorized support system.

	Thus, a need exists for improved apparatus and methods for supporting the body-weight of a patient during gate therapy.

59. With identical backgrounds and observance of supposed improvements need in the art, in my opinion Erturk and the ’316 patent are in the same field of endeavor and highly analogous to one another.

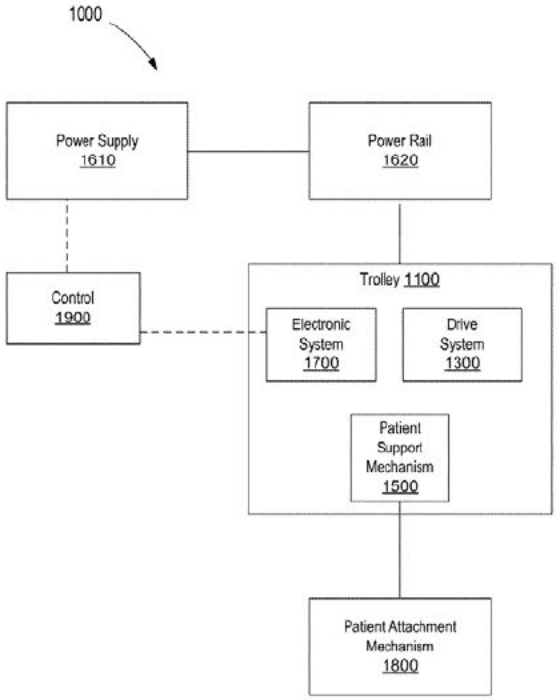
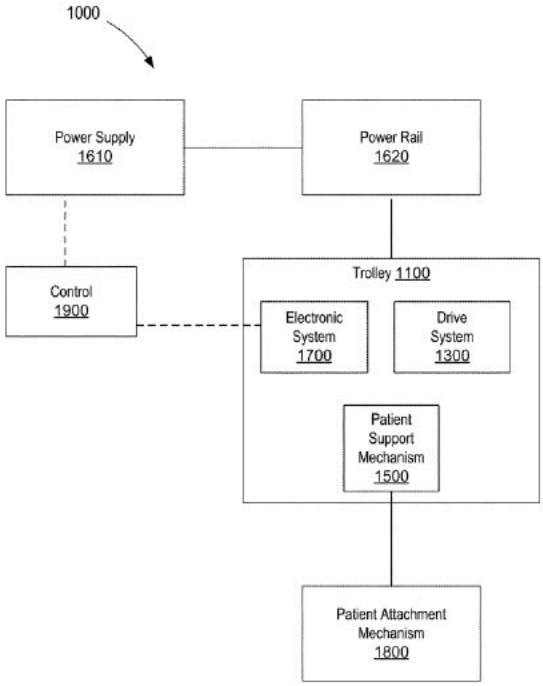
60. Moreover, and further emphasizing that Erturk is reasonably pertinent to the problem allegedly addressed by the’316 patent: Erturk recognizes the need in the art for systems equipped with safety features that minimize the risk of injury resulting from a fall, and safety mechanisms to detect, limit, break, and/or catch a patient’s fall during gait training (i.e., Fall Detection and Prevention). Ex-1009, [0003], [0070]-[0071], [0152]; *compare* Ex-1001, 1:37-40; 12:11-17. Erturk teaches detecting when a patient falls and programming the system to “actively reduce the amount a patient falls after stumbling.” Ex-1009, [0071], [0072], [0152].

61. Erturk enables its safety feature by providing that “the vertical (weight bearing) drive system is operational to compensate for … falls,” among other things. Ex-1009, [0070]; *compare* Ex-1001, 12:11-18.

62. Erturk provides its safety feature in an automated, real-time fashion with an “electronic system 1700 [that] can respond to a change in force exerted on the tether in a relatively short amount of time (e.g., much less than a second) to actively limit the magnitude of the fall of the patient.” Ex-1009, [0071]; *compare* Ex-1001, 12:56-64. Thereby, “the support system 2000 can actively reduce the amount a patient falls after stumbling or falling for other reasons.” Ex-1009, [0152].

63. Erturk delivers its features with an intelligent trolley coupled to a support track, where the trolley includes a drive system configured to movably suspend the trolley along the

support track. The "drive system 2300 and the patient support mechanism 2500 of the trolley 2100 can be actively controlled in response to a change in force exerted on the tether 2505 and based at least in part on the current and/or previous states of the drive system 2300 and the patient support system 2500." Ex-1009, [0152]. *See also* the Figures of comparative elements of the Erturk system and '316 patent system below.

