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November 03, 2022

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APPLICATION NUMBER: *15/896,731*
FILING DATE: *February 14, 2018*
PATENT NUMBER: *10668316*
ISSUE DATE: *June 02, 2020*

UNITED STATES PATENT AND TRADEMARK OFFICE · DEPARTMENT OF COMMERCE

Certified by

Kathi

Performing the Functions and Duties of the
Under Secretary of Commerce
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Patent and Trademark Office

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	BION-051/12US 307799-2333
	Application Number	
Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Keith		MCBRIDE	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Ventura	CA	US

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State/Province	CA
Postal Code	93003
Country	US

Inventor 2 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
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Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

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Postal Code	91355
Country	US

Inventor 3 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Augustine		SMITH	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

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Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM	

City	Santa Clarita	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	21805 Propello Dr.		
Address 2			
City	Santa Clarita	**State/Province**	CA
Postal Code	91350	**Country**	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	58249		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM		
Attorney Docket Number	BION-051/12US 307799-2333	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	69	**Suggested Figure for Publication (if any)**	77

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	58249		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Claims benefit of provisional	62458648	2017-02-14

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

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Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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	Application Number	
Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

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Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
● Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	Bioness Inc.		
Mailing Address Information For Applicant:			
Address 1	25103 Rye Canyon Loop		
Address 2			
City	Valencia	**State/Province**	CA
Country	US	Postal Code	91355
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☒

Organization Name	Bioness Inc.

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	25103 Rye Canyon Loop		
Address 2			
City	Valencia	**State/Province**	CA
Country i	US	Postal Code	91355
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Michael D. Wintemitz/			Date (YYYY-MM-DD)	2018-02-14
First Name	Michael	Last Name	Winternitz	Registration Number	73,102

Additional Signature may be generated within this form by selecting the Add button. Add

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	Application Number	
Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

Cross-Reference to Related Applications

[1001] This application claims priority to and the benefit of U.S. Provisional Patent Application No. 62/458,648 entitled, "Methods and Apparatus for Body Weight Support System," filed February 14, 2017, the disclosure of which is incorporated herein by reference in its entirety.

[1002] This application is related to U.S. Patent Publication No. 2015/0143627 entitled, "Methods and Apparatus for Body Weight Support System," filed February 3, 2015, which is a continuation-in-part of U.S. Patent No. 9,855,177 entitled, "Methods and Apparatus for Body Weight Support System," filed March 26, 2014, which is a continuation-in-part of U.S. Patent No. 9,682,000 entitled, "Methods and Apparatus for Body Weight Support System," filed January 20, 2013, the disclosure of each of which is incorporated herein by reference in its entirety.

Background

[1003] 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.

[1004] 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 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.

[1005] 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

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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).

[1006] 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.

[1007] 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 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).

[1008] 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.

[1009] 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.

[1010] 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.

[1011] 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.

[1012] Thus, a need exists for improved apparatus and methods for supporting the body-weight of a patient during gate therapy.

Summary

[1013] Apparatus and methods for supporting the body weight of a patient during gait therapy are described herein. In some embodiments, a method of using the body weight support

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system to provide body weight support during gait training includes defining a reference length of a tether included in the body weight support system. The tether is configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system. The reference length of the tether is defined when the attachment device is in an initial position. A threshold length of the tether is defined. 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 of the tether. A second amount of body weight support is provided 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 method further includes displaying data associated with the gait training on a display of an electronic device included in the body weight support system.

Brief Description of the Drawings

[1014] FIG. 1 is a schematic illustration of a body weight support system according to an embodiment.

[1015] FIGS. 2 and 3 are perspective views of a body weight support system according to an embodiment.

[1016] FIGS. 4-7 are various perspective views of a trolley included in the body weight support system of FIG. 2.

[1017] FIG. 8 is a top perspective view of a housing included in the trolley of FIG. 4.

[1018] FIG. 9 is an exploded view of the housing of FIG. 8.

[1019] FIG. 10 is an enlarged view of a portion of the trolley of FIG. 4 identified as region Z.

[1020] FIG. 11 is a bottom perspective view of an electronic system included in the trolley of FIG. 4.

[1021] FIG. 12 is a perspective view of a drive mechanism included in the trolley of FIG. 4.

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[1022] FIGS. 13 and 14 are perspective views of a first drive assembly included in the drive mechanism of FIG. 12.

[1023] FIGS. 15 and 16 are exploded views of the first drive assembly of FIG. 13.

[1024] FIGS. 17-19 are perspective views of a first support member, a second support member, and a third support member, respectively, included in the first drive assembly of FIG. 13.

[1025] FIG. 20 is an exploded view of a drive wheel subassembly included in the first drive assembly of FIG. 13.

[1026] FIG. 21 is a perspective view of a secondary wheel subassembly included in the first drive assembly of FIG. 13.

[1027] FIG. 22 is a perspective view of a portion of the first drive assembly of FIG. 13, illustrating the secondary wheel subassembly of FIG. 21 coupled to the second support member of FIG. 18.

[1028] FIG. 23 is a perspective view of the first drive assembly of FIG. 13 in contact with a support track.

[1029] FIG. 24 is a perspective view of a second drive assembly included in the drive mechanism of FIG. 12.

[1030] FIG. 25 is an exploded view of the second drive assembly of FIG. 24.

[1031] FIG. 26 is a perspective view of the second drive assembly of FIG. 24 in contact with the support track of FIG. 20.

[1032] FIG. 27 is a perspective view of a support mechanism and a base included in the housing of FIG. 8 both of which are included in the trolley of FIG. 4.

[1033] FIG. 28 is a perspective view of the support mechanism of FIG. 27.

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[1034] FIG. 29 is a perspective view of a winch assembly included in the support mechanism of FIG. 27.

[1035] FIG. 30 is an exploded view of the winch assembly of FIG. 29.

[1036] FIG. 31 is an exploded view of a guide assembly included in the support mechanism of FIG. 27.

[1037] FIG. 32 is a perspective view the support mechanism of FIG. 27 shown without the winch assembly of FIG. 28.

[1038] FIG. 33 is an exploded view of a cam assembly included in the support mechanism of FIG. 27.

[1039] FIG. 34 is a perspective view of a patient attachment mechanism according to an embodiment.

[1040] FIG. 35 is a perspective view of a body weight support system according to an embodiment.

[1041] FIG. 36 is a cross sectional view of the body weight support system of FIG. 35 taken along the line X-X.

[1042] FIG. 37 is a schematic illustration of a support system according to an embodiment.

[1043] FIG. 38 is a perspective view of a portion of a support system according to an embodiment.

[1044] FIG. 39 is a perspective view of a push cart included in the support system of FIG. 38.

[1045] FIG. 40 is a cross-sectional view of a connection member included in the push cart of FIG. 39, taken along the line 40-40.

[1046] FIGS. 41 and 42 are a top perspective view and a bottom perspective view of a portion of a support system according to an embodiment.

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[1047] FIG. 43 is a perspective view of a portion of a support system according to an embodiment.

[1048] FIG. 44 is a cross-sectional view of a stopping mechanism included in the support system of FIG. 43, taken along the line 44-44.

[1049] FIGS. 45-47 are schematic illustrations of an optical tracking system included in a support system according to an embodiment.

[1050] FIG. 48 is a schematic illustration of a control diagram according to an embodiment.