Erturk, Figs. 1-47.	'316 patent, Figs. 1-47.
 FIG. 1	 FIG. 1

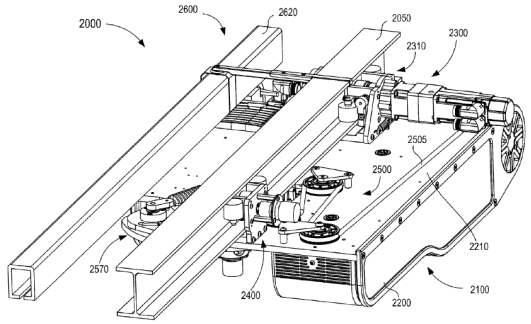


FIG. 2

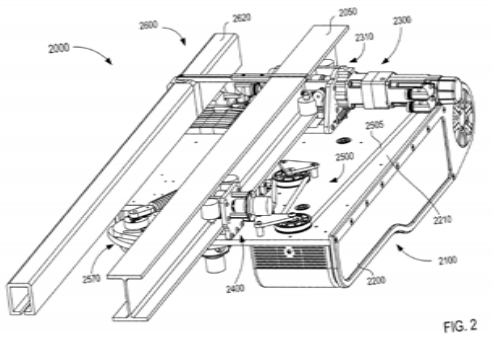


FIG. 2

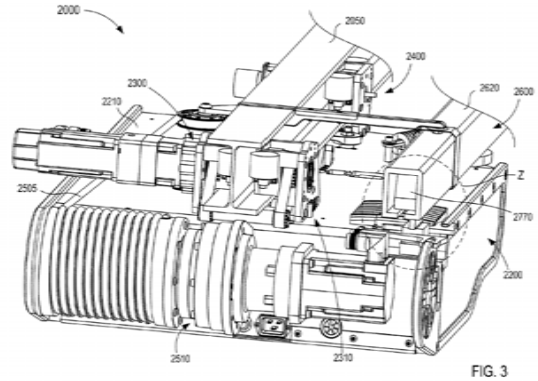


FIG. 3

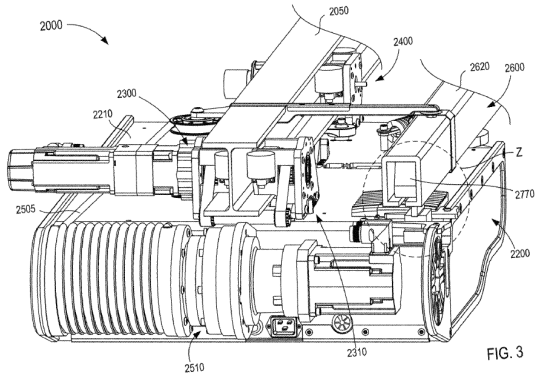


FIG. 3

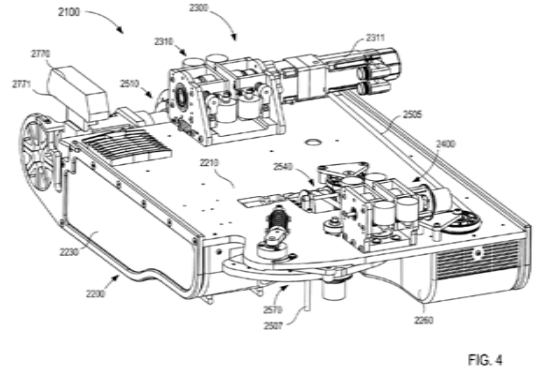


FIG. 4

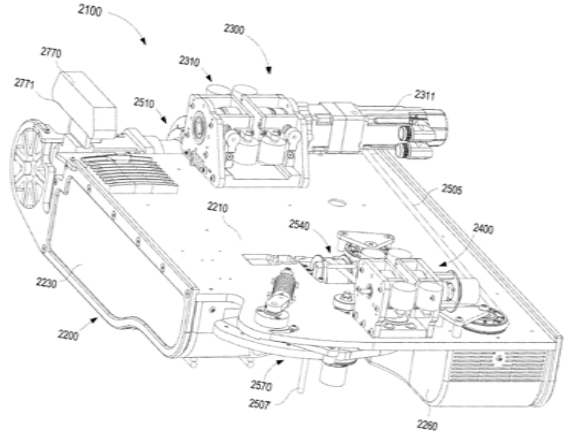


FIG. 4

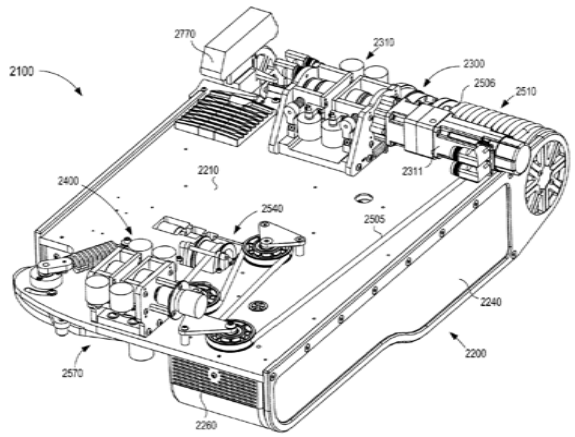


FIG. 5

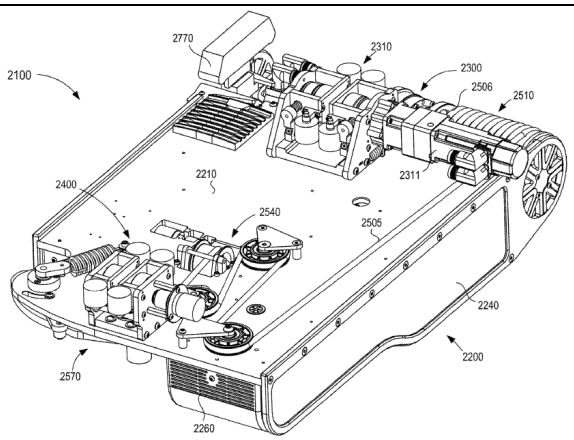


FIG. 5

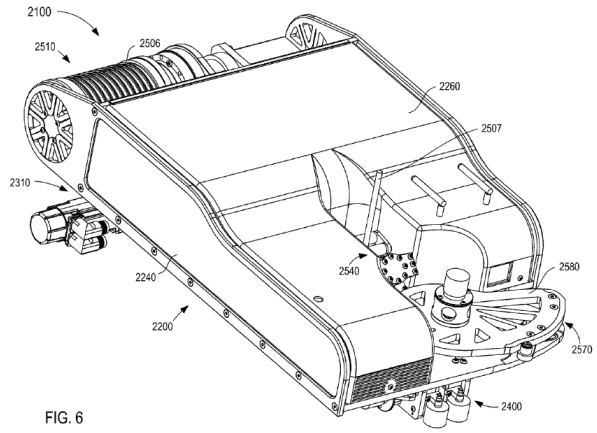


FIG. 6

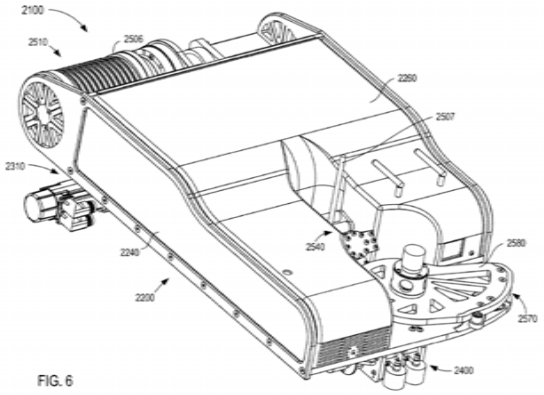


FIG. 6

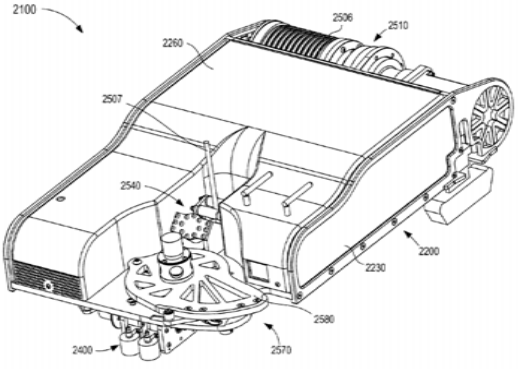


FIG. 7

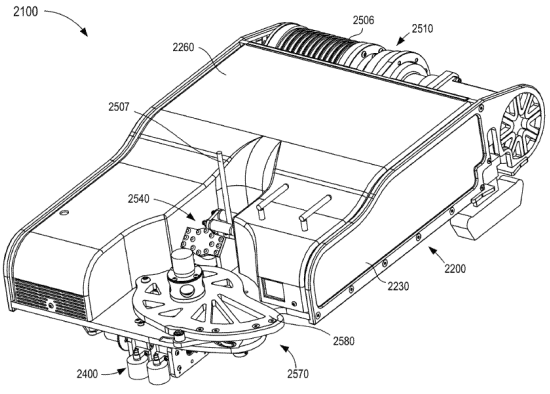


FIG. 7

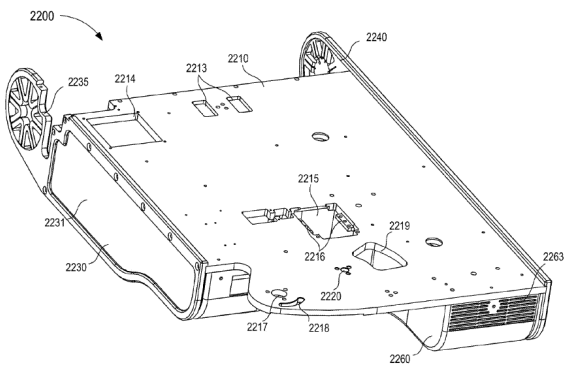


FIG. 8

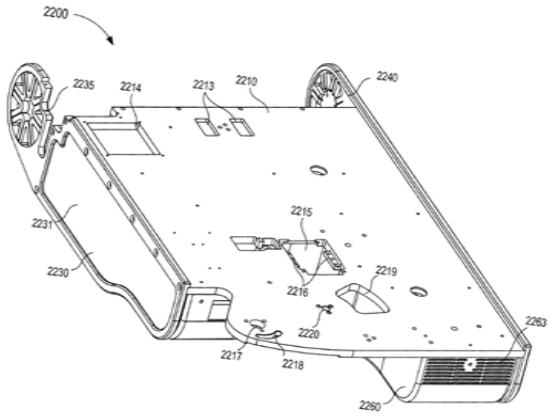


FIG. 8

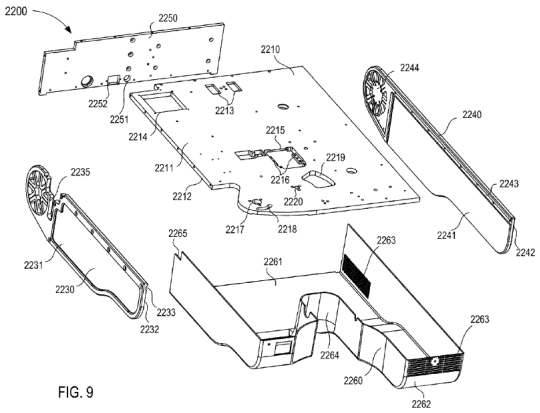


FIG. 9

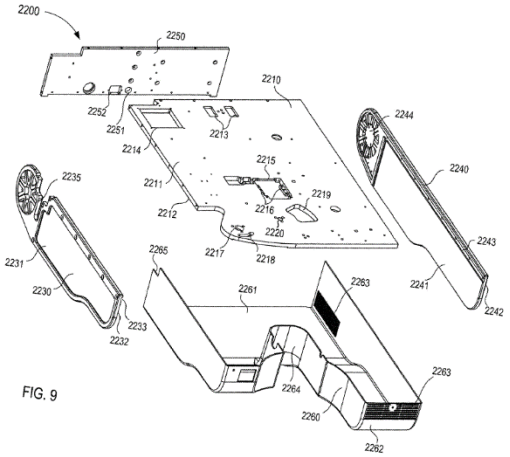


FIG. 9

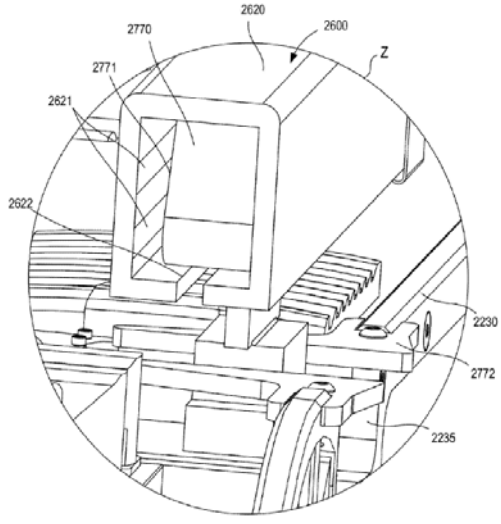


FIG. 10

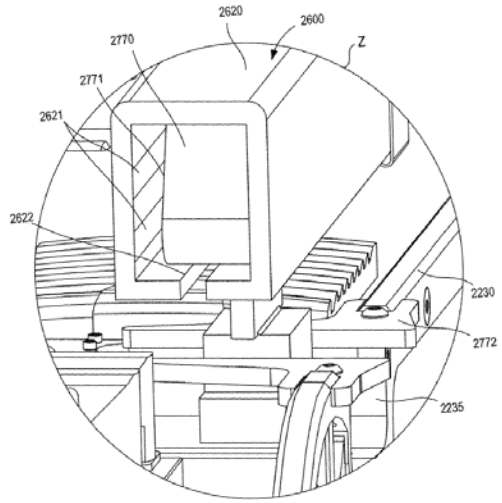


FIG. 10

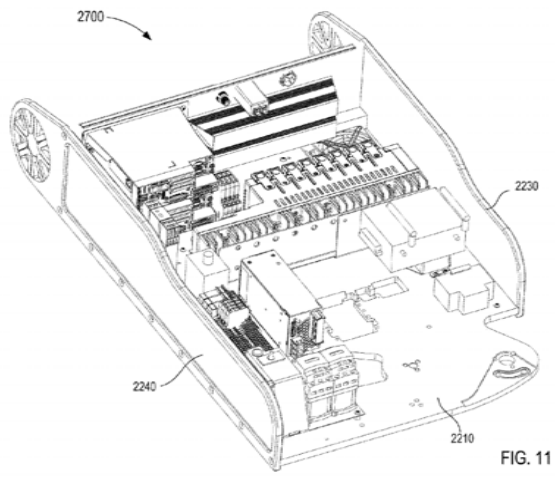


FIG. 11

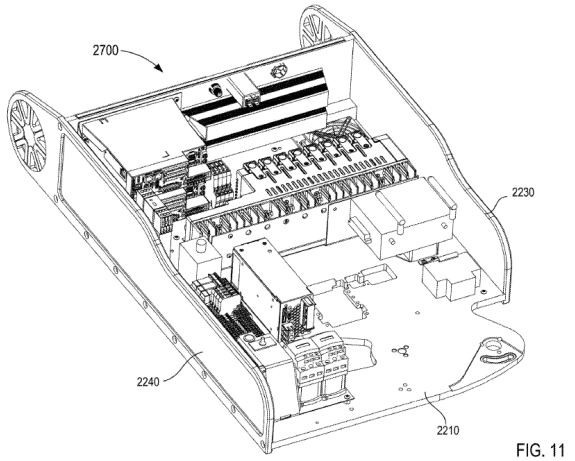


FIG. 11

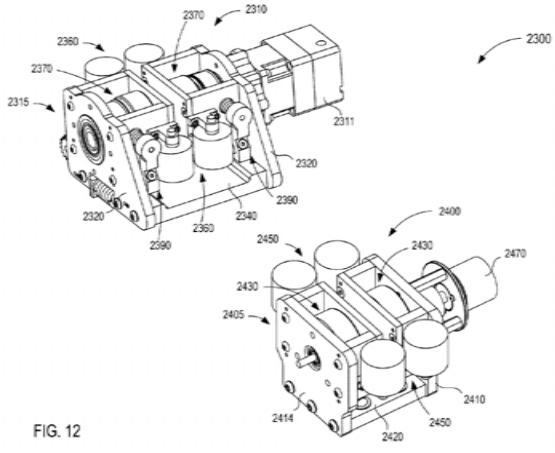


FIG. 12

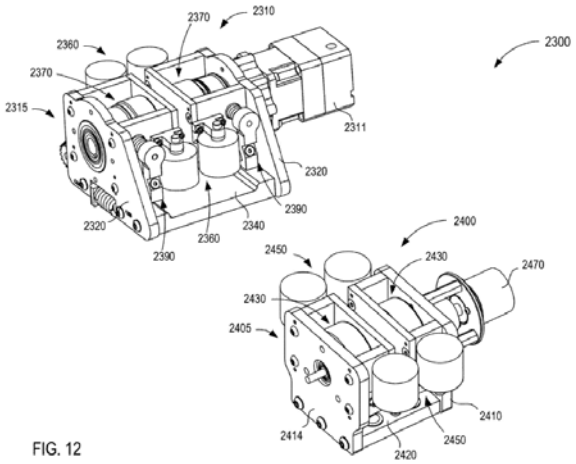


FIG. 12

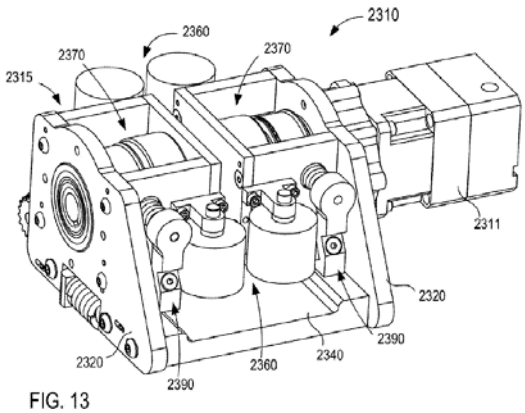


FIG. 13

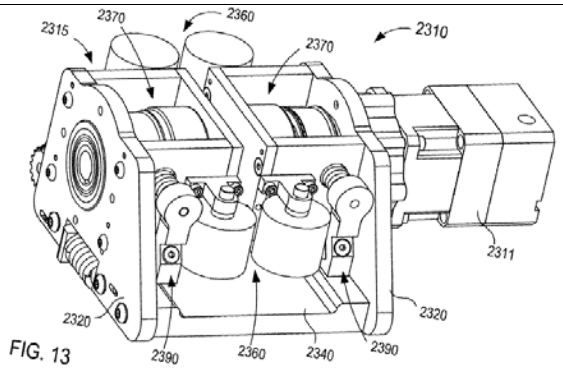


FIG. 13

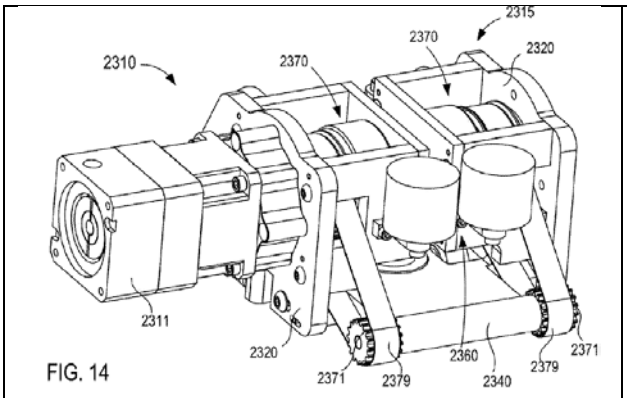


FIG. 14

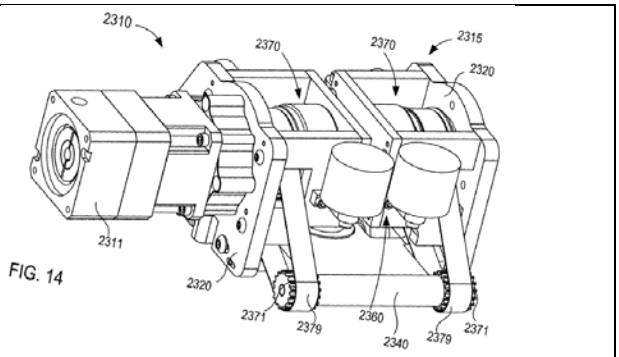


FIG. 14

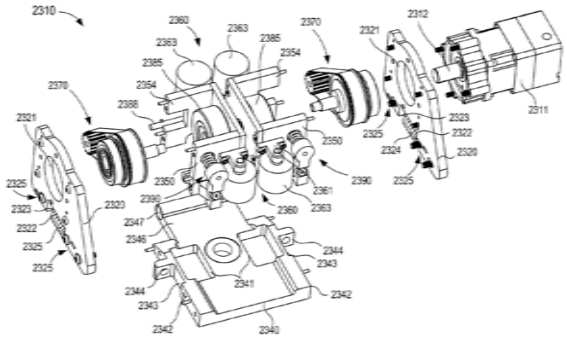


FIG. 15

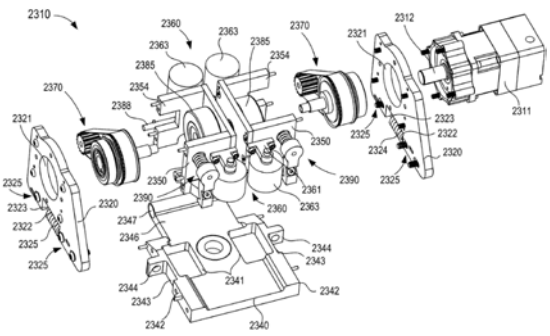


FIG. 15

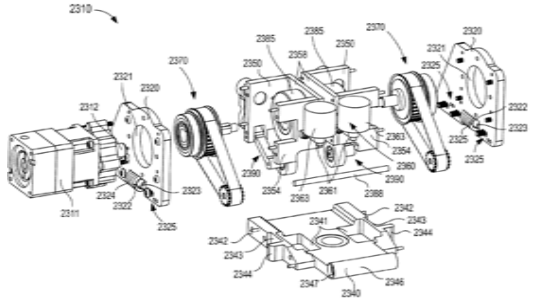


FIG. 16

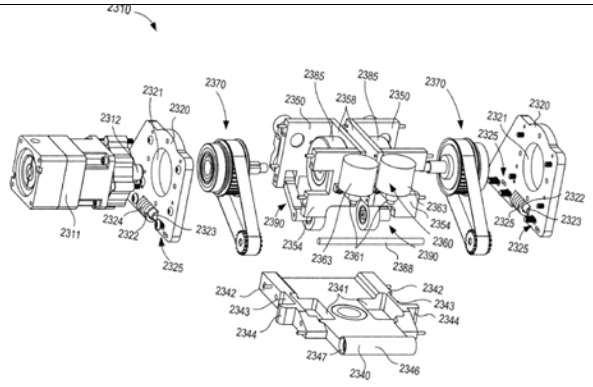


FIG. 16

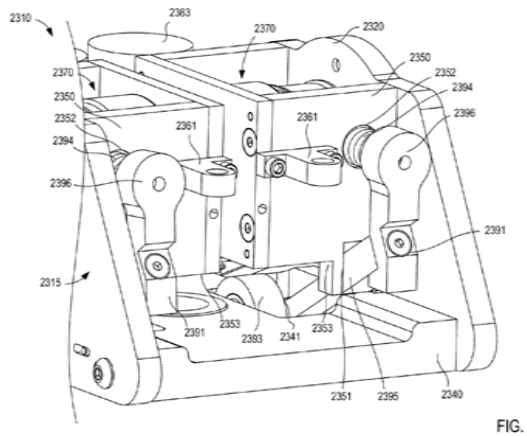


FIG. 22

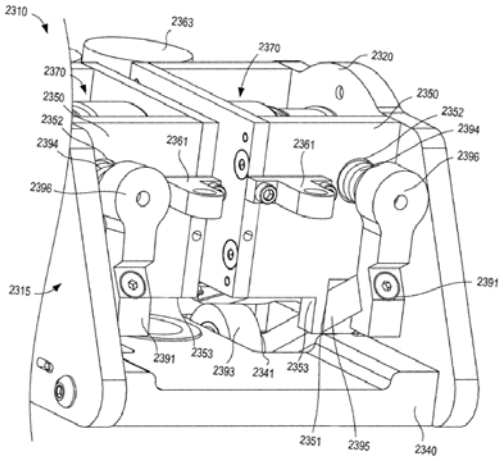


FIG. 22

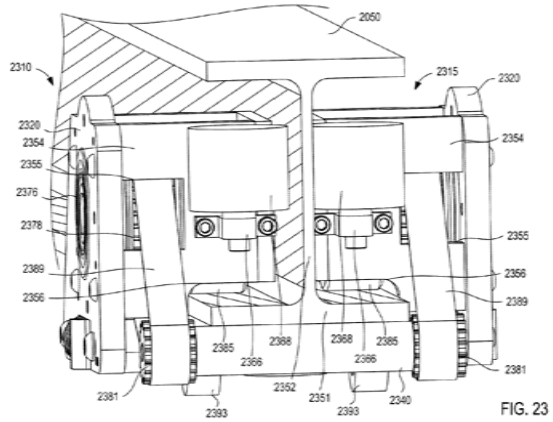


FIG. 23

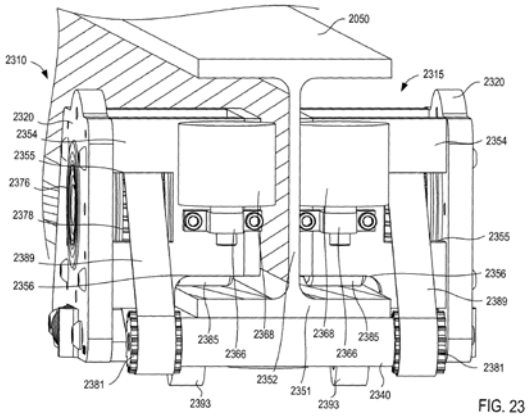


FIG. 23

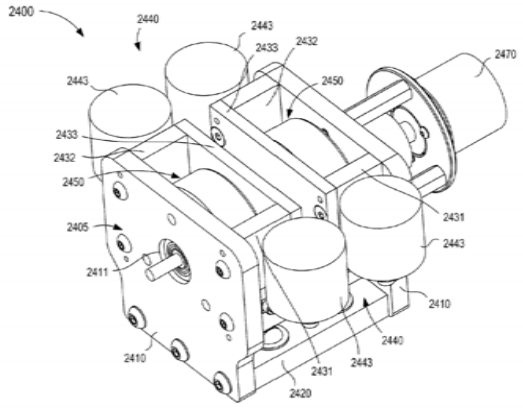


FIG. 24

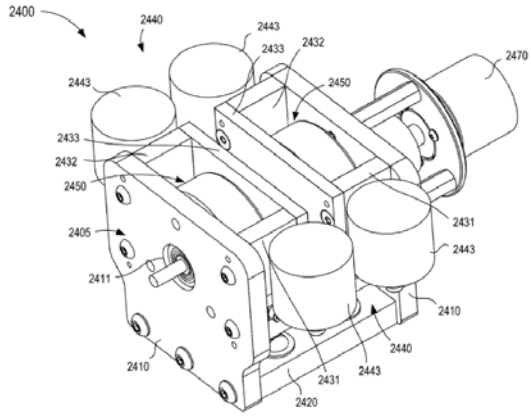


FIG. 24

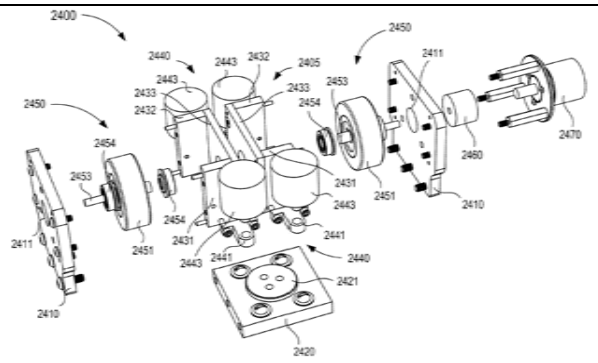


FIG. 25

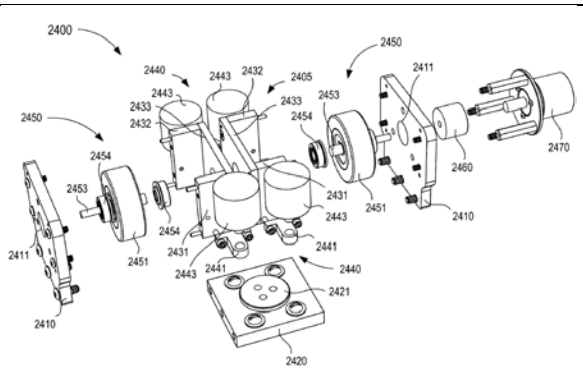


FIG. 25

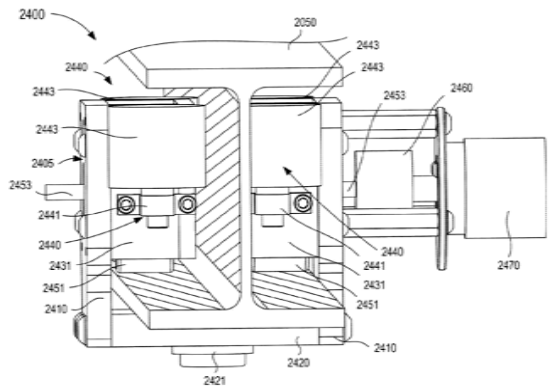


FIG. 26

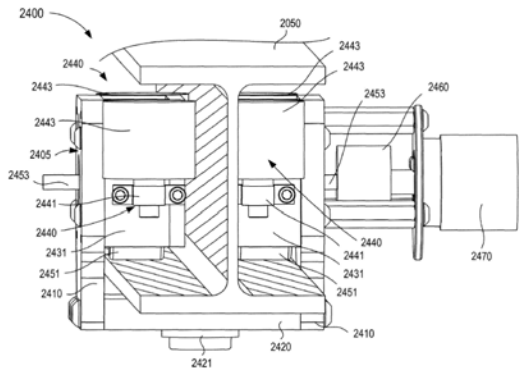


FIG. 26

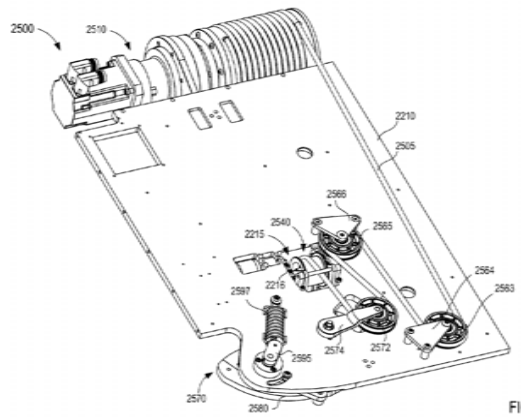


FIG. 27

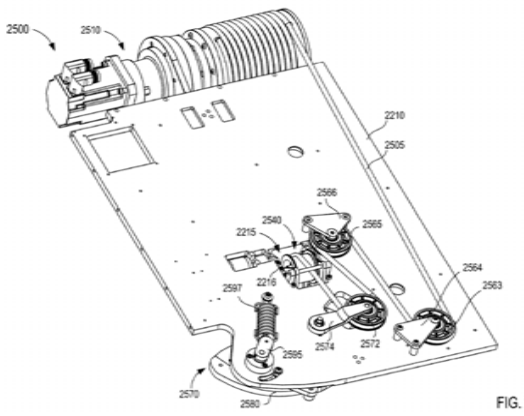


FIG. 27

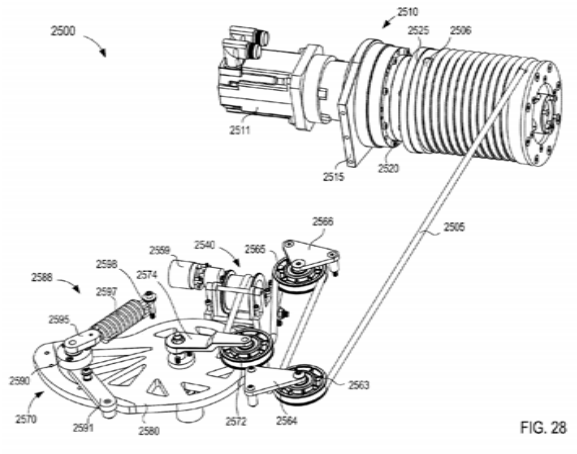


FIG. 28

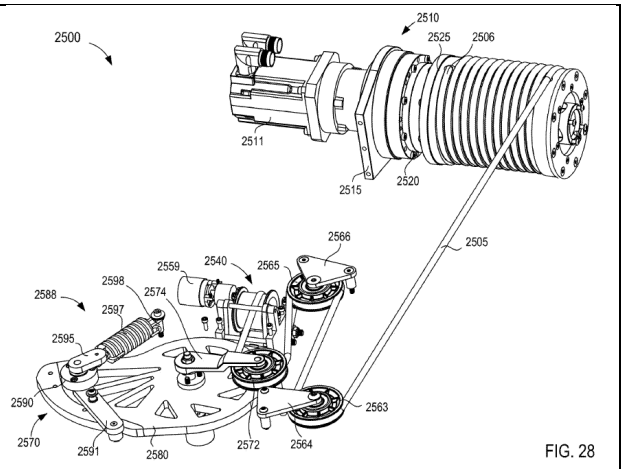


FIG. 28

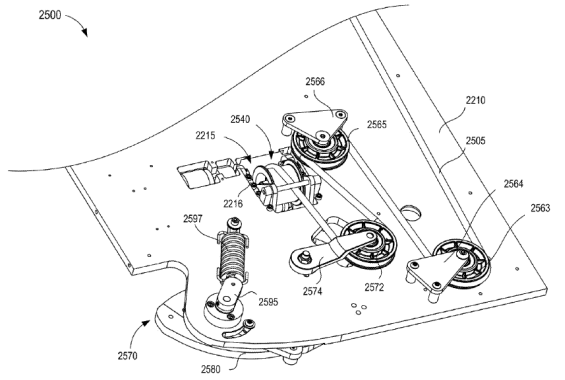


FIG. 32

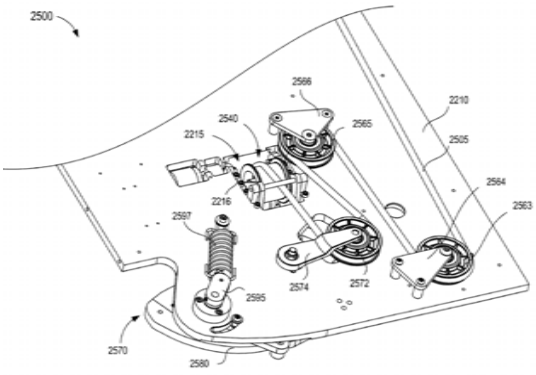


FIG. 32

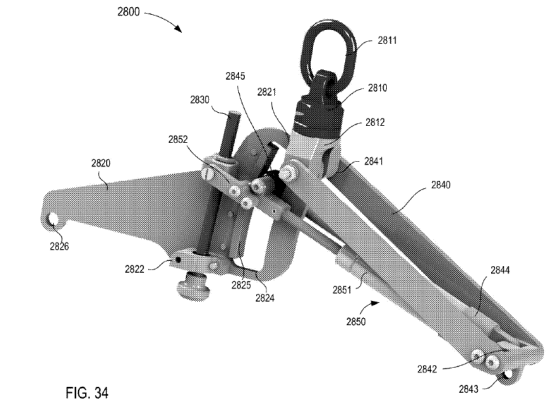


FIG. 34

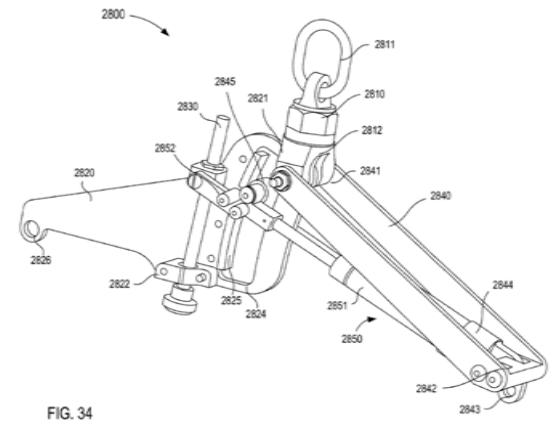


FIG. 34

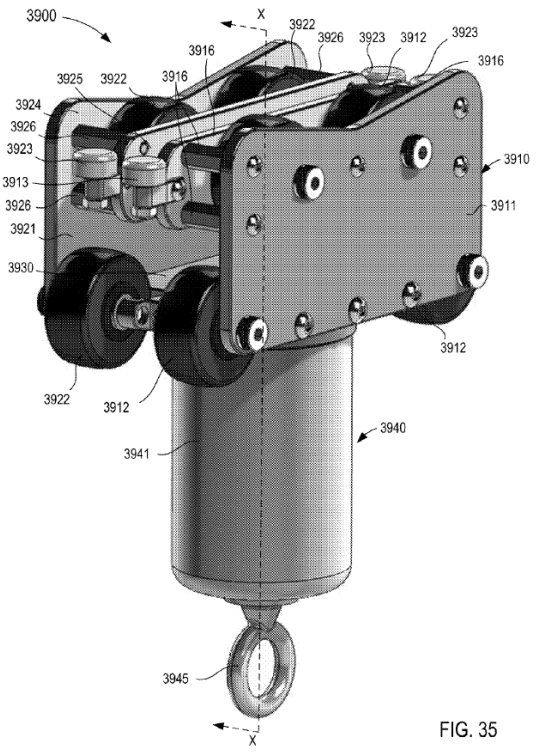

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FIG. 35

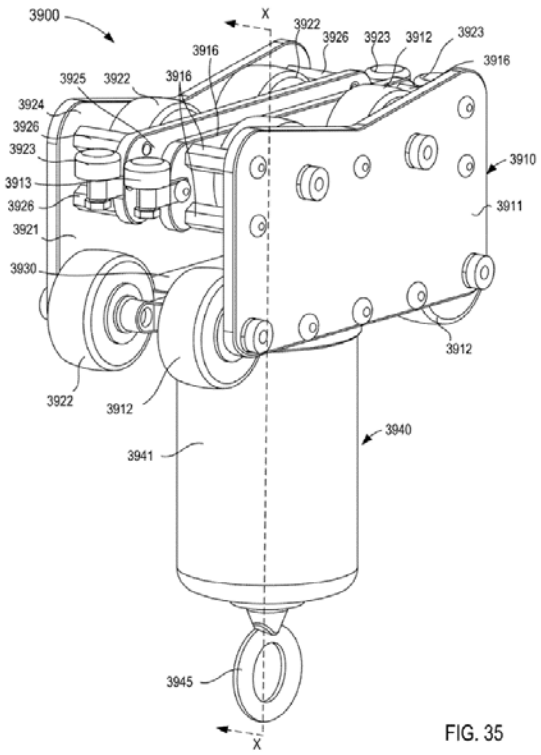

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FIG. 35

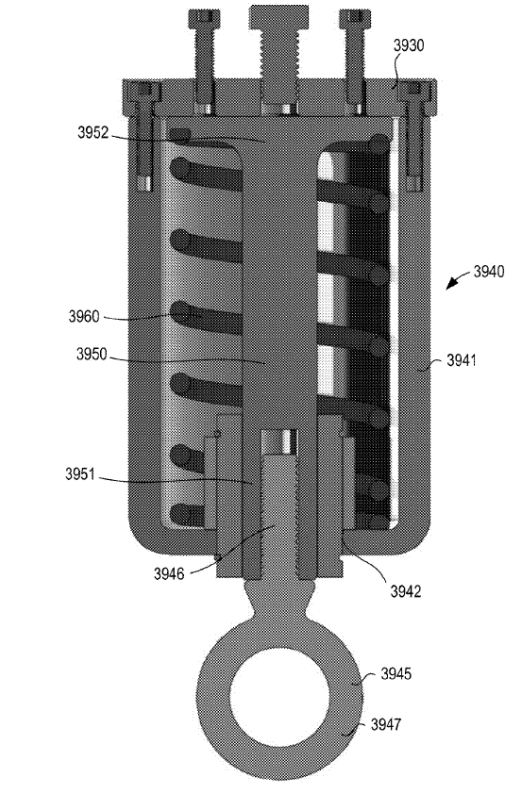


FIG. 36

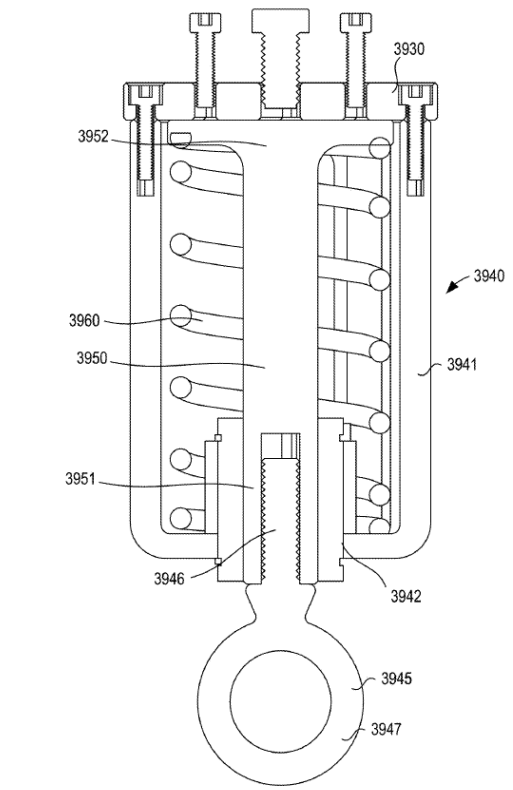


FIG. 36

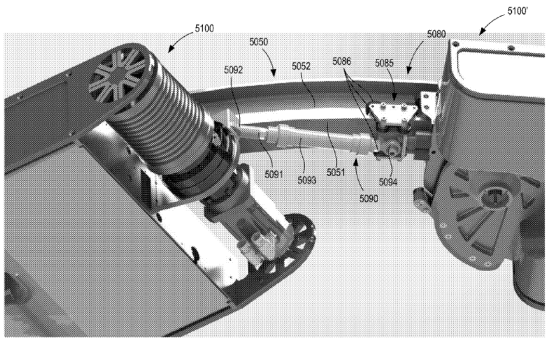


FIG. 38

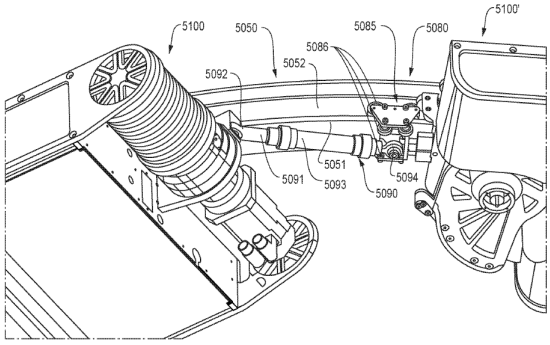


FIG. 38

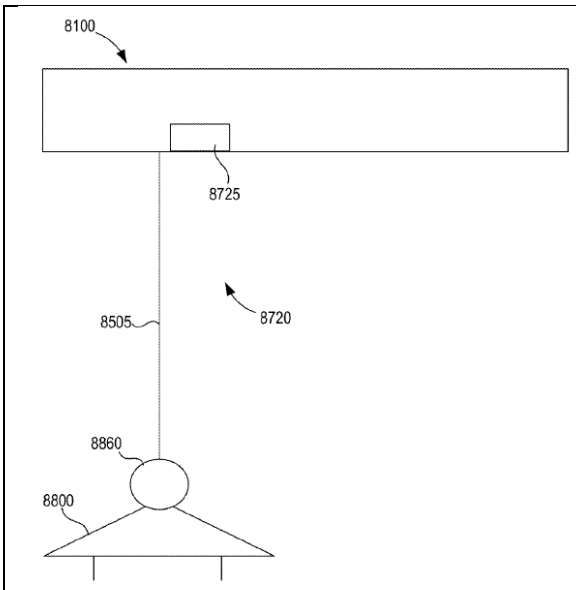


FIG. 45

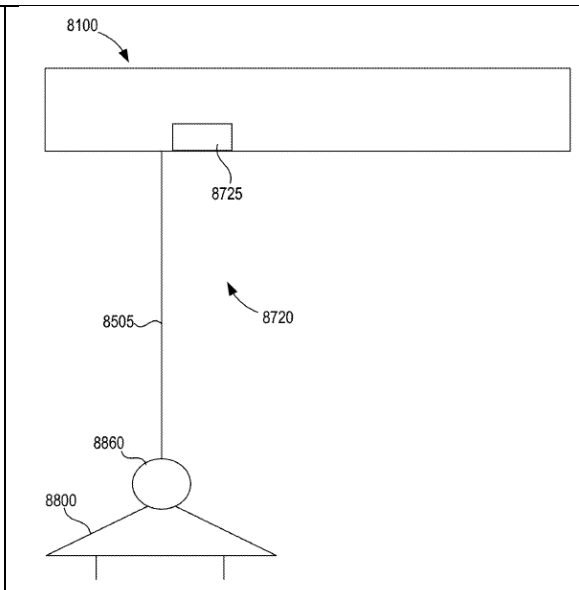


FIG. 45

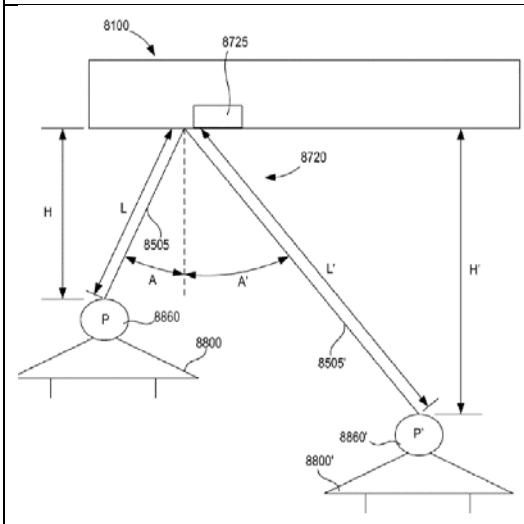


FIG. 47

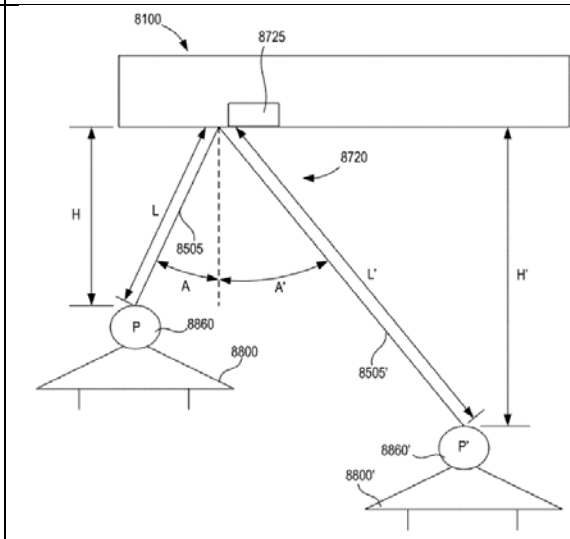


FIG. 47

64. In my opinion Erturk addresses the problems in the art with a system that is substantially similar – in both structure and function – to the systems and methods described in

the ’316 patent. Indeed, it is my opinion that Erturk contains teachings of the very same features that the Examiner erroneously found were unique to the ’316 patent, and, during prosecution, erroneously found were missing from the prior art (i.e., the overhead trolley tracking feature). For example, Erturk teaches a “tracking system” that maintains the trolley “substantially over-head of the patient” to reduce “drag” on the patient just like the ’316 patent (i.e., Overhead Trolley Tracking). *Compare* Ex-1009, [0149] (“configured to remain substantially over-head of the patient”) *with* Ex-1001, Claim 1 (“configured to … maintain the body weight support system in a substantially overhead position relative to the user …”), Claim 7 (“maintaining the body weight support system in a substantially overhead position relative to the user”); *see also* Ex-1009, [0051], [0181]-[0185].

65. Erturk also addresses problems in the art arising from “static unloading” by incorporating “dynamic unloading” into its BWS system, just as described in the ‘316 patent (i.e., Dynamic Unloading). *Compare* Ex-1009, [0053] (“The patient support assembly is coupled to the trolley and is configured to dynamically support a body weight of a patient”) *with* Ex-1001, 8:29-31 (“The patient support assembly is coupled to the trolley and is configured to dynamically support a body weight of a patient”); 63:2 (an amount or level of dynamic unloading).

66. In my opinion, at least in view of the above, Erturk discloses solutions to the aforementioned problems in the art much like the methods claimed in the 316 patent.

B. Vector Guide

67. I understand that Vector is prior art to the ’316 patent under 35 U.S.C. §102(a)(1) because it was published and publicly available more than one year before the Critical Date. Based on my review, it is my opinion that there are several ways that a POSITA exercising reasonable diligence could have located Vector more than a year before the Critical Date.

68. For example, I understand that Vector was prepared by Patent Owner and provided to customers who purchased the Vector Elite BWS system at least as of April 10, 2014. Based on my review of materials I viewed on the USPTO's website, I understand that one Keith McBride signed and submitted a declaration to the USPTO in which he swore, as of at least April 10, 2014, that the Vector Guide was "delivered with Applicant's product." Ex-1022, 2. I understand that Keith McBride submitted this declaration to the USPTO with a "specimen" to evidence that Patent Owner's VECTOR GAIT AND SAFETY SYSTEM trademark (Ser. No. 85822129) was being used in commerce. *Id*. The "specimen" that Keith McBride submitted included "select pages" from Vector. Based on my review, the "select pages" that Keith McBride submitted included several pages from Vector. Among other things, the "specimen" included the first page, the table of contents, and the last page of Vector. *See* Ex-1023; *compare* Ex-1010 *with* Ex-1023. Based on my review, I understand that the documents bear the same content, the same Document ID Number of "612-00624-001", the same Table of Contents/page numbering, the same revision number of "Rev. B," and the same date of "09/2013". *Id*.

69. Based on my review, I also understand that the Vector Elite system was advertised and sold prior to the Critical Date, with the advertisements invariably directing viewers to Patent Owner's websites where Vector could be downloaded. *See* https://www.youtube.com/watch?v =1OWXwpaq9U4 (showing that on September 14, 2015—more than one year prior to the Critical Date—the Patent Owner uploaded a video describing the Vector Elite product to YouTube and highlighting various websites, bioness.com, bionesstherapy.com, bionessvector.com, where an interested POSITA would have navigated more information on the Vector Gait & Safety System Based on my review, and as explained in more detail below in ¶70, Vector was available for download for free by the public, through

Patent Owner's website, at least as early as June 6, 2015. *See* Ex-1015, Ex-1025, Ex-1027, Ex-1038.

70. Moreover, a POSITA exercising reasonable diligence would have been able to locate Vector on Patent Owner's website because a POSITA would have known that Patent Owner was one of a small number of companies that manufactured overhead BWS systems. In my opinion, a POSITA would have known that Patent Owner's website (www.bioness.com) was a likely location to obtain materials concerning such systems. Once at the website, a POSITA would navigate the various pages and, in the process, would have discovered a page where he/she could download Vector for free. Although there are many different possible navigation paths, in one example POSITA could have easily navigated to Vector in just three clicks from the bioness.com home page. *See, e.g.*, Ex-1025 (showing an example navigation path that a POSITA could and would have pursued in the 2014-2015 timeframe). As I depict in Ex-2025, from the bioness.com home page, a POSITA could simply select the "For Healthcare Professionals" tab (**First Click**) then at the next page hover over the "Vector Gait & Safety System" tab to reveal a "Resources" link. After clicking the "Resources" link (**Second Click**), the POSITA would be presented with a page with several additional links to "Downloadable Materials and Support to Help You Get the Most From the Vector Gait and Safety System." Ex-1025, 3. The links are labeled "Vector Elite Clinician Guide," "Vector Base Clinician Guide," and "Vector Product Brochure." *Id.* A POSITA would have selected the "Vector Elite Clinician Guide" link (**Third Click**), as well as the other links, and would have arrived at the downloadable version of the Vector manual that I rely upon in this declaration. *See, e.g.*, Ex-1025 (an example navigation path); Ex-1015; Ex-1038, 1, 18-74.

71. In addition to the above, in my opinion a POSITA would have been able to locate Vector on Bioness's website using a search engine, such as Google, and employing basic search terms. For example, in February 2014, entering "body weight support system" (a commonly used term for such systems) into a Google search field resulted in an auto-populated list of suggestions, including the "vector body weight support system." *See* Ex-1024; Ex-1038.

72. Moreover, in my opinion a POSITA also would have been led to Vector by searching – at any point after September 14, 2015 – BWS systems on YouTube using YouTube's well-known searching functionality. Ex-1037. *See* https://www.youtube.com/watch?v=1OWXwpaq9U4 (showing Patent Owner's advertisement video directing viewers to visit bioness.com, bionesstherapy.com and bionessvector.com for more information on its "Vector" BWS system). Once at the Patent Owner's website, the POSITA could and would have located Vector using reasonable diligence, including as noted above.

73. Confirming the above, I reviewed additional materials that illustrate that ordinary artisans did, in fact, locate and cite Vector through the Patent Owner's website, including more than one year before the Critical Date. For example, a Master's thesis submitted to Aalto University in Finland on August 18, 2014 cites and copies images from Vector. Ex-1020, 6 (copying a Figure from Vector), Ex-1020 (citing the same version of Vector I applied in Section VII, below); Ex-1038.

74. In view of the foregoing, Vector was available to the public as required under §102(a)(1).

75. It is also my opinion that Vector is analogous to the '316 patent. Based on the Title, system parameters, and descriptions, Vector can be described as an operating manual designed to instruct clinicians on how to use the Patent Owner's Vector Elite "body weight

support system." Vector provides an image of the body weight support system it is describing, shown below. Ex-1010, 1-2.

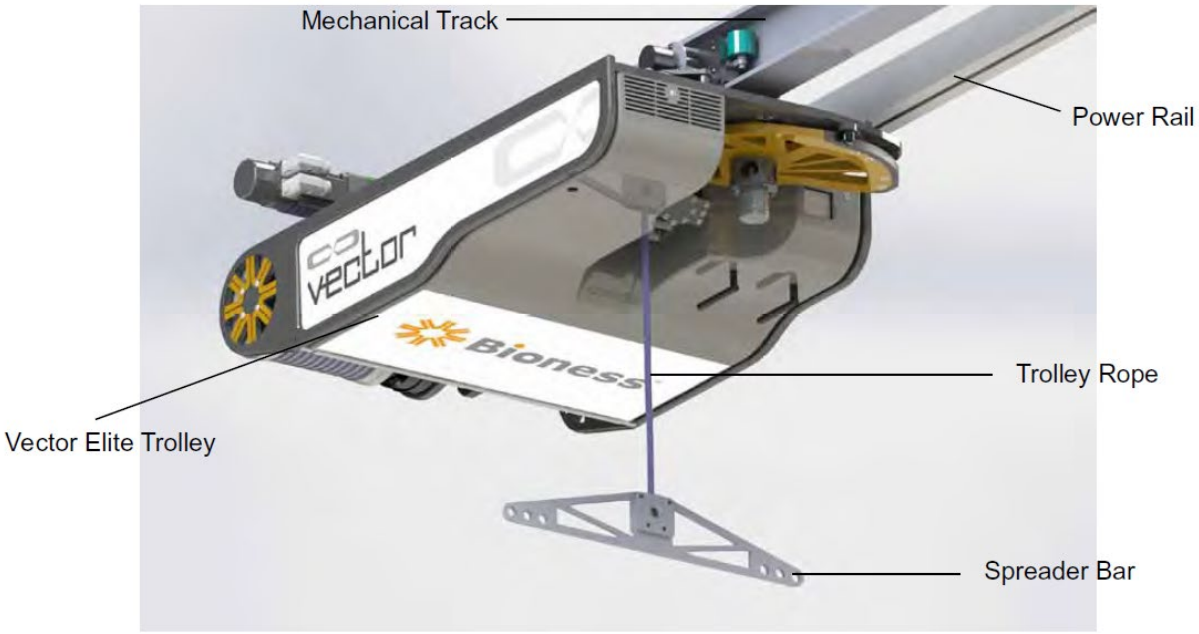


Figure 1-1: Vector Elite Trolley

76. Vector represents the Vector Elite system as "consist[ing] of a mechanical track, power rail, power station, motorized trolley with rope, spreader bar, PC computer with proprietary software and an optional remote control." Ex-1010, 1. The "rope" (tether) is connected to a "spreader bar" that "provides three attachment points to attach to a patient harness." Ex-1010, 15. Vector also provides an image of its "spreader bar" and an example "patient harness." When properly coupled together and fitted to a patient, the Vector Elite Trolley, the Trolley Rope and Spreader Bar are designed to support all or a portion of the

patient's weight during gait training. Ex-1010, 6.

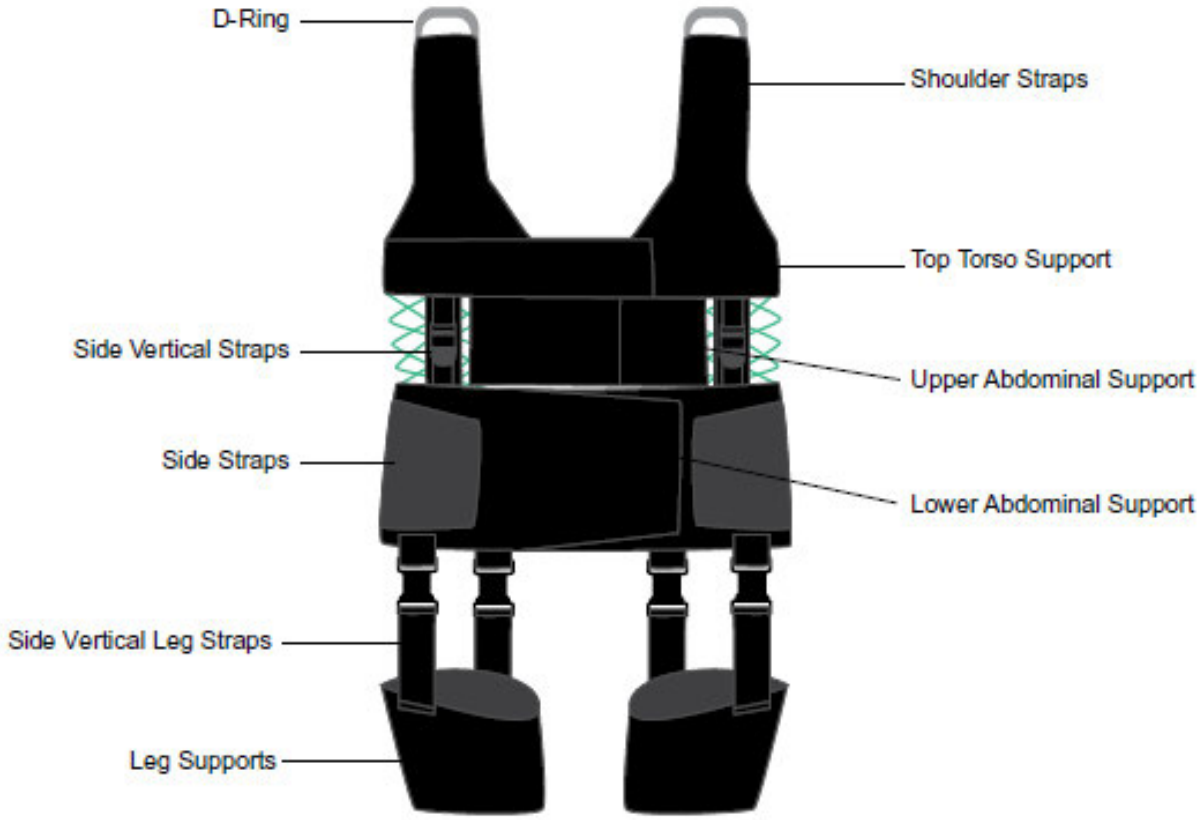


Figure 3-1: Maine Anti-Gravity Systems Patient Harness Features.

Ex-1010, 6.

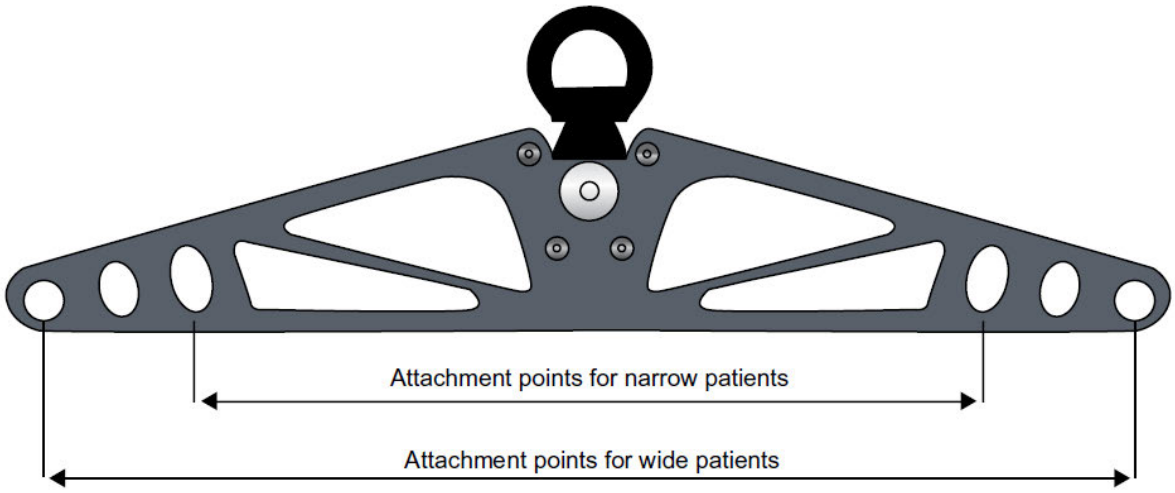


Figure 5-5: Spreader Bar attachment points

Ex-1010, 6.

77. Based on my review, Vector teaches that the Vector Elite System comes equipped with a series of "Training Controls" including "Trolley Tracking" (related to the feature I refer to above as Overhead Trolley Tracking via an Overhead Support Track, *see supra* ¶21) "Dynamic Body Weight Support (DBWS)" (related to the feature I refer to above as Dynamic Unloading, *see supra* ¶21) and "Fall Limit" and responsive "lock[ing]" of the tether to provide fall support (related to the feature I refer to above as the Fall Detection and Prevention, *see supra* ¶21). Ex-1010, 16-18. Vector also teaches that the Vector Elite System comes with the ability to gather and display data associated with the gait training session and system status information on the screen of a PC computer (related to the feature I refer to above as Monitoring and Display, *see supra* ¶21). Ex-1010, 1, 7, 17-19. These teachings are of particular relevance to the Challenged Claims. Each of these features is detailed further below.

Overhead Trolley Tracking

78. Vector discloses a trolley tracking feature that uses a "computer controlled motor" to "keep[] the trolley at a desired location relative to the patient." Ex-1010, 1, 16. Vector explains that when "[t]he default setting for the trolley position is 'normal', the trolley will remain directly above the patient during a training session." *Id*., 16.

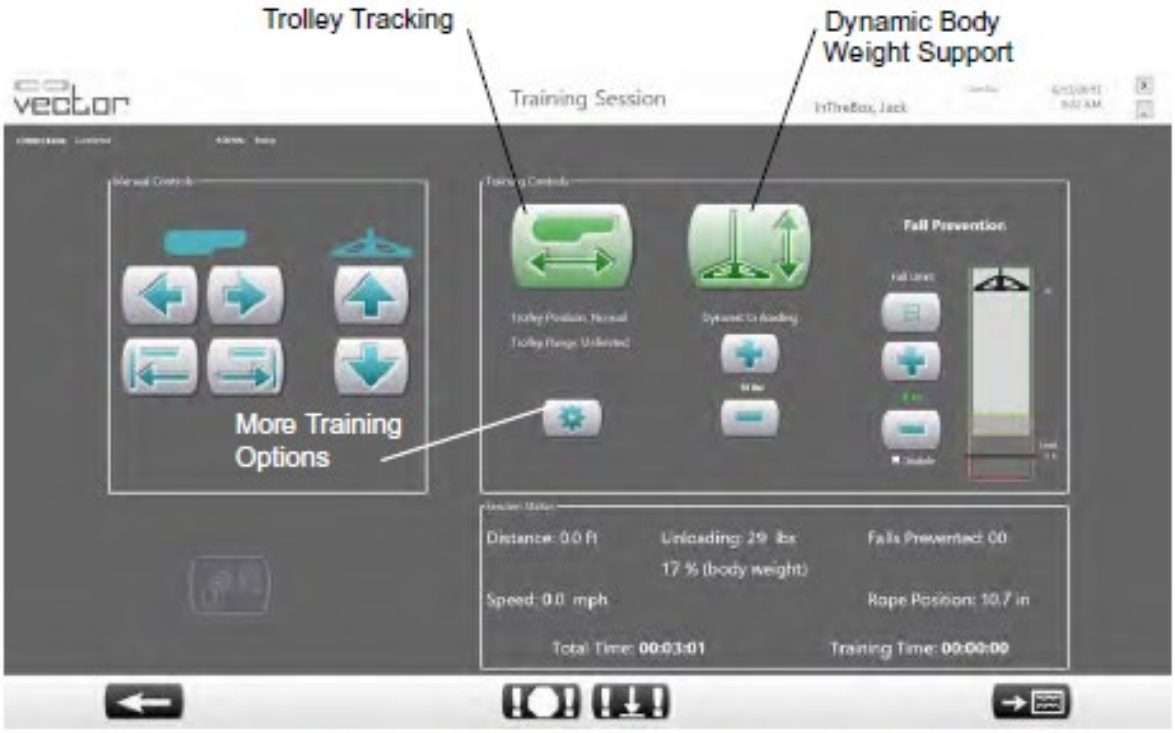


Figure 5-6: Training Session Screen with Training Controls Section Activated

Id., 16.

79. Based on the disclosures in Vector, the status of the trolley tracking feature can be viewed, engaged, and changed in connection with the trolley tracking icon shown above, which is shown more clearly in the image below.



Trolley Tracking

When activated the Trolley Tracking feature keeps the trolley at a desired location relative to the patient. The default setting for the trolley position is "normal", the trolley will remain directly above the patient during a training session. The default setting for the trolley range is "unlimited", the trolley will run along the entire length of track.

To change the settings press on the More Training Options button, this will open a new window. The More Training Options window allows the user to change the trolley position and range. See Figure 5-7.

Trolley Position: (this setting determines the target rope angle)

Normal – this setting will adjust the trolley position so it remains directly above the patient while the patient moves.

Posterior – this setting will adjust the trolley position so it remains slightly behind the patient while the patient moves.

Id., 16.

Dynamic Body Weight Support (DBWS)

80. Vector discloses a Dynamic Body Weight Support (DBWS) feature which, "[w]hen activated … keeps the rope tension at a desired value." Ex-1010, 17. Vector explains that, "[a]s the patient moves the trolley will make adjustments to the rope to keep the dynamic unloading at the desired value," which by default is "10 lbs." *Id*. Based on my review, I understand that, ty using the Dynamic Unloading controls (shown in the image below), a clinician can make on-the-fly adjustments to the DBWS settings for a given patient or a given exercise.



Dynamic Unloading

The default dynamic unloading setting is 10 lbs (4.5 kg). Dynamic unloading can be adjusted between 10 lbs (4.5 kg) to 200 lbs (90.7 kg). To change the setting use the plus or minus button and the change will appear in the text between the buttons.

Ex-1010, 17.

Fall Limit

81. Vector discloses a Fall Limit as "a safety feature that prevents the patient from falling." Ex-1010, 18. Vector explains that "[t]he programmed fall limit value is the amount of

descent that the patient can travel before the system locks the rope winch, deactivates trolley tracking (if enabled) and detects a fall." *Id*. Vector explains how a clinician can adjust the "Fall Limit" value from "4.0 inches" all the way up to "36 inches." *Id*., 18. Based on my review, I understand that by using the "+" and "-" Fall Limit controls (shown in the image below), the clinician can make adjustments as needed for a given patient and/or for a given exercise.



Fall Limit

The Fall Limit is a safety feature that prevents the patient from falling. The programmed fall limit value is the amount of descent that the patient can travel before the system locks the rope winch, deactivates trolley tracking (if enabled) and detects a fall.

The default Fall Limit setting is 4.0 inches (10.1 cm). The Fall Limit setting can be adjusted from 4.0 inches (10.1 cm) to 36 inches (91.4 cm), depending on the training activity. To adjust the setting, use the plus and minus buttons to increase the Fall Limit in increments of 1 inch (2.5 cm) and click on the Save button. The revised setting will appear in the text between the buttons. Make sure the Fall Limit value is in green color. If not, click on the Save button to ensure that the fall limit value has been set properly.

Id., 18.

82. In addition to the Training Controls, Vector also discloses various "window[s]" that provide graphical user interfaces on a computer display that a clinician can view and interact with (e.g., via a "PC Computer"). *Id*., 17-19. These interfaces display a variety of information, including information about the training session (e.g., total time elapsed during a given session, training time, etc.), information about the Vector Elite System (e.g., status, unloading setting, rope position, etc.), and many other types of information. *See*, *e.g.*, *id*., 19 (Fig. 5-8), 20 (Fig. 5-9), 21 (Fig. 5-10), 22 (Fig. 5-11), 23 (Fig. 5-12), 35 (Fig. 7-5).

83. In my opinion, based at least on the above, Vector is directed to BWS systems used during gait therapy training, and is from the same field of endeavor as the '316 patent (gait therapy systems). It is also reasonably pertinent to the problems addressed by the alleged invention, including the trolley tracking and fall prevention features reflected in the Challenged Claims. For example, Vector teaches a trolley tracking feature that keeps the trolley "directly

above the patient during a training session." *Id*., 16. Vector further teaches providing "dynamic" body weight support, not just "static" body weight support. *Id.*, 17-18. Vector further teaches a "fall limit" feature ("a safety feature that prevents the patient from falling") that detects when a patient is falling based on the length of the rope tether and adjusts the body weight support accordingly. Ex-1010, p.18. Indeed, in my opinion the Vector Elite system discussed in Vector appears to be the Patent Owner's commercial embodiment of the system described in the Patent Owner's '316 patent.

84. For at least the foregoing reasons, in my opinion, Vector is analogous prior art to the '316 patent.

85. Further, based on my review, Vector was not submitted or cited during examination of the '316 patent, and was never considered by the patent office in determining patentability of the Challenged Claims during original prosecution.

C. Stockmaster

86. I have reviewed the Stockmaster reference (Ex-1011). Based on the face of the Stockmaster publication itself, I understand that Stockmaster is a publication of a patent filing submitted on February 3, 2016, and which published on September 8, 2016. Ex-1011. Stockmaster is entitled "Medical Rehab Body Weight Support System and Method With Horizontal and Vertical Force Sensing and Motion Control." Ex-1011 (field 54).

87. Based on my review of the file history of the '316 patent, I understand that Stockmaster was identified in the Examiner's search for relevant prior art, but the Examiner did not consider it sufficient to apply it in a rejection of the claims. Based on my review of the file history of the '316 patent, the only reference made to Stockmaster was a single reference in the list of references identified by the Examiner on the PTO-892 form. Ex-1004, 220. I understand

that the Examiner did not otherwise cite or apply Stockmaster against the claims or discuss Stockmaster in any office action rejecting the claims of the ’316 patent.

88. I understand that Stockmaster is prior art to the ’316 patent under at least 35 U.S.C. § 102(a)(1) and (2) because Stockmaster was filed on February 3, 2016 and published on September 8, 2016, both more than one year before the filing date of the ‘316 patent (Feb. 14, 2018). Even if the ’316 patent is accorded the benefit of priority to its provisional application which was filed on February 14, 2017, I understand that Stockmaster is still prior art to the ’316 patent under at least pre-AIA § 102(a)(1) because it was filed on February 3, 2016, more than one year before February 14, 2017. *See* Ex-1011 (field 22).

89. In my opinion, Stockmaster is analogous prior art to the ’316 patent at least because it is directed to body weight support systems used to promote safe and effective gait therapy training. *See* Ex-1011, [0002]-[0004], [0010], [0316], [0329]-[0331]. In my opinion, Stockmaster is reasonably pertinent to the problems addressed by the alleged invention, including (1) overhead trolley tracking via drive system coupled with an overhead support track, (2) fall detection and prevention features (3) active/dynamic unloading, (4) monitoring and display of data associated with gait therapy, among others, each of which are features addressed by the ’316 patent.

90. For example, Stockmaster teaches how to “reliably control the horizontal position of the support along the track” in order to “mov[e] the moveable support unit horizontally along the track to follow the person, thus minimizing the effect on the person.” Ex-1011, [0008]-[0009], [0301]-[0303]; *see also id.* at [0318]. Stockmaster depicts the result of its overhead trolley tracking feature in Figure 1 (shown below), which, in my opinion, together with its

disclosures illustrates that its movable support (trolley) maintained in a substantially over-head position relative to the patient.

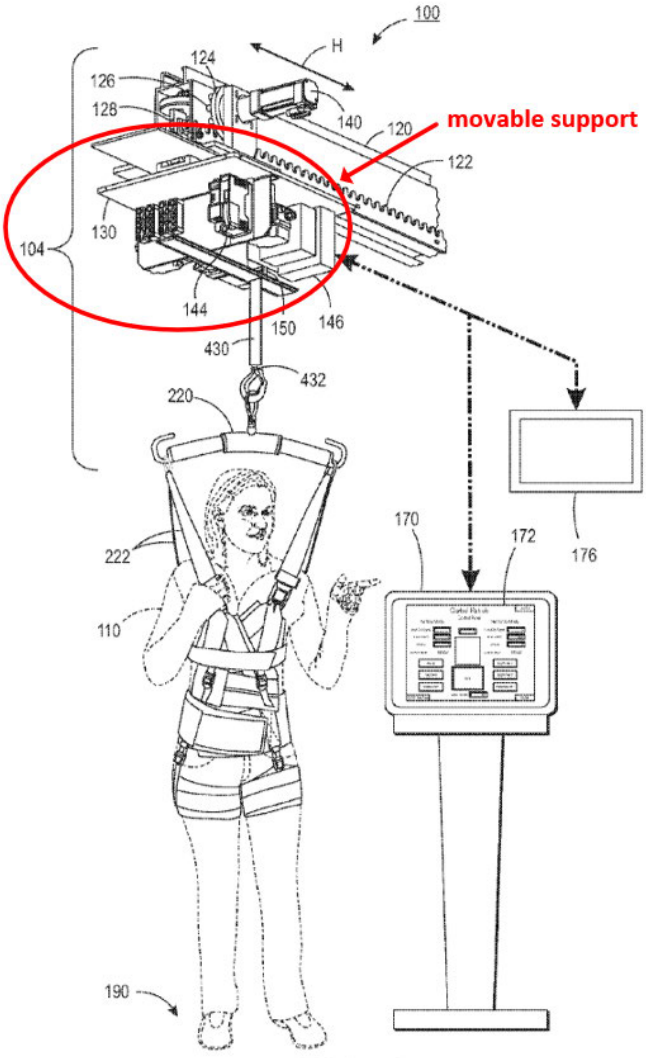


FIG. 1

See Ex-1011, Fig. 1 (annotation added to identify the general region where the movable support (e.g., trolley) is depicted).

91. In my opinion, Stockmaster teaches a "Dynamic Fall Protection" feature for detecting when a patient falls too far (past a preset "[d]escent [l]imit") and/or too fast (faster than a preset "speed … threshold"). Based on my review, its system is configured to react by

"inhibit[ing]" any "further vertical movement in the downward direction" when a fall is detected. Ex-1011, [0338]; see also id., [0339]-[0341]. In my opinion, Stockmaster also depicts a computer interface showing some example controls for its Dynamic Fall Protection feature in Figure 44 (shown below).

92. Its system is configured to react by "inhibit[ing]" any "further vertical movement in the downward direction" when a fall is detected. Ex-1011, [0338]; *see also id.*, [0339]-[0341]. Stockmaster's Figure 44 (shown below) depicts example controls for its Dynamic Fall Protection feature.

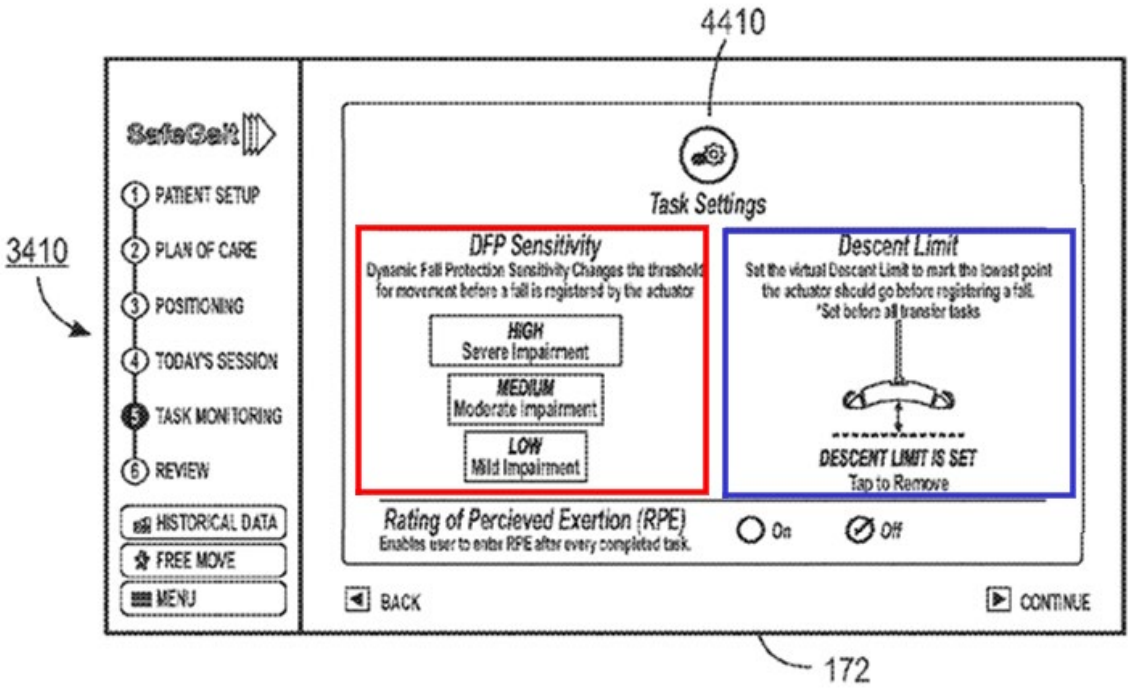


FIG. 44

Ex-1011, Fig. 44 (color-coded annotations added to identify features in Stockmaster's interface that are comparable to those in the '316 patent)

93. Based on my review, Stockmaster's "DFP Sensitivity" and "Descent Limit" features depicted in FIG. 44 of Stockmaster are substantially similar to the "Assistance" and "Fall Limit" features, respectively, shown in FIGS. 60 and 61 of the '316 patent:

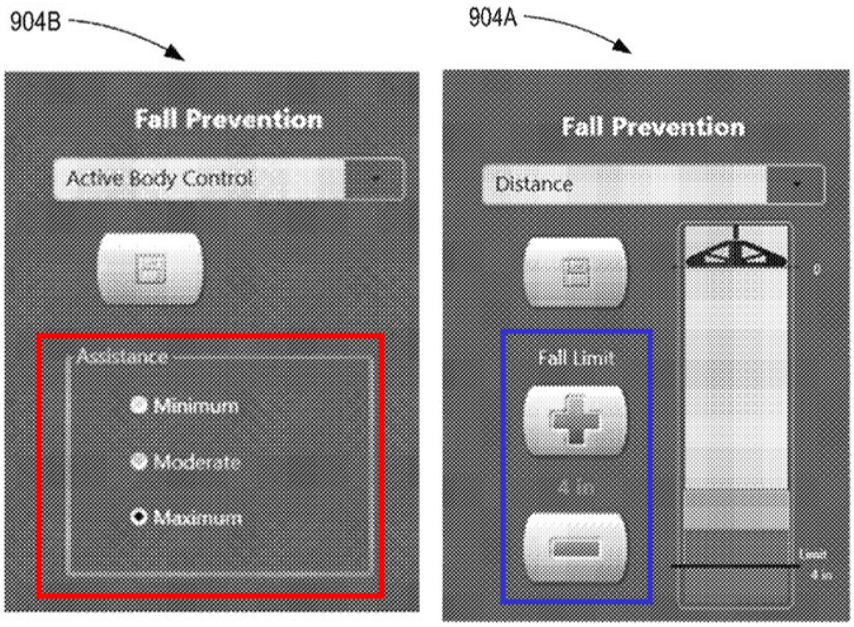


FIG. 61 FIG. 60

Ex-1001, Figs. 60-61 (color-coded annotations added to identify features in the '316 patent that are comparable to those in Stockmaster's interface (shown above)).

94. Based on my review of the file history of the '316 patent, Stockmaster was identified in the Examiner's search for relevant prior art and listed on form PTO-892. Ex-1004, 220. Other than the line item cite on form PTO-892, I understand that the Examiner never cite or apply Stockmaster against the claims of the '316 patent, nor did the Office ever discuss Stockmaster in any Office Action rejecting the claims of the '316 patent. In my opinion, to the extent the Examiner considered Stockmaster and dismissed the reference without substantively addressing its disclosures, that was erroneous, particularly in view of its direct teaching the limitations added by amendment during prosecution ("maintain[ing] the body weight support

system in a substantially overhead position relative to the user as the user moves relative to the surface") to move the claims to issuance, and which the Examiner appears to have understood to provide novelty to the claims (but did not).

D. Raanan

95. I have reviewed the Raanan reference (Ex-1012). Based on the face of the Raanan publication itself, I understand that Raanan is a publication of an international patent filing, bearing the title "Fall Detection Device and Method" submitted on September 16, 2015, and which published in English on March 24, 2016. Ex-1011.

96. Based on my review, I understand that Raanan was not cited or considered during prosecution of the '316 patent, based primarily on the fact that Raanan is not cited on the face of the patent, nor have I seen the reference discussed in the prosecution history of the '316 patent.

97. I understand that Raanan is prior art to the '316 patent under at least 35 U.S.C. § 102(a)(1) because Raanan was published in English on March 24, 2016, more than one year before the filing date of the '316 patent (Feb. 14, 2018). Even if the '316 patent is accorded the benefit of priority to its provisional application which was filed on February 14, 2017, I understand that Raanan is still prior art to the '316 patent under at least pre-AIA § 102(a)(1) because it was published in English on March 24, 2016, over 10 months before February 14, 2017. *See* Ex-1012 (field 43).

98. In my opinion, Raanan is analogous prior art to the '316 patent because, just like the '316 patent, it is directed toward fall prevention techniques that attempt to avoid injuries, particularly in the situation where vertical changes during exercise may be confused with a true fall event, and distinguishing between the two is desirable. That is, it teaches methods of detecting and preventing falls that are reasonably pertinent to problem addressed by the alleged invention of the '316 patent.

99. In my opinion, Raanan is analogous prior art to the ’316 patent because it teaches a method of detecting and preventing falls that is reasonably pertinent to the problem addressed by the alleged invention of the ’316 patent. For example, Raanan teaches the use of electronic devices (e.g. sensors) to measure, *inter alia*, a person’s velocity, acceleration, and distance relative to the floor for the purpose of detecting when a person falls while performing exercises or other activities. Ex-1012, Abstract.