[1051] FIG. 49 is a graph illustrating a displacement of a center of mass of a patient according to an embodiment.

[1052] FIGS. 50-53 are graphs illustrating operating conditions associated with a patient support mechanism in response to a patient's movement, according to an embodiment.

[1053] FIG. 54 illustrates graphical representations of one or more operating conditions associated with an electric stimulator and/or an impaired patient's gait while using a body weight support system, according to an embodiment.

[1054] FIG. 55 illustrates graphical representations of a set of gait characteristics of a patient, which were determined based at least in part on data associated with a body weight support system and, for example, an electric stimulator, according to an embodiment.

[1055] FIG. 56 is a screen shot of a display showing a graphical representation of data associated with a symmetry analysis of a patient's gait determined, at least in part by a body weight support system, according to an embodiment.

[1056] FIG. 57 is a screen shot of a display showing a graphical representation of data associated with a timed-up-and-go test of a patient determined, at least in part by a body weight support system, according to an embodiment.

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[1057] FIG. 58 is a screen shot of a display showing a graphical representation of data associated with a timed-distance test of a patient determined, at least in part by a body weight support system, according to an embodiment.

[1058] FIG. 59 is a screen shot of a display showing a graphical representation of data associated with a fall prevention system included in and/or implemented by a body weight support system according to an embodiment.

[1059] FIGS. 60-62 are screen shots of the display graphically representing a portion of the fall prevention system illustrated in FIG. 59 in a first mode and/or configuration, a second mode and/or configuration, and a third mode and/or configuration, respectively.

[1060] FIG. 63 is a screen shot of the display graphically representing a portion of the fall prevention system illustrated in FIG. 59.

[1061] FIGS. 64-69 are various screen shots of a display showing graphical representations of data associated with the use of a body weight support system while a patient uses a treadmill, according to an embodiment.

[1062] FIG. 70 is a schematic illustration of a portion of a support track, a portion of a power rail, and a turntable according to an embodiment.

[1063] FIG. 71 is a schematic illustration of a support system according to an embodiment.

[1064] FIGS. 72 and 73 are each a perspective view of a portion of a power system according to different embodiments.

[1065] FIGS. 74-76 are a front, side, and bottom view, respectively, of a body weight support system according to an embodiment.

[1066] FIGS. 77-79 are each a flowchart illustrating a method of providing body weight support, each according to a different embodiment.

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Detailed Description

[1067] In some embodiments, a method of using the body weight support system to provide body weight support during gait training includes defining a reference length of a tether included in the body weight support system. The tether is configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system. The reference length of the tether is defined when the attachment device is in an initial position. A threshold length of the tether is defined. 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 of the tether. A second amount of body weight support is provided 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 method further includes displaying data associated with the gait training on a display of an electronic device included in the body weight support system.

[1068] In some embodiments, a method of using a body weight support system to provide body weight support during gait training includes defining a reference length of a tether included in the body weight support system. The tether is configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system. The reference length of the tether is defined when the attachment device is in an initial position. A first criterion associated with a change in a length of the tether is defined and a second criterion associated with a change in a length of the tether is defined. An amount of the body weight support to provide in response to the user falling during the gait training is defined. The method includes determining a fall has occurred based on the first criterion and the second criterion being satisfied and the amount of body weight support is provided in response to the first criterion and the second criterion being satisfied.

[1069] In some embodiments, a method of using a body weight support system to provide body weight support during gait training includes defining a reference length of a tether included in the body weight support system. The tether is configured to be coupled to an attachment device worn by a user to couple the user to the body weight support system. The reference length of the tether is defined when the attachment device is in an initial position. A threshold length of the tether is defined. The threshold length of the tether is associated with the user

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falling during the gait training. A threshold number of falls during the gait training is defined. The method includes providing a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls. The predetermined amount of body weight support to be provided to the user during the gait training is increased in response to the threshold number of falls being met. The method further includes displaying data associated with the gait training on a display of an electronic device included in the body weight support system.

[1070] In some embodiments, an apparatus includes a trolley having a drive mechanism, a patient support mechanism, and an electronic system. The drive mechanism is configured to movably suspend the trolley from a support track. The drive mechanism includes a first sensor configured to sense an operating condition of the drive mechanism. The patient support mechanism includes a tether and a second sensor. The second sensor is configured to sense an operating condition of the patient support mechanism. The tether can be operatively coupled to a patient such that the patient support mechanism supports the patient. The electronic system is configured update at least one operating condition of the drive mechanism or the patient support mechanism in response to receiving a signal from the first sensor and a signal from the second sensor such that the patient support mechanism supports a predetermined amount of the patient's body weight.

[1071] In some embodiments, an apparatus includes a drive mechanism, a patient support mechanism, and an electronic system. The drive mechanism is included in a trolley and is configured to suspend the trolley from a support track. The drive mechanism includes a first sensor configured to sense an operating condition of the drive mechanism. The patient support mechanism couples to the trolley and includes a tether and a second sensor. The tether is configured to be operatively coupled to a patient such that the patient support mechanism supports at least a portion of a weight of the patient. The second sensor is configured to sense an operating condition of the patient support mechanism. The electronic system is included in the trolley and has at least a processor and a memory. The processor is configured to define a gait characteristic of the patient based at least in part on a signal received from the first sensor and a signal received from the second sensor.

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[1072] In some embodiments, a method includes receiving a signal associated with a first operating condition of at least one of a drive mechanism or a patient support mechanism. The patient support mechanism is coupled to an active trolley and configured to support a patient. The drive mechanism is coupled to the active trolley and configured to move the trolley along a support track in response to a movement of the patient. A signal associated with a second operating condition of the at least one of the drive mechanism or the patient support mechanism is received. A difference between the first operating condition and the second operating condition is determined. Based at least in part on the determining, a gait characteristic of the patient supported by the patient support mechanism is defined.

[1073] In some embodiments, a method includes receiving a first signal from a first sensor. The first signal is associated with an operating condition of a patient support mechanism included in a patient support system. The patient support mechanism includes a tether configured to tether a patient to the patient support mechanism so that the patient support system supports at least a portion of a weight of the patient. A second signal is received from a second sensor. The second signal is associated with an operating condition of a drive mechanism included in the patient support system. The drive mechanism is configured to (1) suspend the patient support system from a support track and (2) move along the support track in response to a movement of the patient. At least one gait characteristic associated with the movement of the patient is determined based at least in part on the operating condition of the patient support mechanism and the operating condition of the drive mechanism. A third signal is sent to an output device. The third signal is indicative of an instruction to output data associated with the at least one gait characteristic via the output device.

[1074] In some embodiments, a system includes a first trolley and a second trolley movably suspended from a support track. The first trolley includes a patient attachment mechanism configured to support a first patient. The first trolley is configured to move relative to the support track. The second trolley includes a patient attachment mechanism configured to support a second patient. The second trolley is configured to move relative to the support track such that the movement of the second trolley is independent of the movement of the first trolley. A collision management assembly is configured to be coupled to one of the first trolley and the

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second trolley. The collision management assembly includes a bumper that is configured to prevent the first trolley from directly contacting the second trolley.

[1075] In some embodiments, an apparatus includes a coupling portion and a trolley portion. The coupling portion is coupled to an end portion of a support track. The coupling portion includes a first member and a second member. The second member is maintained in a fixed position relative to the support track, while the first member is configured to move relative to the support track to transition the coupling portion between a first configuration and a second configuration. The trolley portion is movably suspended from the support track and is coupled to an end portion of the first member. The trolley portion includes a bumper that is configured to be placed in contact with a portion of a patient support system such that when the bumper is in contact with the portion of the patient support system and the patient support system moves along the support track towards the end portion, the trolley portion is moved from a first position to a second position relative to the support track. The first member of the coupling portion is moved relative to the second member of the coupling portion as the trolley portion is moved from the first position to the second position, thereby placing the coupling portion in the second configuration. The trolley portion and the coupling portion collectively limit movement of the patient support system towards the end portion of the support track when the coupling portion is in the second configuration.

[1076] In some embodiments, an apparatus includes a trolley, a patient attachment mechanism, and a tracking member. The trolley is movably suspended from a support track. The trolley includes an electronic system having an imaging device. The electronic system is configured to control a movement of the trolley along a length of the support track. The patient attachment mechanism is coupled to the trolley and is configured to support a patient as the patient moves from a first position to a second position. The tracking member is coupled to the patient attachment mechanism and is configured to be moved relative to the trolley from a first position, associated with the first position of the patient, to a second position, associated with the second position of the patient. The imaging device of the trolley is configured to capture an image of the tracking member in its first position and an image of the tracking member in its second position the electronic system is configured to control the movement of the trolley along

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the length of the support track based at least in part on the image of the tracking member in its first position and the image of the tracking member in its second position.

[1077] In some embodiments, a body weight support system includes a trolley, a power rail operative coupled to a power supply, and a patient attachment mechanism. 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. The control system can control at least a portion of the patient support mechanism based at least in part on a force applied to the patient attachment mechanism.

[1078] In some embodiments, a body weight support system includes a closed loop tack, a powered conductor coupled to the closed loop track, an actively controlled trolley, and a patient support assembly. The actively controlled trolley is movably suspended from the closed loop track and is electrically coupled to the powered conductor. The patient support assembly is coupled to the trolley and is configured to dynamically support a body weight of a patient.

[1079] In some embodiments, a body weight support device includes a housing, a drive element, a wheel assembly, and a patient support assembly. At least a portion of the drive element and at least portion of the wheel assembly is disposed within the housing. The patient support assembly is coupled to the drive element and is configured to dynamically support a body weight of a patient.

[1080] As used in this specification, the singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, the term "a member" is intended to mean a single member or a combination of members, "a material" is intended to mean one or more materials, or a combination thereof.

[1081] As used herein, the terms "about" and "approximately" generally mean plus or minus 10% of the value stated. For example, about 0.5 would include 0.45 and 0.55, about 10 would include 9 to 11, about 1000 would include 900 to 1100.

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[1082] As used herein, the term "set" can refer to multiple features or a singular feature with multiple parts. For example, when referring to set of walls, the set of walls can be considered as one wall with multiple portions, or the set of walls can be considered as multiple, distinct walls. Thus, a monolithically constructed item can include a set of walls. Such a set of walls may include multiple portions that are either continuous or discontinuous from each other. For example, a monolithically constructed wall can include a set of detents can be said to form a set of walls. A set of walls can also be fabricated from multiple items that are produced separately and are later joined together (e.g., via a weld, an adhesive, or any suitable method).

[1083] As used herein, the term "parallel" generally describes a relationship between two geometric constructions (e.g., two lines, two planes, a line and a plane or the like) in which the two geometric constructions are substantially non-intersecting as they extend substantially to infinity. For example, as used herein, a line is said to be parallel to another line when the lines do not intersect as they extend to infinity. Similarly, when a planar surface (i.e., a two-dimensional surface) is said to be parallel to a line, every point along the line is spaced apart from the nearest portion of the surface by a substantially equal distance. Two geometric constructions are described herein as being "parallel" or "substantially parallel" to each other when they are nominally parallel to each other, such as for example, when they are parallel to each other within a tolerance. Such tolerances can include, for example, manufacturing tolerances, measurement tolerances or the like.

[1084] As used herein, the term "tension" is related to the internal forces (i.e., stress) within an object in response to an external force pulling the object in an axial direction. For example, an object with a mass being hung from a rope at one end and fixedly attached to a support at the other end exerts a force to place the rope in tension. The stress within an object in tension can be characterized in terms of the cross-sectional area of the object. For example, less stress is applied to an object having a cross-sectional area greater than another object having a smaller cross-sectional area. The maximum stress exerted on an object in tension prior to plastic deformation (e.g., permanent deformation such as, for example, necking and/or the like) is characterized by the object's tensile strength. The tensile strength is an intensive property of (i.e., is intrinsic to) the constituent material. Thus, the maximum amount of stress of an object in

tension can be increased or decreased by forming the object from a material with a greater tensile strength or lesser tensile strength, respectively.

[1085] As used herein, the term "kinematics" describes the motion of a point, object, or system of objects without considering a cause of the motion. For example, the kinematics of an object can describe a translational motion, a rotational motion, or a combination of both translational motion and rotational motion. When considering the kinematics of a system of objects, known mathematical equations can be used to describe to the motion of an object relative to a plane or set of planes, an axis or set of axes, and/or relative to one or more other objects included in the system of objects.

[1086] As used herein, the terms "feedback", "feedback system", and/or "feedback loop" relate to a system wherein past or present characteristics influence current or future actions. For example, a thermostat is said to be a feedback system wherein the state of the thermostat (e.g., in an "on" configuration or an "off" configuration) is dependent on a temperature being fed back to the thermostat. Feedback systems can include a control scheme such as, for example, a proportional-integral-derivative (PID) controller. Expanding further, an output of some feedback systems can be described mathematically by the sum of a proportional term, an integral term, and a derivative term. PID controllers are often implemented in one or more electronic devices. In such controllers, the proportional term, the integral term, and/or the derivative term can be actively "tuned" to alter characteristics of the feedback system.

[1087] Electronic devices often implement feedback systems to actively control the kinematics of mechanical systems in order to achieve and/or maintain a desired system state. For example, a feedback system can be implemented to control a force within a system (e.g., a mass-spring system and/or the like) by changing the kinematics and/or the position of one or more components relative to any other components included in the system. Expanding further, the feedback system can determine current and/or past states (e.g., position, velocity, acceleration, force, torque, tension, electrical power, etc.) of one or more components included in the mechanical system and return the past and/or current state values to, for example, a PID control scheme. In some instances, an electronic device can implement any suitable numerical method or any combination thereof (e.g., Newton's method, Gaussian elimination, Euler's method, LU

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decomposition, etc.). Thus, based on the past and/or current state of the one or more components, the mechanical system can be actively changed to achieve a desired system state.

[1088] FIG. 1 is a schematic illustration of a body weight support system 1000 according to an embodiment. The body weight support system 1000 (also referred to herein as "support system") includes at least a trolley 1100, a patient attachment mechanism 1800 (also referred to herein as "attachment mechanism"), a power supply 1610, a powered conductor or rail 1620, and a control 1900. The 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. In such instances, the support system 1000 can be used to support at least a portion of the patient's body weight to facilitate the gait therapy. In other instances, the support system 1000 can be used to simulate, for example, low gravity scenarios for the training of astronauts or the like. In some embodiments, the 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.