100. Moreover, though not a BWS system specifically designed for gait therapy, is directed to an apparatus that can be worn by a worn around a person’s waist (similar to the harness of the BWS systems used in gait therapy), including during the performance of exercise tasks, and it is equipped to provide a safety feature for preventing injuries when a user falls while walking or otherwise moving about.

(54) Title: FALL DETECTION DEVICE AND METHOD

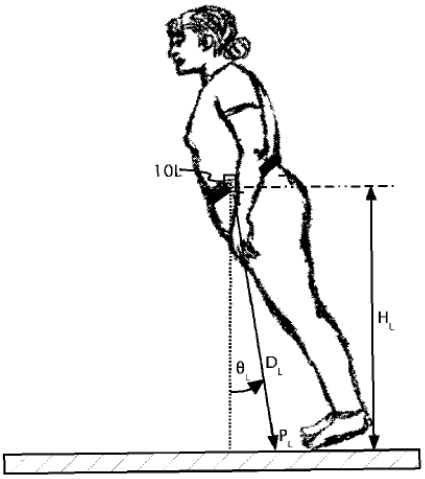


Fig. 2

(57) Abstract: Detection of a fall of a user wearing the device. A processor is configured to time sample and to input multiple values over time of: the acceleration vector, the angular velocity and the point-to-point distance. The processor is configured to determine over time the direction of gravity from the acceleration vector. The processor is configured to integrate over time the angular velocity to produce an orientation angle of the protection device relative to the direction of gravity. The processor, responsive to the point-to-point distance and the orientational angle, is configured to determine heights over time of the distance sensor from the ground. The processor is configured to indicate initiation of a potential fall event by a change in downward acceleration measured by the accelerometer or a rapid decrease in the determined heights of the distance sensor from the ground. The processor is configured, responsive to the point-to-point distance and the orientation angle, to determine at least one height before the initiation of the potential fall event and at least one height after the initiation of the potential fall event of the distance sensor from the ground.

Ex-1012, Fig. 2, Abstract, Title.

BACKGROUND

1. Technical Field

The present invention relates to a wearable device for performing fall detection.

2. Description of Related Art

Each year, millions of elderly people around the world especially women experience falls resulting in hip fractures mainly, femoral neck fractures. Hip fractures in the elderly result in physical suffering, loss of independence, a deteriorating mental state and high mortality rate.

US patent application publication, US20130312168 of the present Applicant, discloses an active hip protector system and method for hip fracture prevention including a belt-like pouch, worn over the user's waist, containing airbags which are inflated to a large size ensuring that the user's thighs will not hit the ground upon impact, once the system detects a fall. The pouch contains distance measurement sensors, acceleration and spatial orientation sensors. A pneumatic system, including the airbags, is carried within the pouch or in another location.

Ex-1012, 1:3-9.

101. As I explain further below in Section I.B, in my opinion a POSITA interested in fall prevention technologies that could be used in BWS systems would have been motivated to look to references dealing with human fall detection and prevention technologies more generally – including in other spaces that could be easily adapted for use in BWS systems – especially those like Raanan with details about how to distinguish falls from exercise patterns having relevance to gait therapy exercises.

102. Raanan also teaches that "a rapid" or "significant decrease in … height [of the user above the ground]" signals the "[i]nitiation of a potential fall event."[2] Ex-1012, 2:13-20,

[2] Raanan specifies that (1) "The term 'rapid in the context of 'rapid' decrease in heights refers to a decrease greater than 20% … over time period of 200 milliseconds or less," and (2) The term "initiation of potential fall event" as used herein refers to a measurement of "rapid" decrease in computed heights or a measurement of a change in acceleration in the downward direction." Ex-1012, 13:7-13.

3:9-4:24, 11:20-21. Then, to "verif[y]" it is "a real fall event," Raanan teaches that additional criteria should be observed to "eliminate false positive[s]." Ex-1012, 6:23-4:2. One of these validating criteria is "[c]ontinuity of velocity towards ground V_z" for a duration that makes the event "compar[able] to actual fall scenarios." Ex-1012, 12:7-17. Based on my review, Raanan teaches that if the "rapid" velocity lasts long enough that the user's activity is unlikely to just be an exercise movement, then the "fall event" is confirmed. In my opinion, by looking at two or more criteria, Raanan teaches that some fall scenarios can be identified with greater reliability and that "false positive detection rates and unnecessary activation of protective means" may be reduced. Ex-1012, 6:6-7:2.

103. Raanan also discloses the use of sensors to measure a person's velocity, acceleration, and distance to the floor, and that several data points should be considered with some degree of redundance in order to obtain the best results. Raanan states that "[t]he more height data points used prior to activation [of a fall protection measure,] the better is the reliability of determination of a true fall event and elimination of false positive events." Ex-1012, 6:26-28. In my opinion, Raanan's view about more data points providing the basis for a more reliable determination is a generally accepted conclusion when making determinations of this type.

104. Further, Raanan also discloses that "[a] change in measured acceleration A_z in the downward (−Z) direction" signals an "initiation of a potential fall event." Ex-1012, 6:28-30. This measurement can be followed by a "[v]erification of … the potential fall event with a real expectation of a completion of a fall may be performed by measuring distance to the floor or ground." Ex-1012, 6:30-31. The purpose of using this second criteria, again, is to confirm that a

fall is actually occurring – as opposed to an exercise that involves up and down movements "such as squats due to sudden distance changes to the floor and abrupt acceleration changes"– and to provide greater accuracy and helps avoid false positives. Ex-1012, 7:8-9.

V. LEVEL OF ORDINARY SKILL IN THE ART

105. In determining the characteristics of a hypothetical person of ordinary skill in the art of the '316 patent at the time of the claimed invention ("POSITA"),[3] I considered several things, including various prior art techniques relating to rehabilitative gait therapy systems, the type of problems that such techniques gave rise to, and the rapidity with which innovations were made. I also considered the sophistication of the technologies involved, and the educational background and experience of those actively working in the field at the time. I also considered the level of education that would be necessary to understand the '316 patent. Finally, I placed myself back in the relevant period of time and considered the engineers and scientists that I have worked with in the field of bioengineering, robotics, and rehabilitative technologies.

106. Based on the above, I came to the conclusion that a POSITA in the field of art of the '316 patent would have a bachelor's degree in biomedical engineering, electrical engineering, mechanical engineering, or similar field with at least two years of experience in research in, development of, or practice providing therapy using robotic medical devices/systems. A person

[3] I considered the level of ordinary skill in the art on February 14, 2017, the aforementioned Critical Date of the 316 patent. I understand that Petitioner is not aware of any claim by the Patent Owner that the '316 patent is entitled to an earlier priority date. Even so, in my opinion the level of skill for the POSITA would not change if the claims were entitled to a priority date up to at least one year earlier.

with less formal education but more relevant practical experience may also meet this standard. Similarly, a person with less relevant practical experience but more formal education may also meet this standard. Such a person would have been capable of understanding the '316 patent and the prior art references discussed herein. Based on my education, training, and professional experience in the field of the claimed invention, I am familiar with the level and abilities of a person of ordinary skill in the art at the time of the claimed invention. Additionally, I met at least these minimum qualifications to be a person having ordinary skill in the art as of the time of the claimed invention of the '316 Patent.

VI. CLAIM CONSTRUCTION[4]

107. For purposes of this declaration, I have considered the claim language, specification, and portions of the prosecution history, to determine the meaning of the claim language as it would have been understood by a person of ordinary skill in the art at the time of the invention. It is my understanding that the "plain and ordinary meaning" or *Phillips* standard is applied in district court litigation, where a claim term is given its plain and ordinary meaning in view of the specification from the view point of a person of ordinary skill in the art. I further understand that the *Phillips* standard applies to this *inter partes* review that was filed after November 13, 2018.

108. I have applied the *Phillips* standard in my analysis. Unless otherwise stated, I have applied the plain and ordinary meaning to claim terms. I have not formed and do not offer an opinion on the indefiniteness of any claims.

[4] Throughout Sections VI and VII, I denote the '316 patent's claim language in ***bold italics*** instead of within quotation marks, and the language from the prior art in quotation marks.

VII. INVALIDITY

109. Based on my review and analysis of the materials cited herein, my opinions regarding the understanding of a POSITA, and my training and experience, it is my opinion that the Challenged Claims are rendered obvious by the Grounds presented in this declaration. The reasons for my conclusions are explained more fully below.

A. Ground 1: Obvious over Erturk in view of Vector Guide

110. In my opinion, Claims 1-5 of the ’316 patent are invalid because they are obvious over Erturk in view of Vector, including as detailed below.

1. Overview of the Combination of Erturk and Vector

111. Ground 1 is based on a combination of Erturk and Vector. As is set forth below, Erturk teaches a BWS system that includes many of the elements of claims 1-5. In particular, Erturk teaches limitations 1[pre] (a BWS system with a drive assembly, support track, tether, and attachment device), 1[e] (overhead trolley tracking), and 1[f] (displaying data). Erturk also teaches the additional elements of claims 2-5. In many cases, Erturk’s teachings are nearly identical—often verbatim—to the specification of the ’316 patent.

112. Erturk suggests, but does not explicitly disclose, details found in Elements 1[a]-1[d] (defining a reference length of the tether, defining a threshold length of the tether, and providing different amounts of body weight support based on the threshold being exceeded). Erturk does, however, teach the generally desirability of including a fall detection and prevention mechanism in a BWS system. Meanwhile, Vector teaches such a fall detection and prevention mechanism that corresponds to the limitations in Elements 1[a]-1[d]. Indeed, the fall detection and prevention mechanism taught in Vector is nearly identical to the exemplary fall detection and prevention mechanism described and claimed in the ’316 patent. As I discuss further below, a POSITA would have been motivated to modify the BWS system of Erturk to include the fall

detection and prevention feature of Vector. In my opinion, Vector provides these teachings more expressly than Erturk, and it would have been obvious for a POSITA to incorporate the features of Vector corresponding to Elements 1[a]-1[d] into the Erturk system. In my opinion, Erturk in view of Vector renders obvious claims 1-5.

2. Motivation to Combine (Erturk in view of Vector)

113. In my opinion, a POSITA would have had many motivations to combine Erturk with Vector.

114. First and foremost, in my opinion Erturk includes an express teaching and suggestion to a POSITA that it would be desirable to include fall detection and prevention features in a BWS system. For example, Erturk states that, "[i]n some embodiments, audible feedback can be provided when the patient begins to fall." Ex-1009, [0082]. Erturk also states that the BWS system may be "actively controlled" so that "the support system 2000 can actively reduce the amount a patient falls after stumbling or falling for other reasons." Ex-1009, [0152]. Based at least on these teachings and suggestions from the Erturk specification, in my opinion a POSITA would have been motivated to combine Erturk's BWS system with the fall detection and prevention feature taught in Vector.

115. Secondly, in my opinion a POSITA would have readily understood that combining the teachings of Erturk and Vector would have amounted to using known techniques to improve a similar device in the same way. In my opinion, Erturk and Vector undeniably teach "similar devices." Both references are very clearly from the same field of endeavor – overhead gait therapy – and in my opinion a POSITA would have understood that very plainly from their disclosures. Ex-1009, [0002]-[0003], [0011], [0071], [0122], [0147], [0150]-[0152]; Ex-1010, 1-2, 16-18. In my opinion, both references are also directed to the same objectives – providing a body weight support system for gait therapy in a safe and controlled environment. *See, e.g.*, Ex-

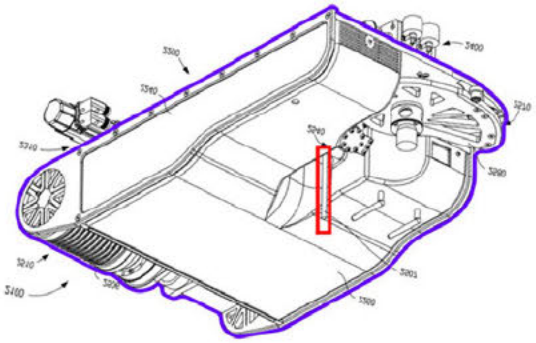
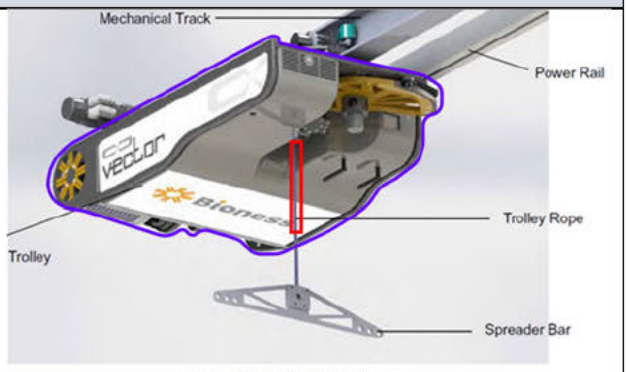
1009, [0008]-[0010], [0053], [0070]-[0071], [0082], [0149], [0152]; Ex-1010, 18-21. Additionally, in my opinion both references disclose to a POSITA that changes in the BWS system can be monitored in order to detect when a patient is falling. See, e.g., Ex-1009, [0070]-[0071], [0082], [0152]; Ex-1010, 18-21. In response, each BWS system can attempt to avoid injuries by providing additional support to catch the patient. See, e.g., Ex-1009, [0070]- [0071], [0082], [0152] (teaching fall detection through measurement of changes in the system, and fall protection by providing additional support during a fall); Ex-1010, 18-21 (same). Both references also teach a system that provides "dynamic" or "active" body weight support to a patient (as opposed to "static" support). See, e.g., Ex-1009, [0071], [0122], [0147], [0150]- [0152] (describing actively/dynamically supporting a patient to provide consistent support through a range of patient motion); Ex-1010, 1, 17-18 (same). In my opinion, both references teach a system that provides an overhead trolley suspended from a track, and is driven by a computer controlled motor so that it remains directly over the patient and reduces drag on the patient as they move. Ex-1009, [0008]- [0010], [0053], [0071], [0149] (disclosing an automatic, overhead, motorized trolley tracking solution); Ex-1010, 16-17 (same).

116. In my opinion, the combination I propose herein would apply the fall detection and prevention feature of Vector in the same way to the BWS system of Erturk. For example, Erturk's BWS system is already configured to detect changes in system components in order to detect a fall, and then to "compensate for th[ose] changes during the … fall." *See* Ex-1009, [0062], [0073], [0092], [0121]-[0130], [0134], [0149]-[0152], [0180]-[0185]. The fall protection feature of Vector is provided in Vector's BWS system in the exact same way. In particular, Vector's BWS system is configured to detect changes in system components (e.g., the "location

of the [tether]") to detect the fall, e.g., by correlating a patient's descent past a "fall limit value" (e.g., "4.0 inches" of decent from an initial position) with a fall event. Ex-1010, p. 18-20.

117. Further, in my opinion the combination of the fall detection feature of Vector with the BWS system of Erturk is a combination of known elements to achieve predictable results. Vector detects falls through a feedback system that monitors changes in the system that correspond to a fall. Ex-1010, 18-20. And indeed, Erturk observes the understanding – which was well known to POSITAs at the time (and more broadly understood across fields involving dynamic mechanical systems) – that "[e]lectronic devices often implement feedback systems to actively control the kinematics of mechanical systems in order to achieve and/or maintain a desired system state." Ex-1009, [0062].

118. Moreover, in my opinion a POSITA also would have reasonably expected success in applying the teachings of Vector to the BWS system of Erturk. As an initial matter, it is my opinion that a POSITA would have recognized that Erturk and Vector teach nearly identical structural designs, as can be seen by comparing FIG. 6 of Erturk with FIG. 1-1 of Vector:

Erturk (Fig. 6, rotated)	Vector (Fig. 1-1)
	 Figure 1-1: Vector Elite Trolley

Ex-1009, Fig. 6. (annotations added to emphasize similarity of design between Erturk and Vector's BWS systems, the purple color indicating the general outline of the trolley, the red color indicating the general outline of a portion of the tether extending out of the trolley); Ex-1010, Figure 1-1 (same).

119. Given the nearly identical structural designs and disclosed functions, in my opinion a POSITA would have had a high expectation of success in implementing features from Vector into the Erturk system, and vice-versa. In my opinion, porting features between the two references would have required very little modification and would have used techniques well known to POSITAs to make any such modifications. For instance, in my opinion a POSITA would have understood that the only change necessary to implement the fall prevention feature of Vector with the BWS system of Erturk would have been adding some basic computer instructions to the Erturk system, consistent with the disclosures in Vector, to achieve the claimed technology. Erturk's BWS system is already configured to generate signals concerning changes in system components holding the tether (including position, velocity, acceleration, etc. of such components), and then to communicate those signals to a processor, which can "execute

a set of instructions" to control the system components so as to "actively reduce the amount a patient falls after stumbling or falling for other reasons." See Ex-1009, [0152], *see also id*., Ex-1009, [0062], [0073], [0092], [0121]-[0130], [0134], [0149]-[0151], [0180]-[0185]. Thus, in my opinion a POSITA would have understood that the fall detection feature of Vector could be incorporated into Erturk's BWS system by simply specifying, within the "set of instructions" executed by the processor, that (1) a fall event should be detected when the drum rotates in an amount corresponding to Vector's fall limit, and (2) upon the fall limit being met or exceeded, a signal should be sent to the motor and/or the winch that locks the movement of those elements or otherwise provides additional support. In my opinion a POSITA would have been able to implement these commands in the computer code with ease.

120. Accordingly, it is my opinion that a POSITA would have been motivated to combine the BWS system of Erturk with the fall prevention feature of Vector, and would have had a reasonable expectation of success in doing so.

3. Claim 1

121. Based on my review and for the reasons that follow, it is my opinion that Erturk in view of Vector discloses and renders obvious Claim 1. I analyze claim 1 in the sub-sections that follow.

a. Element 1[pre]

1[pre]	***A method of using a body weight support system to provide body weight support during gait training, the body weight support system including a drive assembly configured to movably suspend the body weight support system from a support track and a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system, the method comprising:***

122. I understand that a preamble generally does not state a claim limitation. However, to the extent the preamble limits claim 1, it is my opinion that Erturk discloses ***[a] method of using a body weight support system to provide body weight support during gait training, the body weight support system including a drive assembly configured to movably suspend the body weight support system from a support track and a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system*** as recited. Due to its length, I set forth my analysis of 1[pre] in three portions as detailed below.

1[pre(i)] A method of using a body weight support system to provide body weight support during gait training

123. In my opinion, Erturk teaches ***[a] method of using a body weight support system to provide body weight support during gait training*** as recited in 1[pre(i)] because Erturk teaches that "[t]he embodiments described herein relate to apparatus and **methods for supporting the body weight of a patient**" and "more particularly, the embodiments described herein relate to apparatus and **methods for supporting the body weight of a patient during gait therapy**." Ex-1009, [0001]-[0002] (emphasis added); *see also id.*, [0085] (explaining with reference to Figs. 2-33, that "the body weight support system 2000 (also referred to herein as "support system") **can be used to support a portion of a patient's body weight, for example, during gait therapy** or the like").

124. Based on my review, I note that Erturk discloses 1[pre(i)] with language that is near verbatim to the language used in the '316 patent to describe the same thing. By way of example, Erturk states that "[t]he embodiments described herein relate to apparatus and methods for supporting the body weight of a patient during gait therapy." Ex-1009, [0002]. And the '316 patent states the exact same teaching, the only exception being that the term "user" replaces the term "patient. *See* Ex-1001, 1:25-29. A sample of these disclosures are provided side-by-side below.

Ex-1009 (Erturk), [0002].	**Ex-1001 ('316 patent), 1:25-29.**
The embodiments described herein relate to apparatus and methods for supporting the body weight of a patient. More particularly, the embodiments described herein relate to apparatus and methods for supporting the body weight of a patient during gait therapy.	The embodiments described herein relate to apparatus and methods for supporting the body weight of a user. More particularly, the embodiments described herein relate to apparatus and methods for supporting the body weight of a user during gait therapy.

125. Erturk further explains that "the body weight support system 2000 (also referred to herein as "support system") **can be used to support a portion of a patient's body weight, for example, during gait therapy** or the like" and then proceeds to detail the claimed ***method of using*** the system, including as I describe in the sections that follow. Ex-1009, [0085] (*compare* with similar disclosure in Ex-1001, 16:64-17:21); *see also* Sections VII.A.3.b-I.B.2, *infra*.

126. Erturk also provides depictions of the exemplary ***body weight support system*** that is designed to practice the recited ***method of using*** in 1[pre]. By way of example, Figure 2 of Erturk gives such a depiction identifying with numerals the following: a body weight support system 2000, a power system 2600, a power rail 2620, a support track 2050, a trolley 2100, a

drive mechanism 2300, a first drive assembly 2310, a second drive assembly 2400, a base 2210, a housing 2200, a support mechanism 2500, a cam mechanism 2570, and a tether 2505.

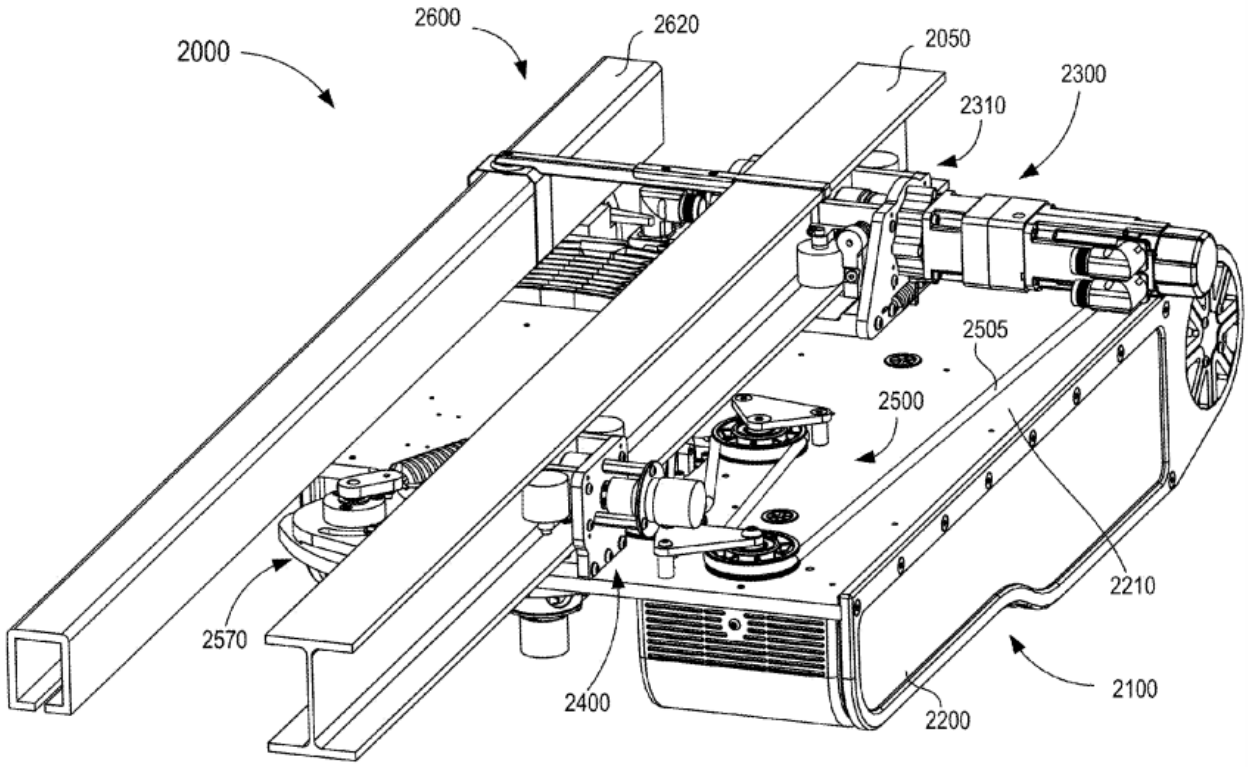


FIG. 2

Ex-1009, Fig. 2.

127. Based on the foregoing, in my opinion Erturk teaches 1[pre(i)].

1[pre(ii)] the body weight support system including a drive assembly configured to movably suspend the body weight support system from a support track and

128. In my opinion, Erturk discloses ***the body weight support system including a drive assembly configured to movably suspend the body weight support system from a support track*** as recited in 1[pre(ii)], at least because Erturk teaches a BWS system that includes a first drive

assembly and a second drive assembly (two drive assemblies) configured to move a trolley that is suspended from a support track.

129. To provide more detail, Erturk's ***body weight support system*** includes a "drive system 2300" that constitutes ***a drive assembly configured to movably suspend the body weight support system from a support track*** as recited 1[pre (ii)]. *See, e.g.*, Ex-1009, [0052] ("The trolley can include a drive system, a control system, and a patient support system. The **drive system is movably coupled to a support rail**. At least a portion of the control system is physically and electrically coupled to the power rail. The patient support mechanism is at least temporarily coupled to the patient attachment mechanism"), [0086]("The trolley 2100 includes a housing 2200 (see e.g., FIGS. 8 and 9), an electronic system 2700 (see e.g., FIGS. 10 and 11), **a drive system 2300 (see e.g., FIGS. 12-26)**, and a patient support mechanism 2500 (see e.g., FIGS. 27-33)"), [0094]("As shown in FIG. 12, the **drive system 2300 includes a first drive assembly 2310 and a second drive assembly 2400**. The drive system 2300 is coupled to the first side 2211 of the base 2210 (see e.g., FIGS. 2 and 3) and arranged such **that the first drive assembly 2310 and the second drive assembly 2400 are aligned (e.g., coaxial)**. In this manner, the first drive assembly 2310 and the second drive assembly 2400 can receive a portion of the support track 2050"), [0095]("**The first drive assembly 2310 includes a motor 2311, a support structure 2315, a set of guide wheel assemblies 2360, a set of drive wheel assemblies 2370, and a set of secondary wheel assemblies 2390** … the electronic system 2700 to cause the motor 2311 to rotate the output shaft 2312 which, in turn, rotates the drive wheel 2385"). That is, the "drive system 2300" is part of the "trolley 2100" in Erturk's "body weight support system 2000." Ex-1009, Figs. 2-4. In sum, Erturk's drive system includes two drive assemblies that move a trolley that is suspended from a support track. Just like the '316 patent, the "drive system 2300"

includes "a first drive assembly 2310" and "a second drive assembly 2400." *See* Ex-1009, [0094]-[0095].

130. Both of Erturk's drive assemblies work together to ***movably suspend*** the "trolley 2100" from the "support track 2050," including under control of a motor. *See* Ex-1009, [0094]-[0095]. The "body weight support system 2000" can move along the "support track 2050" while supporting a patient who is attached (by an attachment mechanism such as a harness) to the "tether 2505." Ex-1009, [0085]-[0086]; *see also* Ex-1009, [0140] ("The patient attachment mechanism 2800 can be mated with the second end portion 2507 of the tether 2505 to couple the patient attachment mechanism 2800 to the trolley 2100. Moreover, the patient attachment mechanism 2800 can be coupled to a harness or the like, worn by the patient, to couple the patient to the support system 2000, as described below"); [0064]-[0065] ("The drive system 1300 of the trolley 1100 can include one or more wheels configured to roll along a surface of the support track such that the weight of the trolley 1100 and a portion of the weight of a patient utilizing the support system 1000 (e.g., the patient is temporarily coupled to the trolley 1100 via the patient attachment mechanism 1800, as described in further detail herein) are supported by the support track.").

131. In my opinion, Figures 2 and 4 of Erturk depict an example of a "first drive assembly 2310" (green) and a "second drive assembly 2400" (yellow) that are part of the disclosed "drive system 2300" that satisfy 1[pre(ii)]. Ex-1009, Figs. 2-4.

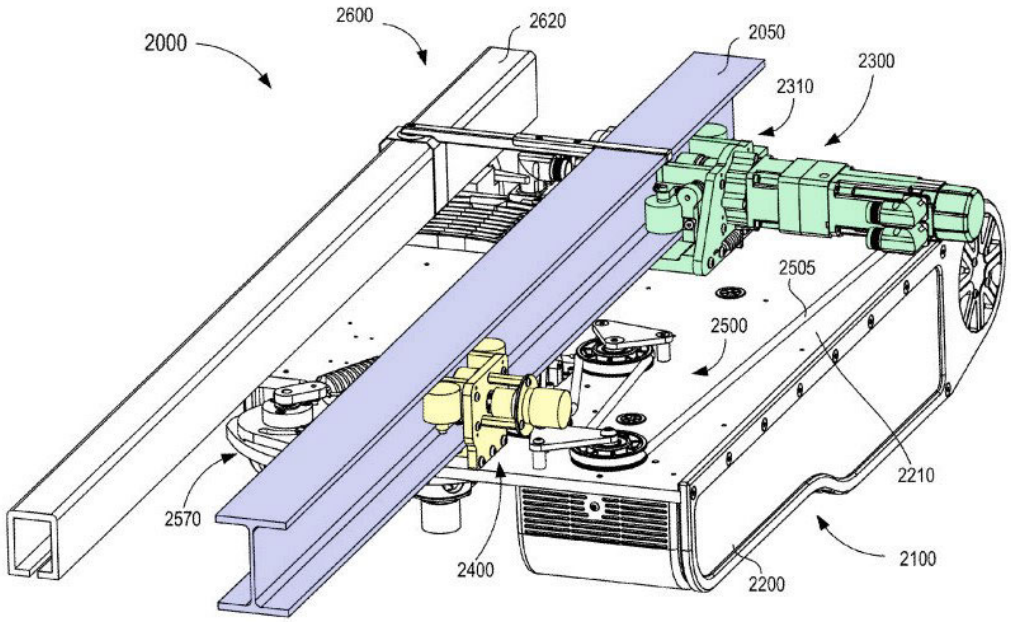


FIG. 2

Ex-1009, Fig. 2 (annotations added).

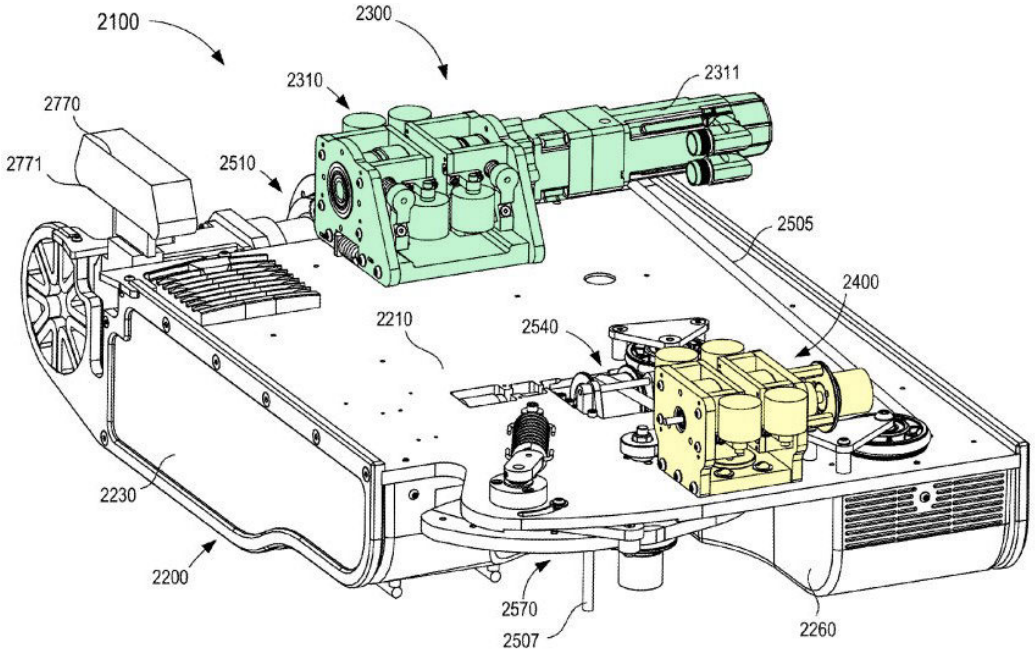
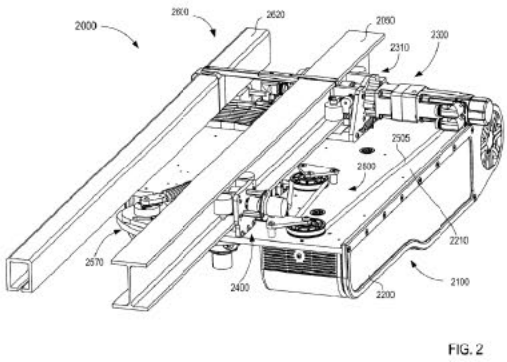
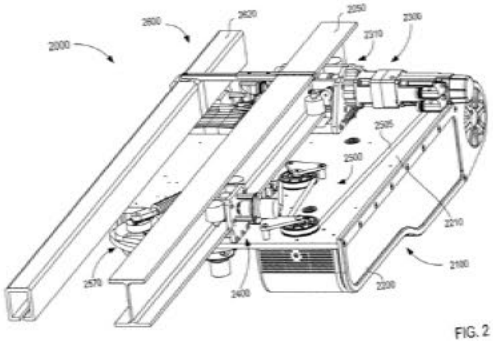
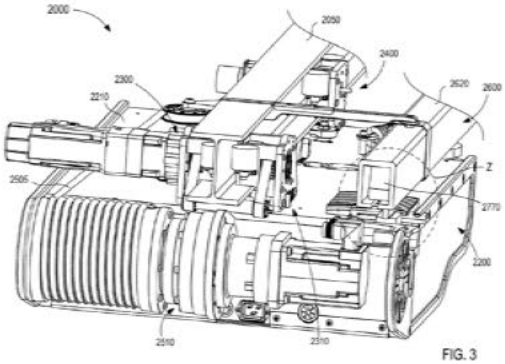
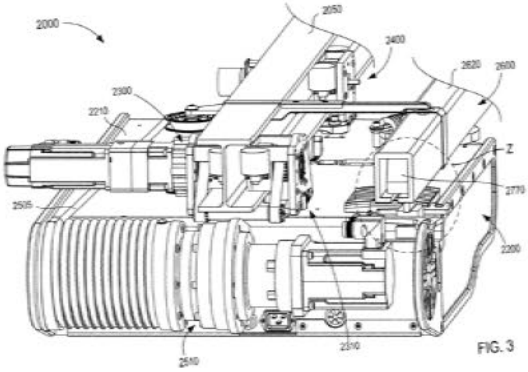
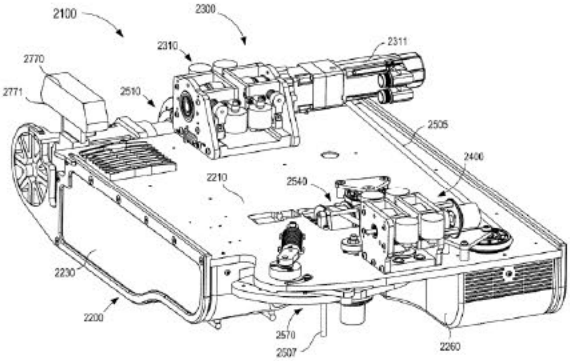
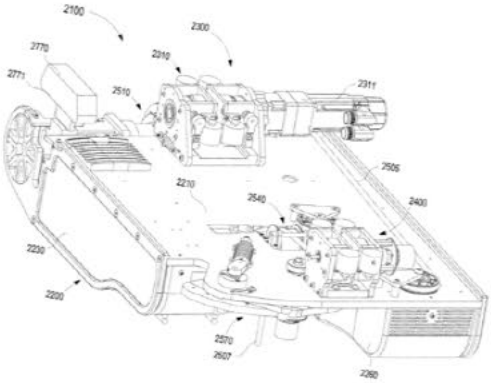


FIG. 4

Ex-1009, Fig. 4 (annotations added). Notably, Erturk's Figures 2 and 4 are identical to, and disclose the same drive assemblies in, comparable Figures 2 and 4 of the '316 patent.

132. As Erturk explains, "[t]he first drive assembly 2310 includes a motor 2311, a support structure 2315, a set of guide wheel assemblies 2360, a set of drive wheel assemblies 2370, and a set of secondary wheel assemblies 2390." Ex-1009, [0095]. And again, "the drive system is movably coupled to a support rail." Ex-1009, [0052]; *see also id*., [0063]-[0067], [0094]-[0095], *compare* '316 patent, 8:12-23, 10:11-11:48, 20:13-46.

133. The teachings of Erturk in this respect are nearly identical to the teachings disclosed in the '316 patent. For example, Figures 2-4 of Erturk are the same as Figures 2-4 of the '316 patent:

Ex-1009 (Erturk), Figures 2-4	Ex-1001 ('316 patent), Figures 2-4
 FIG. 2	 FIG. 2
 FIG. 3	 FIG. 3
 FIG. 4	 FIG. 4

134. Accordingly, it is my opinion that Erturk teaches a ***body weight support system*** (e.g., trolley 2100) that includes ***a drive assembly*** (e.g., first and/or second drive assemblies 2310 and 2400 of drive system 2300) that is ***configured to movably suspend the body weight support system from a support track*** (e.g., support track 2050).

135. Accordingly, in my opinion Erturk discloses 1[pre(ii)].

1[pre (iii)] a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system, the method comprising:

136. In my opinion Erturk also teaches ***a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system*** as recited in1[pre(iii)], at least because Erturk discloses that its tether ("tether 2505") is coupled to a "harness" that is worn by a patient in order to couple the patient to the overhead trolley to provide body weight support. For example, Erturk teaches this in paragraphs [0140]-[0143]:

> [0140] FIG. 34 illustrates the patient attachment mechanism 2800. **The patient attachment mechanism 2800 can be mated with the second end portion 2507 of the tether 2505 to couple the patient attachment mechanism 2800 to the trolley 2100**. Moreover, the patient attachment mechanism 2800 can be coupled to a harness or the like, worn by the patient, to couple the patient to the support system 2000, as described below.
>
> [0141] The patient attachment mechanism 2800 has a first coupling portion 2810 and a second coupling portion 2812. **The first coupling portion 2810 includes a coupling mechanism 2811 configured to couple to the second end portion 2507 of the tether, as described above. For example, the coupling mechanism 2811 can be a loop or hook configured to couple to an attachment device of the tether 2505** (not shown in FIGS. 2-34). The second coupling portion 2821 is movably coupled to a first arm 2820 and a second arm 2840. As described in further detail herein, the first 2820 and the second arm 2840 can pivot relative to each other to absorb at least a portion of a force exerted by the weight of a patient coupled to the patient attachment mechanism 2800.
>
> [0142] The first arm 2820 of the patient attachment mechanism 2800 includes a pivot portion 2821 and a mount portion 2822. The pivot portion 2821 is movably coupled to the second coupling portion 2812. The mount portion 2822 receives a guide rod 2830, as described in further detail herein. The first arm 2820 defines a slot 2824 that receives a portion of the second arm 2840 and an opening 2826 that receives a portion of a harness worn by the patient.
>
> [0143] The second arm 2840 has a pivot portion 2841 and a coupling portion 2842. The pivot portion 2841 is movably coupled to the second coupling portion 2812. In this manner, both the first arm 2820 and the second arm 2840 can pivot relative to the coupling portion 2812 and relative to each

other, as described in further detail herein. The coupling portion 2842 defines an opening 2843 that receives a portion of the harness worn by the patient. The coupling portion 2842 is also movably coupled to a first end portion of a first energy storage member 2844 and a first end portion of a second energy storage member 2851 (collectively referred to as energy storage member 2850). The energy storage members 2850 can be, for example, gas struts or the like.

Ex-1009, [0140]-[0143] (emphasis added); *see also id.*, [0068], [0085], [0157], Figs. 28, 34. The "tether 2505" (red) is depicted, for example, in Figure 28 of Erturk:

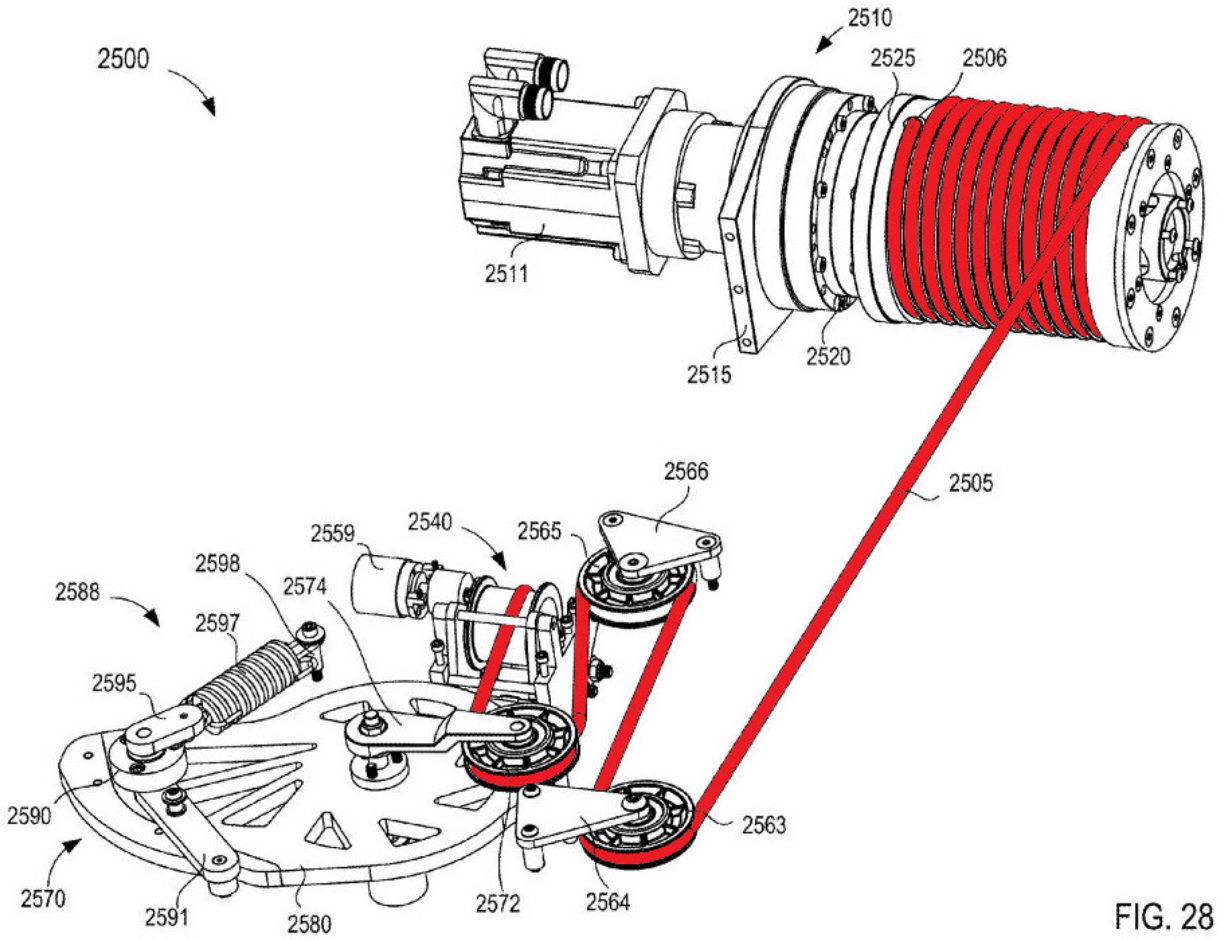


FIG. 28

Ex-1009, Fig. 28 (annotation added)

137. As shown and described, Erturk teaches that the "tether 2505" is coupled to the "trolley 2100" in order to "couple the patient to the support system 2000." Ex-1009, [0122]-

[0125], [0140]. For example, Figure 4 of Erturk depicts an "end portion 2507 of the tether 2505" (red) exiting from the trolley 2100:

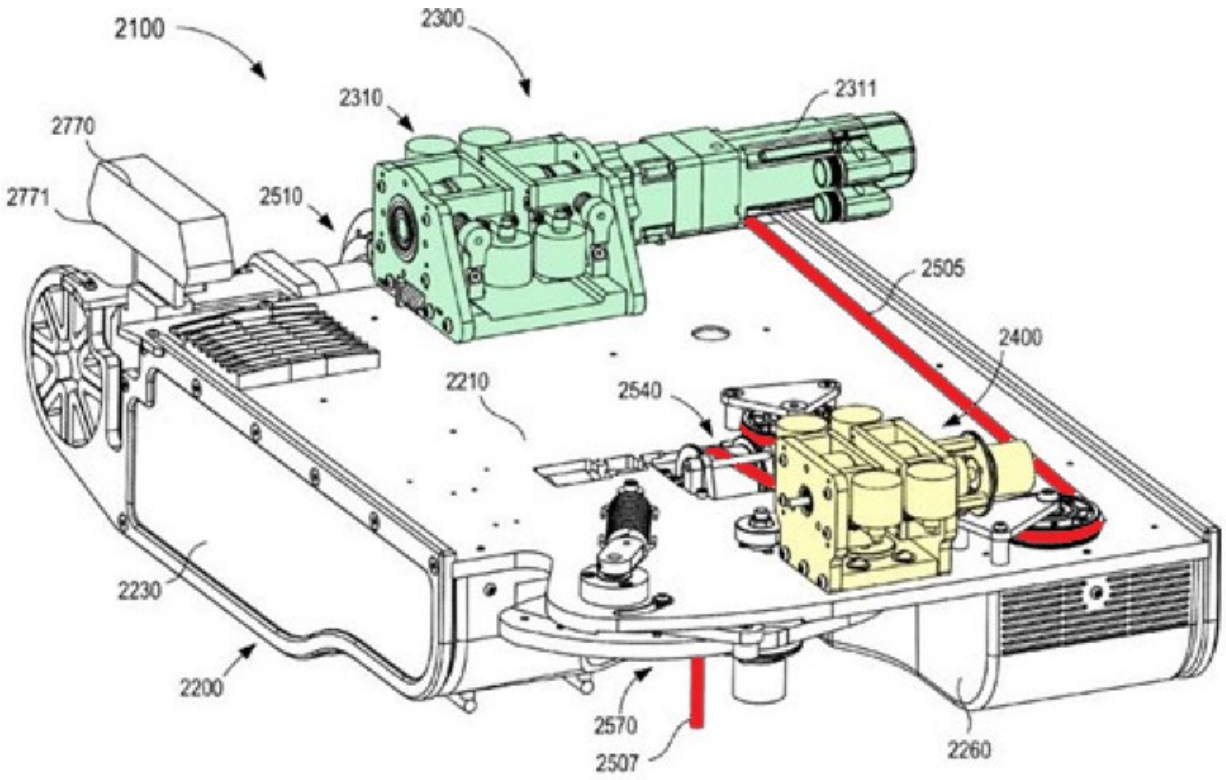


FIG. 4

138. Erturk discloses that the "patient is coupled to the patient attachment mechanism 2800 which, in turn, is coupled to the … tether 2505," and the "tether 2505" is then coupled to the "trolley 2100" in order to "couple the patient to the [body weight] support system 2000." Ex-1009, [0140]-[0143], *see also* [0068], [0085], [0157]. That is, the tether 2505 exits from the trolley 2100 so that it can "couple to the patient attachment mechanism 2800." *Id*. An example of a "patient attachment mechanism 2800" is shown in Figure 34 of Erturk. On the other side, the "harness" worn by the patient is linked to the "patient attachment mechanism 2800" through holes/openings in the "patient attachment mechanism 2800." *Id*. Figure 34 of Erturk is provided below, illustrating an example of the "coupling mechanism 2811" where the tether 2505 is mated

with the "patient attachment mechanism 2800"; and also illustrating "opening 2826" and "opening 2843" where a portion of the patient's harness is coupled. *Id*. Thus, the "patient attachment mechanism 2800" is an element of Erturk's system through which its ***tether*** (e.g., "tether 2050") is ***configured to be coupled to an attachment device worn by a user*** (e.g., the "harness" worn by the patient) ***to couple the user to the body weight support system*** (e.g., the "trolley 2100"). Ex-1009, Fig. 34.

FIG. 34 illustrates the patient attachment mechanism 2800. **The patient attachment mechanism 2800 can be mated with the second end portion 2507 of the tether** 2505 to couple the patient attachment mechanism 2800 to the trolley 2100. **Moreover, the patient attachment mechanism 2800 can be coupled to a harness or the like, worn by the patient**, to **couple the patient to the support system 2000**, as described below.

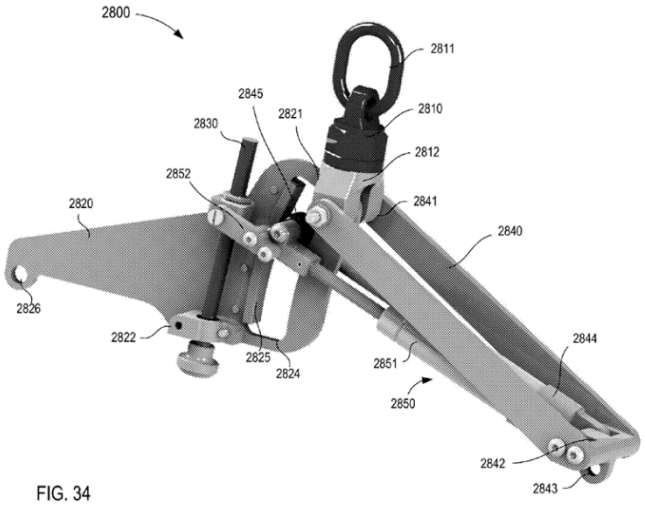


FIG. 34

Ex-1009, [0140]; *see also* [0141]-[0143]. Ex-1009, Fig. 34.

139. Based at least on the foregoing, in my opinion Erturk teaches that "a harness, or the like, worn by the patient" is "coupled to the patient attachment mechanism 2800 which, in turn, is coupled to the … tether 2505" such that the patient is coupled to the body weight support system. Ex-1009, [0140]-[0147]; *see also* [0068], [0085], [0157].

140. In my opinion, Erturk's "tether 2025" constitutes ***a tether*** consistent with the recitations in 1[pre], and Erturk's "harness" constitutes ***an attachment device*** consistent with the recitations in 1[pre]. Ex-1009, [0140]-[0143]; *see also id.*, [0068], [0085], [0157], Fig. 34. As

such, in my opinion Erturk teaches ***a tether*** (tether 2505) ***configured to be coupled to an attachment device worn by a user*** (coupled to "a harness, or the like, worn by the patient" through "patient attachment mechanism 2800") ***to couple the user to the body weight support system*** (the "patient attachment mechanism 2800" coupling the harness (and user, who is wearing the harness) to the "trolley 2100").

141. Based on my review, I observe that Erturk's teachings of this limitation are nearly identical to the teachings in the '316 patent. *Compare, e.g.*, Ex-1009, [0068], [0085], [0089], [0140]-[0147], [0153]-[0157] *with* Ex-1001, 11:49-62, 16:64-17:21, 18:21-38, 33:23-34:48; 36:27-37:33.

Ex-1009 (Erturk)	Ex-1001 ('316 patent)
The patient support mechanism 1500 (also referred to herein as "support mechanism") can be any suitable configuration and can be at least temporarily coupled to the attachment mechanism 1800. For example, in some embodiments, the support mechanism 1500 can include a tether that can be temporarily coupled to a coupling portion of the attachment mechanism 1800. Moreover, the attachment mechanism 1800 can further include a patient coupling portion (not shown in FIG. 1) configured to receive a portion of a harness or the like worn by or coupled to the patient. Thus, the attachment mechanism 1800 and the support mechanism 1500 can support a portion of the body weight of a patient and temporarily couple the patient to the trolley 1100. Ex-1009, [0068].	The patient support mechanism 1500 (also referred to herein as "support mechanism") can be any suitable configuration and can be at least temporarily coupled to the attachment mechanism 1800. For example, in some embodiments, the support mechanism 1500 can include a tether that can be temporarily coupled to a coupling portion of the attachment mechanism 1800. Moreover, the attachment mechanism 1800 can further include a patient coupling portion (not shown in FIG. 1) configured to receive a portion of a harness or the like worn by or coupled to the patient. Thus, the attachment mechanism 1800 and the support mechanism 1500 can support a portion of the body weight of a patient and temporarily couple the patient to the trolley 1100. Ex-1001, 11:49-62.

FIGS. 2-33 illustrate a body weight support system 2000 according to an embodiment. The body weight support system 2000 (also referred to herein as “support system”) can be used to support a portion of a patient's body weight, for example, during gait therapy or the like. FIGS. 2 and 3 are perspective views of the support system 2000. The support system 2000 includes a trolley 2100, a power system 2600, and a patient attachment mechanism 2800 (see e.g., FIG. 34). As shown in FIGS. 2 and 3, the trolley 2100 is movably coupled to a support track 2050 that is configured to support the weight of the trolley 2100 and the weight of the patient utilizing the support system 2000. Although the support track 2050 is shown as having an I-shape, the support track 2050 can be any suitable shape. Furthermore, while the support track 2050 is shown as being substantially linear, the support track 2050 can extend in a curvilinear direction. In other embodiments, the support track 2050 can be arranged in a closed loop such as, for example, circular, oval, oblong, square, or the like. As described in further detail herein, the power system 2600 can include a power rail 2620 that extends substantially parallel to the support track 2050 and is at least electrically coupled to the trolley 2100 to transfer a flow of electrical current from a power source (not shown in FIGS. 2-32) to the trolley 2100. Ex-1009, [0085].	FIGS. 2-33 illustrate a body weight support system 2000 according to an embodiment. The body weight support system 2000 (also referred to herein as “support system”) can be used to support a portion of a patient's body weight, for example, during gait therapy or the like. FIGS. 2 and 3 are perspective views of the support system 2000. The support system 2000 includes a trolley 2100, a power system 2600, and a patient attachment mechanism 2800 (see e.g., FIG. 34). As shown in FIGS. 2 and 3, the trolley 2100 is movably coupled to a support track 2050 that is configured to support the weight of the trolley 2100 and the weight of the patient utilizing the support system 2000. Although the support track 2050 is shown as having an I-shape, the support track 2050 can be any suitable shape. Furthermore, while the support track 2050 is shown as being substantially linear, the support track 2050 can extend in a curvilinear direction. In other embodiments, the support track 2050 can be arranged in a closed loop such as, for example, circular, oval, oblong, square, or the like. As described in further detail herein, the power system 2600 can include a power rail 2620 that extends substantially parallel to the support track 2050 and is at least electrically coupled to the trolley 2100 to transfer a flow of electrical current from a power source (not shown in FIGS. 2-32) to the trolley 2100. Ex-1001, 16:64-17:21.

The cover 2260 is disposed adjacent to the second side 2212 of the base 2210. More specifically, the cover 2260 can be removably coupled to the second side 2212 of the base 2210 such that the portion of the electronic system 2700 enclosed therein can be accessed. The cover 2260 has a first end portion 2261 and a second end portion 2262. The first end portion 2261 is open-ended and defines a notch 2265 configured to receive a portion of the collector 2770, as described in further detail herein. The second end portion 2262 of the cover 2260 is substantially enclosed and is configured to include a recessed region 2264. In this manner, a portion of the support mechanism 2500 can extend into and/or through the recessed region 2264 to couple to the patient attachment mechanism 2800, as described in further detail herein. The cover 2260 also defines a set of vents 2263 that can be arranged to provide a flow of air into the area enclosed by the cover 2260 such that at least a portion of the electronic system 2700 disposed therein can be cooled. Ex-1009, [0089].	The cover 2260 is disposed adjacent to the second side 2212 of the base 2210. More specifically, the cover 2260 can be removably coupled to the second side 2212 of the base 2210 such that the portion of the electronic system 2700 enclosed therein can be accessed. The cover 2260 has a first end portion 2261 and a second end portion 2262. The first end portion 2261 is open-ended and defines a notch 2265 configured to receive a portion of the collector 2770, as described in further detail herein. The second end portion 2262 of the cover 2260 is substantially enclosed and is configured to include a recessed region 2264. In this manner, a portion of the support mechanism 2500 can extend into and/or through the recessed region 2264 to couple to the patient attachment mechanism 2800, as described in further detail herein. The cover 2260 also defines a set of vents 2263 that can be arranged to provide a flow of air into the area enclosed by the cover 2260 such that at least a portion of the electronic system 2700 disposed therein can be cooled. Ex-1001, 18:21-38.

FIG. 34 illustrates the patient attachment mechanism 2800. The patient attachment mechanism 2800 can be mated with the second end portion 2507 of the tether 2505 to couple the patient attachment mechanism 2800 to the trolley 2100. Moreover, the patient attachment mechanism 2800 can be coupled to a harness or the like, worn by the patient, to couple the patient to the support system 2000, as described below.	FIG. 34 illustrates the patient attachment mechanism 2800. The patient attachment mechanism 2800 can be mated with the second end portion 2507 of the tether 2505 to couple the patient attachment mechanism 2800 to the trolley 2100. Moreover, the patient attachment mechanism 2800 can be coupled to a harness or the like, worn by the patient, to couple the patient to the support system 2000, as described below.
The patient attachment mechanism 2800 has a first coupling portion 2810 and a second coupling portion 2812. The first coupling portion 2810 includes a coupling mechanism 2811 configured to couple to the second end portion 2507 of the tether, as described above. For example, the coupling mechanism 2811 can be a loop or hook configured to couple to an attachment device of the tether 2505 (not shown in FIGS. 2-34). The second coupling portion 2821 is movably coupled to a first arm 2820 and a second arm 2840. As described in further detail herein, the first 2820 and the second arm 2840 can pivot relative to each other to absorb at least a portion of a force exerted by the weight of a patient coupled to the patient attachment mechanism 2800.	The patient attachment mechanism 2800 has a first coupling portion 2810 and a second coupling portion 2812. The first coupling portion 2810 includes a coupling mechanism 2811 configured to couple to the second end portion 2507 of the tether, as described above. For example, the coupling mechanism 2811 can be a loop or hook configured to couple to an attachment device of the tether 2505 (not shown in FIGS. 2-34). The second coupling portion 2821 is movably coupled to a first arm 2820 and a second arm 2840. As described in further detail herein, the first 2820 and the second arm 2840 can pivot relative to each other to absorb at least a portion of a force exerted by the weight of a patient coupled to the patient attachment mechanism 2800.
The first arm 2820 of the patient attachment mechanism 2800 includes a pivot portion 2821 and a mount portion 2822. The pivot portion 2821 is movably coupled to the second coupling portion 2812. The mount portion 2822 receives a guide rod 2830, as described in further detail herein. The first arm 2820 defines a slot 2824 that receives a portion of the second arm 2840 and an opening 2826 that receives a portion of a harness worn by the patient.	The first arm 2820 of the patient attachment mechanism 2800 includes a pivot portion 2821 and a mount portion 2822. The pivot portion 2821 is movably coupled to the second coupling portion 2812. The mount portion 2822 receives a guide rod 2830, as described in further detail herein. The first arm 2820 defines a slot 2824 that receives a portion of the second arm 2840 and an opening 2826 that receives a portion of a harness worn by the patient.
The second arm 2840 has a pivot portion 2841 and a coupling portion 2842. The pivot portion 2841 is movably coupled to the second coupling portion 2812. In this manner,	The second arm 2840 has a pivot portion 2841 and a coupling portion 2842. The pivot portion 2841 is movably coupled to the second coupling portion 2812. In this manner,

both the first arm 2820 and the second arm 2840 can pivot relative to the coupling portion 2812 and relative to each other, as described in further detail herein. The coupling portion 2842 defines an opening 2843 that receives a portion of the harness worn by the patient. The coupling portion 2842 is also movably coupled to a first end portion of a first energy storage member 2844 and a first end portion of a second energy storage member 2851 (collectively referred to as energy storage member 2850). The energy storage members 2850 can be, for example, gas struts or the like.	both the first arm 2820 and the second arm 2840 can pivot relative to the coupling portion 2812 and relative to each other, as described in further detail herein. The coupling portion 2842 defines an opening 2843 that receives a portion of the harness worn by the patient. The coupling portion 2842 is also movably coupled to a first end portion of a first energy storage member 2844 and a first end portion of a second energy storage member 2851 (collectively referred to as energy storage member 2850). The energy storage members 2850 can be, for example, gas struts or the like.
As shown in FIG. 34, the energy storage members 2850 are configured to extend towards the first arm 2820. More specifically, the second energy storage member 2851 includes a coupling portion 2852 that is movably coupled to the guide rod 2830 of the first arm 2820. The first energy storage member 2844 also includes a coupling portion (not shown in FIG. 34) that is movably coupled to an engagement member 2845 and further coupled to the coupling portion 2852 of the second energy storage member 2851. Similarly stated, the coupling portion of the first energy storage member 2844 extends in a substantially perpendicular direction relative to a longitudinal centerline (not shown) of the first energy storage member 2844.	As shown in FIG. 34, the energy storage members 2850 are configured to extend towards the first arm 2820. More specifically, the second energy storage member 2851 includes a coupling portion 2852 that is movably coupled to the guide rod 2830 of the first arm 2820. The first energy storage member 2844 also includes a coupling portion (not shown in FIG. 34) that is movably coupled to an engagement member 2845 and further coupled to the coupling portion 2852 of the second energy storage member 2851. Similarly stated, the coupling portion of the first energy storage member 2844 extends in a substantially perpendicular direction relative to a longitudinal centerline (not shown) of the first energy storage member 2844.
The engagement member 2845 is movably coupled to the coupling portion of the first energy storage member 2844 and the coupling portion 2852 of the second coupling portion 2851. The engagement member 2845 is configured to be placed in contact with an engagement surface 2825 of the first arm 2820 that at least partially defines the slot 2825. Similarly stated, the engagement member 2845 is disposed within the slot 2824 defined by the first arm 2820 and in contact 2825 with the engagement surface 2825. Moreover, the arrangement of the engagement	The engagement member 2845 is movably coupled to the coupling portion of the first energy storage member 2844 and the coupling portion 2852 of the second coupling portion 2851. The engagement member 2845 is configured to be placed in contact with an engagement surface 2825 of the first arm 2820 that at least partially defines the slot 2825. Similarly stated, the engagement member 2845 is disposed within the slot 2824 defined by the first arm 2820 and in contact 2825 with the engagement surface 2825. Moreover, the arrangement of the engagement

member 2845 and the energy storage members 2850 allows the engagement member 2845 to roll along the engagement surface 2825. When a force is exerted on the first arm 2820 the second arm 2840 by the patient, the first arm 2820 and the second arm 2840 pivot about the second coupling portion 2812 towards one another. The pivoting of the first arm 2820 and the second arm 2840 moves the engagement member 2845 along the engagement surface 2825 and further moves the energy storage members 2850 for a configuration of lower potential energy to a configuration of higher potential energy (e.g., compresses a gas strut). Thus, the energy storage members 2850 can absorb at least a portion of a force exerted of the patient attachment mechanism 2800. Moreover, when the force exerted on the patient attachment mechanism 2800 is less than the potential energy of the energy storage members 2850 in the second configuration, the energy storage members 2850 can move towards their first position to pivot the first arm 2820 and the second arm 2840 away from one another. In use, the patient support system 2000 can be used to actively support at least a portion of the body weight of a patient that is coupled thereto. For example, in some instances, a patient is coupled to the patient attachment mechanism 2800 which, in turn, is coupled to the second end portion 2507 of the tether 2505, as described above. In this manner, the support system 2000 (e.g., the tether 2505, the trolley 2100, and the support rail 2050) can support at least a portion of the body weight of the patient. Ex-1009, [0140]-[0147].	member 2845 and the energy storage members 2850 allows the engagement member 2845 to roll along the engagement surface 2825. When a force is exerted on the first arm 2820 the second arm 2840 by the patient, the first arm 2820 and the second arm 2840 pivot about the second coupling portion 2812 towards one another. The pivoting of the first arm 2820 and the second arm 2840 moves the engagement member 2845 along the engagement surface 2825 and further moves the energy storage members 2850 for a configuration of lower potential energy to a configuration of higher potential energy (e.g., compresses a gas strut). Thus, the energy storage members 2850 can absorb at least a portion of a force exerted of the patient attachment mechanism 2800. Moreover, when the force exerted on the patient attachment mechanism 2800 is less than the potential energy of the energy storage members 2850 in the second configuration, the energy storage members 2850 can move towards their first position to pivot the first arm 2820 and the second arm 2840 away from one another. In use, the patient support system 2000 can be used to actively support at least a portion of the body weight of a patient that is coupled thereto. For example, in some instances, a patient is coupled to the patient attachment mechanism 2800, which, in turn, is coupled to the second end portion 2507 of the tether 2505, as described above. In this manner, the support system 2000 (e.g., the tether 2505, the trolley 2100, and the support rail 2050) can support at least a portion of the body weight of the patient. Ex-1001, 33:23-34:48.

While the patient support system 2000 is described above with reference to FIGS. 2-34 as actively supporting a portion of the body weight of the patient, in some embodiments, a patient support system can passively (i.e., not actively) support a portion of the body weight of a patient. For example, FIGS. 35 and 36 illustrate a body weight support system 3900 according to an embodiment. The body weight support system 3900 (also referred to herein as "support system") can be used to support a portion of a patient's body weight, for example, during gait therapy, gait training, or the like. The support system 3900 can be movably coupled to a support track (not shown) that is configured to support the weight of the support system 3900 and the weight of the patient utilizing the support system 3900. The support track can be, for example, similar to or the same as the support track 2050 described above.	While the patient support system 2000 is described above with reference to FIGS. 2-34 as actively supporting a portion of the body weight of the patient, in some embodiments, a patient support system can passively (i.e., not actively) support a portion of the body weight of a patient. For example, FIGS. 35 and 36 illustrate a body weight support system 3900 according to an embodiment. The body weight support system 3900 (also referred to herein as "support system") can be used to support a portion of a patient's body weight, for example, during gait therapy, gait training, or the like. The support system 3900 can be movably coupled to a support track (not shown) that is configured to support the weight of the support system 3900 and the weight of the patient utilizing the support system 3900. The support track can be, for example, similar to or the same as the support track 2050 described above.
The support system 3900 includes a first coupling portion 3910 and a second coupling portion 3940. The first coupling portion 3910 is configured to movably couple to the support track, as described above. The first coupling portion 3910 includes a first side assembly 3911, a second side assembly 3921, and a base 3930. The first side assembly 3911 includes a set of drive wheels 3912, a set of guide wheels 3913, an outer wall 3914, an inner wall 3915, and a set of couplers 3916. The couplers 3916 are configured to extend between the outer wall 3914 and the inner wall 3915 to couple the outer wall 3914 and the inner wall 3915 together. The outer wall 3914 is further coupled to the base 3930. The drive wheels 3912 are arranged into an upper set of drive wheels 3912 configured to be disposed on a top surface of the support track, and a lower set of drive wheels 3912 configured to be disposed on a bottom surface of the support track. In this manner, the drive wheels 3912 roll along a horizontal portion of the support track (not shown in FIGS. 35 and	The support system 3900 includes a first coupling portion 3910 and a second coupling portion 3940. The first coupling portion 3910 is configured to movably couple to the support track, as described above. The first coupling portion 3910 includes a first side assembly 3911, a second side assembly 3921, and a base 3930. The first side assembly 3911 includes a set of drive wheels 3912, a set of guide wheels 3913, an outer wall 3914, an inner wall 3915, and a set of couplers 3916. The couplers 3916 are configured to extend between the outer wall 3914 and the inner wall 3915 to couple the outer wall 3914 and the inner wall 3915 together. The outer wall 3914 is further coupled to the base 3930. The drive wheels 3912 are arranged into an upper set of drive wheels 3912 configured to be disposed on a top surface of the support track, and a lower set of drive wheels 3912 configured to be disposed on a bottom surface of the support track. In this manner, the drive wheels 3912 roll along a horizontal portion of the support track (not shown in FIGS. 35 and

36). The guide wheels 3913 are arranged in a perpendicular orientation relative to the drive wheels 3912 and are configured to roll along a vertical portion of the support track (e.g., as similarly described above with reference to FIG. 23.	36). The guide wheels 3913 are arranged in a perpendicular orientation relative to the drive wheels 3912 and are configured to roll along a vertical portion of the support track (e.g., as similarly described above with reference to FIG. 23.
The second side assembly 3921 includes a set of drive wheels 3922, a set of guide wheels 3923, an outer wall 3924, an inner wall 3925, and a set of couplers 3916. The first side assembly 3911 and the second side assembly 3921 are substantially the same and arranged in a mirrored configuration. Therefore, the second side assembly 3921 is not described in further detail herein and should be considered the same as the first side assembly 3921 unless explicitly described.	The second side assembly 3921 includes a set of drive wheels 3922, a set of guide wheels 3923, an outer wall 3924, an inner wall 3925, and a set of couplers 3916. The first side assembly 3911 and the second side assembly 3921 are substantially the same and arranged in a mirrored configuration. Therefore, the second side assembly 3921 is not described in further detail herein and should be considered the same as the first side assembly 3921 unless explicitly described.
As shown in FIG. 36, the second coupling portion 3940 includes a cylinder 3941, an attachment member 3945, a piston 3950, and an energy storage member 3960. The cylinder 3941 is coupled to the base 3930 and is configured to house the spring 3960 and at least a portion of the piston 3950. More specifically, the cylinder 3941 defines an opening 3942 at an end portion, opposite the base 3930, through which at least a first end portion 3951 of the piston 3950 can move. The piston 3950 further has a second end portion 3952 that is in contact with a portion of the energy storage member 3960. The energy storage member 3960 can be any suitable device configured to move between a first configuration having lower potential energy and a second configuration having a higher potential energy. For example, as shown in FIG. 36, the energy storage member 3960 can be a spring that is compressed when moved to its second configuration.	As shown in FIG. 36, the second coupling portion 3940 includes a cylinder 3941, an attachment member 3945, a piston 3950, and an energy storage member 3960. The cylinder 3941 is coupled to the base 3930 and is configured to house the spring 3960 and at least a portion of the piston 3950. More specifically, the cylinder 3941 defines an opening 3942 at an end portion, opposite the base 3930, through which at least a first end portion 3951 of the piston 3950 can move. The piston 3950 further has a second end portion 3952 that is in contact with a portion of the energy storage member 3960. The energy storage member 3960 can be any suitable device configured to move between a first configuration having lower potential energy and a second configuration having a higher potential energy. For example, as shown in FIG. 36, the energy storage member 3960 can be a spring that is compressed when moved to its second configuration.
The attachment mechanism 3945 includes a first coupling portion 3946 that is coupled to the first end portion 3951 of the piston 3950, and a second coupling portion 3947 that can	The attachment mechanism 3945 includes a first coupling portion 3946 that is coupled to the first end portion 3951 of the piston 3950, and a second coupling portion 3947 that can

be coupled to, for example, a harness worn by a patient. As shown in FIGS. 35 and 36, the second end portion 3952 can be an annular protrusion. In this manner, a portion of the harness such as a hook or the like can be at least partially disposed within the opening defined by the second coupling portion 3947 to couple the patient to the support system 3900. Ex-1009, [0153]-[0157].	be coupled to, for example, a harness worn by a patient. As shown in FIGS. 35 and 36, the second end portion 3952 can be an annular protrusion. In this manner, a portion of the harness such as a hook or the like can be at least partially disposed within the opening defined by the second coupling portion 3947 to couple the patient to the support system 3900. Ex-1001, 36:27-37:33.

142. Accordingly, in my opinion Erturk discloses 1[pre(iii)] and the entirety of 1[pre].

b. Element 1[a]

1[a]	*defining a reference length of the tether when the attachment device is in an initial position;*

143. In my opinion, the combination of Erturk and Vector teaches ***defining a reference length of the tether when the attachment device is in an initial position*** as recited in 1[a], at least because Vector teaches setting a "zero point" that defines a reference corresponding to the length of the tether used to measure relative changes in a patient's position, including as I further explain below. *See* Ex-1010, pp. 19-20.

144. To begin, the 316 patent teaches that "defin[ing] a threshold length of a tether" can be done by a therapist providing input to "define a 'zero point" or reference point associated with a neutral position … which in turn … corresponds to a determined or determinable length of the tether." Ex-1001, 68:50-61. The 316 patent further provides:

> As shown in FIGS. 59 and 60, in some embodiments, the default fall limit and/or the default threshold amount of lengthening of the tether can be, for example, about 4 inches (in.). After a length of the tether has been increased beyond the threshold (e.g., after a patient and/or user has descended (fallen) beyond the fall limit), the support system can transition to a support configuration in which the tether can be locked and/or a tracking system or drive system is deactivated (e.g., a support configuration or fall prevention

configuration). In some instances, **the patient, user, and/or clinician can adjust the fall limit and/or threshold by engaging the graphical interface** shown, for example, in the screenshot 904A of FIG. 60 (e.g., by pressing one or more on-screen buttons and/or otherwise by selecting a predetermined fall limit, threshold, and/or criterion). As shown, the adjusted value, limit, and/or threshold can be presented on the graphical interface (e.g., in text or via one or more images).

In some embodiments, for example, the fall limit and/or threshold can be between about 1.0 in. and about 36.0 in. In such embodiments, setting the fall limit to 1.0 in. can be such that the support system provides the highest level of support (e.g., allows the least amount of falling prior to initiating support of the patient), and setting the fall limit to 36.0 in. can be such that the support system provides the lowest level of support (e.g., allows the most amount of falling prior to initiating support of the patient). In some embodiments, the fall limit and/or threshold can be adjusted by increments of about 1.0 in. In other embodiments, the adjustment increments can be greater than 1.0 in. or less than 1.0 in. In some instances, the fall limit and/or threshold can be adjusted and/or changed while the support system is in use or between uses. Moreover, in some instances, the support system and/or electronics assembly can be configured to calculate and/or determine a height of, for example, a patient attachment mechanism and data associated with the height can be graphically represented on a display. For example, as shown in FIGS. 59 and 60, a height of the tether, patient, and/or patient attachment mechanism can be graphically represented on a bar graph or the like relative to the fall limit and/or threshold, which can allow for substantially real time visualization of a user's performance or the like.

In some embodiments, **an administrator or user can program and/or set an initial tether length or the like corresponding to a predetermined and/or desired height of a patient attachment mechanism** (e.g., the patient attachment mechanism 2800 described above with reference to FIG. 34). More specifically, the user and/or administrator can input and/or can provide patient information such as, for example, height, weight, etc. Based on the user's height, the support system can be configured to calculate a predetermined and/or desired height or position (e.g., in the y-direction) of the patient attachment mechanism when attached to the tether and a harness worn by the user. In this manner, **the predetermined and/or desired position of the patient attachment mechanism (e.g., a neutral position or "zero point") can be, for example, a reference point or the like against which a current position of the patient attachment mechanism can be compared**. If, for example, the patient attachment mechanism is higher than the zero point, a level or amount of support may be reduced (e.g., to reduce an amount of tension in the tether and/or to otherwise allow for more "slack" in the tether) and/or the patient support system may be reset to define a new zero point. Conversely, if the patient attachment

> mechanism is below the zero point, a level or amount of support may be increased (e.g., to increase an amount of tension in the tether and/or to otherwise reduce an amount of slack in the tether).

Ex-1001, 57:12-58:36.

145. Moreover, as recognized in the ’316 patent, the starting position of a gait therapy exercise may vary from one patient to the next (e.g., based on height of the patient), and that the range of positions may vary from one exercise to the next (e.g., based on the vertical range anticipated for a given exercise: for instance, squat exercises may have a larger vertical range than mere walking exercises). See, e.g., Ex-1001, 2:1-8, 5:44-6:17, 12:11-18, 59:29-31, 68:50-61. Because of these variations, in order to measure changes in a particular patient’s position as the patient performs an exercise, it is helpful to define a reference point corresponding to the length of the tether in patient’s starting position. That is, the initial length of the tether when the user is in a neutral position can serve as a reference point against which to measure changes relevant to that given patient and/or exercise. *Id*., 68:50-61. The ’316 patent refers to defining this reference length of the tether as “defin[ing] a zero point.” *Id*. Changes in position/length can then be measured against this reference. *Id*., 68:50-69:32.

146. Based on my review, it is my opinion that Vector teaches the recited step of ***defining a reference length of the tether when the attachment device is in an initial position*** in the same way it is taught in the ’316 patent. Just like the ’316 patent, Vector teaches setting “a zero point” that “represents the location of the rope when DBWS [Dynamic Body Weight Support] is activated.” Ex-1010, p.19-20, 34.

Fall Limit Detection

During a training session the Vector Elite System will detect and prevent a fall when the fall distance from the zero point is greater than the set Fall Limit value. When the system detects and prevents a fall the trolley is locked and placed into Static Unload mode.

1. Vector Elite System detects a fall and the Fall Prevented window appears in the software. See Figure 5-10.
2. Press the Manual Controls winch up button to help the patient regain control, so they are in a standing position. Or if necessary use the Emergency Lower button to lower the patient to the ground.
3. Close the Fall Prevented window and if the patient is in a standing position press the Dynamic Body Weight Support button and (if applicable) the Trolley Tracking button to resume the training session.

Ex-1010, 20 (annotations added).

Adjusting the fall limit value during a training session:
The fall limit can be adjusted while the patient is in Dynamic Body Weight Support mode or Trolley Tracking mode.

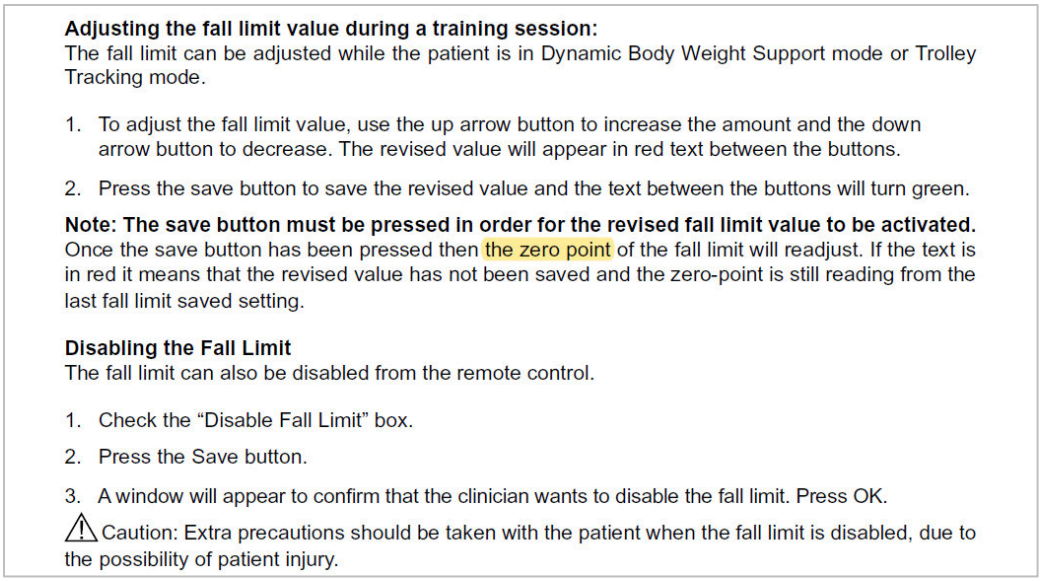
1. To adjust the fall limit value use the plus and minus buttons and the revised value will appear in red text between the buttons.
2. Press the save button to save the revision and the text between the buttons will turn green.

Note: The save button must be pressed in order for the revised fall limit value to be activated. Once the save button has been pressed then the zero point of the fall limit will readjust. The zero point represents the location of the rope when DBWS is activiated. If the text is in red it means that the revised value has not been saved and the zero-point is still reading from the last fall limit saved setting.

vector ELITE

Note: It is suggested that at the start of each exercise that the save button is pressed to ensure that the zero-point of the fall limit value has been readjusted.

Ex-1010, 19-20 (annotations added).



Adjusting the fall limit value during a training session:
The fall limit can be adjusted while the patient is in Dynamic Body Weight Support mode or Trolley Tracking mode.

1. To adjust the fall limit value, use the up arrow button to increase the amount and the down arrow button to decrease. The revised value will appear in red text between the buttons.
2. Press the save button to save the revised value and the text between the buttons will turn green.

Note: The save button must be pressed in order for the revised fall limit value to be activated.
Once the save button has been pressed then the zero point of the fall limit will readjust. If the text is in red it means that the revised value has not been saved and the zero-point is still reading from the last fall limit saved setting.

Disabling the Fall Limit
The fall limit can also be disabled from the remote control.

1. Check the "Disable Fall Limit" box.
2. Press the Save button.
3. A window will appear to confirm that the clinician wants to disable the fall limit. Press OK.

⚠ Caution: Extra precautions should be taken with the patient when the fall limit is disabled, due to the possibility of patient injury.

Ex-1010, 34 (annotations added).

As shown above and disclosed in Vector, the "zero point" can be set at the start of each individual exercise by pressing the "save" button—"[o]nce the save button has been pressed then the zero point of the fall limit will readjust." Ex-1010, p.19; *see also id.*, p.20 ("It is suggested that at the start of each exercise that the save button is pressed to ensure that the zero-point of the fall limit value has been readjusted."). Setting the "zero point" thus defines the length of the tether at an initial position (e.g., at the start of an exercise) to act as a reference. Ex-1010, p.19-20, 34.

147. Once the "zero point" and "fall limit" have been set, the Vector system is equipped to measure changes in the patient's position as the patient performs an exercise. The reference length is used to evaluate the magnitude of such changes, including to evaluate how far a patient descends during their exercises. *See* Ex-1010, p.18 (discussing calculating the amount of descent by using the zero point reference length of the "rope" (which is Vector's language for the tether)). For example, the reference length can be used to determine whether the tether has extended by more than a threshold amount (e.g., 36 inches) from a set zero point, which may

indicate that a patient is falling: "[d]uring a training session the Vector Elite System will detect and prevent a fall when the fall **distance from the zero point** is greater than the set Fall Limit value." Ex-1010, p.20; *see also* Ex-1010, p.18 (discussing fall limits between 4.0 inches and 36 inches, which are measurements relative to the "zero point" corresponding to the reference length of the tether when the system is initialized for a patient at the outset of a training session).

148. In my opinion, Vector thus teaches ***defining a reference length of the tether*** (by setting a "zero point") ***when the attachment device is in an initial position*** ("at the start of each exercise … ensure that the zero-point of the fall limit value has been readjusted").

149. Thus, in my opinion Vector discloses and renders obvious Element 1[a].

c. Element 1[b]

1[b]	*defining a threshold length of the tether;*

150. In my opinion, the combination of Erturk and Vector teaches ***defining a threshold length of the tether*** because Vector teaches defining a "fall limit," which is ***a threshold length of the tether*** measured relative to the "zero point" that I discussed above for Element 1[a].

151. To begin with the context of the '316 patent, the '316 patent notes that in addition to setting a "zero point" (to ***define a reference length of the tether***), the '316 patent explains that "the user, therapist, trainer, etc. can provide an input, selection, instruction, etc. operable to cause the support system to **define a threshold length of the tether** that is associated with and/or otherwise is indicative of the user falling during the gait training." Ex-1001, 57:27-31; *see also* 57:12-58:67. As an example of such a threshold length, the '316 patent discloses a "fall limit." *Id.*, 57:12-58:67. In particular, '316 patent explains that the "user … can set a fall limit (e.g., a criterion or threshold) that corresponds to a threshold amount a length of the tether can be

increased prior to the support system providing support for the patient." *Id*. Thereby, "a user, … can set a fall tolerance and/or maximum distance that a user can fall prior to the support system providing support." *Id*. In particular, the '316 patent recites:

> In some instances, the patient, user, therapist, and/or trainer can set **a fall limit (e.g., a criterion or threshold) that corresponds to a threshold amount a length of the tether** can be increased prior to the support system providing support for the patient. In other words, a user, therapist, trainer, etc. can set a fall tolerance and/or maximum distance that a user can fall prior to the support system providing support.

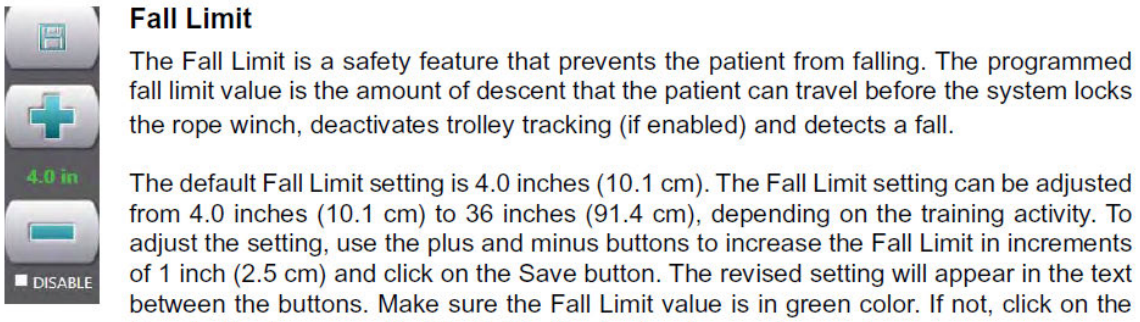
Ex-1001, 57:27-34 (emphasis added).

> As shown in FIGS. 59 and 60, in some embodiments, the default fall limit and/or **the default threshold amount of lengthening of the tether can be, for example, about 4 inches (in.).** After a length of the tether has been increased beyond the threshold (e.g., after a patient and/or user has descended (fallen) beyond the fall limit), the support system can transition to a support configuration in which the tether can be locked and/or a tracking system or drive system is deactivated (e.g., a support configuration or fall prevention configuration). In some instances, the patient, user, and/or clinician can adjust the fall limit and/or threshold by engaging the graphical interface shown, for example, in the screenshot 904A of FIG. 60 (e.g., by pressing one or more on-screen buttons and/or otherwise by selecting a predetermined fall limit, threshold, and/or criterion). As shown, the adjusted value, limit, and/or threshold can be presented on the graphical interface (e.g., in text or via one or more images).
>
> In some embodiments, for example, **the fall limit and/or threshold can be between about 1.0 in. and about 36.0 in. In such embodiments, setting the fall limit to 1.0 in. can be such that the support system provides the highest level of support (e.g., allows the least amount of falling prior to initiating support of the patient), and setting the fall limit to 36.0 in. can be such that the support system provides the lowest level of support (e.g., allows the most amount of falling prior to initiating support of the patient).** In some embodiments, the fall limit and/or threshold can be adjusted by increments of about 1.0 in. In other embodiments, the adjustment increments can be greater than 1.0 in. or less than 1.0 in. In some instances, the fall limit and/or threshold can be adjusted and/or changed while the support system is in use or between uses. Moreover, in some instances, the support system and/or electronics assembly can be configured to calculate and/or determine a height of, for example, a patient attachment mechanism and data associated with the

> height can be graphically represented on a display. For example, as shown in FIGS. 59 and 60, a height of the tether, patient, and/or patient attachment mechanism can be graphically represented on a bar graph or the like relative to the fall limit and/or threshold, which can allow for substantially real time visualization of a user's performance or the like.

Ex-1001, 57:35-58:9 (emphasis added).

152. Vector discloses this exact same implementation as the ’316 patent, even down to the default “fall limit” amount of 4.0 inches, and the maximum “fall limit” amount of 36.0 inches. Likewise, Vector teaches that a therapist can define a “Fall Limit value” that corresponds to “the amount of descent that the patient can travel before the system locks the rope winch, deactivates trolley tracking (if enabled) and detects a fall.” Ex-1010, 18.



Ex-1010, 18.