[1089] The trolley 1100 included in the support system 1000 can be any suitable shape, size, or configuration and can include one or more systems, mechanisms, assemblies, or subassemblies (not shown in FIG. 1) that can perform any suitable function associated with, for example, supporting at least a portion of the body weight of a patient. The trolley 1100 can include at least a drive system 1300, a patient support mechanism 1500, and an electronic system 1700. In some embodiments, the drive system 1300 can be movably coupled to a support track (not shown in FIG. 1) and configured to move (e.g., slide, roll, or otherwise advance) along a length of the support track. The support track can be any suitable shape, size, or configuration. For example, in some embodiments, the support track can be substantially linear or curvilinear. In other embodiments, the support track can be a closed loop such as, for example, circular, oval, oblong, rectangular (e.g., with or without rounded corners), or any other suitable shape. In some embodiments, the support track can be a beam (e.g., an I-beam or the like) included in a roof or ceiling structure from which at least a portion of the trolley 1100 can "hang" (e.g., at least a portion of the trolley 1100 can extend away from the beam). In other embodiments, at least one end portion of the support track can be coupled to a vertical wall or the like. In still other

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embodiments, the support track can be included in a freestanding structure such as, for example, a gantry or an A-frame.

[1090] 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. Similarly stated, one or more wheels of the drive system 1300 can be disposed adjacent to and on top of a horizontal surface of the support track; thus, the trolley 1100 can be "hung" from or suspended from the support track. In other embodiments, the surface from which the trolley 1100 is hung need not be horizontal. For example, at least a portion of the support track can define a decline (and/or an incline) wherein a first end portion of the support track is disposed at a first height and a second end portion of the support track is disposed at a second height, different from the first height. In such embodiments, the trolley 1100 can be hung from a surface of the support track that is parallel to a longitudinal centerline (not shown) of the trolley 1100. In such embodiments, the trolley can be used to support a patient moving across an inclined/declined surface, up or down stairs, etc.

[1091] In some embodiments, the trolley 1100 can have or define a relatively small profile (e.g., height) such that the space between a surface of the trolley 1100 and a portion of the patient can be sufficiently large to allow the patient to move between a seated position to a standing position such as, for example, when a patient rises out of a wheelchair. Furthermore, with the trolley 1100 being hung from the support track, the weight of the trolley 1100 and the weight of the patient utilizing the support system can increase the friction (e.g., traction) between the one or more wheels of the drive system and the surface of the support track from which the trolley 1100 is hung. Thus, the one or more wheels of the drive system 1300 can roll along the surface of the support track without substantially slipping.

[1092] In some embodiments, the trolley 1100 can be motorized. For example, in some embodiments, the trolley 1100 can include one or more motors configured to power (e.g., drive, rotate, spin, engage, activate, etc.) the drive system 1300. In some embodiments, the motor(s) can be configured to rotate the wheels of the drive system 1300 at any suitable rate and/or any

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suitable direction (e.g., forward or reverse) such that the trolley 1100 can pace a patient utilizing the support system 1000, as described in further detail herein. In some embodiments, the electronic system 1700 and/or the control 1900 can be operatively coupled (e.g., electrically connected) to the one or more motors such that the electronic system 1700 and/or the control 1900 can send an electronic signal associated with operating the motor(s). In some embodiments, the motor(s) can include a clutch, a brake, or the like configured to substantially lock the motor(s) in response to a power failure or the like. Similarly stated, the motor(s) can be placed in a locked configuration to limit movement of the trolley 1100 (e.g., limit movement of the drive system 1300 and/or the patient support mechanism 1500) in response to a power failure (e.g., a partial power failure and/or a total power failure).

[1093] 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.

[1094] In some embodiments, an end portion of the tether can be coupled to, for example, a winch. In such embodiments, the winch can include a motor that can rotate a drum to coil or uncoil the tether. Similarly stated, the tether can be wrapped around the drum and the motor can rotate the drum in a first direction to wrap more of the tether around the drum and can rotate the drum in a second direction, opposite the first direction, to unwrap more of the tether from around the drum. In some embodiments, the support mechanism 1500 can include one or more pulleys that can engage the tether such that the support mechanism 1500 gains a mechanical advantage. Similarly stated, the pulleys can be arranged such that the force exerted by the winch to coil or uncoil the tether around the drum while a patient is coupled to the attachment mechanism 1800 is reduced.

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[1095] The horizontal drive system/motor that is configured to allow for movement of the trolley along the track, and the vertical drive system configured to move to control the tether can be simultaneously controlled and operated or not. For example, when a patient is walking over a treadmill, there is little or no horizontal movement, but the vertical (weight bearing) drive system is operational to compensate for the changes during the gait, falls, etc.

[1096] 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

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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.

[1097] As described above, the electronic system 1700 included in the trolley 1100 can control at least a portion of the trolley 1100. The electronic system 1700 includes at least a processor and a memory. The memory can be, for example, a random access memory (RAM), a memory buffer, a hard drive, a read-only memory (ROM), an erasable programmable read-only memory (EPROM), and/or the like. In some embodiments, the memory stores instructions to cause the processor to execute modules, processes, and/or functions associated with controlling one or more mechanical and/or electrical systems included in the patient support system 1000, as described above. In some embodiments, control signals are delivered through the powered rail using, for example, a broadband over power-line (BOP) configuration.

[1098] The processor of the electronic device can be any suitable processing device configured to run or execute a set of instructions or code. For example, the processor can be a general-purpose processor (GPU), a central processing unit (CPU), an accelerated processing unit (APU), and/or the like. The processor can be configured to run or execute a set of instructions or code stored in the memory associated with controlling one or more mechanical and/or electrical systems included in a patient support system 1000. For example, the processor can run or execute a set of instructions or code associated with controlling one or more motors, sensors, communication devices, encoders, or the like, as described above. More specifically, the processor can execute a set of instructions in response to receiving a signal from one or more sensors and/or encoders associated with a portion of the drive system 1300 and/or the support mechanism 1500. Similarly stated, the processor can be configured to execute a set of instructions associated with a feedback loop (e.g., based on a proportional-integral-derivative (PID) control method) wherein the electronic system 1700 can control the subsequent action of the drive system 1300 and/or the support system 1500 based at least in part on current and/or previous data (e.g., position, velocity, force, acceleration, angle of the tether, or the like) received from the drive system 1300 and/or the support system 1500, as described in further detail herein.

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[1099] In some embodiments, the electronic system 1700 can include a communication device (not shown in FIG. 1) that can be in communication with the control 1900. For example, in some embodiments, the communication device can include one or more network interface devices (e.g., a network interface card). The communication device can be configured to transmit data over a wired and/or wireless network (not shown in FIG. 1) associated with sending data to and/or receiving data from the control 1900. The control 1900 can be any suitable device or module (e.g., hardware module or software module stored in the memory and executed in the process). For example, in some embodiments, the control 1900 can be an electronic device that includes at least a processor and a memory (not shown in FIG. 1) and is configured to run, for example, a personal computer application, a mobile application, a web page, and/or the like. In this manner, a user can engage the control 1900 to establish a set of system parameters associated with the support system 1000, as described in further detail herein. In some embodiments, the control 1900 can be implemented as a handheld controller.