Vector’s “fall limit value” acts as a ***threshold*** for taking action to prevent a patient from falling, the “fall limit” corresponding directly to a length of the rope (***tether***) that has been extended out of the winch of the trolley. *See e.g.*, Ex-1010, 14. Vector explains that “[d]uring a training session the Vector Elite System will detect and prevent a fall when the fall distance from the zero point is greater than the set Fall Limit value” (***threshold length of the tether***). Ex-1010, 17-20. And just like the ’316 patent, Vector teaches that the “fall limit value” is set as a ***length of the***

tether. For example, the "fall limit value" threshold may be "adjusted from 4.0 inches (10.1 cm) to 36 inches (91.4 cm)." *Id*., 18 ("[t]he default Fall Limit setting is 4.0 inches (10.1 cm) … [and] can be adjusted from 4.0 inches (10.1 cm) to 36 inches (91.4 cm), depending on the training activity."); *see also id.*, 18 ("[t]o adjust the setting, use the plus and minus buttons to increase the Fall Limit in increments of 1 inch (2.5 cm) and click on the save button."). Vector includes a section called "Starting a Training Session," which notes that the 4.0 inch setting is the "default setting." Thus, if a 4.0 inch Fall Limit is not suitable for a given patient (based on their stature) or a given exercise (based on the anticipated vertical range of movement in the exercise), the therapist or other user should "adjust the fall limit value using the plus and minus buttons" as Vector suggests. *See* Ex-1010, p.18 (discussing default settings at the beginning of a training session):

Starting a Training Session

Note: During a training session a clinician should stay by the PC computer in order to operate the Vector Elite System software controls. Another clinician/assistant should stay by the patient to ensure their safety during the session.

1. At a start of a training session the dynamic unloading amount will be the default setting of 10 lbs (4.5 kg). To adjust the dynamic unloading value, use the plus and minus buttons. The revised value will display in the text between the buttons.
2. At a start of a training session the fall limit value will be the default setting of 4.0 inches (10.1 cm). If necessary adjust the fall limit value using the plus and minus buttons. Then press the save button to save the revised value, which will display in the text between the buttons.
3. To activate the Trolley Tracking, apply at least 10 lbs (4.5 kg) of load and press the button. The Trolley Tracking button will go from green to red indicating that the feature is turned on. See Figure 5-8.

153. Thus, in my opinion Vector's disclosure of defining a "fall limit" representing "maximum distance that a user can fall prior to the support system providing support" is consistent with ***defining a threshold length of the tether*** as disclosed and claimed in the '316 patent. Indeed, it is my opinion that a POSITA would have understood Vector's disclosure of the "fall limit" as disclosing ***defining a threshold length of the tether*** because the "fall limit"

corresponds directly to a length of Vector's rope (***tether***) that has been extended or drawn out of the trolley (e.g., by being uncoiled from the winch). *See e.g.*, Ex-1010, 14-18.

154. Accordingly, in my opinion Vector discloses 1[b].

d. Element 1[c]

1[c]	*providing a first amount of body weight support during the gait training as the user moves relative to a surface and the length of the tether is less than the threshold length of the tether;*

155. In my opinion, the combination of Erturk and Vector discloses and renders obvious ***providing a first amount of body weight support during the gait training as the user moves relative to a surface and the length of the tether is less than the threshold length of the tether***, at least because Vector teaches setting the BWS system to provide a specified amount of body weight support while the length of its rope (i.e., its tether) is less than the preset "fall limit value."

156. In my opinion Vector discloses the very same type of active/dynamic body weight support provided to the user (***a first amount of body weight support***) as taught in the '316 patent in connection with this limitation. See, e.g., Ex-1001, 12:9-66, 12:12-58, 12:25-32, 12:35-64.

157. In my opinion, Vector discloses the exact same type of active body weight support (***a first amount of body weight support***). Ex-1010, 17-18. Vector refers to such support as "Dynamic Body Weight Support (DBWS)," and explains that the "desired value" of "dynamic body weight support" can be set by a clinician. *Id* ("the trolley will make adjustments to the rope to keep the dynamic unloading at the desired value."). Vector teaches that the "desired value" is typically set as some "percent[age] of [the patient's] body weight" (exactly as discussed in the '316 patent). *Id.*; *compare* Ex-1001, 70:17-23; 12:52-56. And just like the '316 patent explains with respect to its active support, Vector explains that "[w]hen activated the Dynamic Body

Weight Support (DBWS) feature keeps the rope tension at a desired value." *Id*. 17; *see also* Ex-1001, 12:26-35.

158. Moreover, Vector teaches that "[a]s the patient moves," naturally making slight upward and downward movements relative to the "ground" (***as the user moves relative to a surface***) as they practice "over-ground walking" during gait training, "the trolley will make adjustments to the rope to keep the dynamic unloading at the desired value." Ex-1010, 1, 2, 17, 18-20. This "desired value" is provided to the patient constantly throughout their gait training session – including during "over-ground walking" – until a fall is detected, at which point the system provides the patient with a greater amount of support to stop the fall (i.e., an amount of support at least as great as the patient's total body weight), which I describe further below with reference to Element 1[d]. *Id*; *see also* Section VII.A.3.e. Said differently, Vector teaches that the "desired value" of the body weight support "will remain on until … a fall is detected," at which point more support is provided to prevent the fall. Ex-1010 p. 17; *see also* Section VII.A.3.e, below (discussing how the additional support is provided by the BWS system when the "fall limit" threshold is exceeded).

159. In my opinion, a POSITA would have understood Vector to disclose and render obvious ***providing a first amount of body weight support*** (the "desired value" of "unloading" for the DBWS feature) ***during the gait training as the user moves relative to a surface*** (as the patient walks along a path) ***and the length of the tether is less than the threshold length of the tether*** (the length of the tether is less than the length corresponding to the fall limit).

160. Moreover, although Vector squarely teaches Element 1[c], it is also my opinion that Erturk independently teaches providing ***a first amount of body weight support*** as well, at least because it discloses providing "active[]" support as the patient ambulates. Indeed, Erturk

discloses providing a "force such that the tension within the tether is substantially unchanged" as the user ambulates, including "over and across level ground." Ex-1009, [0071], [0063]. In my opinion, the "tension" provided by Erturk's BWS as the user ambulates before falling is ***a first amount of body weight support*** as claimed.

161. Thus, in my opinion, it would have been obvious to a POSITA that prior to a fall being detected, Erturk's BWS system would provid[e] a first amount of body weight support – such as the "DBWS" support of Vector or the "active" support of Erturk – to support the patient while they perform therapy exercises in the desired fashion (with falling not being desired).

162. Accordingly, in my opinion Vector alone, and/or Erturk in view of Vector, each discloses Element 1[c].

e. Element 1[d]

1[d]	*providing a second amount of body weight support during the gait training as the user moves relative to the surface and the length of the tether is greater than the threshold length of the tether,*

163. In my opinion, the combination of Erturk and Vector teaches Element 1[d] because Vector teaches locking the tether – providing full-stop support – when the length of the tether exceeds the "fall limit value" threshold as the patient walks along a path.

164. By way of background, the '316 patent recognizes that if the patient's movements go beyond the predefined "range of motion," the patient is likely falling and in need of additional support. *See, e.g.,* Ex-1001, 12:19-64, *see also id*, 57:35-58:11. Specifically, the '316 patent teaches that after a length of the tether has been increased beyond the threshold (when the patient has stumbled and fallen beyond the fall limit), the support system transitions to a support configuration in which the tether is locked and/or a tracking system or drive system is deactivated," *See, e.g.*, Ex-1001, 57:35-58:11:

> As shown in FIGS. 59 and 60, in some embodiments, the default fall limit and/or the default threshold amount of lengthening of the tether can be, for example, about 4 inches (in.). After a length of the tether has been increased beyond the threshold (e.g., after a patient and/or user has descended (fallen) beyond the fall limit), the support system can transition to a support configuration in which **the tether can be locked and/or a tracking system or drive system is deactivated** (e.g., a support configuration or fall prevention configuration). In some instances, the patient, user, and/or clinician can adjust the fall limit and/or threshold by engaging the graphical interface shown, for example, in the screenshot 904A of FIG. 60 (e.g., by pressing one or more on-screen buttons and/or otherwise by selecting a predetermined fall limit, threshold, and/or criterion). As shown, the adjusted value, limit, and/or threshold can be presented on the graphical interface (e.g., in text or via one or more images).

Ex-1001, 57:35-58:11 (emphasis added).

165. In my opinion, Vector discloses the same "lock[ing]" type support (***a second amount of body weight support***) as taught in the '316 patent in connection with this limitation. Ex-1010, 18-20. Just like the '316 patent , Vector teaches that when a patient falls – moving downward relative to the "ground" (***as the user moves relative to the surface***) as they practice "over-ground" gait training (***during the gait training***) – and the rope exceeds to or beyond the "fall limit" (***the length of the tether is greater than the threshold length of the tether***), then the "system locks the rope winch" (***providing a second amount of body weight support***), thereby catching the user before they hit the ground. *Id*., p.18 ("[t]he programmed fall limit value is the amount of descent that the patient can travel before the system locks the rope winch, deactivates trolley tracking (if enabled) and detects a fall").

166. In my opinion, a POSITA would have understood that locking the rope winch provides additional body weight support (***providing a second amount of body weight support***) above and beyond the "desired value" provided during non-fall activities as set by the clinician (the ***first amount of body weight support***). Additionally, in my opinion a POSITA would have

also understood that the additional support provided by "lock[ing] the rope winch" would be more than the preset "desired value" for normal exercise patterns, and could be up to and include the full weight of the patient plus the harness (up to the maximum physical capacity of the mechanical components). Indeed, the primary purpose of locking the winch in this scenario is to provide such additional support (beyond the "desired value") to "prevent[] the patient from falling" and ultimately hitting the ground with a force that could result in injury. Ex-1010, p.18.

167. In my opinion, when the "system locks the rope winch," the system provides an amount of support that is great enough to stop the patient's fall (beyond the "fall limit"), where the earlier provided "desired value" of dynamic support was insufficient to stop the patient's fall and would permit a descent to the fall limit. Ex-1010, 18. Said differently, in my opinion, because: (1) the "desired value" of the "dynamic unloading" tension (the ***first amount of body weight support***, discussed with reference to Element 1[c]) is some percentage of the patient's body weight that allows the user to fall to the fall limit (necessarily less than 100% of the patient's body weight), and because (2) stopping the user by "lock[ing] the rope winch" necessarily delivers additional support (e.g., up to and including the full weight of the patient plus the harness) in order to prevent further descent during the fall, Vector clearly discloses providing ***a second amount of body weight support*** that is different than the ***first amount of body weight support***, consistent with the criteria for providing the same as recited in the claim. Ex-1010, 18.

168. Moreover, for the reasons set forth in Section VII.A.2, above, in my opinion a POSITA would have been motivated to modify the BWS system of Erturk to incorporate Vector's teaching of Element 1[d].

169. Moreover, although Vector squarely teaches Element 1[c], it is also noteworthy and I render it as my opinion that Erturk teaches ***providing a second amount of body weight support*** as well, including at least because it teaches that the "active" body weight support (which I noted in Element 1[c]) can be adjusted in response to a patient falling. In particular, when a user falls and the additional downward force of their body on the tether increases, Erturk's BWS can "respond to [the] change in force exerted on the tether … to actively limit the magnitude of the fall of the patient." Ex-1009, [0071]; *see also id*., [0152]-[0153].

> In some embodiments, the pulley system can include at least one pulley that is configured to move (e.g., pivot, translate, swing, or the like). For example, the pulley can be included in or coupled to a cam mechanism (not shown) that is configured to define a range of motion of the pulley. In such embodiments, the movement of the at least one pulley can coincide and/or be caused by a force exerted on the attachment mechanism 1800. For example, in some instances, the patient can move relative to the trolley 1100 such that the force exerted on the tether by the weight of the patient is changed (e.g., increased or decreased). In such instances, the pulley can be moved according to the change in the force such that the tension within the tether is substantially unchanged. Moreover, with the pulley included in or coupled to the cam mechanism, the movement of the pulley can move the cam through a predetermined range of motion. In some embodiments, the electronic system 1700 can include a sensor or encoder operatively coupled to the pulley and/or the cam that is configured to determine the amount of movement of the pulley and/or the cam. In this manner, the electronic system 1700 can send a signal to the motor included in the winch associated with coiling or uncoiling the tether around the drum in accordance with the movement of the pulley. **For example, the pulley can be moved in a first direction in response to an increase in force exerted on the tether and the electronic system 1700 can send a signal to the motor of the winch associated with rotating the drum to uncoil a portion of the tether from the drum. Conversely, the pulley can be moved in a second direction, opposite the first direction, in response to a decrease in force exerted on the tether and the electronic system 1700 can send a signal to the motor of the winch associated with rotating the drum to coil a portion of the tether about the drum.** Thus, **the support mechanism 1500 can be configured to exert a reaction force in response to the force exerted by the patient such that the portion of the body weight supported by the support system 1000 remains substantially unchanged**. Moreover, by actively supporting the portion of the body weight of the patient, the support system 1000 can limit the likelihood and/or the magnitude of a fall of the

> patient supported by the support system 1000. **Similarly stated, the support mechanism 1500 and the electronic system 1700 can respond to a change in force exerted on the tether in a relatively short amount of time (e.g., much less than a second) to actively limit the magnitude of the fall of the patient**.

Ex-1009, [0071] (emphasis added).

Based at least on this teaching, in my opinion it would have been obvious to a POSITA that, after a fall is detected, Erturk's BWS system (in combination with Vector as described above) would ***provid[e] a second amount of body weight support*** to provide more support to the patient in an attempt to avoid the injury that might otherwise be caused by the patient making forceful impact with the surface they are traversing (e.g., ground, treadmill, ramp, stairs, etc.). It would have been obvious to a POSITA that this ***second amount of body weight support*** could be, for example, the full body weight support of Vector's "lock[ing] the rope winch," or the increased body weight support of Erturk's "active" support mechanism that changes within a matter of seconds in response to the added downward force present during a fall. *Id*.

170. Accordingly, in my opinion either Vector alone, or Erturk in view of Vector, discloses Element 1[d].

f. Element 1[e]

1[e]	*the drive assembly configured to move the body weight support system relative to the support track to maintain the body weight support system in a substantially overhead position relative to the user as the user moves relative to the surface; and*

171. In my opinion, Erturk teaches Element 1[e] at least because Erturk teaches an overhead trolley tracking feature that uses drive assemblies that move a trolley suspended from a support track to keep the trolley substantially above the patient, in a substantially overhead position, as the patient ambulates, including as I detail below.

172. As I explained previously, Erturk's aforementioned drive assemblies are coupled to a trolley in a manner that enables the functionality recited in 1[e]. Ex-1010, 18-20. See my discussion of 1[pre(ii)], above. In short, Erturk includes two drive assemblies that, under the control of a motor, movably suspend the trolley from the overhead support track.

173. Erturk further discloses that the "trolley 2100 can be configured to remain substantially over-head of the patient." *See, e.g.*, Ex-1009, [0149]. Erturk explains that this feature can be provided by "controlling the motor 2311 of the drive system 2300" based on "information received from, for example, the encoder 2470 of the drive system 2300." *Id*., *see also id.* at claims 1, 10, 20; see also my discussion of 1[pre(ii)], *supra*. Thus, in my opinion, Erturk teaches that the drive assemblies are configured to ***maintain the body weight support system in a substantially overhead position relative to the user as the user moves relative to the surface***.

174. Additionally, I note that Erturk discloses the very same overhead trolley tracking feature that is taught in the '316 patent, which also maintains the body weight support system in a substantially overhead position relative to the user as the user moves relative to the surface as claimed. *See, e.g.*, Ex-1009, [0149] *compare* Ex-1001, 34:64-35:34.

175. Notably, Erturk discloses this element in near verbatim fashion to the '316 patent disclosure. By way of example, I provide the following comparable recitations from each (with emphasis added).

'316 patent (Ex-1001), 34:64-35:34	Erturk (Ex-1009), [0149]
With the system parameters entered, the patient can begin, for example, a gait therapy session. In some instances, the trolley 2100 can move along the support structure 2050 (as described above with reference to FIGS. 23 and 26) in response to the movement of the patient. Similarly stated, the trolley 2100 can move along the support structure 2050 as the patient walks. In some instances, **the trolley 2100 can be configured to remain substantially over-head of the patient**. In such instances, the electronic system 2700 can execute a set of instructions associated with controlling the motor 2311 of the drive system 2300 based on information received from, for example, the encoder 2470 of the drive system 2300, the encoder 2561 of the guide mechanism 2540, and/or the encoder 2587 of the cam assembly 2570. For example, the electronic system 2700 can send a signal to the motor 2311 of the drive system 2300 operative in changing the rotational velocity of the drive wheels 2385 based at least in part on information associated with the encoder 2561 of the guide mechanism 2540. Expanding further, in some instances, the patient may walk faster than the trolley 2100, thereby changing the angle of the tether 2505	With the system parameters entered the patient can begin, for example, a gait therapy session. In some instances, the trolley 2100 can move along the support structure 2050 (as described above with reference to FIGS. 23 and 26) in response to the movement of the patient. Similarly stated, the trolley 2100 can move along the support structure 2050 as the patient walks. In some instances, **the trolley 2100 can be configured to remain substantially over-head of the patient**. In such instances, the electronic system 2700 can execute a set of instructions associated with controlling the motor 2311 of the drive system 2300 based on information received from, for example, the encoder 2470 of the drive system 2300, the encoder 2561 of the guide mechanism 2540, and/or the encoder 2587 of the cam assembly 2570. For example, the electronic system 2700 can send a signal to the motor 2311 of the drive system 2300 operative in changing the rotational velocity of the drive wheels 2385 based at least in part on information associated with the encoder 2561 of the guide mechanism 2540. Expanding further, in some instances, the patient may walk faster than the trolley 2100, thereby changing the angle of the tether 2505

and the guide mechanism 2540 relative to the base 2210. Thus, the encoder 2561 of the guide mechanism 2540 can send a signal associated with the angle of the guide mechanism 2540 relative to the base 2210 and upon receiving the signal, the electronic system 2700 can send a signal to the motor 2311 of the drive system 2300 to increase the rotational velocity of the drive wheels 2385. In this manner, the position of the trolley 2100 relative to the patient can be actively controlled based at least in part on a user defined parameter and further based at least in part on information received from the encoder 2470 of the drive system 2300, the encoder 2561 of the guide mechanism 2540, and/or the encoder 2587 of the cam assembly 2570. Although described as being actively controlled to be over-head of the patient, in other instances, the user can define a parameter associated with the trolley 2100 trailing the patient by a desired distance or leading the patient by a desired distance.	and the guide mechanism 2540 relative to the base 2210. Thus, the encoder 2561 of the guide mechanism 2540 can send a signal associated with the angle of the guide mechanism 2540 relative to the base 2210 and upon receiving the signal, the electronic system 2700 can send a signal to the motor 2311 of the drive system 2300 to increase the rotational velocity of the drive wheels 2385. In this manner, the position of the trolley 2100 relative to the patient can be actively controlled based at least in part on a user defined parameter and further based at least in part on information received from the encoder 2470 of the drive system 2300, the encoder 2561 of the guide mechanism 2540, and/or the encoder 2587 of the cam assembly 2570. Although described as being actively controlled to be over-head of the patient, in other instances, the user can define a parameter associated with the trolley 2100 trailing the patient by a desired distance or leading the patient by a desired distance.

176. Thus, it is my opinion that Erturk discloses that the "trolley 2100 can be configured to remain substantially over-head of the patient" just like the '316 patent. *See, e.g.*, Ex-1009, [0149] *compare* Ex-1001, 34:64-35:34.

177. Again, Erturk explains that this feature can be provided by "controlling the motor 2311 of the drive system 2300" – which includes the drive assembly as noted in connection with

1[pre(ii)], supra – "based on information received from, for example, the encoder 2470 of the drive system 2300." *Id*. Accordingly, in my opinion Erturk discloses and renders obvious Element 1[e]. Ex-1009, Claims 1, 10, 20, [0149]; *see also* Section VII.A.3.a, *supra*.

g. Element 1[f]

1[f]	*displaying data associated with the gait training on a display of an electronic device included in the body weight support system.*

178. In my opinion, Erturk teaches, discloses, and renders obvious ***displaying data associated with the gait training on a display of an electronic device included in the body weight support system***. In particular, Erturk teaches that the trolley (***the body weight support system***) includes an "electronic system 1700" (***an electronic device***) that can include a "touch screen" (***a display***) displaying, among other things, "parameters for the support system" for a given training session (***displaying data associated with the gait training***). *See, e.g.*, Ex-1009, [0064], [0079], [0148].

179. To provide further detail, FIG. 1 of Erturk discloses an electronic device ***included in*** the body weight support system because FIG. 1 teaches an "electronic system 1700" (outlined in blue) that is included in the "trolley 1100" (outlined in red):

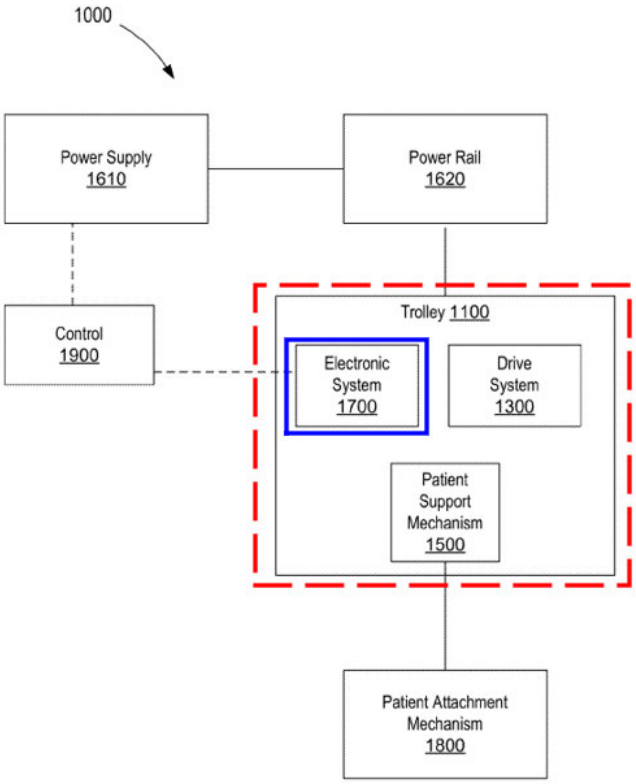


FIG. 1

Ex-1009, Fig. 1 (emphasis added); *compare* with Ex-1001, Fig. 1 (same).

180. Notably, Erturk's Figure 1 discloses this element in identical fashion to embodiments disclosed in the '316 patent. Figure 1 of the '316 patent is shown below, with identical architecture:

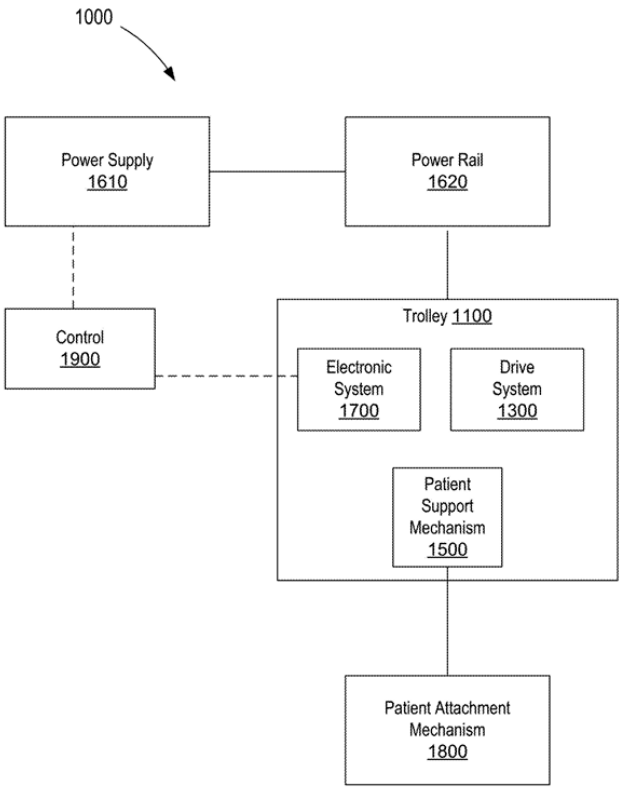


FIG. 1

181. In my opinion, Erturk teaches displaying data associated with the gait training on a display of an electronic device included in the body weight support system because Erturk teaches that "electronic system 1700 can include a user interface (e.g., a touch screen and/or one or more dials, buttons, switches, toggles, or the like)." Ex-1009, [0079].

182. Moreover, in my opinion, a POSITA would have understood that Erturk's user interface displays data associated with the gait training because the user interface is designed to permit a therapist to interact with it to, at the very least, input and receive information concerning the gait training. By way of a nonlimiting example, Erturk teaches that "a user (e.g., a physical therapist, a doctor, a nurse, a technician, etc.) can engage the user interface associated with control 1900 to establish a set of parameters for the support system 1000." Ex-1009, [0079].

Moreover, Erturk teaches that these "system parameters" that a therapist can input (using the touch screen) include data associated with the gait training. Ex-1009, [0148]. For instance, Erturk provides:

> In some instances, a user (e.g., a technician, a therapist, a doctor, a physician, or the like) can input a set of system parameters associated with the patient and the support system 2000. For example, in some embodiments, the user can input a set of system parameters via a remote control device such as, for example, a personal computer, a mobile device, a smart phone, or the like. **In other embodiments, the user can input system parameters on, for example, a control panel included in or on the trolley 2100. The system parameters can include, for example, the body weight of the patient, the height of the patient, a desired amount of body weight to be supported by the support system 2000, a desired speed of the patient walking during gait therapy, a desired path or distance along the length of the support track 2050, or the like**.

Ex-1009, [0148] (emphasis added).

In my opinion, a POSITA would have understood that inputting such data associated with the gait training would also involve displaying the data on the touch screen display/control panel display.

183. In my opinion, Erturk also includes other teachings of ***displaying data associated with the gait training on a display of an electronic device*** as recited. For instance, Erturk teaches that "electronic system 1700" provides video "feedback" to a patient both in "real-time" and "post-session." Ex-1009, [0083]. Erturk further teaches that this visual feedback ("video monitoring") can be correlated to other data associated with the gait training, including the "sensed rope position, speed, tension, etc.," as well as "muscle usage (e.g., leg muscles, torso muscles, etc.)." Ex-1009, [0083], [0183]-[0184]. Thereby, Erturk teaches and suggests Element 1[f] in multiple disclosures.

184. Although Erturk squarely discloses Element 1[f], I note that Vector also teaches Element 1[f], and, in my opinion a POSITA also would have found it obvious to use the touch

screen display/control panel display of Erturk to display the gait training data disclosed in Vector. Vector teaches displaying the same data/parameters discussed in Erturk, as well as others that that a user could input via the touch screen of Erturk:



Figure 5-8: Trolley Tracking and DBWS Active

185. As shown above, Vector teaches displaying, among other data, the very types of data that Erturk addresses in connection with "electronic system 1700." For instance, Vector teaches displaying, e.g., the desired amount of body weight to be supported by the support system (see above in Fig 5-8, showing 10 lbs, or 6%, of the patient's body weight), the speed of the patient's travel during gait therapy (see above in Fig 5-8, showing 0.2 mph by way of example), the distance walked (see above in Fig 5-8, showing 8.7 ft traveled by way of example), and the rope position (see above in Fig 5-8, showing 0.8 in by way of example), among other data associated with the gait training (e.g., fall limit amount and status, number of falls prevented, trolley position setting and range, and training time). Ex-1010, p.19 (Figure 5-8); *compare id. with* Ex-1009, [0079], [0083].

186. In my opinion, it would have been obvious to combine Vector's further teachings of displaying gait training data into Erturk's BWS system (including touch screen/control panel display) because the combination would have amounted to use of a known technique to improve a similar device in the same way. As I noted in Section VII.A.2, above, the BWS systems taught in Erturk and Vector are nearly identical. Moreover, using a display in a BWS system to display data related to gait training therapy was a known and routine feature of such systems. *See, e.g.*, Ex-1014, [0063]-[0066], Figs. 19-21 (together with the discussion of those figures); Ex-1016, Figs. 5-6, 27, 30-33, 36-38 (together with the discussion of those figures).

187. Moreover, it is also my opinion that displaying additional gait training data on the touch screen/control panel of Erturk in view of the teachings of Vector would also be obvious to a POSITA because it is simply a combination of known elements to achieve predictable results. As noted, use of displays to display data associated with gait training in BWS systems was known, and the general concept of displaying monitored data on a display device for a system was conventional at the time. In my opinion, a POSITA would have been motivated to use the touch screen of Erturk to display gait training data, including as taught in Vector, to achieve predictable results. Further, in my opinion a POSITA would have understood that displaying data on the screen would (1) promote safe operation of a BWS system by allowing a therapist to verify that the desired "system parameters" were entered correctly, and (2) increase the flexibility and efficacy of a BWS system by allowing a therapist to receive real-time data concerning the gait training and make corresponding adjustments to the system parameters. For at least this reason, a POSITA would have been motivated to do so.

188. Moreover, in my opinion a POSITA also would have expected success in combining the display teachings of Erturk and Vector. As explained above, Erturk already

teaches a touch screen display/control panel that is used to enter the gait training data displayed on the screen of Erturk. To the extent any modification of Erturk would be necessary to accomplish this (e.g., to display data not expressed in Erturk (number of falls prevented)), in my opinion the modification would be minimal. An example modification would involve simple addition of a display command into the executable software executed by the processors of control 1900, where the display command would cause the interface to display the number(s) or string(s) corresponding to the results of calculations already performed by the processor of the electronic system 1700.

189. For at least these reasons, in my opinion, Erturk alone teaches displaying data associated with the gait training (e.g., amount of body weight support, speed, distance) on a display (e.g., a "touch screen"/"control panel") of an electronic device ("electronic system 1700") included in the body weight support system (the trolley). Thus, in my opinion, to the extent Erturk is not found to teach Element 1[f], it would nonetheless have been obvious to modify the touch screen/control panel of Erturk to display a wide range of gait training data in view of the teachings of Vector concerning displaying such data.

190. Accordingly, in my opinion Erturk alone, as well as Erturk in view of Vector, discloses and renders obvious Element 1[f].

4. Claims 2 & 3

2	*The method of claim 1, wherein the length of the tether is increased in response to an increase in force exerted by the user on the tether.*
3	*The method of claim 2, wherein the increase in the force exerted by the user on the tether is associated with the user falling during the gait training.*

191. Claims 2 and 3 both relate to the length of the tether being increased in response to increased force being exerted on the tether by a user (e.g., during a fall), thus adding related limitations to claim 1. For convenience and brevity, I will address these limitations together.

192. With respect to claim 2, Erturk's "winch assembly" is configured to rotate a drum to "uncoil" some of the tether (***wherein the length of the tether is increased***) "when a user falls or stumbles [and] the force exerted on the tether increases (i.e., ***in response to an increase in force exerted by the user on the tether;*** and ***wherein the increase in the force exerted by the user on the tether is associated with the user falling during the gait training***). *See, e.g.*, Ex-1009, [0071], ("… in response to an increase in force exerted on the tether …, the electronic system 1700 can send a signal to the motor of the winch … to uncoil a portion of the tether from the drum."); [0150] ("[b]y way of example, a patient may stumble, thereby increasing the amount of force exerted on the tether."). This way, "the tension within the tether is substantially unchanged" and the BWS system can provide a "dynamic" amount of support as opposed to a "static" amount of support that can inhibit recovery. *Id*. Figure 28 of Erturk shows these component parts, with the winch assembly and motor (brown), the pulleys of the pulley system (blue), and the tether(red).

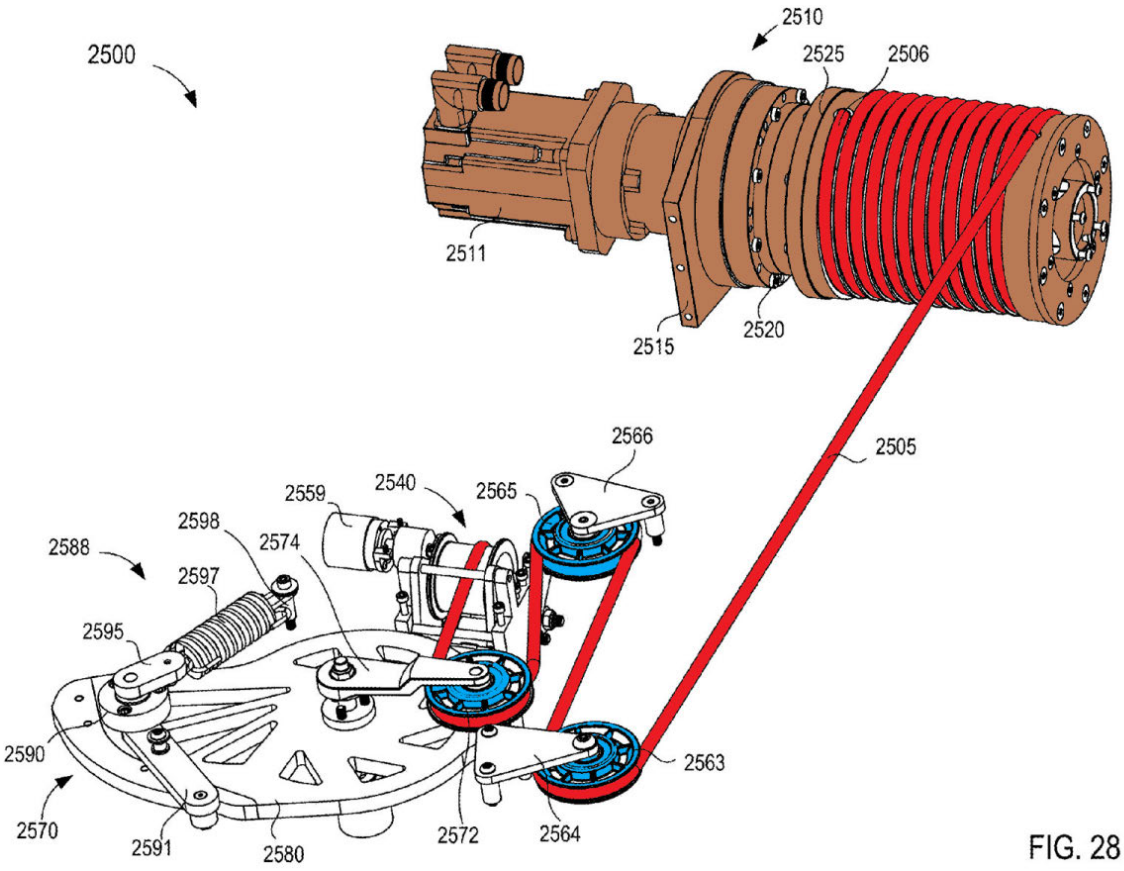


FIG. 28

Ex-1009, Figure 28 (emphasis added).

193. When the pulley is moved, the system can sense the "amount of movement of the pulley and/or the cam," and then send a "send a signal to the motor included in the winch associated with coiling or uncoiling the tether around the drum in accordance with the movement of the pulley." Ex-1009, [0071].

> In some embodiments, the pulley system can include at least one pulley that is configured to move (e.g., pivot, translate, swing, or the like). For example, the pulley can be included in or coupled to a cam mechanism (not shown) that is configured to define a range of motion of the pulley. In such embodiments, the movement of the at least one pulley can coincide and/or be caused by a force exerted on the attachment mechanism 1800. For example, in some instances, the patient can move relative to the trolley 1100 such that the force exerted on the tether by the weight of the patient is changed (e.g., increased or decreased). In such instances, the pulley can be moved according to the change in the force such that the tension within the tether is substantially unchanged. Moreover, with the pulley included in or coupled to the cam mechanism, the movement of the pulley can move the

> cam through a predetermined range of motion. **In some embodiments, the electronic system 1700 can include a sensor or encoder operatively coupled to the pulley and/or the cam that is configured to determine the amount of movement of the pulley and/or the cam**. **In this manner, the electronic system 1700 can send a signal to the motor included in the winch associated with coiling or uncoiling the tether around the drum in accordance with the movement of the pulley**. For example, the pulley can be moved in a first direction in response to an increase in force exerted on the tether and the electronic system 1700 can send a signal to the motor of the winch associated with rotating the drum to uncoil a portion of the tether from the drum. Conversely, the pulley can be moved in a second direction, opposite the first direction, in response to a decrease in force exerted on the tether and the electronic system 1700 can send a signal to the motor of the winch associated with rotating the drum to coil a portion of the tether about the drum. Thus, the **support mechanism 1500 can be configured to exert a reaction force in response to the force exerted by the patient such that the portion of the body weight supported by the support system 1000 remains substantially unchanged**. Moreover, by actively supporting the portion of the body weight of the patient, the support system 1000 can limit the likelihood and/or the magnitude of a fall of the patient supported by the support system 1000. Similarly stated, the support mechanism 1500 and the electronic system 1700 can respond to a change in force exerted on the tether in a relatively short amount of time (e.g., much less than a second) to actively limit the magnitude of the fall of the patient.

Ex-1009, [0071] (emphasis added).

In my opinion, a POSITA would have understood that "uncoil[ing] a portion of the tether from the drum" necessarily increases the length of the tether that extends out of the trolley. Ex-1009, [0071].

194. Moreover, viewing the additional limitations recited in claim 3, in my opinion Erturk associates the way a patient "falls after stumbling" with an "increase" in downward force on the tether to which the patient is coupled. Ex-1009, [0152]. Indeed, after recognizing that "[i]n some instances, the amount of force exerted on the tether 2505 by the patient may increase or decrease," Erturk highlights that "[b]y way of example, a patient may stumble, thereby increasing the amount of force exerted on the tether 2505." Ex-1009, [0150]; *see also id.*, at [0158]-[0159].

> **In some instances, the amount of force exerted on the tether 2505 by the patient may increase or decrease. By way of example, a patient may stumble, thereby increasing the amount of force exerted on the tether 2505**. In such instances, the increase of force exerted on the tether 2505 can pivot the guide mechanism 2540 and can move the cam pivot arm 2571 in response to the increase in force. The movement of the cam pivot arm 2571 moves the cam assembly 2570 (as described above with reference to FIG. 33). In this manner, the encoder 2561 of the guide mechanism 2540 and the encoder 2587 of the cam assembly 2570 can send a signal to the electronic system 2700 associated with the changes in the state of the guide mechanism 2540 and the cam assembly 2570, respectively.

Ex-1009, [0150] (emphasis added).

195. With respect to both claims 2 and 3, and as noted above with reference to claim 2, to achieve dynamic body weight support Erturk discloses a pulley system and winch assembly coupled to the trolley, where "the movement of at least on pulley can coincide and/or be caused by a force exerted on the attachment mechanism" by the patient. Ex-1009, [0071]. When the pulley is moved, the system can sense the "amount of movement of the pulley and/or the cam," and then "send a signal to the motor included in the winch associated with coiling or uncoiling the tether around the drum in accordance with the movement of the pulley." *Id*.

196. Accordingly, in my opinion Erturk in view of Vector discloses and renders obvious claims 2 and 3.

5. Claim 4

4	*The method of claim 1, wherein the surface relative to which the user moves is a stationary surface.*

197. In my opinion, the combination of Erturk and Vector teaches the additional elements of claim 4. Indeed, both references disclose that a patient may perform gait training exercises over a variety of stationary surfaces, including the ground and other surfaces.

198. By way of background, the '316 patent teaches that a "stationary surface" can be "for example, the floor, the ground, a platform, and/or any other suitable surface … [such as] a set of steps, a ramp, etc."…" Ex-1001, 62:27-36.

> In some embodiments, the patient support systems and/or the body weight support systems can be used while a user (or patient) walks along and/or otherwise moves relative to any suitable surface. In some instances, for example, the user can walk along and/or move relative to a surface that is stationary beneath the user's feet as the user stands, walks, runs, etc. Such a stationary surface can be, for example, **the floor, the ground, a platform, and/or any other suitable surface**. Moreover, the stationary surface can be substantially flat or can be inclined or declined (e.g., **a set of steps, a ramp, etc.).** In other instances, the user can walk along and/or move relative to a surface that is not stationary beneath the user's feet as the user stands, walks, runs, etc. Said another way, the patient support systems and/or body weight support systems described herein can be used to support at least a portion of a user's weight as the user moves relative to and/or walks on a surface, which in turn, moves beneath the user's feet as the user moves, walks, runs, etc. The moving surface can be any surface such as, for example, a moving surface (belt) of a treadmill, a moving balance platform, and/or the like.

Ex-1001, 62:27-36 (emphasis added).

199. Based on my review, Erturk discloses three of these example stationary surfaces: the ground, a set of steps, and a ramp. In particular, Erturk discloses that its "support system 1000 can be used to support a patient over … stairs instead of or in addition to supporting a patient over and across level ground." Ex-1009, [0063]. Erturk also discloses that "the trolley can be used to support a patient moving across an inclined/declined surface, up or down stairs, etc." Ex-1009, [0065] (emphasis added).

200. Although Erturk squarely discloses the additional limitations of claim 4, I also offer it as my opinion that Vector also teaches that ***the surface relative to which the user moves is a stationary surface***. In particular, Vector teaches that "[t]he patient may walk along a predetermined path" and perform "over-ground walking." Ex-1010, pp. 1, 18. A POSITA would

have understood "over-ground" to disclose a stationary surface, just as the '316 patent recognizes the same.

Starting a Training Session

Note: During a training session a clinician should stay by the PC computer in order to operate the Vector Elite System software controls. Another clinician/assistant should stay by the patient to ensure their safety during the session.

1. At a start of a training session the dynamic unloading amount will be the default setting of 10 lbs (4.5 kg). To adjust the dynamic unloading value, use the plus and minus buttons. The revised value will display in the text between the buttons.
2. At a start of a training session the fall limit value will be the default setting of 4.0 inches (10.1 cm). If necessary adjust the fall limit value using the plus and minus buttons. Then press the save button to save the revised value, which will display in the text between the buttons.
3. To activate the Trolley Tracking, apply at least 10 lbs (4.5 kg) of load and press the button. The Trolley Tracking button will go from green to red indicating that the feature is turned on. See Figure 5-8.

Note: The Trolley Tracking feature should be activated if the patient is practicing over-ground walking. It is suggested not to activate the Trolley Tracking feature for certain exercise activities such as deep knee bends and sit-to-stand activities.

Ex-1010, pp. 18 (emphasis added).

201. Accordingly, in my opinion both Erturk and Vector disclose the additional limitations recited in claim 4, and Erturk in view of Vector renders obvious the entirety of claim 4.

6. Claim 5

5	*The method of claim 1, wherein the surface relative to which the user moves is a moving surface included in a treadmill.*

202. In my opinion, the combination of Erturk and Vector teaches the additional elements of claim 5. Indeed, both references disclose that a patient may perform gait training exercises over a variety of surfaces, including on a treadmill.

203. In particular, Erturk discloses that its "support system 1000 can be used to support a patient **over a treadmill** or stairs instead of or in addition to supporting a patient over and

across level ground." Ex-1009, [0063]; *see also* [0070] (describing operation of the drive system "when the patient is walking over a treadmill").

204. Moreover, Vector also teaches that "[t]he patient may walk along a predetermined path or on a treadmill." Ex-1010, p. 1

205. Accordingly, in my opinion Erturk discloses the additional limitations recited in claim 5, and Erturk in view of Vector renders obvious the entirety of claim 5.

A. Ground 2: Obviousness over Erturk in view of Vector and Stockmaster

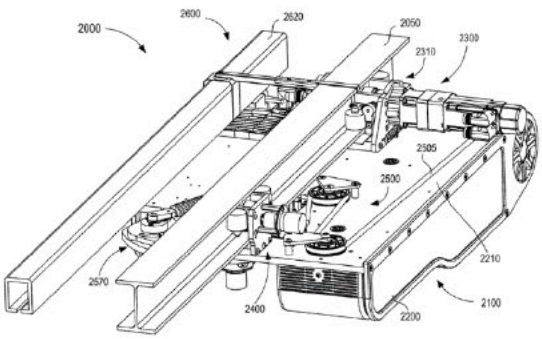
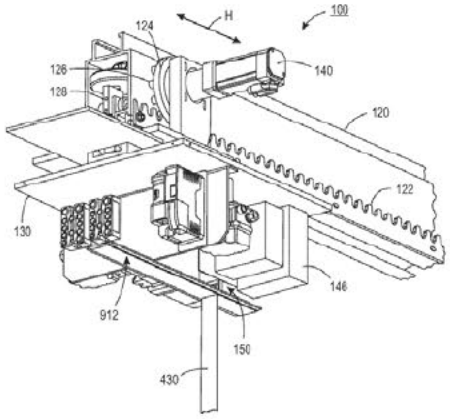
206. In my opinion, Claims 7-8 of the '316 patent are invalid because they are obvious over the teachings of Erturk in view of Vector and Stockmaster.