[1100] In some embodiments, control of the trolley 1100 can be accomplished using one or more controllers. In embodiments in which multiple controllers are utilized (e.g., a personal computer control and a handheld control), only one controller can be used at a time. In other embodiments, one of the controllers (e.g., the handheld controller) can override the personal computer controller. In other embodiments, a user can designate which controller is utilized by actuating the relevant controller. In other words, the user either can take control using a controller or can pass control to the other controller by actuating the controller.

[1101] In some embodiments, the patient support system 1000 is configured to improve gait and stability rehabilitation training by adding visual and audio feedback to a gait and stability assistance device. The trolley 1100 coordinates the feedback with heuristic patient data from past training sessions, and stores the data for each therapy/training

[1102] As shown in FIG. 1, the trolley 1100 is operatively coupled to the power rail 1620. The power rail 1620 is further coupled to the power source 1610 that is configured to provide a flow of electrical current (e.g., electrical power) to the power rail 1620. More specifically, the power rail 1620 can include any suitable transformer, converter, conditioner, capacitor, resistor, insulator, and/or the like (not shown in FIG. 1) such that the power rail 1620 can receive the flow

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of electrical current from the power source 1610 and transfer at least a portion of the flow of electrical current to the trolley 1100. The power rail 1620 can include one or more electrical conductors to deliver, for example, single or multiphase electrical power to one or more trolleys 1100. For example, in some embodiments, the power rail 1620 is a substantially tubular rail configured to receive a conductive portion of the electronic system 1600 of the trolley 1100. In such embodiments, the power rail 1620 can include one or more conductive surfaces disposed within an inner portion of the tubular rail along which a conductive member of the electronic system 1700 can move (e.g., slide, roll, or otherwise advance). In other embodiments, the power rail 1620 can be and/or can have a substantially open configuration (e.g., is not substantially tubular). In such embodiments, the power rail 1620 can include one or more conductive members disposed on any suitable surface or combination of surfaces of the power rail 1620.

[1103] The power rail 1620 is configured to transmit a flow of electrical current from the power source 1610 to the electronic system 1700 of the trolley 1100, as described in further detail herein. The power rail 1620 can be any suitable shape, size, or configuration. For example, the power rail 1620 can extend in a similar shape as the support track (not shown in FIG. 1) and can be arranged such that the power rail 1620 is substantially parallel to the support track. In this manner, the trolley 1100 can advance along a length of the support track while remaining in electrical contact with the power rail 1620. Furthermore, the arrangement of the power rail 1620 and the trolley 1100 is such that movement of the trolley 1100 along the length of the support track is not hindered or limited by a bundle of cables, as described above with reference to known support systems. In other embodiments, the power rail 1620 and/or a portion thereof can be coupled to, disposed along, and/or otherwise at least partially integrated with the support track or a portion thereof. In still other embodiments, the power rail 1620 can be and/or can have a telescoping configuration in which the power rail 1620 extends, for example, from a central power source to the trolley 1100.

[1104] Although described above as being coupled to a power rail 1620, in some embodiments, the trolley 1100 can be battery powered. In such embodiments, the trolley 1100 can include one or more batteries or a battery system that is suitable for providing the trolley 1100 with a flow of electrical current. In such embodiments, the battery or batteries can be configured to provide electric power in addition to and/or instead of electric power received from

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the power rail 1620. In some embodiments, the battery or batteries included in such embodiments can be rechargeable. For example, at least a portion of the flow of electric power or electric current received from the power rail 1620 can be delivered to the battery or batteries (e.g., to charge or re-charge the battery). In some embodiments, the power rail 1620 and/or support track can include one or more charging station(s) located in certain location(s) on or along the support track. In such embodiments, the trolley 1100 can, for example, automatically dock to the charging station(s) according to a predetermined or desired algorithm, schedule, and/or condition. For example, the trolley may travel to and dock with such a charging station when a power level of one or more batteries is below predetermined and/or desired level or during the break periods (for example when the system is not in use for a given time, at night, or at predetermined times).

[1105] While the trolley 1100 is described above as receiving electric power from one or more of the power rail 1620 or a battery or battery system, in some embodiments, the support system 1000 can include an uninterruptible power supply (or any other suitable energy capacitor or energy storage device) that can provide electric power to at least a portion of the support system 1000. For example, in some embodiments, an uninterruptible power supply (UPS) can be included to provide a backup to the power supply 1610 and/or one or more batteries included in the trolley 1100. That is to say, the UPS can be electrically connected between the power source 1610 and the power rail 1620 or the power source 1610 and the trolley 1100. In other embodiments, the UPS can be configured to provide electric power to the power supply 1610, for example, in response to a power grid failure and/or interruption. That is to say, the UPS can be electrically connected between the power grid and the power source 1610. In still other embodiments, the trolley 1100 can include a UPS that can provide electric power to the trolley 1100 if a flow of electric power from the power rail 1620 or from one or more batteries is interrupted or otherwise stops. In some embodiments, the support system 1000 can include a UPS configured to provide primary or backup power to the trolley 1100 and one or more additional devices included in the support system 1000 (e.g., a secondary training device such as a treadmill, one or more compute devices such as a personal computer, server, etc., and/or any other suitable device).

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[1106] In some embodiments, electric power and/or energy can be transferred from the power rail 1620 (or one or more portions of the power rail 1620) to the trolley 1100 via any suitable mode of transfer. For example, in some embodiments, a conductive member of the trolley 1100 (e.g., a collector or the like) can be in physical and/or electrical contact with a conductor or conductive portion of the power rail 1620. In other embodiments, the trolley 1100 can include one or more induction coils along which a flow of electric current is induced in response to an alternating electromagnetic field generated by or along at least a portion the power rail 1620 and/or a conductive portion or surface of the track 1050. In such embodiments, electric power received via induction can be used to provide electric power for the trolley 1100 and/or can be used to, for example, charge one or more batteries of the trolley 1100.

[1107] Moreover, the control 1900 can also be operatively coupled to the power supply 1610 and can be configured to control the amount of power delivered to the power rail 1620 and/or the trolley 1100. For example, the control 1900 can be configured to begin a flow of electrical current from the power supply 1610 to the power rail 1620 to turn on or power up the support system 1000. Conversely, the control 1900 can be configured to stop a flow of electrical current from the power supply 1610 to the power rail 1620 to turn off or power down the support system 1000.

[1108] While the control 1900 is shown in FIG. 1 as being independent from and operatively coupled to the trolley 1100, in some embodiments, the control 1900 can be included in the electronic system 1700 of the trolley 1100. For example, in some embodiments, the control 1900 can be a hardware module and/or a software module that can be executed by the processor of the electronic system 1700. In such embodiments, the 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). Thus, a user (e.g., a physical therapist, a doctor, a nurse, a technician, etc.) can engage the user interface associated with the control 1900 to establish a set of system parameters for the support system 1000.

[1109] Although not shown in FIG. 1, in some embodiments, more than one trolley 1100 can be coupled to the same support track. In such embodiments, the trolleys 1100 hung from the support track can include, for example, sensors (e.g., ultrasonic proximity sensors and/or the

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like) that can send a signal to the electronic system 1700 associated with the proximity of one or more trolleys 1100 relative to a specific trolley 1100. In this manner, the electronic system 1700 of the trolleys 1100 can control, for example, a motor included in the drive system 1300 to prevent collision of the trolleys 1100. Thus, the support system 1000 can be used to support more than one patient (e.g., a number of patients corresponding to a number of trolleys 1100 disposed about the support track) while keeping the patients at a desired distance from one another.