1. Motivation to Combine (Erturk in view of Vector, and further in view of Stockmaster)

207. As an initial matter, for the reasons I noted in Section VII.A.2, it is my opinion that a POSITA would have been motivated to combine Erturk and Vector to implement Vector's fall detection and prevention technologies into the Erturk BWS system. In connection with claim 7 and its dependent claims, it is also my opinion that a POSITA would have been motivated to further modify the combination of Erturk and Vector to utilize the additional fall detection criteria taught in Stockmaster.

208. As I noted in Section VII.A.2, Erturk expressly teaches and suggests that it would be desirable to include fall detection and prevention features, such as the fall detection and prevention features taught in Stockmaster. *See* Section VII.A.2. For the same reasons, and based on these same express teachings and suggestions, in my opinion a POSITA would have been similarly motivated to combine Stockmaster with Erturk (and/or Vector) to incorporate the fall detection and prevention methods in Stockmaster into Erturk's BWS system.

209. Moreover, in my opinion a POSITA would have understood that combining the teachings of Erturk, Vector, and Stockmaster would have amounted to use of a known technique to improve a similar device in the same way. As was the case with Erturk and Vector (see Section VII.A.2), Erturk and Stockmaster also teach undeniably similar devices. *Id*. Both references are from the same field of endeavor (overhead gait therapy) and both are directed to the same objectives (providing a body weight support system for gait therapy in a safe and controlled environment). Ex-1009, [0002]-[0003], [0008]-[0011], [0053], [0070]- [0071], [0082], [0122], [0147], [0149]-[0152]; *compare* Ex-1011, Abstract, [0002]-[0009]; Figs. 1-2. Below I provide some example figures and language from both references that illustrate this:

Ex-1009 (Erturk)	Ex-1011 (Stockmaster)
 FIG. 2 Ex-1011, Fig. 2. *** The embodiments described herein **relate to apparatus and methods for supporting the body weight of a patient**. More particularly, the embodiments described herein relate to **apparatus and methods for supporting the body weight of a patient during gait therapy**. Ex-1009, [0002] (emphasis added). *** **Successfully delivering intensive yet safe gait therapy to individuals with significant walking deficits can present challenges to skilled therapists**. **In the acute stages of many neurological injuries such as stroke, spinal cord injury, traumatic brain injury, or the like individuals often exhibit highly unstable walking patterns and poor endurance, making it difficult to safely practice gait for both the patient and therapist**. Because of this, rehabilitation	 FIG. 3 Ex-1011, Fig. 3. *** A body-weight support system is disclosed, including **an improved body weight support apparatus and method**. The system enables not only the **support of patients undergoing rehabilitation therapies**, but exercise modes that are both customizable and dynamic in nature, including alternative functionality at differing locations. Ex-1011, Abstract (emphasis added). *** **The process of providing rehabilitative services and therapy to individuals with significant walking deficits and other physical impairments presents a challenge to even the most skilled therapists**. **For example, patients suffering from neurological injuries such as stroke, spinal cord injury, or traumatic brain injury often exhibit an inability to support themselves, poor endurance or walking patterns that are unstable. Such deficiencies make it difficult, at best, for**

centers often move **over-ground gait training to a treadmill where body-weight support systems can help minimize falls while raising the intensity of the training**. Ex-1009, [0003] (emphasis added).	**the patient and therapist to engage in particular exercises, therapies, etc**. Accordingly, it is increasingly common for such therapies to involve **some sort of body-weight support system to reduce the likelihood of falls or other injuries, while enabling increased intensity or duration of the training or therapy**. Ex-1011, [0003] (emphasis added).
***	***
In other **known systems**, a patient may be supported by a passive trolley and rail system configured to support the patient while **the patient physically drags the trolley along the overhead rail during gait therapy. While the trolley may have a relatively small mass, the patient may feel the presence of the mass**. **Accordingly, rather than being able to focus on balance, posture, and walking ability, the patient may have to compensate for the dynamics of the trolley**. For example, on a smooth flat surface, if the subject stops abruptly, the **trolley may continue to move forward and potentially destabilize the subject, thereby resulting in an abnormal compensatory gait strategy that could persist when the subject is removed from the device**. Ex-1009, [0008] (emphasis added).	Some **existing support systems** obstruct a therapist's interaction with the patient, by presenting barriers between the patient and the therapist. **Other stand-alone support systems require assistance, or the patient, to manage the horizontal movement of the support system, rather than focusing on their own balance and preferred form of the therapy**. **In other words, the patient may be forced to compensate for the dynamics of the support system**. **Such a confounding effect could result in the patient's development of abnormal compensatory movements that persist when the patient is removed from the support system**. Ex-1010, [0004] (emphasis added).
***	***
Some known gait support systems are configured to provide static unloading to a patient supported by the system. That is, under static unloading, the **length of shoulder straps that support the patient are set to a fixed length** such that the patient either bears substantially all of their weight when the straps are slack or substantially no weight when the straps are taught. **Static unloading systems have been shown to**	**Yet a further problem with some systems is that under static unloading, the length of the supporting straps is set to a fixed length**, so the subject either bears all of their weight when the straps are slack or no weight when the straps are taught. **Static unloading systems are known to produce abnormal ground reaction forces and altered muscle activation pattern**. Moreover, **static**

result in abnormal ground reaction forces and altered muscle activation patterns in the lower extremities. In addition, **static unloading systems may limit the vertical excursions of a patient that prevent certain forms of balance and postural therapy where a large range of motion is necessary**. As a result, some known systems may not be able to raise a patient from a wheelchair to a standing position, thereby restricting the use of the system to individuals who are not relegated to a wheelchair (e.g., those patients with minor to moderate gait impairments). Ex-1009, [0006]-[0007] (emphasis added). *** Thus, **a need exists for improved apparatus and methods for supporting the body-weight of a patient during gate therapy**. Ex-1009, [0011] (emphasis added).	**unloading systems may limit the patient's vertical excursions (e.g., up and over steps, stairs and the like) and thereby prevent certain therapies where a large range of motion is required**. Another problem observed with systems that are programmed to follow the patient's movement are significant delays in the response of the system (often the result of mechanics of sensors, actuators and system dynamics), where the patient feels that they are exerting greater force than necessary just to overcome the support system—resulting in the patient learning adaptive behaviors that may destabilize impaired patients when they ultimately begin self-supported activities for which they are being trained. Ex-1010, [0005] (emphasis added). *** In light of the current body-weight support systems **there is a need for a medical rehab support system and method that overcomes the limitations of the systems characterized above**. Ex-1010, [0006] (emphasis added).

Moreover, both teach providing a BWS system for gait therapy in a safe and controlled environment, and both teach fall prevention through system monitoring and system response. Ex-1009, [0070]-[0071], [0082], [0152]; *compare* Ex-1011, [0338]-[0341]. Below I provide some example language from both references that illustrate this:

Ex-1009 (Erturk)	Ex-1011 (Stockmaster)
Thus, the drive system 2300 and the patient support mechanism 2500 of the trolley 2100 can be actively controlled in response to a change in force exerted on the tether 2505 and based at least in part on the current and/or previous states of the drive system 2300 and the patient support system 2500. **Similarly stated, the support system 2000 can actively reduce the amount a patient falls after stumbling or falling for other reasons**. Ex-1009, [0152] (emphasis added). *** In this manner, the electronic system 1700 can send a signal to the motor included in the winch associated with coiling or uncoiling the tether around the drum in accordance with the movement of the pulley. …. Thus, **the support mechanism 1500 can be configured to exert a reaction force in response to the force exerted by the patient such that the portion of the body weight supported by the support system 1000 remains substantially unchanged. Moreover, by actively supporting the portion of the body weight of the patient, the support system 1000 can limit the likelihood and/or the magnitude of a fall of the patient supported by the support system 1000. Similarly stated, the support mechanism 1500 and the electronic system 1700 can respond to a change in force exerted on the tether in a relatively short amount of time (e.g., much less than a second) to actively limit the magnitude of the fall of the patient**. Ex-1009, [0071] (emphasis added). ***	**Dynamic Fall Protection**—Dynamic Fall Protection (DFP), as briefly mentioned above, and as represented in FIG. 44, enables the device to sense a fall instead of, or in addition to, setting a pre-defined fall limit (Descent Limit). This makes the response of the **SafeGait** system more intuitive for a therapist who does not need to pre-determine a height for fall arrest. It also provides fall protection in cases where a Descent Limit cannot be set or may have been set very low; for instance transfer tasks such as supine-to-stand requiring the patient's full vertical range of motion. **When a fall is detected with DFP, further vertical movement in the downward direction is inhibited**. The patient is allowed movement in only the upward direction and horizontally, albeit at a reduced speed, making it easier to right themselves. Ex-1010, [0388] (emphasis added). **There are at least two options for DFP monitoring, including detection of a change in force or a change in speed for the patient being supported by the system. In the force-based option, the force being applied via the strap 430 is continuously monitored for a change that is indicative of a possible fall or other rapid downward movement of the patient**. In the speed-based option the speed of the downward vertical movement of strap 430 is monitored, and in the event of the speed exceeding a threshold the motion is dampened or stopped by the system. **As will be appreciated, the thresholds applied for the force or speed, in the respective options, are possible variables that may be modified to adjust the sensitivity of the system for fall detection and prevention. Moreover, there may be other system performance metrics that could be used in**

In some embodiments, audible feedback is provided to the patient when the patient's gate is incorrect. In some embodiments, audible feedback can be provided when the patient begins to fall. Different audible tones can be provided for different issues/purposes. Ex-1009, [0082].	**fall detection (e.g., rapid change in strap angle), and it is also contemplated that a combination of two or more detection options may also be implemented in order to permit the system to detect other "fall" scenarios**. Descent Limit—A secondary fall protection feature, referred to as Descent Limit (see FIG. 44), sets a maximum amount of downward travel of the strap 430 (and patient) and the limit is a variable level based on the patient's position and height. The descent limit can be toggled on or off at will during a task, and set to whatever height within the actuator's range is needed for the task to be performed. When a fall is detected with Descent Limit, further vertical movement of the strap in the downward direction is inhibited. The patient is allowed movement in the upward direction and horizontally, albeit at a reduced speed, once again making it easier to right themselves. Ex-1010, [0340]-[0341] (emphasis added).

Further, both teach providing "dynamic" or "active" body weight support to support a patient in a manner that avoids issues arising from only providing "static" unloading. *See, e.g.*, Ex-1009, [0071] ("… configured to exert a reaction force in response to the force exerted by the patient such that the portion of the body weight supported by the support system 1000 remains substantially unchanged"), *see also* [0122], [0147], [0150]-[0152]; *compare* Ex-1011, [0035] (Referring to FIG. 1, depicted therein is a system 100 (e.g., "… supporting a selectable portion (e.g., percentage) of the weight of a person or patient 110").

Based at least on the foregoing, in my opinion the proposed combination of Erturk, Vector, and Stockmaster would simply apply fall prevention features of Stockmaster to the BWS system of

Erturk in the same way. As noted previously, Erturk's BWS is already configured to detect changes in system components such as the tether position, velocity, etc. *See* Section VII.A.2; *see also* Ex-1009, [0062], [0073], [0092], [0121]-[0130], [0134], [0149]-[0152], [0180]-[0185].The fall protection feature of Stockmaster is provided in a BWS in the very same way. Stockmaster's BWS is configured to detect changes in system components (e.g., the "downward travel of the strap 430 (and patient)" and "speed of the downward vertical movement of strap 430") to detect the fall. Ex-1011, [0338]-[0341].

210. Moreover, in my opinion the combination of the fall detection feature of Stockmaster with the BWS system of Erturk is a combination of known elements to achieve predictable results. In my opinion, the combination of the known elements discussed above (from Erturk, Stockmaster, as well as Vector in the previous section) would only require minor software modifications, including a software modification to the fall detection algorithm in the "set of instructions or code" of Erturk's BWS system. *See* Ex-1009, [0062], [0073]. This software modification would be straightforward, particularly because it would simply leverage data that Erturk's BWS system is already configured to capture. *See* Ex-1009, [0062], [0073], [0092], [0121]-[0130], [0134], [0149]-[0152], [0180]-[0185]. Thus, the data needed to use Stockmaster's algorithm are already determined or readily computable from the data that Erturk's BWS system is already equipped to capture. For at least these reasons, in my opinion a POSITA would have had a reasonable expectation of success in applying the teachings of Stockmaster to the BWS of Erturk.

211. Additionally, it is my opinion a POSITA would have been motivated to consider the "speed-based" fall detection criteria discussed in Stockmaster – in in combination with other fall detection criteria such as the fall limit criteria of Vector, the force based criteria of Erturk,

and/or the descent limit criteria of Stockmaster – in order to improve Erturk's BWS. For example, considering two or more such criteria in combination would, for various exercises and fall scenarios, enhance Erturk's ability to distinguish between training exercises that include rapid descents, on the one hand, and fall scenarios where the patient's descent continues for longer than would occur during such exercises, on the other. Part of this motivation comes directly from the references themselves. For instance, Stockmaster itself suggests to a POSITA that detection of various fall scenarios can be enabled by – and the capability of BWS systems improved by – using "**a combination of two or more detection options**." Ex-1011, [0340]. Additionally, the use of two or more criteria was well known, particularly in the field of fall prevention, and numerous references directed fall detection at the time confirm this – emphasizing the desire to consider multiple criteria to increase the reliability of such detections and avoidance of false positives. *See, e.g.*, Ex-1012, 6:6-7:2 ("the more … data points used prior to activation [of the fall prevention mechanism] the better is the reliability of determination of a true fall event and elimination of false positive events."); Ex-1016, 1:30-41, 4:50-5:5, Fig. 34; Ex-1018, Fig. 11B(1)-(2) (and related discussion); Ex-1019, 12902-12921 ("[t]he main concept is to construct a set of rules for detecting ADLs or falls based on thresholds of one or more features"). Pannurat (Ex-1019) provides an overview of a wide range of fall detection algorithms, measuring a variety of criteria, and in some cases notes that considering multiple criteria together increases the accuracy of the detection and the avoidance of a false positive:

Sum vector magnitude (F5) has been used in most studies for detecting abnormal signals. The highest peak during the sudden change of this value is used to indicate a fall [32,38,46,48–50,53,65,67–70,72–75,77–82,84–86,89–91,93,96,97,101,102,104,106,107]. In [85], F5 was used to indicate the free-fall state (*i.e.*, vertical speed increases linearly with time due to gravity). Using only F5 alone, however, is not sufficient for accurate fall detection since jumping at once also generates a sudden change of this feature which can trigger a false alarm. To solve this problem, the activity that follows the peak is sometimes used. For example, if the sudden change is followed by standing, then it is not a fall. Velocity during fall (F12, F13, F14), vertical acceleration (F15), or differential pressure (F42) are sometimes used in addition to F5 to achieve higher detection accuracy [32,46,65,67,70,97]. In [83], a multiple regression equation of the absolute peak acceleration values in the movement and the horizontal directions (F43) was used to detect falls.

F37–F41 are calculated using a gyroscope. Similar to F5 of an accelerometer, the resultant angular velocity (F40) can be used to identify possible falls using a gyroscope. For fall detection, resultant angular acceleration (F39) and resultant change in trunk angle (F41) were used in [88]. To derive F39 and F41, trunk angle (F37) and trunk angular acceleration (F38) are first calculated. More accurate device orientation, particularly during dynamic motions, can be obtained by combining signals from different types of motion sensors. In [55], an electronic compass was used in conjunction with a tri-axial accelerometer to estimate the orientation of a smart phone. F44–F50 are accelerometer-based features used in existing studies with no equation provided. They are referred to in Table 5 and therefore are also listed for completeness.

Ex-1019, 12919 (emphasis added).

212. Accordingly, in my opinion, a POSITA would have been motivated to combine the BWS system of Erturk with the fall prevention feature of Stockmaster as set forth herein, and would have had a reasonable expectation of success in doing so.

2. Claim 7

a. Preamble

7[pre]	***A method of using a body weight support system to provide body weight support during gait training, the body weight support system including a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system, the method comprising:***

213. I understand that a preamble generally does not state a claim limitation. However, to the extent the preamble limits claim 7, it is my opinion that Erturk discloses ***[a] method of using a body weight support system to provide body weight support during gait training, the body weight support system including a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system*** as recited in 7[pre].

Based on my review, the elements of 7[pre] include the same recitations as the elements of 1[pre], with the exception that here in 7[pre] there is no recitation of ***a drive assembly configured to movably suspend the body weight support system from a support track***. Because it recites less than 1[pre] in this manner, but is otherwise the same as 1[pre], it is my opinion that 7[pre] is broader than 1[pre]. As such, Erturk discloses 7[pre] for at least the same reasons I detailed above with reference to 1[pre]. *See* Section VII.A.3.a.

a. Element 7[a]

7[a]	***defining a reference length of the tether when the attachment device is in an initial position;***

214. Based on my review, the recited limitations of Element 7[a] are the same as the limitations recited in Element 1[a], which I already detailed. As such, the combination of Erturk and Vector teaches Element 7[a] as detailed above in connection with Element 1[a]. *See* Section VII.A.3.b . I note that the term "reference length" does not appear again anywhere in claim 7, nor in any of claims 8, 9, 10, or 11. Based on my review, the term "reference length" only appears in the claims again in dependent claim 12 (which I understand is not challenged by Petitioner in the Petition to which this declaration is attached).

b. Element 7[b]

7[b]	***defining a first criterion associated with a change in a length of the tether;***

215. In my opinion, both Vector and Stockmaster teach ***defining a first criterion associated with a change in a length of the tether***.

216. For example, in my opinion Vector teaches the limitations recited in Element 7[b], at least because Vector teaches setting a "fall limit value," which constitutes a criterion

(***defining a first criterion***) for determining whether a user is falling. *See* Sections VII.A.3.c-VII.A.3.e above. Moreover, it is my opinion that the "fall limit value" is ***associated with a change in the length of the tether***, at least because the fall limit value is defined as the change in the length of the tether against the "zero point" (which represents the initial "location of the rope" at the outset of a training session. *See* Ex-1010, pp.17-20. For example, Vector teaches that "[d]uring a training session the Vector Elite System will detect and prevent a fall when the **fall distance from the zero point** is **greater than the set Fall Limit value**," where the "**zero point represents the location of the rope.**" *Id*.



Fall Limit

The Fall Limit is a safety feature that prevents the patient from falling. The programmed fall limit value is the amount of descent that the patient can travel before the system locks the rope winch, deactivates trolley tracking (if enabled) and detects a fall.

The default Fall Limit setting is 4.0 inches (10.1 cm). The Fall Limit setting can be adjusted from 4.0 inches (10.1 cm) to 36 inches (91.4 cm), depending on the training activity. To adjust the setting, use the plus and minus buttons to increase the Fall Limit in increments of 1 inch (2.5 cm) and click on the Save button. The revised setting will appear in the text between the buttons. Make sure the Fall Limit value is in green color. If not, click on the Save button to ensure that the fall limit value has been set properly.

The fall limit could also be disabled for certain circumstances such as performing pre-gait activities. To disable the fall limit check the box next to the word “Disable” and press the Save button. A window will appear to confirm that the clinician wants to disable the fall limit. Press the OK button.

⚠ Caution: Extra precautions should be taken with the patient when the fall limit is disabled, due to the possibility of patient injury.

The animated graphic bar next to the fall limit visually shows how close to the Fall Limit the patient is at any given time during a training session.

Session Status Section

The Session Status section displays real-time information during a training session. See Figure 5-8. It displays the amount of weight unloaded, total session time, training time, walking speed, rope position, number of falls prevented and total distance walked during the training session.

Starting a Training Session

Note: During a training session a clinician should stay by the PC computer in order to operate the Vector Elite System software controls. Another clinician/assistant should stay by the patient to ensure their safety during the session.

1. At a start of a training session the dynamic unloading amount will be the default setting of 10 lbs (4.5 kg). To adjust the dynamic unloading value, use the plus and minus buttons. The revised value will display in the text between the buttons.
2. At a start of a training session the fall limit value will be the default setting of 4.0 inches (10.1 cm). If necessary adjust the fall limit value using the plus and minus buttons. Then press the save button to save the revised value, which will display in the text between the buttons.
3. To activate the Trolley Tracking, apply at least 10 lbs (4.5 kg) of load and press the button. The Trolley Tracking button will go from green to red indicating that the feature is turned on. See Figure 5-8.

Note: The Trolley Tracking feature should be activated if the patient is practicing over-ground walking. It is suggested not to activate the Trolley Tracking feature for certain exercise activities such as deep knee bends and sit-to-stand activities.

4. To activate Dynamic Body Weight Support press the button. The DBWS button will go from green to red indicating that the feature is turned on. See Figure 5-8.

Note: If the Dynamic Body Weight Support feature is not activated (the button is green) then the system is in a Static Unload mode. The position of the rope will be maintained regardless of patient movement.

Note: The Trolley Tracking feature and DBWS feature can be enabled one at a time or both together.



Figure 5-8: Trolley Tracking and DBWS Active

Adjusting the dynamic unloading value during a training session:
The dynamic unloading value can be adjusted while the patient is in Dynamic Body Weight Support mode.

1. To adjust the unloading value use the plus and minus buttons and the revised value will display in the text between the buttons. The adjustment will be instantaneous and can occur while the patient is actively training.

Adjusting the fall limit value during a training session:
The fall limit can be adjusted while the patient is in Dynamic Body Weight Support mode or Trolley Tracking mode.

1. To adjust the fall limit value use the plus and minus buttons and the revised value will appear in red text between the buttons.
2. Press the save button to save the revision and the text between the buttons will turn green.

Note: The save button must be pressed in order for the revised fall limit value to be activated. Once the save button has been pressed then the zero point of the fall limit will readjust. The zero point represents the location of the rope when DBWS is activiated. If the text is in red it means that the revised value has not been saved and the zero-point is still reading from the last fall limit saved setting.

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Note: It is suggested that at the start of each exercise that the save button is pressed to ensure that the zero-point of the fall limit value has been readjusted.

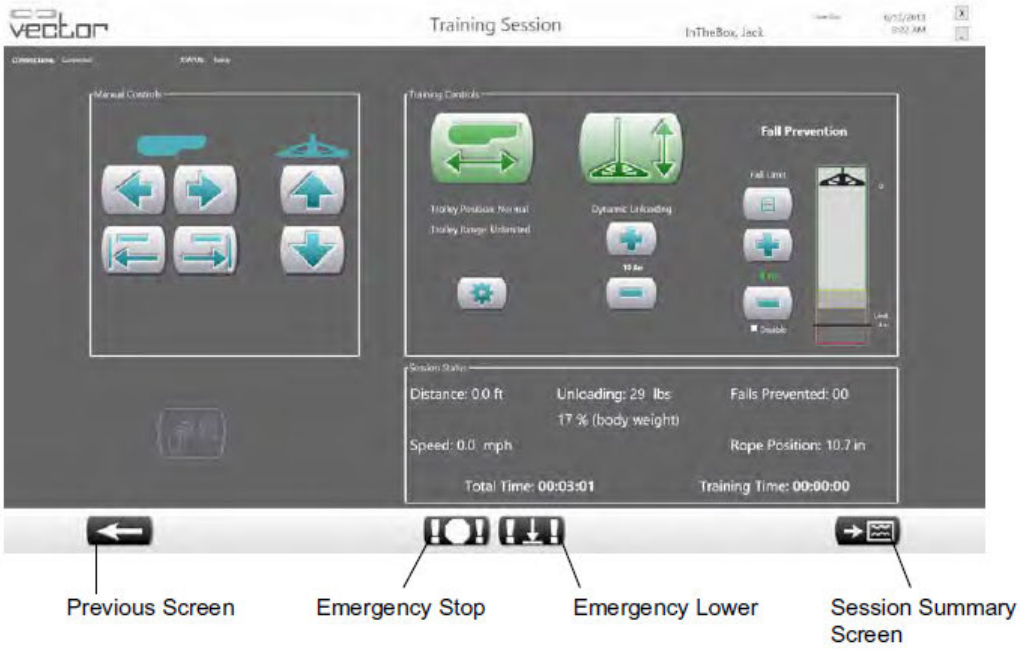


Figure 5-9: Training Session Screen

Fall Limit Detection

During a training session the Vector Elite System will detect and prevent a fall when the fall distance from the zero point is greater than the set Fall Limit value. When the system detects and prevents a fall the trolley is locked and placed into Static Unload mode.

1. Vector Elite System detects a fall and the Fall Prevented window appears in the software. See Figure 5-10.
2. Press the Manual Controls winch up button to help the patient regain control, so they are in a standing position. Or if necessary use the Emergency Lower button to lower the patient to the ground.
3. Close the Fall Prevented window and if the patient is in a standing position press the Dynamic Body Weight Support button and (if applicable) the Trolley Tracking button to resume the training session.

Ex-1010, pp.18-20 (emphasis added).

217. Next, it is my opinion that Stockmaster teaches using multiple distinct criterion for detecting a fall, any one of which would qualify as the ***first criterion***:

> 4.7.3.7.2 Actuator Settings—FIG. 44 provides a display window 4410 that permits the adjustment of machine (actuator) parameters such as dynamic fall prevention (DFP) sensitivity (low, medium, high), limits on the height (descent limit) at which the system declares the patient to be falling and triggers a stop to the descent, and means for allowing the system to track a user-entered exertion score (RPE) upon completion of each task (see FIG. 45);
>
> Ex-1011, [0269].
>
> Dynamic Fall Protection—Dynamic Fall Protection (DFP), as briefly mentioned above, and as represented in FIG. 44, enables the device to sense a fall instead of, or in addition to, setting a pre-defined fall limit (Descent Limit). This makes the response of the SafeGait system more intuitive for a therapist who does not need to pre-determine a height for fall arrest. It also provides fall protection in cases where a Descent Limit cannot be set or may have been set very low; for instance transfer tasks such as supine-to-stand requiring the patient's full vertical range of motion. When a fall is detected with DFP, further vertical movement in the downward direction is inhibited. The patient is allowed movement in only the upward direction and horizontally, albeit at a reduced speed, making it easier to right themselves.
>
> Ex-1011, [0338].
>
> Dynamic Fall Protection (DFP) Sensitivity Levels—The DFP Sensitivity Levels are set via an interface screen such as FIG. 44, and allows therapists to adjust fall protection sensitivity to one of a plurality of sensitivities to accommodate patients at varying stages of independence (e.g., High, Medium, Low). At High sensitivity, a fall is detected with very slight movement in the vertical direction. On the other hand, at Low sensitivity a fall is only detected with much more drastic vertical movement (approaching freefall).
>
> Ex-1011, [0339].
>
> There are at least two options for DFP monitoring, including detection of a change in force or a change in speed for the patient being supported by the system. In the force-based option, the force being applied via the strap 430 is continuously monitored for a change that is indicative of a possible fall or other rapid downward movement of the patient. In the speed-based option

> the speed of the downward vertical movement of strap 430 is monitored, and in the event of the speed exceeding a threshold the motion is dampened or stopped by the system. As will be appreciated, the thresholds applied for the force or speed, in the respective options, are possible variables that may be modified to adjust the sensitivity of the system for fall detection and prevention. Moreover, there may be other system performance metrics that could be used in fall detection (e.g., rapid change in strap angle), and it is also contemplated that a combination of two or more detection options may also be implemented in order to permit the system to detect other "fall" scenarios.
>
> Ex-1011, [0340].
>
> Descent Limit—A secondary fall protection feature, referred to as Descent Limit (see FIG. 44), sets a maximum amount of downward travel of the strap 430 (and patient) and the limit is a variable level based on the patient's position and height. The descent limit can be toggled on or off at will during a task, and set to whatever height within the actuator's range is needed for the task to be performed. When a fall is detected with Descent Limit, further vertical movement of the strap in the downward direction is inhibited. The patient is allowed movement in the upward direction and horizontally, albeit at a reduced speed, once again making it easier to right themselves.
>
> Ex-1011, [0341].

218. In one example, Stockmaster teaches defining a "Descent Limit" that would qualify as ***a first criterion*** as claimed. Ex-1011, [0338] ("… setting a pre-defined fall limit (Descent Limit)"); [0341] ("… a fall is detected with Descent Limit"). Stockmaster teaches that the "Descent Limit" is a fall protection feature that "set[s] a maximum amount of downward travel of the strap 430 (and patient)," thus being ***associated with a change in the length of the tether***. *Id*. [5]

219. In another example, Stockmaster teaches using a "speed-based" fall detection criterion as part of its "Dynamic Fall Protection (DFP)" feature. *See, e.g.*, Ex-1011, [0339]-[0340]. In my opinion, Stockmaster's "speed-based" fall detection feature qualifies as ***a first***

[5] Notably, Stockmaster's "Descent Limit" criteria is similar to Vector's "fall limit value" criteria.

criterion as claimed. Stockmaster's "speed-based" criterion involves setting a speed "threshold" (***defining a first criterion***) for to evaluate the "speed of the downward vertical movement of strap 430" against (***associated with a change in a length of the tether***). Stockmaster monitors "the speed of the downward vertical movement of strap 430" and then, "in the event of the speed exceeding a threshold" during a patient's training session, the patient's fall can be "dampened or stopped by the system." *See id*.

220. In view of the above, in my opinion a POSITA would have been motivated to combine one or both of (i) Vector's "fall limit value" criterion, and (ii) Stockmaster's "speed-based" criterion with the teachings of Erturk, including for at least the reasons I detailed in Section VII.A.2.

c. Element 7[c]

7[c]	***defining a second criterion associated with a change in a length of the tether;***

221. In my opinion, the combination of Erturk, Vector, and Stockmaster discloses and renders obvious ***defining a second criterion associated with a change in a length of the tether***.

222. As I noted above (*see* ¶217), Stockmaster teaches using multiple distinct criterion for detecting a fall, any one of which qualifies as the ***first criterion*** of claim 7. Similarly, if any one of those criterion (or the Vector "fall limit value" criterion also described in connection with Element 7[b]) is identified as the ***first criterion***, any of the remaining criterion could and would qualify as a ***second criterion***. For example, where Vector's "fall limit value" or Stockmaster's "Descent Limit" are identified as the first criterion, Stockmaster's speed-based criterion qualifies as a ***second criterion associated with a change in a length of the tether***.

223. In my opinion, the "speed-based" criterion of Stockmaster's Dynamic Fall Protection (DPF) feature would qualify as the claimed ***second criterion*** because it teaches defining a threshold speed as a criteria for determining when a user is experiencing a fall. In my opinion, the threshold speed is ***associated with a change in a length of the tether*** because Stockmaster teaches that the speed is measured based on the downward movement of the strap (and the "strap" is a "tether"). In Stockmaster, "the speed of the downward vertical movement of strap 430 is monitored, and in the event of the speed exceeding a threshold the motion is dampened or stopped by the system." Ex-1011, [0340].

224. Furthermore, it is my opinion that Stockmaster also teaches defining additional criteria related to other metrics that suggest the criteria would also qualify as a ***second criterion associated with a change in a length of the tether***. For example, Stockmaster teaches that "there may be other system performance metrics that could be used in fall detection (e.g., rapid change in strap angle), and it is also contemplated that **a combination of two or more detection options** may also be implemented in order to permit the system to detect other "fall" scenarios." Ex-1011, [0340] (emphasis added).

d. Element 7[d]

7[d]	***defining an amount of the body weight support to provide in response to the user falling during the gait training;***

225. In my opinion, the combination of Erturk, Vector, and Stockmaster discloses and renders obvious ***defining an amount of the body weight support to provide in response to the user falling during the gait training***.

226. In my opinion, Vector teaches Element 7[d] for the same reasons it teaches Element 1[d]. *See* Section VII.A.3.e, above. To explain, when Vector's BWS system detects that

a user is falling, the "system locks the rope winch" and thereby catches the patient before he/she hits the ground. By "lock[ing]" the winch, the BWS system provides support for 100% of the user's bodyweight. Vector specifies that the "Trolley Patient Weight Limit" is "400lbs (181.4 kg)." Ex-1010, p.51. In my opinion, setting the system to provide 100% body weight support, up to 400 lbs, when the system detects a fall teaches ***defining an amount of the body weight support to provide in response to the user falling during the gait training*** as recited in Element 7[d].

227. In my opinion, Stockmaster also discloses and renders obvious ***defining an amount of the body weight support to provide in response to the user falling during the gait training***. Stockmaster teaches that "[w]hen a fall is detected with DFP, further vertical movement in the downward direction is inhibited." Ex-1011, [0338]. In this scenario, "[t]he patient is allowed movement in only the upward direction and horizontally, albeit at a reduced speed, making it easier to right themselves." Ex-1011, [0338]. By the system being configured to provide full body weight support (inhibiting further vertical movement) when the system detects a fall, Stockmaster thus teaches ***defining an amount of the body weight support to provide in response to the user falling during the gait training***.

228. Accordingly, it is my opinion that the combination of Erturk, Vector, and Stockmaster discloses and renders obvious Element 7[d].

e. Element 7[e]

7[e]	***maintaining the body weight support system in a substantially overhead position relative to the user as the user moves relative to a surface;***

229. On my review, the limitations of Element 7[e] are largely the same as the limitations of Element 1[e], with the exception that Element 7[e] does not require a ***drive assembly configured to move the body weight support system relative to the support track***.

230. Because Element 7[e] is broader than Element 1[e] and, in my opinion Erturk teaches 7[e] as I detailed in Section I.A.2.e, above.

f. Element 7[f]

7[f]	***determining a fall has occurred based on the first criterion and the second criterion being satisfied; and***

231. In my opinion, the combination of Erturk, Vector, and Stockmaster discloses and renders obvious ***determining a fall has occurred based on the first criterion and the second criterion being satisfied***.

232. As I already detailed in Sections I.A.2.b-I.A.2.c, Stockmaster discloses and renders obvious a body weight support system that can use multiple criteria to detect falls, and teaches that these can be used in combination. Thus, in my opinion Stockmaster teaches the satisfaction of both ***a first criterion*** **and** ***a second criterion*** —the "Descent Limit" threshold/criteria and the "speed-based" threshold/criteria (and/or other performance metrics, e.g., changes in strap angle)—can be considered to detect a fall, both associated with a change in the length of the tether. *See* Sections I.A.2.b-I.A.2.c (citing Ex-1010, [0338]-[0341]).

233. Stockmaster explains that it is "also contemplated that a combination of two or more detection options may also be implemented in order to permit the system to detect other 'fall' scenarios." Ex-1011, [0340].

> There are at least two options for DFP monitoring, including detection of a change in force or a change in speed for the patient being supported by the system. In the force-based option, the force being applied via the strap 430 is continuously monitored for a change that is indicative of a possible fall or other rapid downward movement of the patient. In the speed-based option the speed of the downward vertical movement of strap 430 is monitored, and in the event of the speed exceeding a threshold the motion is dampened or stopped by the system. As will be appreciated, the thresholds applied for the force or speed, in the respective options, are possible variables that may be modified to adjust the sensitivity of the system for fall detection and prevention. Moreover, there may be other system performance metrics that could be used in fall detection (e.g., rapid change in strap angle), and it is also contemplated that **a combination of two or more detection options may also be implemented in order to permit the system to detect other "fall" scenarios**.

Ex-1011, [0340].

In my opinion, a POSITA would have understood Stockmaster to disclose that its system would be configured so that falls could be detected based on two criteria being satisfied.

234. Moreover, based on Stockmaster's suggestion to use multiple criteria, together with Stockmaster's recognition that "other system performance metrics that could be used in fall detection," and also in view of the similarity of the BWS systems (as between each of Erturk, Vector, and Stockmaster), in my opinion a POSITA would have understood that Vector's "fall limit value" criteria could also be used in combination with any of Stockmaster's fall detection criteria. *See, e.g.*, Ex-1011, [0340]. Thus, even if Vector's "fall limit value" is identified as the ***first criterion*** (see Element 7[b]) and Stockmaster's speed-based threshold is identified as the ***second criterion*** (see Element 7[c]), the combination of Erturk, Vector, and Stockmaster discloses and renders obvious Element 7[f].

235. Accordingly, it is my opinion that the combination of Erturk, Vector, and Stockmaster teaches Element 7[f].

g. Element 7[g]

7[g]	***providing the amount of body weight support in response to the first criterion and the second criterion being satisfied.***

236. In my opinion, Erturk in view of Vector and Stockmaster discloses and renders obvious ***providing the amount of body weight support in response to the first criterion and the second criterion being satisfied***.

237. As I discussed above in connection with Element 7[f], Stockmaster teaches and suggests detecting a fall when two or more criterion are both satisfied. *See* Section I.A.2.f. Further, as discussed in Element 7[d], Stockmaster teaches that, "[w]hen a fall is detected … further vertical movement in the downward direction is inhibited" such that the system bears the entire weight of the patient (***providing the amount of body weight support***) instead of just a portion or a partial amount of the patient's weight. Ex-1011, [0338]-[0341].

238. Similarly, Vector teaches that in response to detecting a fall, the "system locks the rope winch" and bears the entire weight of the user (***providing the amount of body weight support in response***). *See* Section I.A.2.d.

239. Accordingly, in my opinion Erturk in view of Vector and further in view of Stockmaster discloses ***providing the amount of body weight support in response to the first criterion and the second criterion being satisfied***.

3. Claim 8

8	***The method of claim 7, wherein the first criterion is a rate of change in the length of the tether.***

240. In my opinion the combination of Erturk, Vector, and Stockmaster discloses claim 7 as detailed above. Further, in my opinion the combination of Erturk, Vector, and Stockmaster discloses and renders obvious the additional limitations recited in claim 8: ***wherein the first criterion is a rate of change in the length of the tether***.

241. As noted in connection with Element 7[b], Stockmaster's "speed-based" criteria may be identified as ***the first criterion***. Stockmaster's "speed-based" criteria is both ***associated with*** a rate of change in the length of the tether, and it in fact *is* ***a rate of change in the length of the tether***. Indeed, a POSITA would have understood that "the speed of the downward vertical movement of strap 430" is ***a rate of change in the length of the tether***. When this ***first criterion*** is applied to Erturk's BWS system, the "speed-based" criteria corresponds to the rate at which the length of the tether is changing as a user's speed of descent increases when they fall toward the ground. *See, e.g.,* Ex-1011, [0338]-[0341]; Ex-1009, [0130] (discussing the Erturk BWS system's ability to measure/determine the "feed rate of the tether"), *see also* [0140].

B. Grounds 3: Obviousness over Erturk in view of Vector, Stockmaster and Raanan

7. Motivation to Combine (Erturk in view of Vector, further in view of Stockmaster, and further in view Raanan)

242. In my opinion, a POSITA would have been motivated to combine Erturk, Vector, and Stockmaster for at least the reasons detailed in Section I.A.1, above. In particular, it is my opinion that a POSITA would have been motivated to further modify the fall detection and prevention feature of Erturk (including in combination with Vector and Stockmaster as described herein) to utilize additional fall detection criteria taught in Raanan.

243. First, as noted earlier, Erturk includes an express teaching and suggestion that it would be desirable to include a fall detection and prevention feature such as the feature taught in Raanan. *See* Section I.A.1 (citing Ex-1009 and discussing the suggestion). Based on the express teachings and suggestions noted earlier, in my opinion a POSITA would have likewise been motivated to combine Raanan's fall detection and prevention methods into Erturk's BWS system (both alone, and as modified by Vector and/or Stockmaster).

244. Moreover, in my opinion a POSITA would have understood that combining the teachings of Erturk and Raanan would have amounted to use of a known technique to improve a similar device in the same way. Even though Raanan is not directed to an overhead gait BWS system specifically, it is directed to the same safety objectives, including fall detection and prevention (like Erturk) in an environment where a user is performing exercises while using a device that is fixed around his/her waist (protection belt) and configured to monitor the device's and the user's movements (again, like Erturk). Ex-1012, Abstract, 7:13-18. Raanan's technology uses "sensors" to detect changes in the person's height above the ground that are indicative of a fall, both in terms of distance, velocity, and acceleration, among others. *See, e.g.*, Ex-1012, Abstract, 2:1-4:26 (referencing different sensor types), 5:30-6:5 (same), 11:1-12 (discussing measurements of height above the ground), 15 (claim 4). In my opinion, a POSITA would have understood Raanan's use of sensors to measure these quantities to be well known, and also to be similar to methods used in Erturk's BWS system — Erturk's BWS system being already equipped with "sensors" and "encoders" designed to collect the same type of data ("position," "velocity," "acceleration," etc.) to detect changes indicative of a fall. *See, e.g.*, Ex-1009, [0062], [0073], [0092], [0121]-[0130], [0134], [0149]-[0152], [0180]-[0185].

245. Moreover, in my opinion the combination of the fall detection feature of Raanan with the BWS system of Erturk (including in combination with Vector and Stockmaster as described herein) is a combination of known elements to achieve predictable results. In my opinion, the combination of the known elements from Raanan's fall detection algorithm would only require minor software modifications to Erturk's BWS system, and a POSITA would have understood that it would simply amount to leveraging data that Erturk's BWS system was already configured to capture via other sensors. *See* Ex-1009, [0062], [0073], [0092], [0121]-[0130], [0134], [0149]-[0152], [0180]-[0185]. Indeed, at least because of the simplicity and relatively minor software modifications needed to implement this feature, a POSITA would have had a reasonable expectation of success in applying the fall detection algorithms of Raanan to the BWS system of Erturk (including in combination with Vector and Stockmaster as described herein).

246. Further, it is my opinion that a POSITA would have been motivated to use Raanan's multiple criteria based fall detection approach in Erturk's system (including in combination with Vector and Stockmaster as described herein) in order to enhance the fall detection capabilities of Erturk's system and avoid false positives. More specifically, in my opinion a POSITA would have been motivated to use Raanan's "continuity of velocity" for a minimum duration (as the ***second criterion***) to confirm that Stockmaster's velocity/speed-based criteria (as the ***first criterion***) was satisfied for long enough to confirm that a true fall event is taking place. S*ee* Ex-1012, 12:10-13, 3:9-15. This would enhance Erturk's ability to distinguish between training exercises that include rapid descents, on the one hand, and fall scenarios where the patient's descent continues for longer than would occur during such exercises, on the other, and a POSITA would have been motivated to achieve that objective through the combination of

teachings proposed. Indeed, Raanan itself suggests to a POSITA that detection of various fall scenarios can be enhanced by considering multiple criteria in combination. *See, e.g.*, Ex-1012, 6:6-7:2 ("the more … data points used prior to activation the better is the reliability of determination of a true fall event and elimination of false positive events."). Indeed, it was a well-known technique to a POSITA to use multiple criteria together – including measures of position/velocity over time – to detect falls. *See, e.g.*, Ex-1016, 4:50-5:5 ("if at any point the vertical height of the subject falls more than four inches or if their vertical speed moves faster than ten inches per second, the system automatically switches into a holding mode and prevents the subject from descending."); *see also* 1:30-41, 4:50-5:5, Fig. 34; Ex-1019, 12902-12921.

247. Accordingly, in my opinion a POSITA would have been motivated to combine the fall detection features of Raanan into the BWS system of Erturk (including in combination with Vector and Stockmaster as described herein), and would have had a reasonable expectation of success in doing so.

1. Claims 9 & 10

9.	***The method of claim 7, wherein the second criterion is a duration during which the length of the tether is changed.***
10	***The method of claim 9, wherein the second criterion is a minimum duration.***

248. Claims 9 and 10 both relate to the duration during which the length of the tether is changed, thus adding related limitations to claim 7. For brevity, I will address these limitations together.

249. In my opinion the combination of Erturk, Vector, and Stockmaster discloses claim 7 as detailed above. Further, in my opinion the combination of Erturk, Vector, Stockmaster and Raanan discloses and renders obvious the additional limitations recited in claim 9 (***wherein the***

first criterion is a rate of change in the length of the tether) and claim 10 (***wherein the second criterion is a minimum duration***). Further, Raanan teaches each of the additional elements of claims 9 and 10.

250. To begin, Claims 9 and 10 both recite additional limitations for the ***second criterion***. In my opinion, viewing Stockmaster's speed-based criteria as the first criterion, it would have been obvious to a POSITA to also consider "duration" of the "speed-based" criteria (and/or other criteria) to discriminate between exercises that include rapid descents from fall scenarios where the patient's descent continues for longer than would be expected to occur during such exercises.

251. As noted previously, Stockmaster suggests to a POSITA that "a **combination of two or more detection options**" can be considered together for advanced detection of "other 'fall' scenarios." Ex-1011, [0340]. Moreover, Raanan also discloses multiple factor fall detection, including a method where the first criterion is based on the velocity of the user's descent exceeding a speed threshold labeled as "rapid" (the threshold computed as: "a decrease [in height] greater than 20% of the current or default height measurement over time period of 200 milliseconds or less"), and the second criterion is the ***duration*** of that the "rapid" speed condition being satisfied. Ex-1012, 12:7-13, 13:7-9.

252. Similar to Stockmaster's "speed-based" criterion, Raanan considers the patient's "velocity towards ground V_z" in detecting whether or not a fall event is taking place. Ex-1012, 12:7-13, compare Ex-1011, [0340]. If a user's descent increases at a rate that meets or exceeds the "rapid" condition described in Raanan, the device recognizes that a potential fall event may be occurring, and then moves to the next step where it confirms whether or not the potential fall event is a true fall event. To confirm this, in one embodiment Raanan considers how long the

increased speed is occurring (e.g., a ***second criterion***). In particular, Raanan discloses that a "continuity of velocity towards ground V_z" measured over time should be considered to confirm that the suspected fall is actually occurring, and to avoid false fall detections where the user is merely performing an intensive exercise. In my opinion, "[c]ontinuity of velocity towards ground V_z" measured over a minimum amount of time constitutes ***a duration*** of the velocity. Ex-1012, 12:10-13, 3:9-15 (describing that a fall may not be detected, and a false positive avoided, if the "decrease of the computed heights is followed by an increase in computed heights indicating that the user is exercising). Moreover, it is my opinion that when Raanan's technology is combined with Erturk's system (including as combined with Vector and Stockmaster)—and as an additional criterion to the Stockmaster's "speed-based" criteria—Raanan's "continuity of velocity" criterion (to confirm a true fall event is occurring) corresponds to ***a duration during which the length of the tether is changed*** as recited in claim 9.

253. In connection with claim 10, with further limits to claim 9, it is also my opinion that Raanan discloses and renders obvious a minimum duration. Indeed, it is my opinion that by specifying that the "continuity of velocity" is confirmed by a second velocity measurement that is "separated in time by at least 200 milliseconds" from the initial velocity measurement, Raanan discloses a minimum duration. *See* Ex-1012, 13:10-16.

254. Raanan prescribes that "at least 200 milliseconds" must pass between velocity samples (suggesting that the amount of time may be greater than 200 milliseconds in some applications). In my opinion, Raanan's disclosure that the "continuity of velocity" criterion must continue during at least the period of time required to take both the first sample and the second sample, plus the amount of time corresponding to the aforementioned "at least 200 milliseconds," discloses and renders obvious a ***minimum duration*** as recited in claim 10. Ex-

1012, 6:23-7:2, 11:18-12:17, 13:13-16. Accordingly, in my opinion Erturk in view of Vector, Stockmaster and Raanan discloses ***wherein the second criterion is a minimum duration*** in accordance with claim 10.

2. Claim 11

11[a]	***The method of claim 7, wherein the first criterion is a rate of change in the length of the tether,***
11[b]	***the second criterion is a duration during which the length of the tether is changed, and***
11[c]	***the amount of body weight support provided in response to the first criterion and the second criterion being satisfied is a first amount of body weight support, the method further comprising:***
11[d]	***providing a second amount of body weight support when at least one of the first criterion or the second criterion is not satisfied, the second amount of body weight support being less than the first amount of body weight support.***

255. In my opinion, Erturk in view of Vector, Stockmaster and Raanan discloses and renders obvious claim 11.

256. On my review, the elements of limitations 11[a], 11[b], and 11[c] are the same as the elements of claim 8, claim 9, and Element 7[g], respectively. Thus, in my opinion the combination of Erturk, Vector, Stockmaster and Raanan teaches limitations 11[a], 11[b], and 11[c] as I detailed in sections above. *See* Sections I.B.1 (claim 8) I.A.3 (claim 9), I.A.2.g (claim element 7[g]).

257. Further, Raanan discloses that if the "continuity of velocity" criteria – the ***second criterion*** for purposes of claims 9 and 10 – is not satisfied, and instead the "decrease of the computed heights is followed by an increase in computed heights indicating that the user is exercising," Raanan will not detect a fall nor attempt to prevent it. Ex-1012, 3:9-15. In such a case, the combined system will not "lock[] the rope winch" (i.e., will not provide full body

weight support) because it will not detect a fall event. *Id*. Rather, it will continue providing the dynamic/active body weight support that is some fractional percentage of the patient's body weight (an amount that is less than full/100% body weight support). *Id*.

258. Accordingly, in my opinion the combination of Erturk, Vector, Stockmaster and Raanan teaches limitations 11[d] and the entirety of claim 11.

VIII. RESERVATION OF RIGHTS

259. My opinions are based upon the information that I have considered to date. I am unaware of any evidence of secondary considerations with respect to the '316 patent that would render any of the challenged claims non-obvious. I reserve the right, however, to supplement my opinions in the future to respond to any arguments raised by the owner of the '316 patent and to take into account new information that becomes available to me.

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

Executed on January 10, 2023.

By:  David J. Reinkensmeyer, Ph.D.

APPENDIX 1: CURRICULUM VITAE OF DAVID J. REINKENSMEYER, PH.D.

CURRICULUM VITAE

David J. Reinkensmeyer, Ph.D.

Office Address and Phone Number: 3225 Engineering Gateway, Zot: 3975, (949)824-5218

Current Position: Professor, Department of Mechanical and Aerospace Engineering, Department of Anatomy and Neurobiology, Department of Biomedical Engineering, Department of Physical Medicine and Rehabilitation

Home Address and Phone Number: 46 Urey Ct., Irvine, CA 92617

Date of Birth: 9/22/66

Place of Birth: Moline, Illinois

Current Citizenship: U.S.

Education:
Ph.D. in Electrical Engineering, 1993, University of California, Berkeley
M.S. in Electrical Engineering, 1991, University of California, Berkeley
B.S. in Electrical Engineering, 1988, Massachusetts Institute of Technology

Professional Interests: biological motor control, neurorehabilitation, robotics, mechatronics

Academic Appointments:

Professor, Step VIII, Department of Mechanical and Aerospace Engineering, Department of Anatomy and Neurobiology, University of California, Irvine, July 2022 – current

Professor, Step VII, Department of Mechanical and Aerospace Engineering, Department of Anatomy and Neurobiology, University of California, Irvine, 2019 – 2022

Professor, Step V, Department of Mechanical and Aerospace Engineering, Department of Anatomy and Neurobiology, University of California, Irvine, 2016 – 2019

Professor, Step IV, Department of Mechanical and Aerospace Engineering, Department of Anatomy and Neurobiology, University of California, Irvine, 2013 – 2106

Professor, Step III, Department of Mechanical and Aerospace Engineering, Department of Anatomy and Neurobiology, University of California, Irvine, 2010 – 2013

Professor, Step II, Department of Mechanical and Aerospace Engineering, University of California, Irvine, 2007 – 2010

Associate Professor, Step III, Department of Mechanical and Aerospace Engineering, University of California, Irvine, 2005 – 2007

Associate Professor, Step II, Department of Mechanical and Aerospace Engineering, University of California, Irvine, 2003 – 2005

Assistant Professor, Step V, Department of Mechanical and Aerospace Engineering, University of California, Irvine, 2002 – 2003

Assistant Professor, Step IV, Department of Mechanical and Aerospace Engineering, University of California, Irvine, 2000 – 2002

Assistant Professor, Step III, Department of Mechanical and Aerospace Engineering, University of California, Irvine, 1998 – 2000

Adjunct Assistant Professor, Department of Physical Medicine and Rehabilitation, Northwestern University Medical School, 1998 – present

Research Assistant Professor, Department of Physical Medicine and Rehabilitation, Northwestern University Medical School, 1997 – 1998

Post-Doctoral Fellow, Sensory-Motor Performance Program, Rehabilitation Institute of Chicago and Department of Physical Medicine and Rehabilitation, Northwestern University Medical School, 1994 – 1997, Mentor: Prof. Zev Rymer

Lecturer, Department of Human Biodynamics, University of California, Berkeley, 1994

Research Assistant, Motor Control Laboratory, Department of Human Biodynamics, Graduate Group in Bioengineering, University of California, Berkeley, 1990 – 1994; Mentor: Prof. Steve Lehman

Research Assistant, Neurology Unit, Department of Electrical Engineering, University of California, Berkeley, 1989 – 1990; Mentor: Prof. Larry Stark

Research Assistant, Artificial Intelligence Laboratory and Department of Brain and Cognitive Sciences, Massachusetts Institute of Technology, 1986 – 1988; Mentor: Prof. Chris Atkeson

Academic Affiliations:
Reeve-Irvine Research Center
UCI Center for the Health Effects of Exercise in Children
Center for the Neurobiology of Learning and Memory
Sue and Bill Gross Stem Cell Center
Northwestern University Department of Physical Medicine and Rehabilitation

Consulting Activities:
Founding Member, Robomedica Inc., Technical Advisory Board
Paid Consultant: Hocoma A.G.
Founder, Paid Consultant: Flint Rehabilitation Technologies

Awards and Honors:

2022	Plenary Speaker, 2022, SOMFER, Societe Francaise de Medicine Physique et de Readaptation on December 1 in Rennes, France
2022	Keynote Speaker, 2022 Rehabweek Conference, which combines 8 societies, including International Conference on Rehabilitation Robotics,International Functional Electrical Stimulation Society, International Society for Virtual Rehabilitation.
2020	UCI's Greek life Faculty Favorite May 2020
2019	Fellow, American Institute of Medical and Biological Engineers
2017 - 2021	Member, National Advisory Board for Medical Rehabilitation Research, NIH
2017	Elected Fellow, UC Irvine Center for the Neurobiology of Learning and Memory
2017	Google Scholar Classic Paper author –One of ten most-cited articles in Rehabilitation Therapy that were published ten years earlier.
2017	HSSOE Dean's Honoree for Teaching Excellence

2017	Mechanical and Aerospace Engineering Student Council Professor of the Year
2016	Brenes Keynote Lecturer, University of Pittsburgh Rehabilitation Research Day
2016	UC Irvine Distinguished Mid-Career Award for Research
2016	Henry Samueli School of Engineering Innovator of the Year Award
2014	Mechanical and Aerospace Engineering Student Council Professor of the Year
2013	Keynote Speaker, 2013 IEEE International Conference on Rehabilitation Robotics
2012	2012 Most Innovative Technology Award 2nd IEEE EMBS Unconference on Rehabilitation Robotics (for work with Dan Zondervan on the Smart Wheelchair Trainer).
2011	2011 Most Innovative Technology Award 1st IEEE EMBS Unconference on Wearable and Ubiquitous Technology for Health and Wellness (for work with Nizan Friedman and Prof. Mark Bachman on the MusicGlove).
2011	NIH National Institute of Biomedical Imaging and Bioengineering Lecture, Biomedical Engineering Society Annual Meeting
2011	IEEE Transactions on Neural Systems and Rehabilitation Engineering Best Paper of the Journal Award for 2011
2009-2012	Chair, NSF/WTEC European Study on Technology for Mobility
2004	Fariborz Maseeh Best Faculty Research Award, Henry Samueli School of Engineering
2000	Chancellor's Award for Excellence in Fostering Undergraduate Research, Henry Samueli School of Engineering
2000	Special Computer Award for Undergraduate Research, Division of Undergraduate Education and the Office of Academic Computing
1999	UCI Faculty Career Development Award
1998	Whitaker Foundation Biomedical Engineering Research Grant
1998	Sarah Baskin Award for Excellence in Research at the Rehabilitation Institute of Chicago
1996 – 1997	NIH National Research Service Award Fellow
1994 – 1995	National Institute for Disability and Rehabilitation Training Fellow
1993	Franklyn M. Henry Grant
1988 – 1991	National Science Foundation Graduate Fellowship
1988	Ernst M. Guillemin Prize for Best Undergraduate Thesis in Electrical Engineering at MIT
1987	Tau Beta Pi
1985	NCR Scholastic Achievement Award

Citation Statistics
Citations 17988, h-index 72 (Google Scholar, 9/20/22)

Professional Association Memberships:
IEEE Robotics and Automation Society
IEEE Engineering in Medicine and Biology Society
Society for Neuroscience

Professional Service and Activities:

Editor-in-Chief, Journal of Neuroengineering and Rehabilitation, 2014 – current
Associate Editor, Archives of Physical Medicine and Rehabilitation, 2013 – 2014
Associate Editor, IEEE Transactions on Neural Systems and Rehabilitation Engineering, 2002-2010
Chair, NSF/WTEC International Study on Technology for Mobility, 2009-2012
Member, National Advisory Board for Medical Rehabilitation Research, NIH, 2017 - 2021

Track Chair/Associate Editor, 2007 IEEE EMBS Conference, Rehabilitation engineering and biorobotics themes, co-chair EMBC07 sessions Robotic Devices for Rehabilitation I and II; Scientific Program Committee and Session Chair: 2005 IEEE International Conference on Rehabilitation Robotics, Chicago, Illinois, June 28-July 1, 2005, 6th International Conference on Rehabilitation Robotics, Stanford University, Stanford, California, U.S.A., July 1-2, 1999; "Ergonomics of Assistive Technology II," 1st Joint Meeting of BMES and EMBS, Atlanta, Georgia , Oct 13-16, 1999; Reviewer American Society of Biomechanics Conference 2007; Co-referee, Doctoral thesis of Tobias Nef, student of Prof. Dr.-Ing. Robert Riener, Professor for Rehabilitation Engineering, ETH and University Zurich, Switzerland; Referee for Doctoral thesis of Jan Veneman, student of Prof. Frans van der Loos, University of Twente, Netherlands; Referee for Doctoral thesis of Ludovic Dovat, student of Etienne Burdet, National University of Singapore. Best Paper Selection Committee, 2009 IEEE International Conference on Rehabilitation Robotics, Invited Participant, NSF Workshop on Neuromechanical Engineering, Arlington, VA September 14-15, 2009; Invited Participant, NICHD Scientific Vision Workshop on Diagnostics and Therapeutics, Bethesda, MD March 1-2, 2011, Site Review Panel, Swiss National Science Foundation National Centre of Excellence (NCCRs) in Intelligent Robots for Improving the Quality of Life, 2011-2021, Invited Participant, 2nd Roadmapping Workshop on US Medical and Healthcare Robotics, sponsored by NSF and USC 2012; Conference Committee 2012 IEEE EMBS Unconference on Rehabilitation Robotics; Advisory Board, Stanford University Restore Center, 2020-2021, Invited Participant Liberate 2021 NSF Workshop on Living Better through Rehabilitative and Assistive Technologies. Senior Program Committee; American Psychological Association's Technology, Mind & Society conference to be held virtually on November 3-5, 2021

Reviewer: Stroke, IEEE Transactions on Biomedical Engineering, Neurorehabilitation and Neural Repair, IEEE Transactions on Neural Systems and Rehabilitation Engineering; Advanced Robotics; Journal of Rehabilitation Research and Development; Journal of Neurophysiology, Experimental Brain Research, IEEE Sensors Journal, Journal of Applied Biomechanics, Journal of Neuroscience, Journal of Neuroengineering and Rehabilitation, IEEE Transactions on Robotics, International Journal of Robotic Research, Paralyzed Veterans of America Spinal Cord Research Foundation; Annual Meeting of the Rehabilitation Engineering Society of North America, 2000; 6th International Conference on Rehabilitation Robotics, Stanford University, 1999; Proposal Pre-reviewer, VA Medical Center, Palo Alto, California; Rehabilitation Institute of Chicago, Illinois; 7th International Conference on Rehabilitation Robotics, Evry, France, 2001; American Institute of Biological Sciences/Army Medical Research and Materiel Command; Engineering and Physical Sciences Research Council (United Kingdom); Reviewer, Scientific Review and Evaluation Board, Department of Veterans Affairs, Rehabilitation Research and Development Service, 1999, 2000, 2002, 2003; NIH MRS Study Section 2009, 2011; IROS 2009; Review Panel member, NSF Collaborative Research in Computational Neuroscience Program 2010; Craig Neilsen Foundation 2011, IEEE ICORR 2011, PLOS Computational Biology 2012,2013, Nature Medicine, Israeli Ministry of Science and Technology 2013, 2013 IEEE International Conference on Rehabilitation Robotics, 2013 Frontiers in Computational Neuroscience, 2013 IEEE Transactions on Haptics, 2013 Journal of Motor Behavior, 2014 Data Safety and Monitor Board, Spaulding Rehabilitation Hospital, "Lower Extremity Allotransplantation: An Experimental Rehabilitation Protocol in an Inpatient Setting.", 2014 Science, 2014 Neuron, Experimental Brain Research, Journal of Neurophysiology, Neurorehabilitation and Neural Repair, Journal of Motor Behavior, Journal of Neural Engineering, IEEE Transactions on Neural Systems and Rehabilitation Engineering, 2016 NIDILRR Grant Review Panelist, 2016 Science Translational Medicine, 2017 NIDILRR Grant Review Panelist 2017 NIH Quantum (Major Technology Advances in Medicine) Grant Review Panelist, 2017 Science Robotics, 2017 PNAS, 2018 Science Robotics, NSF 2020, Stanford Restore Center 2020, Current Biology 2021

Post-doctoral Advisees:

1. Raul Benitez, Ph.D.

9/05-6/06, subsequent position: Asst. Professor, Dept of Systems Engineering, Universitat Politècnica de Catalunya, Spain

2. Jose Galvez, Ph.D.
3/03 – 7/07, subsequent position: Research Engineer, Biomechanics Institute of Valencia

3. Marie-Helene Milot, P.T., Ph.D. (co-advised with Prof. S. Cramer, Neurology)
2/08 – 12/10, subsequent position : Researcher, Center for Research on Aging, Adjoint Professor, School of Rehabilitation, U. Sherbrooke, Canada

4. Riccardo Secoli, Ph.D.
7/10 – 6/11, subsequent position: Postdoctoral fellow, Dept of Bioengineering, Imperial College, London

5. Sergio Gago, Ph.D.
9/12 – 7/14, subsequent position: Research Staff, Calit2 Irvine

6. Oliver Stoller, P.T., Ph.D.
9/15 – 11/16, subsequent position: Head of Therapy Department at Rehaklinik Zihlschlacht, Zürich Area, Switzerland

7. Joan Lobo Prat, Ph.D.
11/16 – 11/18, subsequent position: Rehabilitation Engineer at ABLE Human Motion Barcelona, Catalonia, Spain

8. Marti Comellas, Ph.D.
9/19 – 9/21, subsequent position: Assistant Professor, University of Lleida

9. Edgar de Jesus Munoz, Ph.D.
11/19 – 11/20, subsequent position: Consultant

10. Juan Perez, Ph.D.
2/21 – current, supported by Hewitt Foundation Postdoctoral Fellowship

Ph.D. Advisees:
1. Craig Takahashi
Date: 9/98 – 12/03
Dissertation title: Computational motor adaptation in real-world conditions: The effects of noise, neural damage, neuromuscular development, and fatigue
Post-doctoral employment: Postdoctoral fellow, Department of Neurology, U.C. Irvine; Currently, Assistant Professor, Department of Engineering, Santa Ana College

2. Wojciech Timosyzk
Date: 9/98 – 12/03
Dissertation title: Robotic devices for the study of rat locomotion after spinal cord injury
Postdoctoral employment: Stryker, Dallas TX

3. Robert Sanchez (co-advisor was Prof. Bobrow)
Date: 6/03 – 8/05
Dissertation title: Passive and active orthoses for upper extremity movement training after stroke
Postdoctoral employment: Alcon, Irvine CA

4. Jeff Nessler
Date: 5/02 – 8/05

Dissertation title: Robotic assessment of locomotor ability following spinal cord injury in rats
Postdoctoral employment: Postdoctoral fellow, Rehabilitation Institute of Chicago/Northwestern University; Currently, Assistant Professor, Department of Kinesiology, Cal State San Marcos

5. Lennie Kahn (a Ph.D. Student in Biomedical Engineering at Northwestern University. Primary advisor was Dr. W. Zev Rymer, Northwestern University)
Date: 1/98 – 8/05
Dissertation title: Kinetically altered reaching in chronic hemiparetic stroke: understanding strength and coordination impairment and implications for recovery.
Postdoctoral employment: GE Healthcare, Chicago IL

6. Jiayin Liu
Date: 9/03 – 3/06
Dissertation title: Robotic Environments for Training and Assessing the Human Motor System
Postdoctoral employment: Research Engineer, Aubrey Group (Biomedical device consulting)

7. Jeremy Emken
Date: 7/02 – 4/06
Dissertation title: Human Locomotor Control, Adaptation, and Rehabilitation
Postdoctoral employment: Postdoctoral fellow, California Institute of Technology; Currently – Engineer, Verily Life Sciences, formerly Google [X].

8. Daisuke Aoyagi (primary Ph.D. advisor was Prof. J.E. Bobrow)
Date: 1/03 – 6/06
Dissertation title: A robotic device for human gait rehabilitation: Achieving naturalistic assistance for the pelvis and legs through compliant pneumatic actuation and temporal synchronization
Postdoctoral employment: Research engineer, Rancho Los Amigos National Rehabilitation Hospital; Currently – Assistant Professor, Dept of Mechanical Engineering, Cal State Chico

9. Eric Wolbrecht (primary advisor was Prof. J.E. Bobrow)
7/04 – 6/07
Dissertation title: A pneumatic robot for retraining arm movement after stroke
Postdoctoral employment: Assistant Professor, Dept. of Mech. Eng., University of Idaho

10. Julius Klein
9/05 – 5/09
Dissertation title: Performance enhancing mechanisms for human manipulation
Postdoctoral employment: Postdoctoral fellow, Department of Bioengineering, Imperial College, London; Currently – Research Engineer, Technalia, Spain

11. Laura Marchal
7/05 – 5/09
Dissertation title: Haptic guidance for enhancing human motor learning: application to a robot-assisted powered wheelchair trainer
Postdoctoral employment: Postdoctoral fellow, Swiss Federal Institute of Technology (ETH-Zurich)
Currently – Assistant Professor, University of Bern, Switzerland

12. Steve Spencer
4/08 – 11/11
Dissertation title: Movement Training and Post-Stroke Rehabilitation Using a Six Degree of Freedom Upper-Extremity Robotic Orthosis and Virtual Environment
Postdoctoral employment: Research Engineer, Los Alamos National Laboratory

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13. Sergi Perez
9/07 – 12/2012
Dissertation title: Estimating Maximal Effort Movement during Rehabilitative Training of Humans and Rodents
Postdoctoral employment: Software engineering – Amazon.com; currently, software engineer Google

14. Nizan Friedman – Rehabilitation Devices for Training, Assessing, and Monitoring Hand Function
6/10 – 5/13 (co-advised with Prof. Mark Bachman)
Postdoctoral employment: CEO of start-up, Flint Rehabilitation Devices

15. Danny Zondervan – Leveraging Mechanical Resonance into Mobility and Recovery for Stroke Survivors: a Novel Rehabilitation Technique 6/10 – 5/14
Postdoctoral employment: CTO of start-up, Flint Rehabilitation Devices

16. Jaime Duarte – Effects of Robotic Challenge Level on Motor Learning, Rehabilitation, and Motivation: The Real-World Challenge Point Framework, 6/09 – 8/14
Postdoctoral employment – Postdoctoral fellow, ETH Zurich , CEO of MyoSwiss

17. Justin Rowe – Evaluating Robotic Assistance and Developing Wearable Activity Monitors to Correct Learned Nonuse after Stroke 6/10 – 8/15; Postdoctoral employment – Research Engineer, Flint Rehabilitation Devices

18. Brendan Smith – Unexpected Elements of Human Force Control and Instances of Preservation after Severe Stroke: Implications for Optimality, Variability and Rehabilitation Technology
9/11 – 3/17; Postdoctoral employment – Assistant Professor, Department of Mechanical Engineering, Loyola Marymount University

19. Morgan Ingemanson – Proprioception and motor learning after stroke – insights from neuroimaging studies (Dept. of Anatomy and Neurobiology)
9/13 – 6/2017; Postdoctoral employment: Medical Affairs Manager, Evoke Neuroscience

20. Sumner Norman – Brain computer interface design for robot assisted neurorehabilitation
9/12 – 9/17; Postdoctoral employment: Postdoctoral fellow, Cal Tech, Andersen Lab

21. Yasemin Sarigul-Klijn – Design and Evaluation of a New Class of Device for Therapy and Mobility: ExoChairs, Dept. of Biomedical Engineering, 9/14 – 11/17

22. Diogo Schwerz de Lucena – New Technologies for On-Demand Hand Rehabilitation in the Living Environment after Neurologic Injury 9/14 – 7/19; Postdoctoral employment: Postdoctoral fellow, Harvard, Walsh Lab

23. Quentin Sanders – Hand Rehabilitation after Stroke: Understanding and Optimizing the Usage of Wearable Robotic Technologies 9/15 – 9-20; Postdoctoral employment: Biomedical Engineer at x – the moonshot factory (formerly GoogleX)/Postdoctoral Fellow North Carolina State University

24. Merav Senesh – Breaking the Routine: Understanding the Interplay of Control Synergies and Reinforcement Learning to Improve Motor Training and Recovery in Neurologic Conditions after stroke
9/17 – 6-21; Postdoctoral employment, Rafael Advanced Defence Systems, Israel

25. Dylan Reinsdorf – Engineering for Arm Use After Stroke: A Precision Rehabilitation Model, Minimalistic Robot Design Pattern, and Proprioception-Targeting Gaming Paradigm
9/19 – 8/22; Postdoctoral employment, research engineer, iRhythm, San Francisco

26. Shusuke Okita – Wearable sensing for neurorehabilitation
9/18 – current

27. Veronica Swanson – Determinants of uptake of robotic rehabilitation technologies
9/20 – current

28. Chris Johnson – Robotic assessment of ankle sensory motor ability
9/20 – current

29. Caitlin Callaghan – Clinical assessment of hand function
9/21 – current

M.S. Advisees:

1. Chris Painter
Date: 6/99 – 7/00
Master's Project: Web-based motion control for physical rehabilitation

2. Clifton Pang
Date: 9/99 – 3/01
Master's Project: Java Therapy, a web-based system for stroke rehabilitation

3. John Wynne
Master's Project: A backdriveable robotic device for manipulating and measuring stepping
Date: 9/00 – 3/02

4. Jeff Nessler
Master's Project: Affordable actuator backdriveability for human robot interaction: the series elastic servomotor
Date: 1/01 – 5/02

5. Shawn McGuan
Master's Thesis: A biomechanical model for studying spinal control of stepping in the rat
Date: 1/99 – 12/02

6. Karen Ngai
Master's Thesis: The Mechanical Design of a Backdriveable Robot for Measuring and Manipulating Pelvic Motion
Date: 9/02 – 12/03 (co-advisor with J. Bobrow)

7. Jason Lin
Master's Thesis: Pelvic Assist Manipulator Version 2.0: Design of Control hardware and Algorithm
Date: 9/02 – 6/04 (co-advisor with J. Bobrow)

8. Gigi Au
Master's Project: TIM, A Three-dimensional Interactive Manipulandum, As an Input Device for Java Therapy
Date: 9/03 – 8/04

9. Wade Ichinose – Pelvic Assist Manipulator Version 3.0: Design of Mechanical Hardware, Safety Features, and a New Leg Robot
Date: 9/02 – 12/04 (co-advisor with J. Bobrow)

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10. Megan Thomas – SARA: Stand Assist Rehabilitation Apparatus
Date: 9/02 – 6/05

11. Laura Marchal – A Simulator and Control Algorithm for Teaching Children to Drive a Powered Wheelchair
Date: 7/05 – 4/06

12. Kareem Adnan – Baby wrist simulator
9/05 – 12/07

13. Steve Spencer – Hand movement training device
9/05 – 8/07

14. Cole Young – Master's Thesis Project: Quantifying movement quality in competitive diving
9/2009 – 8/2011

15. Justin Spring – Master's Thesis Project: Robotic perturbations for measuring strategies for control of the pelvis during walking
9/11-9/12

16. Miquel Batalle Lopez – Master's Thesis Project: Stiffness and grip force measurement using an eccentric mass motor: a dynamic model and experimental verification 9/11-8/12

17. Adan Amarallis – Master's Thesis: Comparing Haptic Guidance to Error Amplification in Robot-Assisted Training of a Golf-Putting Task Performed by Initially Skilled Trainees 9/12—12/13

18. Aurelia Darling – Master's Thesis: Feedback Control for a Smart Wheelchair Trainer Based on the Kinect Sensor 1/14 – 9/14

19. Derek Bissell – Master's Thesis: Mechanism for tone-cancellation for the severely impaired wrist after stroke 1/14 – 7/15

20. Hugo Dominguez-Marzo – Master's Project: Tone-cancelling exoskeleton 9/15 – 7/15

21. Wyatt Moscoso – Master's Thesis: Effect of Ball Inflation Pressure and Padded Headgear on Ball-Head Impacts in Water Polo and Soccer 9/15 – 3/13/17

22. Gerard Moreso – MovIt: A powered wheelchair interface for integrated, moderate exercise 9/16 – 12/17

23. Yinchu Dong: Development and evaluation of two control methods for MOVit: An exercise-enabling driving interface for powered wheelchair users 9-17 - 6/18

24. Yasmeen AbuZeid: Arm movement pattern recognition for infants with perinatal brachial plexus injury for contingent reinforcement 9/18 – 6/19

25. Pol Sin Arumi: Data science for regenerative robotic rehabilitation 9/19 – 12/20/21

26. Kyle Seward: A robot for rehabilitation of the mouse forelimb; 9/19 – 6/21

27. Claire Chaisson: Neural correlate of proprioception; 9/20-6/21

28. Caitlin Callaghan: Role of memory in proprioceptive recall; 9/19 – 6/21

Student Awards
Wojciech Timoszyk, Student Paper Award, IEEE EMBS Conference, 2003
Liu, Graduate Student Travel Award based on Best Paper Award, 9 h IEEE International Conference on Rehabilitation Robotics, 2005
Aoyagi, Graduate Student Travel Award based on Best Paper Award, 9 h IEEE International Conference on Rehabilitation Robotics, 2005
Sanchez, Graduate Student Travel Award based on Best Paper Award, 9th IEEE International Conference on Rehabilitation Robotics, 2005
Nessler, Graduate Student Travel Award based on Best Paper Award, 9th IEEE International Conference on Rehabilitation Robotics, 2005
Laura Marchal best poster, 2006 Maseeh Graduate Student Poster Award, Henry Samueli Engineering Symposium
Eric Wolbrecht, student travel award, 2007 IEEE Conference on Neural Engineering
Laura Marchal, 2009, Dean's Dissertation Fellowship
2013 IEEE International Conference on Rehabilitation Robotics (1st and 3rd prize awarded to Ph.D. students Dan Zondervan, Brendan Smith and Jaime Duarte for work on Resonating Arm Exercise/Propulsion and Real-World Challenge Point in Rehabilitation)

Student M.S. and Ph.D. Committees
2012-2013 Mark Plecnik MAE MS Thesis Committee, Arthur Valadares, Qualifying Exam,
Anatomy and Neurobiology Advancement and Dissertation Committee: Virginia Liu 2013
Anatomy and Neurobiology, Advisement Committee, Inez Falcon, Jennifer Wu
Anatomy and Neurobiology Advancement Exam Committee, Calvin Schneider, 2013
2013 Joan Aguilar MAE Ph.D. Qualifying Committee
2013 Inez Falcon, Anatomy and Neurobiology, Advancement Committee
2014 Aggie Szymanska BME Ph.D. Qualifying Committee
2014 Brian Parrish MAE Qualifying and Dissertation Committee
2014 Kaustubh Sonawale, Qualifying Committee
2014 Mark Plecnik, Qualifying Committee
2014 Christine King, BME Qualifying and Dissertation Committee
2014 Jennifer Wu, Anatomy and Neurobiology, Advancement Exam Committee
2014 Katie Jo Turk, Department of Dance MFA Committee
2014 Beatrice Hui, Department of Dance MFA Committee
2014 Brandon Tsuge, MAE, Ph.D. Qualifying Committee
2015 Shramana Ghosh, MAE, Ph.D. Qualifying Committee
2015 Marco Minniti, MAE, Ph.D. Qualifying Committee
2016 Crystal M. Reyna, Dept. of Ecology and Evolutionary Biology, Ph.D. Qualifying Committee
2017 External reviewer of Ph.D. dissertation, Diana Rui, Departamento de Informatica e Ingenieria de Sistemas, Universidad de Zaragoza
2017 External reviewer of Ph.D. dissertation, Federica Aprigliano, Biorobotics Ph.D. Program, Scuola Superiore Sant'Anna
2017 Maria Bauer, MAE, Ph.D. Qualifying Committee
2017 Peter Wong, MAE, Ph.D. Qualifying Committee
2018 Vatche Donikian, MAE, Ph.D. Qualifying Committee
2018 Joseph Bell, MAE, Ph.D. Qualifying Committee
2021 Raffaele Ranzani, ETH Zurich, Ph.D. Thesis Defense Committee
2021 Maria Masquini, Scuola Superiore Sant'Anna, PhD. Thesis External Reviewer
2022 Eshan Shamloo, ChemE, Ph.D. Defense
2022 Jessica Vidmark, BME, Ph.D. Qualifying Committee
2022 Jeanette Plantin, Karolinska Institute, Ph.D. Thesis Opponent

2022 Maral Kasiri, BME, Ph.D. Qualifying Committee
2022 Dina Abulon, MAE, Ph.D. Qualifying Committee

Extramural Funding:

Previous:

G1: Principal Investigator, “Mechanical Imaging of the Hemiplegic Workspace”, National Research Service Award, National Institutes of Health, F32HD08067-01, 1/1/95-12/31/96, $60,000

G2: Principal Investigator, “Mechatronic Rehabilitation for Arm Movement after Stroke”, Whitaker Foundation Biomedical Engineering Research Grant, 9/1/98-2/28/01, $210,000

G3: Principal Investigator, “Development of a Rehabilitator for Arm Therapy after Brain Injury” National Institute on Disability and Rehabilitation Research, H133G80052, 5/1/98 – 4/30/03, $371,238, 8%

G4: Principal Investigator, “Exploring PC Accessibility: A Dynamic Force Feedback System for Rehabilitation”, Microsoft Corporation New Discoveries Grant, 5/01/99 – 4 /30/01, $50,000

G5: Co-Investigator, “Mechanically Assisted Upper Limb Movement for Assessment and Therapy”, National Institutes of Health Small Business Innovation Research Grant (Phase II) to Rehabilitation Technologies Division of Applied Resources Corporation, 8/1/01 – 7/30/03, Total: $720,000; UCI Subcontract: $108,589, 8%

G6: Principal Investigator, “Robotic outcome assessment in spinal cord injury and regeneration”, Roman Reed Grant Program, $61,293, 1/1/02 – 12/31/02, 1%

G7: Co-Investigator, “Operating System for Internet Facilitated Stroke Rehabilitation”, National Institutes of Health Small Business Innovation Research Grant (Phase I) to Rehabilitation Technologies Division of Applied Resources Corporation, 1/1/02 – 1/1/03, Total: $100,000; UCI Subcontract: $30,603, 8%

G8: Co-Investigator, “Use Dependent Plasticity of Spinal Inhibition”, National Institutes of Health, R01 NS40917 PI: Allan Tobin, Brain Research Institute, UCLA, 4/01/02 – 3/31/07, Total: $2,563,743; UCI Subcontract $78,283, 8%

G9: Principal Investigator, “Development of a Robotic Step Training Device”, Robomedica, Inc. Santa Monica, CA, 4/1/02 – 9/30/02, Total: $30,000, 1%

G10: Co-Investigator, “Robotically Generated Locomotion in Rodents”, National Institutes of Health, R01 NS42951, Bioengineering Research Partnership, PI: V. Reggie Edgerton, Brain Research Institute, UCLA, 7/01/02 – 6/31/07, Total: $1,500,326; UCI Subcontract $351,518, 16%

G11: Co-Investigator, “Development of a Robotic Step Training Device for Teaching Individuals with Neurologic Impairments to Walk”, PI: Kevin Vallence, Robomedica, Inc., NIST Advanced Technology Program, ATP 00-00-4906, 7/1/02 – 10/31/05 Total: $2,000,000, UCI Subcontract $521,884, 8%

G12: Principal Investigator, “Gait training robotic assist device”, NIDRR Rehabilitation Engineering Research Center on Spinal Cord Injury, H133E020732, Project V, Lead Institution: Rancho Los Amigos Rehabilitation Hospital, 11/1/02 – 10/30/07. Grant Total: $4,500,000, Project V Total: $726,123, UCI Subcontract: $118,942

G13: Principal Investigator: “Home-based, telerehabilitation system for improving functional hand and arm movement recovery”, NIDRR Rehabilitation Engineering Research Center on Rehabilitation

Robotics and Telemanipulation, H133E020724, Project V, Lead Institution: Rehabilitation Institute of Chicago, 11/1/02 – 10/30/07. Grant Total: $4,352,960, Project V Total: $433,120, UCI Subcontract: $272,397.

G14: Co-Investigator: “Facilities of research in spinal cord injury: Developing new relevant methods for evaluating recovery from spinal cord dysfunction,” DJR subproject title: “Robotic methods for evaluating recovery from spinal cord injury”, NIH Contract awarded to Reeve-Irvine Center, NO1 NS3235, Principal Investigator: Oswald Steward. DJR’s subproject is one of three subprojects on this contract that will share experimental and staff resources at the Reeve-Irvine Center. Grant total: $2,640,463, DJR subproject total (approximate): $871,000, 1/01/03-12/31/08

G15: Principal Investigator, NIH Contract N01-HD-3-3352, “Robotic device for rehabilitation therapy” 10/03 -- 9/06, $862,000; co-investigators are Prof. James Bobrow (UCI MAE) and Prof. Steve Cramer (UCI Neurology)

G16: Co-Investigator: Using Robotics to Assess the Adaptive Capacity of the Human Lumbosacral Spinal Cord, PI: Susan Harkema, UCLA, Project V of NIH PPG Grant, P01 NS16333-22, PI V. Reggie Edgerton 6/01/03 – 12/30/04, UCI Subcontract: $32,000

G17: Co-Principal Investigator, Gesture Therapy: Low-Cost Computer Vision for Arm Movement Training at Home after Stroke, Co-Principal Investigator L. Enrique Sucar, UC Mexus/Conacyt CN-15-179, 6/01/05 – 12/31/06, $25,000, DJR total: $12,500

G18: Principal Investigator, “Home Based System for Exercise: Smart Sensors and Adaptive Signal Processing”, California-Catalonia Research Grant, 9-1-08 – 8/30/09, $35,000.

G19: Principal Investigator, NIH Contract Extension for N01-HD-3-3352, “Robotic device for rehabilitation therapy” 10/06 -- 9/09, $1,362,819; co-investigators are Prof. James Bobrow (UCI MAE) and Prof. Steve Cramer (UCI Neurology)

G20: Principal Investigator, NIH Contract Extension for N01-HD-3-3352, “Robotic device for rehabilitation therapy” 9/09 --3/11, $275,000, co-investigators are Prof. James Bobrow (UCI MAE) and Prof. Steve Cramer (UCI Neurology)

G21: Principal Investigator: “A robotic powered wheelchair trainer with haptic guidance as needed”, NIDRR, H133G090111, 10/01/09 – 9/30/12, $200,000

G22: Principal Investigator: “Targeting T-WREX to improve functional outcomes of upper extremity therapy”, NIDRR Rehabilitation Engineering Research Center on Rehabilitation Robotics and Telemanipulation, H133E070013, Lead Institution: Rehabilitation Institute of Chicago, 10/1/07 – 9/30/12. Grant Total: $4,352,960, Project V Total: $322,170, UCI Subcontract: $252,787. The goal is to develop technology for improving functional recovery of arm movement.

G23: Principal Investigator: “Determinants of the effectiveness of robot-assisted hand movement training”, NIH-R01HD062744-01, $1,471,924, 3/12/10 – 3/28/16. The goal is to study the role of range of motion, effort, previous history of practice, and corticospinal tract integrity of hand motor rehabilitation after stroke.

G24: Principal Investigator: “Enhancing use-dependent hand motor recovery during spinal cord injury regeneration with a grasp training robot and an implanted hand grasp sensor”, Roman Reed Foundation, $100,000, 1/1/12 – 12/31/12. The goal is to develop devices for improving hand rehabilitation in primate model of spinal cord injury.

G25: Co- Investigator: “A music-based rehabilitation device for training and assessing hand function, $150,000 (UCI Subcontract: $48,000) NIH SBIR Grant 10/1/12 – 3/30/13, PI is Nizan Friedman at Flint Rehabilitation Devices. UCI PI is Steve Cramer. The goal of this project is to develop and test a commercial prototype of a sensorized glove for retraining and measuring hand function of chronic stroke patients. The research prototype of the glove was developed at the iMove collaboratory in the Sue and Bill Gross Stem Cell Research Center.

G26: Co-Principal Investigator, “Engineering career development center in movement and rehabilitation sciences”, NIH K12 1K12HD073945-01, lead institution is Northwestern University, $2,500,000, UCI Subcontract $69,705 9/1/12 – 5/31/17. The goal of this center is to develop scholars with engineering and other quantitative backgrounds to become successful rehabilitation scientists in basic, translational, and/or clinical research, by providing salary support for the scholars to be trained through a network of mentors provided through Northwestern University, University of California at Irvine, the Rehabilitation Institute of Chicago, University of North Carolina, Case Western Reserve University, Marquette University, Stanford University, and University of Delaware.

G27: Co-Principal Investigator, “Machines Assisting Recovery from Stroke and Spinal Cord Injury for Reintegration into Society (MARS3)”, National Institute of Disability and Rehabilitation Research Rehabilitation Engineering Research Center on Rehabilitation Robotics , H133E120010, other Co-Principal Investigator Jim Patton, University of Illinois at Chicago, Lead Institution: Rehabilitation Institute of Chicago, 10/1/12 – 9/30/17. Grant Total: $4,748,665, UCI Subcontract $653,666. The goal of this center is to progress the intelligent use of robotic devices for rehabilitation therapy and assistance for people with a physical impairment after stroke, spinal cord injury, and cerebral palsy. Also PI for the Project D3: “Wheelchair-based, robotic, upper extremity exercise and power-assisted propulsion”, the goal of which is to develop a robotic, power-assist lever drive for a manual wheelchair that people with severe upper extremity impairment can use to both exercise and ambulate.

G28: Co- Investigator: “A music-based rehabilitation device for training and assessing hand function”, $75,000 (UCI Subcontract: $25,000) NIDRR SBIR Grant 11/1/12 –43/30/13, PI is Nizan Friedman at Flint Rehabilitation Devices. UCI PI is Steve Cramer. The goal of this project is to develop and test a commercial prototype of a sensorized glove for retraining and measuring hand function of sub-acute stroke patients.