[1110] In some embodiments, the support system is configured to provide feedback to a patient during use. In some embodiments, a laser or culminated light source is coupled to the trolley 1100 to create a light path for a patient to follow during a session. The light path allows the patient to look ahead or look at their feet while attempting to train their brain to properly control the leg/foot/hip motion. In some embodiments, a second light source is configured to illuminate a "target" location at which the patient can aim to plant their foot in a proper location. In some embodiments, the size of the target can be varied depending upon the dexterity of the user. In other words, for a user with greater muscle control, the target can be smaller. The light path and target location can be modified using a user interface as described in greater detail herein.

[1111] 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.

[1112] In some embodiments, a CCD camera interface is configured for video monitoring for future analysis and can be correlated to sensed rope position, speed, tension, etc. In some embodiments, monitors can be coupled to a patient's body to monitor muscle usage (e.g., leg muscles, torso muscles, etc.). Such information can be wirelessly transmitted to the electronic system 1700 and coordinated in the feedback provided to the patient during and after a therapy/rehabilitation session. Said another way, all of the data collected by the various sensors, cameras, etc. can be coordinated to provided dynamic, real-time feedback and/or post-session feedback.

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[1113] 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.

[1114] FIGS. 4-7 are perspective views of the trolley 2100. The trolley 2100 can be any suitable shape, size, or configuration. For example, the trolley 2100 can suspended from the support track 2050 (as described in further detail herein) and can have or define a relatively small profile (e.g., height) such that the space between the trolley 2100 and a patient can be maximized. In this manner, the support system 2000 can be used to support patients of varying heights as well as supporting a patient rising from a sitting position to a standing position as is common in assisting patient at least partially relegated to a wheelchair. 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).

[1115] As shown in FIGS. 8 and 9 the housing 2200 includes a base 2210, a first side member 2230, a second side member 2240, a third side member 2250, and a cover 2260. The housing 2200 is configured to enclose and/or cover at least a portion of the electronic system 2700, as described in further detail herein. As shown in FIG. 9, the base 2210 has a first side

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2211 and a second side 2212. The base 2210 defines a set of drive mechanism openings 2213, a fan opening 2214, a guide mechanism opening 2215, a bias mechanism opening 2217, a guide member opening 2218, and a cam pulley opening 2219, a cam pivot opening 2220. As described in further detail herein, the drive mechanism openings 2213 receive at least a portion of a first drive assembly 2310 included in the drive mechanism 2300 such that a set of wheels included therein can rotate without contacting the base 2210. The fan opening 2214 is receives a portion of a fan 2740 included in the electronic system 2700. More specifically, a portion of the fan 2740 can extend through the opening such that the fan can remove heat from within the housing 2200 produced by the electronic system 2700. The guide mechanism opening 2215 receives a portion of a guide mechanism 2540 included in the patient support mechanism 2500 (also referred to herein as "support mechanism"). More specifically, the base 2210 includes a set of mounting tabs 2216 configured to extend from a surface of the base 2210 that defines the guide mechanism opening 2215. In this manner, the guide mechanism 2540 can be coupled to the mounting tabs 2216. The bias mechanism opening 2217, the guide member opening 2218, the cam pulley opening 2219, and the cam pivot opening 2220 can each movably receive a portion of a cam mechanism 2570 included in the support mechanism 2500, as described in further detail herein.

[1116] The first side member 2230 has a first side 2231 and a second side 2232. The second side 2232 defines a slot 2233 that receives a portion of the base 2210 to couple the base 2210 thereto. The first side member 2230 also includes a mounting portion 2235 that is coupled to a portion of a collector 2770 included in the electronic system 2700, as described in further detail herein. The second side member 2240 has a first side 2241 and a second side 2242. The second side 2242 defines a slot 2243 that receives a portion of the base 2210 to couple the base 2210 thereto. The second side 2242 also includes a recessed portion 2244 that is coupled to a portion of a winch assembly 2510 included in the support mechanism 2500. The third side member 2250 is coupled to the first side member 2230, the second side member 2240, and the base 2210 and defines a light opening 2251 that receives an indicator light and a power outlet opening that receives a power outlet module.

[1117] 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

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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.

[1118] FIGS. 10 and 11 illustrate the electronic system 2700 of the trolley 2100. The electronic system 2700 includes a set of electronic devices that are collectively operated to control at least a portion of the trolley 2100. As described above, the electronic system 2700 includes the collector 2770 that is coupled to a portion of the housing 2200 and that is placed in physical and/or electrical contact with the power rail 2620. The collector 2770 can be any suitable shape, size, or configuration and can be formed from any suitable conductive material, such as, for example, iron, steel, or the like. In this manner, the collector 2770 can receive a flow of electrical current from the power rail 2620. For example, as shown in FIG. 10, the power rail 2620 is a substantially hollow tube that houses or substantially encloses one or more conductive portions 2621 (e.g., individual conductors or surfaces) that are electrically coupled to a power source (not shown). In this manner, the collector 2770 can be disposed within the hollow tube of the power rail 2620 such that a conductive portion 2771 (e.g., individual conductors, a conductive surface, or the like) of the collector 2770 is placed in electrical communication with the one or more conductive portions 2621 of the power rail 2620. Thus, the collector 2770 receives a flow of current from the power source and transferred by the power rail 2620. Moreover, the collector 2770 can be disposed within the power rail 2620 such that a coupling portion 2772 of the collector 2770 extends through a slot 2622 defined by the power rail 2620 to be coupled to the mounting portion 2235 of the housing 2200. The coupling portion 2772 can further be coupled to a power module (not shown) of the trolley 2100. Thus, the trolley 2100 receives power from the power source via the power rail 2620.

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[1119] While the power rail 2620 is shown and described as being a substantially hollow tube, in other embodiments, a power rail can be any suitable configuration. For example, in some embodiments, a power rail can be one or more conductive portions on any suitable surface such as a surface of a relative flat or open power rail. In some embodiments, the power rail can be one or more conductive portions of, for example, the support track 2050 (e.g., one or more inner surface and/or one or more outer surface). As described in further detail herein, a conductive portion of the trolley 2100 (e.g., the collector 2770) can be in electric contact with the power rail 2620 and/or any other suitable conductive surface providing a flow of electric power, which in turn, powers one or more portions of the trolley 2100.

[1120] While not shown in FIGS. 10 and 11, the electronic system 2700 includes at least a processor, a memory, and a communication device. The memory can be, for example, a random access memory (RAM), a memory buffer, a hard drive, a read-only memory (ROM), an erasable programmable read-only memory (EPROM), and/or the like. In some embodiments, the memory stores instructions to cause the processor to execute modules, processes, and/or functions associated with controlling one or more mechanical and/or electrical systems included in the patient support system 2000. For example, the memory can store instructions, information, and/or data associated with a proportion-integral-derivative (PID) control system. In some embodiments, the PID control system can be included in, for example, a software package. In some embodiments, the PID control can be a set of user controlled instructions executed by the processor that allow the user to "tune" the PID control, as described in further detail herein.

[1121] The processor of the electronic device can be any suitable processing device configured to run or execute a set of instructions or code. For example, the processor can be a general-purpose processor (GPU), a central processing unit (CPU), an accelerated processing unit (APU), and/or the like. The processor can be configured to run or execute a set of instructions or code stored in the memory associated with controlling one or more mechanical and/or electrical systems included in a patient support system. For example, the processor can run or execute a set of instructions or code associated with the PID control stored in the memory and further associated with controlling with a portion of the drive system 2300 and/or the patient support mechanism 2500. More specifically, the processor can execute a set of instructions in

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response to receiving a signal from one or more sensors and/or encoders (shown and described below) that can control one or more subsequent actions of the drive system 2300 and/or the support mechanism 2500. Similarly stated, the processor can execute a set of instructions associated with a feedback loop that includes one or more sensors or encoders that send a signal that is at least partially associated with current and/or previous data (e.g., position, velocity, force, acceleration, or the like) received from the drive system 2300 and/or the support mechanism 2500, as described in further detail herein.

[1122] The communication device can be, for example, one or more network interface devices (e.g., network cards) configured to communicate with an electronic device over a wired or wireless network. For example, in some embodiments, a user can manipulate a remote control device that sends one or more signals to and/or receives one or more signals from the electronic system 2700 associated with the operation of the trolley 2100. The remote control can be any suitable device or module (e.g., hardware module or software module stored in the memory and executed in the process). For example, in some embodiments, the remote control can be an electronic device that includes at least a processor and a memory and that runs, for example, a personal computer application, a mobile application, a web page, and/or the like. In this manner, a user can engage the remote control to establish a set of system parameters associated with the support system 2000 such as, for example, the desired amount of body weight supported by the support system 2000.

[1123] 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, as described in further detail herein.

[1124] FIGS. 13-23 illustrate the first drive assembly 2310. 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 motor 2311 is coupled to a side member 2320 of the support structure 2315 and is in electrical communication

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with a portion of the electronic system 2700. The motor 2311 includes an output shaft 2312 (see e.g., FIGS. 15 and 16) that engages a portion of one of the drive wheel assemblies 2370 to rotate a drive wheel 2385 included therein. More specifically, the motor 2311 receives an activation signal (e.g., a flow of electrical current) from the electronic system 2700 to cause the motor 2311 to rotate the output shaft 2312, which, in turn, rotates the drive wheel 2385. As shown in FIGS. 13 and 14, at least a portion of the first drive assembly 2310 is substantially symmetrical about a longitudinal plane (not shown) defined by the first drive assembly 2310. In this manner, each side of the first drive assembly 2310 includes similar components, thereby increasing versatility and decreasing manufacturing costs. For example, while the first drive assembly 2310 is shown including two side members 2320 with the motor 2311 being coupled to a particular side member 2320, in other embodiments, the motor 2311 can be coupled to the other side member 2320.

[1125] The support structure 2315 includes two side members 2320, a base 2340, two leading support members 2350, two trailing support members 2354, and two transverse support members 2358. As shown in FIGS. 13-16, the side members 2320 are the same (e.g., due to the symmetry of the first drive assembly 2310). The side members 2320 each define a bearing opening 2321, a notch 2322, and a set of slots 2325. The bearing opening 2321 of each side member 2320 receives a drive bearing 2376 (FIG. 20) included in the drive wheel assembly 2370. More specifically, the drive bearing 2376 can be disposed within the bearing opening 2321 such that an outer surface of the drive bearing 2376 forms a friction fit with a surface of the side member 2320 that defines the bearing opening 2321. Similarly stated, the drive bearing 2376 and the surface of the side 2320 defining the bearing opening 2321 form a press fit to retain the drive bearing 2376 within the bearing opening 2321.

[1126] The notch 2322 defined by each of the side members 2320 receives a spring rod 2323 and a spring 2324. The spring 2324 is disposed about the spring rod 2323 such that the spring rod 2323 substantially limits the motion of the spring 2324. More specifically, the spring rod 2323 is configured to allow the spring 2324 to move in an axial direction (e.g., compress and/or expand) while substantially limiting movement of the spring 2324 in a transverse direction. As described in further detail herein, the spring rod 2323 and the spring 2324 extend from a surface of the notch 2322 to engage a spring protrusion 2344 of the base 2340. The set of slots 2325 is

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configured such that each slot 2325 receives mounting hardware (e.g., a mechanical fastener, a pin, a dowel, etc.) configured to movably couple the side members 2320 to the base 2340, as described in further detail herein.

[1127] As described above, the base 2340 is movably coupled to the side members 2320. The base 2340 includes a set of sidewalls 2342, and an axle portion 2346. The axle portion 2346 of the base 2340 defines an opening 2347 that receives a transfer axle 2388 included in the drive wheel assembly 2370. More specifically, the transfer axle 2388 can rotate within the opening 2347 of the axle portion 2346 such that a rotational motion can be transferred from one of the drive assemblies 2370 to the other drive assembly 2370, as described in further detail herein.

[1128] The sidewalls 2342 each define a notch 2343 and include the spring protrusion 2344. More specifically, the spring protrusions 2344 each extend in a substantially perpendicular direction from the sidewalls 2342. As shown in FIGS. 13 and 14, when the side members 2320 are coupled to the base 2340, the notches 2322 of the side members 2320 each receive one of the spring protrusions 2344 of the base 2340. Similarly, when the side members 2320 are coupled to the base 2340, the notches 2343 defined by the base 2340 each receive a portion of one of the springs 2324. In this manner, the spring rod 2323 and the spring 2324 of each side member 2320 are aligned with the spring protrusion 2344 extending from the side walls 2342 of the base 2340 such that the spring 2324 is placed in contact with a surface of the corresponding spring protrusion 2344. With the side members 2320 movably coupled to the base 2340 (e.g., by disposing the mounting hardware in the slots 2325), the spring 2324 of each side member 2320 can dampen a movement of the side member 2320 relative to the base 2340. Similarly stated, the spring 2324 of each side member 2320 can engage the surface of the corresponding spring protrusion 2344 to exert a reaction force (e.g., brought on by a compression of the spring) in response to an external force (e.g., operational vibration, torque exerted by the motor, or the like) applied to one or both of the side members 2320.

[1129] FIGS. 17-19 illustrate one of each of the leading support members 2350, the trailing support members 2354, and the transverse support members 2358, respectively. As described above, the symmetry of the first drive assembly 2310 is such that the two leading support member 2350 are the same, the two trailing support members 2354 are the same, and the two

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transverse support members 2358 are the same. The leading support members 2350 are each fixedly coupled to one of the side members 2320. As shown in FIG. 17, the leading support members 2350 each define a lever arm notch 2355 that receives a lever arm 2391 of the secondary wheel assembly 2390, a spring recess 2352 that receives a spring 2394 of the secondary wheel assembly 2390, and a support track notch 2353 that receives, for example, a horizontal portion 2051 of the support track 2050 (see e.g., FIG. 23).