G29: Co- Investigator: “Resonating Arm Exerciser: Affordable Active Assistance for Arm Rehabilitation” $75,000 (UCI Subcontract: $25,000) NIDRR SBIR Grant 11/1/12 –43/30/13, PI is Dan Zondervan at Flint Rehabilitation Devices. UCI PI is Steve Cramer. The goal of this project is to develop and test a commercial prototype of a resonant-assistance lever drive wheelchair for arm therapy after stroke.

G30: Co-Investigator: “A music-based rehabilitation device for training and assessing hand function”, $1,500,000 (UCI Subcontract: $455,340) 2R44HD074331-02 01/15/14-01/14/16 SBIR Phase 2 PI is Nizan Friedman at Flint Rehabilitation Devices. UCI PI is Steve Cramer. The goal of this project is to further develop and test a commercial prototype of a sensorized glove for retraining and measuring hand function of sub-acute stroke and spinal cord injury patients.

G31: Co-Investigator, “Enabling forelimb function with agonist drug and epidural stimulation in SCI”, UCI Subcontract: $150,000. 1U01EB015521-01A1 07/01/13 – 06/30/18. UCLA PI is Daniel Lu. The goal of this project is to restore upper extremity function following spinal cord injury.

G32: Co-Investigator, “Lever actuated rehabilitation of the arm using wheelchair propulsion and computer gaming”. UCI Subcontract: Grant Total: $1,500,000, UCI Subcontract $129,848 R44HD082882 (SBIR Phase 2). PI is Danny Zondervan at Flint Rehabilitation Devices. UCI Subcontract PI is Steve Cramer. 09/03/15-08/31/17 The major goals of this project are to further develop and test a commercial prototype

of an assistive, lever-drive wheelchair specifically designed to provide arm rehabilitation through repetitive elbow/shoulder flexion/extension exercise.

G33: Co-Investigator, “An interactive, wearable device for measuring and motivating hand use after stroke”, UCI Subcontract: Grant Total: $1,500,000, UCI Subcontract $396,354, R44 HD 086953 (SBIR Phase 2) PI is Nizan Friedman at Flint Rehabilitation Devices 05/18/16-04/30/19 The goal of this project is to develop and test a functional prototype of a wearable device designed to track upper extremity movement and to motivate use of the hand and arm following a stroke.

G34: Co-Investigator, VA primate consortium to test novel regenerative therapies after spinal cord injury, 11/1/2014-10/31/2018, UCI IPA is $160,000.

Current:

G35: Principal Investigator, Determinants of the effectiveness of robot-assisted hand movement training NIH-2R01HD062744-06, $1,519,857, 08/01/2018 – 05/31/2023, The goal is to study the role of somatosensory input in robot-assisted hand motor rehabilitation after stroke.

G36: Co-Principal Investigator, “Collaborative Machines Enhancing Therapies (COMET)” National Institute of Disability and Rehabilitation Research Rehabilitation Engineering Research Center on Rehabilitation Robotics, 90REGE0005-01, other Co-Principal Investigator Jim Patton, University of Illinois at Chicago, Lead Institution: Shirley Ryan Ability Lab, 9/30/18 – 9/29/23. Grant Total: $4,624,741 UCI Subcontract $669,915. Positive outcomes require a long and fragile chain of events – development, testing, validation, clinician uptake, and patient acceptance. This center advances collaborative technologies that focus on outcomes in a real-life rehabilitation setting. Device development and pilot testing will be followed by an observational uptake study at the Shirley Ryan AbilityLab, to identify patient, therapist, and machine variables related to clinical uptake of rehabilitation therapy technologies. This involves partnerships with University of California at Irvine, University of Illinois at Chicago, Northwestern University, University of Alabama at Birmingham, North Carolina State University, Delft University of Technology, Harvard; as well as commercial, clinical, and consumer stakeholders.. Also PI for the Project D4: “Wearable sensing for movement practice”, the goal here is to develop and use a custom wearable sensing platform as a research platform to develop and test a new set of algorithms that provides accurate feedback about hand, gait, arm, and custom limb movement, for both people with stroke and spinal cord injury.

G37: Co-Principal Investigator, “Engineering career development center in movement and rehabilitation sciences”, NIH K12 2K12HD073945-06, lead institution is Northwestern University, $2,500,000, UCI Subcontract $49,562 9/1/17 – 8/31/22. The goal of this center is to develop scholars with engineering and other quantitative backgrounds to become successful rehabilitation scientists in basic, translational, and/or clinical research, by providing salary support for the scholars to be trained through a network of mentors provided through Northwestern University, University of California at Irvine, the Shirley Ryan Ability Lab, University of North Carolina, Case Western Reserve University, Marquette University, Stanford University, and University of Delaware.

G38: Co-Investigator, “Enhancing motor retraining using stem cell therapy”, the NIH Alliance for Regenerative Rehabilitation Research and Training, PI is Sunil Gandhi, $100,000, 7/1/2018-6/30/2020. This pilot project takes a novel, live imaging approach to exploring the role of somatosensory feedback in regenerative rehabilitation after spinal cord injury (SCI). The proposed project includes both the use of human neural stem cells as well as motor retraining in a mouse model system.

G39: Co-Investigator, “FitMi Plus: smart functional modules for practicing activities of daily living after stroke”, NIH 1R44HD097803-01 PI is Daniel Zondervan, $1,671,785, UCI Subcontract [[$59,207,]] 03/01/2019 – 08/31/2022. This Fastrack SBIR seeks to develop functional modules for the FitMi home

rehabilitation system. The modules will consist of real-world objects that can be attached to the FitMi Pucks to allow users to practice specific functional tasks while engaging with FitMi's motivating software platform.

G40: Co-Principal-Investigator, "Brain-computer interface-functional electrical stimulation for stroke recovery", NIH 1R01HD095457-01A1. Lead PI is An Do, $3,860,000, 04/01/2019 – 03/21/24. This project seeks to determine if BCI-FES therapy can provide lasting gains in gait function in chronic stroke patients with foot drop; determine what factors influence BCI-FES therapy; and explicitly elucidate the underlying neural repair mechanisms. DJR project budget: $231,429

G41: Principal Investigator, "Sensing Hand Recovery", a development project that is part of the Sensor Technologies Applied to Rehabilitation in Stroke Research Rehabilitation Engineering Research Center, National Institute of Independent Living, Disability, and Rehabilitation Research, 90REGE0010, Center Principal Investigator Zev Rymer, Shirley Ryan Ability Lab, 9/30/19 – 9/29/24. UCI Subcontract $575,000.

G42: Principal Investigator, "Sensor-Enhanced Activity Management (SEAM)", a development project that is part of the ICTS Access for Mobile Rehabilitation (mRehab) Rehabilitation Engineering Research Center, National Institute of Independent Living, Disability, and Rehabilitation Research, 90REGE0011, Center Principal Investigator Mike, Shepherd Center, 9/30/19 – 9/29/24. UCI Subcontract $925,000.

G43: Principal Investigator, "Robotics Technologies in Rehabilitation: A Translational Incubator", Optional Function part of the UCI Institute for Clinical and Translational Science, Institute PI: Dan Cooper, 4/1/19 – 3/30/254, $765,561

G44: Co-Investigator, "Boost: A pragmatic inpatient rehabilitation strategy for improving musculoskeletal arm recovery after stroke", 1R44HD106850-01, PI: Daniel Zondervan, Flint Rehabilitation Devices, The goal of this project is to develop a active arm rest for a manual wheelchair that helps implement a pragmatic rehabilitation for enabling individuals with even severe arm impairment to increase UE motor drive early after stroke. 9/21/21 – 8/31/23, $868,802

Intramural Funding:

IG1: Co-Principal Investigator, "Novel Mechanisms of Motor Control During Growth and Development in Children", CORCLR Multi-Investigator Faculty Research Grant, Co-Principal Investigator: Dan Cooper, M.D., Dept. of Pediatrics, College of Medicine, 7/1/01 – 6/30/02, $12,500

IG2: Co-Principal Investigator, "Mechanisms of motor rehabilitation using robot-like movement training and brain imaging", CORCLR Multi-Investigator Faculty Research Grant, Co-Principal Investigator: Steve Cramer, M.D., Dept. of Pediatrics, College of Medicine, 7/1/05 – 6/30/06, $12,500

IG3: Principal Investigator, iMove Center – Innovate, Regenerate, UCI Ignition Grant, Large-Scale Interdisciplinary Research Ignition Initiative, 4/2010 – current, $40,000. The mission of the iMove Center is to transform human mobility through information technology, robotics, and neuroregenerative therapies, using dance, sport, and computer gaming as the motivating context.

Publications:

U.S. Patents

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P2: Reinkensmeyer DJ, Painter CC, Pang CE (2003) “Method and apparatus for mass-delivered movement rehabilitation ”, Patent No. 6,613,000 (licensed by Applied Resources Corporation)

P3: Reinkensmeyer DJ, Timoszyk W, London N, de Leon RD, Edgerton VR (2005) “Robotic device for locomotor training,” Patent No. 6,880,487 (licensed by Robomedica, Inc., resulting in over $600K in sales for company)

P4: Reinkensmeyer DJ, Wynne JH (2004) “Mechanism for manipulating and measuring legs during stepping”, Patent No. 6,796,926

P5: Wang C-YE, Bobrow JE, Reinkensmeyer DJ (2006) “Robotic gait rehabilitation by optimal motion of the hip”, Patent No. 7,125,388 (licensed by Robomedica, Inc.)

P6: Reinkensmeyer DJ, Sanchez RJ, Smith R, Shah P (2014) Method and apparatus for automating arm and grasping movement training for rehabilitation of patients with motor impairment, Publication date Sep 16, 2014, Filing date Aug 30, 2006, Priority date Aug 31, 2005 U.S. Patent 8,834,169, (licensed by Hocoma, A.G., resulting in over $50M in sales for company)

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P11: Plecnik MM, Bissel D, Reinkensmeyer DJ, McCarthy JM (2019) Torque-Compensating Assistive Wrist Braces. US Patent 10,456,286

P12: Friedman N, Zondervan D, Reinkensmeyer DJ, Bachman M (2019) Systems and methods for monitoring hand and wrist movement. US Patent 10,488,868

P13: Reinkensmeyer DJ, Zondervan D, Comellas M (2020) Wheelchair arm rest device. US Provisional Patent Application 63/054,900 filed July 22, 2020. Non-Provisional filed 7/22/21. Serial No.: 17/383,113.

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B5: Reinkensmeyer DJ (2003) Rehabilitators, *Standard Handbook of Biomedical Engineering & Design,* McGraw-Hill, chapter 35, pp. 35.1 – 35.17

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B8: L.E. Sucar, G. Azcárate, R. Leder, D. Reinkensmeyer, J. Hernández, I., Sánchez, P. Saucedo, ``Gesture Therapy: A vision--based system for arm rehabilitation after stroke", in A. Fred, J. Filipe, H. Gamboa (Eds.), Biomedical Engineering Systems and Technology, Springer-Verlag, pp. 531--540, 2008.

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R2: Abouf E, Atkeson CG, Reinkensmeyer DJ (1987) Task-Level Robot Learning: Ball Throwing. MIT Artificial Intelligence Memorandum 1006

Public Lectures and Presentations:
Prior to 1999, ~ 37 conference presentations.
Presentation, "The Real World of Robots", Beall Center Family Day, March 19, 2005

Keynote Speaker, Robotics track, International Conference on Aging and Disability, February 2006, Tampa Bay
State of the Science Meeting, NIDRR RERC on Robotics and Telerehabilitation, San Diego, CA, March, 2006
Balgrist Hospital Seminar, Zurich, Switzerland, March 2006
Robotics Group Seminar, Ecole Polytechnique Federale de Lausanne, March 2006
U.C.I. Henry Samuelli School of Engineering 5th Annual Research Symposium May, 2006
11th Annual Congress of the European College of Sport Science, Lausanne, Switzerland 2006
USC Dept. of Biokinesiology and Physical Therapy, 2007
Sister Kinney Rehabilitation Institute, Minneapolis, Minnesota, 2007
Robotics Institute, Carnegie Mellon University, 2007
ETH Zurich, 2007
Innovations in Rehabilitation Technology Conference, Hebrew University of Jerusalem 2007
U. Twente, Netherlands 2008
Academic Hospital Munich 2008
Cambridge University 2008
U. Rene Descartes, Paris 2008
UCLA Neural Repair Program 2009
USC Biomedical Engineering Seminar Series 2009
Keynote Speaker Dynamic Walking Conference, Vancouver 2009
Rehabilitation Institute of Chicago Seminar 2009
Invited speaker, IEEE EMBS Conference 2009, 2 sessions
Invited speaker, NSF/WTEC Final Workshop on European Research and Development in Mobility Technology for People with Disabilities, 11/12/2010
Invited speaker, University of North Carolina, North Carolina State Biomedical Engineering Lecture Series, 2011
Keynote Speaker, North American Neurorehabilitation Symposium 2010, Shepherd Rehabilitation Center, Atlanta, GA
Invited Speaker for 2 talks, American Association of Academic Physiatrists Annual Meeting, Chandler Arizona, 2011
Invited Speaker, State of the Science meeting for Machines Assisting Recovery in Stroke, Chicago, IL, 2011
Invited speaker, Wounded Warrior Symposium, U.C. Irvine 2011
Invited speaker, Calit2 EHealth Symposium, U.C. Irvine 2011
Plenary speaker, NIH National Institute of Biomedical Imaging and Bioengineering Lecture, 2011 Biomedical Engineering Society Annual Meeting, Hartford, CT
Invited speaker, 3rd International Symposium on lifechips, February 19, 2012, Calit2, U.C. Irvine
Invited speaker, Translational Technologies in Rehabilitation, 2/25/2012, Rancho Los Amigos National Rehabilitation Center, Downey, CA
Invited speaker, 2012 IEEE International Conference on Robotics and Automation, Wearable Robotics Workshop
Invited speaker, 2012 California Children's Services Annual Therapist Inservice, Irvine Medical Treatment Unit, CA
Plenary Speaker, 2012 Summer School of Neurorehabilitation, Emerging Therapies, Zaragoza, Spain, Sept 16-21
UCI Department of Rehabilitation In-service, June, 2012
UCI Computer Gaming and Virtual Worlds Seminar, October, 2012
UCI Sue and Bill Gross Stem Cell Research Seminar, November, 2012
Surf-IT 8-20-2012
Applications of New Technologies in Rehabilitation, RIC CE course, 10-5-2012
UCI Seminar in Computer Gaming and Virtual Worlds, 10-17-2012
Dept Anatomy and Neurobiology PIN 11-16-2012
UCI Stem Cell Center 11-29-2012

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Wadsworth Center, Division of Translational Medicine, 2-9-2013
Deans Quarterly Lecture, 5-21-2013
Invited Speaker, July 2013 RESNA
Keynote Speaker, July 2013 IEEE Conference on Rehabilitation Robotics
Borchard Colloquium on Computational Neurorehabilitation, July 2013
MARS Advisory Board Meeting, July 2013
TLC Conference, Calit2, 7-29-2013
NIDRR RERC Director's Meeting, August 2013
Keynote Speaker, August 2013 Movement and Rehabilitation Science Day, Northwestern University Medical School
UCI Dept of Physical Medicine and Rehabilitation Residency Training Program, September 2013
UCLA Dept of Physiological Sciences, October 2013
University of Texas Department of Mechanical Engineering Chevron Centennial Distinguished Lecture, October 25, 2013.
University of Illinois, Department of Mechanical Science and Engineering Bio-Interest Group Seminar Series, February, 2014
21st Joint Symposium on Neural Computation, U.C. Irvine, May, 2014
Osher Lifelong Learning Institute, U.C. Irvine, May, 2014
MARS Advisory Board Meeting July 2013, Northwestern University
UCI COSMOS Distinguished Lecture, July, 2014
Inside UCI Lecture, September 2014
UCI Department of Physical Medicine and Rehabilitation Guest Lecture, September 2014
Summer School of Neurorehabilitation, Baiona, Spain, Plenary Speaker, September 2014
Wearable Robotics Conference, Baiona, Spain, Invited Lecture, September 2014
Neurorestorative Care, Scripps Hospital, Invited Lecture, November 2014
UCI Center for Digital Transformation, Keynote Lecture, November 2014
University of Michigan, Rehabilitation Robotics Center, Invited Lecture, November 2014
St. Jude Rehabilitation Center, Invited Lecture, January 29, 2015
UCI Department of Evolutionary Biology and Ecology, February 5, 2015
Arizona State University Piper Robotic Rehabilitation Conference, Plenary Speaker, February 14, 2015
Invited speaker, Bioinspired Robotics: Softer, Smarter, Safer Symposium, Wyss Institute, Harvard University, June 6, 2015
UCI Cosmos, Distinguished All-Cosmos Lecture, July 8, 2015
Inside UCI Lecture, July 20, 2015
UCI Department of Physical Medicine and Rehabilitation Guest Lecture, July 21, 2015
UCI Neurotrauma Symposium, August 12, 2015
Presentation to Skuba University visiting faculty and students, August 31, 2015
Healthsouth Hospital Inservice, September 4, 2015
University of Toronto, Institute of Biomaterials and Biomedical Engineering Distinguished Seminar, September 14, 2015
Neural Prosthesis Seminar Series at Case Western Reserve University, September 17, 2015
ETH Zurich Distinguished Lecture in Robotics, September 22, 2015
Chapman/UCI Stroke Symposium, November 20, 2015
PH194 Lecture on Entrepreneurship, November 11, 2015
Concordia University Irvine, Department of Biology Seminar, March 3, 2016
Brenes Keynote Lecturer, University of Pittsburgh Rehabilitation Research Day, May 18, 2016
USC Department of Biokinesiology Seminar Speaker, May 20, 2016
Webster Elementary, 90 3rd graders, field trip for robotics at UCI, May 25, 2016
Biomechanics and Neural Control of Movement Conference, June 15, 2016, invited speaker
UCI Department of Physical Medicine and Rehabilitation Guest Lecture, August 8, 2016
Invited Speaker, Inside UCI, August 15, 2016
Invited Speaker, Seminar Series of the Department of Biomechanics and the Center for Research in Human Movement Variability of the University of Nebraska Omaha, September 9, 2016

Invited Speaker, Interacting with Robots through Touch Workshop, UC Irvine, September 13, 2016
Davis Magnet School, 6th grade classes presentation on robotics, 12/14/2016
Invited Speaker, Southern California Robotics Symposium, USC, 4/13/2017
Invited Speaker, Wearacon, Phoenix, AZ, 4/21/2017
Invited Speaker, ICORR workshop, Human-robot synchronization for assistive technologies, London, England, 7/17/2017
Invited Speaker, International Neurorehabilitation Symposium, London, England, 7/20/2017
University of Tskuba Student Welcome Lecture, 8/15/2017
UCI PM&R Resident Research Training, 8/31/2017
Invited Speaker, Inside UCI, 8/23/2017
Invited Speaker, Barrow Neurological Institute, 2017 Stroke Rehab Symposium, Current Trends in Stroke Rehabilitation: A Lecture and Lab Based Learning Experience, 10/7/2017
Invited Speaker, UCI Center for the Neurobiology of Learning and Memory, 10/17/2017
Keynote Speaker, Annual Meeting of the American Society of Neurorehabilitation, Baltimore, MD 11/11/2017
Invited Speaker, Department of Health and Exercise Science, Colorado State University, 3/25/2017
Keynote Speaker, Neural Computation and Engineering Connection Meeting, University of Washington 1/18/2018
Invited Speaker, UCI/Univ Twente Arm Support Workshop 1/22/2018
Invited Speaker, UCLA Spinal Cord Injury Course, 2/22/18
Invited Speaker, NSF Mind-Motor-Machine Nexus Meeting, Marconi Conference Center, CA 7/19/2018
Invited Speaker, Progress in Clinical Motor Control, Penn State University, 7/27/2018
UCI Department of Physical Medicine and Rehabilitation Guest Lecture, 8/30/2018
Invited Speaker, Dept of Mechanical Engineering, Rice University, 9/17/2018
South Middle School, 8th grade classes presentations on robotics, 9/25/2018
Invited Speaker and “Power Presenter”, American College of Rehabilitation Medicine, 9/30/2018
Invited Speaker, Depts of Biomedical Engineering and Brain and Behavioral Sciences, UT Dallas, 10/1/2018
Invited Speaker, Department of Mechanical Engineering, UCSB, 11/8/2018
Keynote Speaker, 7th Annual International Symposium on Regenerative Rehabilitation
Seattle, WA | 11/11/2018
Invited Speaker, American Society for Neurorehabilitation, 11/20/2018
Invited Speaker, Institute for Robotics and Intelligent Machines, Georgia Tech, 11/28/2018
Invited Speaker, Shepherd Center, Atlanta, Georgia11/29/2018
Invited Speaker, Pacifica Christian High School, 11/26/2018
Invited Speaker, Sue and Bill Gross Public Stem Cell Talk Series, 1/28/2019
Invited Speaker, St. Joseph Hospital Occupational Therapist Inservice, 2/4/2019
Invited Speaker, UC Davis, Neuroengineering Seminar Series, 2/11/2019
Keynote Speaker UC Irvine Brain Bee, 2/15/2019
Invited Speaker, National Advisory Board for Medical Rehabilitation Research, at NIH, 5/7/2019
Keynote Speaker, University of North Carolina/NC State Biomedical Engineering Department Retreat, 9/28/2019
Invited Speaker, Biola University Science Honors Program, 11/17/2019
Invited Speaker, National Rehabilitation Hospital, 12/3/2019
Invited Speaker, World Congress on Neurorehabilitation, 10/7/2020
Invited Speaker, Universitat Politècnica de Catalunya, Master’s Degree in Neuroengineering and Rehabilitation Program, 10/9/20
Invited Speaker, North Carolina State Biomedical Engineering Seminar, 11/12/2020
Invited Speaker, Burke Neurological Institute | Weill Cornell Medicine, 1/26/2021
Invited Speaker, Frontiers of Regenerative Rehabilitation, AR3T Center, University of Pittsburgh, Stanford, University of Texas, Mayo Clinic, 2/25/2021
Invited Speaker, University of Pennsylvania, Adaptive Devices and Prosthetic Technologies Club, 4/22/2021

Invited Speaker, Department of Biomedical Engineering, University of Delaware, 4/22/2021
Invited Speaker, National Center for Adaptive Neurotechnologies, 4/26/21
Invited Speaker, Notre Dame High School Robotics Club, San Jose, CA 5/5/2021
Invited Speaker, NSF Liberate Workshop, 5/6/2021
Invited Speaker, STEM High School, Highlands Ranch, CO, 5/18/2021
Invited Speaker, NeuroReHack, International Summer/Winter School and Hackathon on Neurorehabilitation Engineering, EdX, 7/10/2021
Invited Speaker, UC-HBCU Stem Program, Irvine, 7/16/2021
Invited Speaker, 2021 IEEE-EMBS International Conference on Biomedical and Health Informatics Jointly organized with the 17th IEEE-EMBS International Conference on Wearable and Implantable Body Sensor Networks 7/28/2021
Invited Speaker, 2021 American Society of Biomechanics Meeting 8/12/21, Symposium on Personalized Neurorehab: How Patient-specific Motor Learning Can Inform Treatment
Invited Speaker, Rehabilitation Technology Commercialization, Rehabilitation Engineering Bootcamp, Northwestern University, 8/23/2021
Plenary Speaker, Summer School: Towards a Continuum of Robot-assisted Therapy, Organized by EPFL, ETHZ, Clinica Hildebrand, Centro di Riabilitazione in Brissago, Ticino, Switzerland, 9/9/21
Speaker, Session on Computational Neurorehabilitation, International Conference on Rehabilitation Robotics, 9/24/2021
Invited Speaker, Universitat Politècnica de Catalunya, Master's Degree in Neuroengineering and Rehabilitation Program, 9/28/2021
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Invited Speaker, Wearable Sensors in Rehabilitation: Tracking for the Future, sponsored by Northwestern University and Shirley Ryan Ability Lab, 10/20/2021
Invited Speaker, University of Minnesota Neurorobotics Consortium Seminar, 12/9/2021
Plenary Speaker, 16th Annual Conference of Korean Society for NeuroRehabilitation, 3/25/2022
Invited Speaker, Robotics and Technology in Rehabilitation Symposium, MossRehab/Einstein Healthcare Network, 4/30/2022
Invited Speaker, GATI-BEAM Program, UC Irvine, 7/15/2022
Invited Speaker, Rehabweek Workshop on Digital Biomarkers and Prediction Models, 7/25/2022
Keynote Speaker, Rehabweek, Rotterdam, Netherlands, 7/27/2022. This is a meeting that combines meetings for 8 societies: International Consortium on Rehabilitation Robotics (ICORR), International Functional Electrical Stimulation Society (IFESS), International Industry Society in Advanced Rehabilitation Technology (IISART), International Society for Virtual Rehabilitation (ISVR), Netherlands Society of Rehabilitation Medicine (NSRM), Dutch Chapter of the International Society for Prosthetics and Orthotics (ISPO-NL), Masterclass in Neurotechnology (MiNT), American Society of Rehabilitation Medicine (ACRM). I spoke at a plenary session attended by all societies.
Invited Speaker, A Robotarium for Latin America, Tec de Monterrey, 9/1/2022
Invited Speaker, Utilizing Technology to Improve Outcomes in Rehabilitation, Cedars-Sinai Medical Center, 9/20/2022
Plenary Speaker for the Societe Francaise de Medicine Physique et de Readaptation, 12/1/2022, Rennes, France. This is the National Meeting of the French Society for Physical Medicine and Rehabilitation attended by about 1500 people.

Courses Taught:
HB110 Biological Motor Control, University of California, Berkeley
MAE106 Mechanical Systems Laboratory
MAE250 Biorobotics
BME120/220 Quantitative Physiology: Sensory Motor Systems
Anatomy 503A Histology
Freshman Seminar: Technology, Children, and Poverty

University Service:
MAE Academic Planning Committee, 10/98 – 6/99
MAE Undergraduate Design Committee, 4/99 – 6/01
MAE High Tech Program Committee, 8/00 – 6/01
MAE Physical Infrastructure Committee, 7/02
Biomedical Engineering Advisory Committee, 10/99 – 1/01
Biomedical Engineering Corporate Internship Committee, 8/99 – 1/01
Biomedical Engineering Undergraduate Committee, 5/99 – 7/01
Biomedical Engineering Graduate Committee, 7/00 – 6/02
Biomedical Engineering Neuroengineering Proposal Committee, 12/02 – 6/03
Biomedical Engineering Seed Grant Review Committee, 2003
Henry Samueli School of Engineering Research and Travel Committee, 2003-2006
Henry Samueli School of Engineering Representative, Divisional Senate Assembly, 2003-2004
Biomedical Engineering Faculty Search Committee, 2004
Biomedical Engineering Preliminary Exam Committee, 2003-2007, 2009
MAE Graduate Studies Committee, 2005-2008
Council on Educational Policy 2009 - 2010
2010, 2011, 2012, 2014, 2015, 2018, 2019 ICTS Cosmos Laboratory – Robotic Rehabilitation
2010 UCI Med School High-School Outreach Program – Robotic Rehabilitation Demos
MAE Undergraduate Studies Committee, 2008-2014
ME ABET Coordinator, 2008-2013
Department of Anatomy and Neurobiology, Faculty Representative, SoM fundraising seminars, 2013
Department of Anatomy and Neurobiology, SoM representative 2012-2013
MAE Undergraduate Advisor 2009 – 2013
Interdepartmental Neuroscience Program – Executive/admissions committee 2014 – 2017
Associate Chair, Department of Mechanical and Aerospace Engineering, 2016 – 2017
HSSOE Strategic Planning Committee 2016 – 2017
DOE/NSF Title IX Compliance Review Interviewee – 5-2017
MAE SED Section Preliminary Exam Coordinator – 2014-2017
Balsells Recognition Luncheon Speaker, 11-30-2017
UCI's Engineering Student Council Shadow Day Lab Tour 2-15-2018
Campus-wide committee on Ph.D. in Neuroscience 2018-2020
Committee on UCI Dual BS/MD degree 2019-2020
Host and provide daily laboratory/research experience for 8-12 U. Tskuba Aerospace Students, 2015-2019 (summer and winter visit 2018)
MAE Undergraduate Studies Committee, 2018-current
Calit2 Division Council 2012 – current
Mentor for Newport Harbor High School Mentoring Program 2014-current
Mentor for HSSOE St. Margaret’s Episcopal High School Summer Internship Program 2012-current
HSSOE Strategic Planning Committee 2022

APPENDIX 2: MATERIALS CONSIDERED IN THE PREPARATION OF THIS DECLARATION

Exhibit No.	Description
1001	U.S. Patent No. 10,668,316 ("'316 Patent")
1002	U.S. Patent Application No. 15/896,731 ("731 Application")
1003	U.S. Provisional Application No. 62/458,648 ("648 Application")
1004	Prosecution File History for the 316 Patent ("'316 File History")
1005	August 9, 2019 Non-Final Office Action and appended Written Opinion of the International Searching Authority ("NFOA")
1006	December 6, 2019 Amendment and Response to the 2019 Office Action ("Response")
1007	January 10, 2020 Notice of Allowance ("NOA")
1009	U.S. Publication No. 2014/0201906A1 ("Erturk")
1010	2013 Bioness Vector Elite Clinician's Guide, Revision B ("Vector")
1011	U.S. Publication No. 2016/0256346A1 ("Stockmaster")
1012	PCT Publication No. WO 2016/042498A1 ("Raanan")
1013	U.S. Publication No. 2004/0143198 ("West")
1014	U.S. Publication No. 2014/0206503A1 ("Gorbel")
1015	Internet Archive Declaration-Part 1
1016	U.S. Patent No. 7,883,450 ("Hidler Patent")
1017	A Novel Mechatronic Body Weight Support System ("Frey")
1018	U.S. Pat. No. 7,462,138 ("Shetty")
1019	Automatic Fall Monitoring ("Pannurat")
1020	2014 Masters Thesis Citing Vector Clinician's Guide Noting Date of Access in 2014 ("Getahun")
1021	ZeroG: Overground gait and balance training system ("Hidler Article")
1022	Declaration of Keith McBride to the Trademark Office ("McBride Declaration")
1023	Specimen submitted for Vector Gait And Safety System (Reg No. 85822129) Trademark
1024	Wayback Machine Web Capture of Google Search of "Body Weight Support System," February 14, 2014.
1025	Example Pathway to Download Vector on Patent Owner's Website.
1026	Wayback Machine Web Capture of Pannurat, dated September 21, 2015

Exhibit No.	Description
1027	Wayback Machine Web Capture of Vector Elite Clinician's Guide, dated June 6, 2015
1028	European Patent Specification No. 1,296,595 ("Livewaves")
1029	Getahun Web Capture
1030	Exhibit U to Bioness Complaint
1031	[Reserved]
1032	[Reserved]
1033	[Reserved]
1034	[Reserved]
1035	US 20120018249A1 ("Mehr")
1036	U.S. Patent Publication No. 2015/0320632 ("Vallery")
1037	Vector YouTube Upload Screenshot
1038	Internet Archive Declaration-Part 2

APPENDIX 3: CHALLENGED CLAIMS

1. A method of using a body weight support system to provide body weight support during gait training, the body weight support system including a drive assembly configured to movably suspend the body weight support system from a support track and a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system, the method comprising:

defining a reference length of the tether when the attachment device is in an initial position;

defining a threshold length of the tether;

providing a first amount of body weight support during the gait training as the user moves relative to a surface and the length of the tether is less than the threshold length of the tether;

providing a second amount of body weight support during the gait training as the user moves relative to the surface and the length of the tether is greater than the threshold length of the tether, the drive assembly configured to move the body weight support system relative to the support track to maintain the body weight support system in a substantially overhead position relative to the user as the user moves relative to the surface; and

displaying data associated with the gait training on a display of an electronic device included in the body weight support system.

2. The method of claim 1, wherein the length of the tether is increased in response to an increase in force exerted by the user on the tether.

3. The method of claim 2, wherein the increase in the force exerted by the user on the tether is associated with the user falling during the gait training.

4. The method of claim 1, wherein the surface relative to which the user moves is a stationary surface.

5. The method of claim 1, wherein the surface relative to which the user moves is a moving surface included in a treadmill.

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7. A method of using a body weight support system to provide body weight support during gait training, the body weight support system including a tether configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system, the method comprising:

defining a reference length of the tether when the attachment device is in an initial position;

defining a first criterion associated with a change in a length of the tether;

defining a second criterion associated with a change in a length of the tether;

defining an amount of the body weight support to provide in response to the user falling during the gait training;

maintaining the body weight support system in a substantially overhead position relative to the user as the user moves relative to a surface;

determining a fall has occurred based on the first criterion and the second criterion being satisfied; and

providing the amount of body weight support in response to the first criterion and the second criterion being satisfied.

8. The method of claim 7, wherein the first criterion is a rate of change in the length of the tether.

9. The method of claim 7, wherein the second criterion is a duration during which the length of the tether is changed.

10. The method of claim 9, wherein the second criterion is a minimum duration.

11. The method of claim 7, wherein the first criterion is a rate of change in the length of the tether, the second criterion is a duration during which the length of the tether is changed, and the amount of body weight support provided in response to the first criterion and the second criterion being satisfied is a first amount of body weight support, the method further comprising:

providing a second amount of body weight support when at least one of the first criterion or the second criterion is not satisfied, the second amount of body weight support being less than the first amount of body weight support.

APPENDIX 4: UNDERSTANDING OF THE LAW

I have applied the following legal principles provided to me by counsel in arriving at the opinions set forth in this declaration.

Legal Standard for Prior Art

I am not an attorney. I have been informed by attorneys of the relevant legal principles and have applied them to arrive at the opinions set forth in this declaration.

I understand that the petitioner for *inter partes* review may request the cancelation of one or more claims of a patent based on grounds available under 35 U.S.C. § 102 and 35 U.S.C. § 103 using prior art that consists of patents and printed publications.

Anticipation and Prior Art

I understand that § 102 specifies when a challenged claim is invalid for lacking novelty over the prior art, and that this concept is also known as "anticipation." I understand that a prior art reference anticipates a challenged claim, and thus renders it invalid by anticipation, if all elements of the challenged claim are disclosed in the prior art reference. I understand the disclosure in the prior art reference can be either explicit or inherent, meaning it is necessarily present or implied. I understand that the prior art reference does not have to use the same words as the challenged claim, but all of the requirements of the claim must be disclosed so that a person of ordinary skill in the art could make and use the claimed subject-matter.

In addition, I understand that § 102 also defines what is available for use as a prior art reference to a challenged claim.

Under § 102(a)(1), a challenged claim is anticipated if it was patented, described in a printed publication, or in public use, on sale, or otherwise available to the public before the effective filing date of the challenged claim(s).

Under § 102(a)(2), a challenged claim is anticipated if it was described in a patent or published application for patent naming another inventor and effectively filed before the effective filing date of the challenged claim(s).

I understand that the effective filing date of a patent or prior art reference is generally the filing date of that application. However, I understand that a patent or prior art reference may be granted an earlier effective filing date if it properly claims priority to an earlier patent application.

I understand that when a challenged claim covers several structures, either generically or as alternatives, the claim is deemed anticipated if any of the structures within the scope of the claim is found in the prior art reference.

I understand that when a challenged claim requires selection of an element from a list of alternatives, the prior art teaches the element if one of the alternatives is taught by the prior art.

Legal Standard for Obviousness

I understand that even if a challenged claim is not anticipated, it is still invalid if the differences between the claimed subject matter and the prior art are such that the claimed subject matter would have been obvious to a person of ordinary skill in the pertinent art at the time the alleged invention.

I understand that obviousness must be determined with respect to the challenged claim as a whole.

I understand that one cannot rely on hindsight in deciding whether a claim is obvious.

I also understand that an obviousness analysis includes the consideration of factors such as (1) the scope and content of the prior art, (2) the differences between the prior art and the challenged claim, (3) the level of ordinary skill in the pertinent art, and (4) "secondary" or "objective" evidence of non-obviousness.

Secondary or objective evidence of non-obviousness includes evidence of: (1) a long felt but unmet need in the prior art that was satisfied by the claimed invention; (2) commercial success or the lack of commercial success of the claimed invention; (3) unexpected results achieved by the claimed invention; (4) praise of the claimed invention by others skilled in the art; (5) taking of licenses under the patent by others; (6) deliberate copying of the claimed invention; and (7) contemporaneous and independent invention by others. However, I understand that there must be a relationship between any secondary evidence of non-obviousness and the claimed invention.

I understand that a challenged claim can be invalid for obviousness over a combination of prior art references if a reason existed (at the time of the alleged invention) that would have prompted a person of ordinary skill in the art to combine elements of the prior art in the manner required by the challenged claim. I understand that this

requirement is also referred to as a "motivation to combine," "suggestion to combine," or "reason to combine," and that there are several rationales that meet this requirement.

I understand that the prior art references themselves may provide a motivation to combine, but other times simple common sense can link two or more prior art references. I further understand that obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that a motivation to combine references may come from market forces.

I understand obviousness to include, for instance, scenarios where known techniques are simply applied to other devices, systems, or processes to improve them in an expected or known way. I also understand that practical and common-sense considerations should be applied in a proper obviousness analysis. For instance, familiar items may have obvious uses beyond their primary purposes.

I understand that the combination of familiar elements according to known methods is obvious when it yields predictable results. For instance, obviousness bars patentability of a predictable variation of a technique even if the technique originated in another field of endeavor. This is because design incentives and other market forces can prompt variations of it, and predictable variations are not the product of innovation, but rather ordinary skill and common sense.

I understand that a particular combination may be obvious if it was obvious to try the combination. For example, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of

ordinary skill has good reason to pursue the known options within his or her technical grasp. This would result in something obvious because the result is the product not of innovation but of ordinary skill and common sense. However, I understand that it may not be obvious to try a combination when it involves unpredictable technologies.

It is further my understanding that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, I understand that any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

It is my understanding that the Manual of Patent Examining Procedure §2143 sets forth the following as exemplary rationales that support a conclusion of obviousness:

- Combining prior art elements according to known methods to yield predictable results;
- Simple substitution of one known element for another to obtain predictable results;
- Use of known technique to improve similar devices (methods, or products) in the same way;
- Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results;
- Choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art;
- Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

A person of ordinary skill in the art looking to overcome a problem will often use the teachings of multiple publications together like pieces of a puzzle, even though the prior art does not necessarily fit perfectly together. Therefore, I understand that references for obviousness need not fit perfectly together like puzzle pieces. Instead, I understand that obviousness analysis takes into account inferences, creative steps, common sense, and practical logic and applications that a person of ordinary skill in the art would employ under the circumstances.

I understand that a claim can be obvious in light of a single reference, if the elements of the challenged claim that are not explicitly or inherently disclosed in the reference can be supplied by the common sense of one of skill in the art.

I understand that obviousness also bars the patentability of applying known or obvious design choices to the prior art. One cannot patent merely substituting one prior art element for another if the substitution can be made with predictable results. Likewise, combining prior art techniques that are interoperable with respect to one another is generally obvious and not patentable.

In order for a claim to be found invalid based upon a modification or combination of the prior art, there must be reasonable expectation that a person of ordinary skill would have successfully modified or combined the prior art to arrive at the claimed arrangement. This does not mean that it must be certain that a person of ordinary skill would have been successful – the law only requires that the person of ordinary skill in the art would have

perceived a reasonable expectation of success in modifying or combining the prior art to arrive at the claimed invention.

In sum, my understanding is that obviousness invalidates claims that merely recite combinations of, or obvious variations of, prior art teachings using understanding and knowledge of one of ordinary skill in the art at the time and motivated by the general problem facing the inventor at the time. Under this analysis, the prior art references themselves, or any need or problem known in the field of endeavor at the time of the invention, can provide a reason for combining the elements of or attempting obvious variations on prior art references in the claimed manner.

Legal Standard for Claim Construction

I understand that before any invalidity analysis can be properly performed, the scope and meaning of the challenged claims must be determined by claim construction.

I understand that a patent may include two types of claims, independent claims and dependent claims. I understand that an independent claim stands alone and includes only the limitations it recites. I understand that a dependent claim depends from an independent claim or another dependent claim. I understand that a dependent claim includes all the limitations that it recites in addition to the limitations recited in the claim (or claims) from which it depends.

In comparing the challenged claims to the prior art, I have carefully considered the patent and its file history in light of the understanding of a person of ordinary skill at the time of the alleged invention.

I understand that to determine how a person of ordinary skill would have understood a claim term, one should look to sources available at the time of the alleged invention that show what a person of ordinary skill in the art would have understood the disputed claim language to mean. It is my understanding that this may include what is called "intrinsic" evidence as well as "extrinsic" evidence.

I understand that, in construing a claim term, one should primarily rely on intrinsic patent evidence, which includes the words of the claims themselves, the remainder of the patent specification, and the prosecution history. I understand that extrinsic evidence, which is evidence external to the patent and the prosecution history, may also be useful in interpreting patent claims when the intrinsic evidence itself is insufficient. I understand that extrinsic evidence may include principles, concepts, terms, and other resources available to those of ordinary skill in the art at the time of the invention.

I understand that words or terms should be given their ordinary and accepted meaning unless it appears that the inventors were using them to mean something else or something more specific. I understand that to determine whether a term has special meaning, the claims, the patent specification, and the prosecution history are particularly important, and may show that the inventor gave a term a particular definition or intentionally disclaimed, disavowed, or surrendered claim scope.

I understand that the claims of a patent define the scope of the rights conferred by the patent. I understand that because the claims point out and distinctly claim the subject matter which the inventors regard as their invention, claim construction analysis must

begin with and is focused on the claim language itself. I understand that the context of the term within the claim as well as other claims of the patent can inform the meaning of a claim term. For example, because claim terms are normally used consistently throughout the patent, how a term is used in one claim can often inform the meaning of the same term in other claims. Differences among claims or claim terms can also be a useful guide in understanding the meaning of particular claim terms.

I understand that a claim term should be construed not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the entire specification. I understand that because the specification is a primary basis for construing the claims, a correct construction must align with the specification.

I understand that the prosecution history of the patent as well as art incorporated by reference or otherwise cited during the prosecution history are also highly relevant in construing claim terms. For instance, art cited by or incorporated by reference may indicate how the inventor and others of skill in the art at the time of the invention understood certain terms and concepts. Additionally, the prosecution history may show that the inventors disclaimed or disavowed claim scope, or further explained the meaning of a claim term.

With regard to extrinsic evidence, I understand that all evidence external to the patent and prosecution history, including expert and inventor testimony, dictionaries, and learned treatises, can also be considered. For example, technical dictionaries may indicate how one of skill in the art used or understood the claim terms. However, I understand that

extrinsic evidence is considered to be less reliable than intrinsic evidence, and for that reason is generally given less weight than intrinsic evidence.

I understand that in general, a term or phrase found in the introductory words or preamble of the claim, should be construed as a limitation if it recites essential structure or steps, or is necessary to give meaning to the claim. For instance, I understand preamble language may limit claim scope: (i) if dependence on a preamble phrase for antecedent basis indicates a reliance on both the preamble and claim body to define the claimed invention; (ii) if reference to the preamble is necessary to understand limitations or terms in the claim body; or (iii) if the preamble recites additional structure or steps that the specification identifies as important.

On the other hand, I understand that a preamble term or phrase is not limiting where a challenged claim defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use for the invention. I understand that to make this determination, one should review the entire patent to gain an understanding of what the inventors claim they invented and intended to encompass in the claims.

I understand that 35 U.S.C. § 112 ¶ 6 created an exception to the general rule of claim construction called a "means plus function" limitation. These types of terms and limitations should be interpreted to cover only the corresponding structure described in the specification, and equivalents thereof. I also understand that a limitation is presumed to be a means plus function limitation if (a) the claim limitation uses the phrase "means for"; (b)

the “means for” is modified by functional language; and (c) the phrase “means for” is not modified by sufficient structure for achieving the specified function.

I understand that a structure is considered structurally equivalent to the corresponding structure identified in the specification only if the differences between them are insubstantial. For instance, if the structure performs the same function in substantially the same way to achieve substantially the same result. I further understand that a structural equivalent must have been available at the time of the issuance of the claim.