[1130] The trailing support members 2354 are each fixedly coupled to one of the side members 2320 and are disposed in a rearward position relative to the leading support members 2354. Expanding further, the trailing support members 2354 are spaced apart from the leading support members 2354 at a distance sufficiently large to allow a portion of the drive wheel assemblies 2370 to be disposed therebetween. As shown in FIG. 18, the trailing support members 2354 each define a belt notch 2355 configured to receive a drive belt 2389 of the drive wheel assembly 2370 and a support track notch 2353 configured to receive the horizontal portion 2051 of the support track 2050 (e.g., as described with reference to the leading support member 2350).

[1131] The transverse support members 2358 are each fixedly coupled to one of the leading support members 2350 and one of the trailing support members 2354. Therefore, with the leading support members 2350 and the trailing support members 2354 each coupled to the corresponding side member 2320, the transverse support member 2358 substantially encloses a space configured to house or receive a portion of the drive wheel assemblies 2370. Furthermore, the arrangement of the support structure 2315 is such that a space defined between adjacent surfaces of the transverse support member 2358 is sufficiently large to receive, for example, a vertical portion 2052 of the support track 2050.

[1132] As shown in FIG. 19, the transverse support member 2358 defines a bearing opening 2359 that receives a support bearing 2377 of the drive wheel assemblies 2370. More specifically, the support bearing 2377 is disposed within the bearing opening 2359 such that an outer surface of the support bearing 2377 forms a friction fit with a surface of the transverse support member 2358 that defines the bearing opening 2359. Similarly stated, the outer surface

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of the support bearing 2377 and the surface of the transverse support member 2358 form a press fit to retain the support bearing 2377 within the bearing opening 2359.

[1133] Referring back to FIGS. 13-15, the first drive assembly 2310 includes four guide wheel assemblies 2360. The guide wheel assemblies 2360 each include a mounting bracket 2361 and a guide wheel 2363. More specifically, each of the guide wheels 2363 are rotatably coupled to one of the mounting brackets 2361 such that the guide wheels 2363 can rotate relative to the mounting brackets 2361.

[1134] The guide wheel assemblies 2360 are each configured to be coupled to a portion of the support structure 2315. Expanding further, as shown in FIGS. 13-16, the mounting bracket 2361 of each guide wheel assembly 2360 is coupled to one of the leading support members 2350 or one of the trailing support members 2354. Similarly stated, both of the leading support members 2350 are coupled to the mounting bracket 2361 included in one of the guide wheel assemblies 2360 and both of the trailing support members 2354 are coupled to the mounting bracket 2361 included in one of the guide wheel assemblies 2360. The guide wheel assemblies 2360 are coupled to the support structure 2315 such that a portion of the guide wheel 2363 extends into the space defined between the transverse members 2358. In this manner, the guide wheels 2363 can roll along a surface of the vertical portion 2052 of the support track 2050 when the first drive assembly 2310 is coupled thereto (see e.g., FIG. 23).

[1135] As shown in FIGS. 13-15, the guide wheel assemblies 2360 can be arranged relative to the support structure 2315 such that the guide wheels 2363 included in the guide wheel assemblies 2360 that are coupled to the leading support member 2350 are disposed substantially below the mounting bracket 2361. Conversely, the guide wheels 2363 included in the guide wheel assemblies 2360 that are coupled to the trailing support member 2350 are disposed substantially above the mounting bracket 2361. This arrangement can increase the surface area of the vertical portion 2051 of the support track 2050 that is in contact with at least one guide wheel 2360. In this manner, a rotational motional about a longitudinal centerline (not shown) of the support track 2050 can be minimized or eliminated. While shown in as being in a particular arrangement, in other embodiments, the guide wheels 2363 can be arranged in any suitable manner. For example, in some embodiments, all the guide wheels 2363 can be mounted below

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the mounting brackets 2361. In other embodiments, all the guide wheels 2363 can be mounted above the mounting brackets 2361. In still other embodiments, the guide wheels 2363 can be mounted to the mounting brackets 2361 in any combination of configurations (e.g., mounted above or below the mounting brackets 2361 in any suitable arrangement).

[1136] FIG. 20 is an exploded view of the drive wheel assembly 2370. As described above, the symmetry of the first drive assembly 2310 is such that the drive wheel assemblies are the same. Thus, a discussion of the drive wheel assembly 2370 shown in FIG. 20 applies to both drive wheel assemblies 2370. The drive wheel assembly 2370 includes a drive shaft 2371, the drive bearing 2376, the support bearing 2377, a drive sprocket 2379, a transfer sprocket 2381, a drive wheel 2385, the transfer axle 2388 (not shown in FIG. 20), and a drive belt 2389. The drive shaft 2371 has a first portion 2372, a second portion 2373, and a third portion 2374 and defines an opening 2375. The first portion 2372 has a first diameter that is at least partially associated with the drive sprocket 2378. Expanding further, the drive sprocket 2378 defines an opening 2380 that has a diameter that is associated with the diameter of the first portion 2372 of the drive shaft 2371. In this manner, the drive sprocket 2378 is disposed about the first portion 2372 of the drive shaft 2371 such that a surface of the drive sprocket 2378 defining the opening 2380 forms a friction fit with an outer surface of the first portion 2372 of the drive shaft 2371. Similarly, the drive bearing 2376 is disposed about the first portion 2372 such that an inner surface of the bearing forms a friction fit with the outer surface of the second portion 2372 of the drive shaft 2371. Thus, a rotation of the drive shaft 2371 within the drive bearing 2376 rotates the drive sprocket 2378. Moreover, with the drive bearing 2376 being retained with the bearing opening 2321 of one of the side member 2370, the drive shaft 2371 can be rotated relative to the corresponding side member 2370, as described in further detail herein.

[1137] The second portion 2373 of the drive shaft 2371 has a second diameter that is smaller than the diameter of the first portion 2372 and that is at least partially associated with the drive wheel 2385. Expanding further, the drive wheel 2385 includes a hub 2386 that defines an opening 2387 with a diameter that is associated with the diameter of the second portion 2373 of the drive shaft 2371. As shown in FIG. 20, the opening 2387 of the drive wheel 2385 includes a keyway configured to receive a key that extends from an outer surface of the second portion

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2373 of the drive shaft 2371. In this manner, the drive wheel 2385 is fixedly disposed about the second portion 2373 of the drive shaft 2373.

[1138] The third portion 2374 of the drive shaft 2371 has a third diameter that is smaller than the diameter of the second portion 2372 and that is at least partially associated with the support bearing 2377. Expanding further, the support bearing 2377 is disposed about the third portion 2374 of the drive shaft 2371 such that an outer surface of the third portion 2374 forms a friction fit with an inner surface of the support bearing 2377. Moreover, with the support bearing 2377 being disposed within the bearing opening 2359 of the transverse support member 2358, the third portion 2374 of the drive shaft 2371 can be at least partially supported.

[1139] The opening 2375 defined by the drive shaft 2371 receives the output shaft 2312 of the motor 2311. More specifically, the drive shaft 2371 can be fixedly coupled, at least temporarily, to the output shaft 2312 of the motor 2311; thus, when the output shaft 2312 is rotated (e.g., in response to an activation signal from the electronic system 2700), the drive shaft 2371 is concurrently rotated. With the drive bearing 2376 and the support bearing 2377 being disposed within the bearing opening 2321 of the side member 2320 and the bearing opening 2359 of the transverse support member 2358, respectively, the drive shaft 2371 can rotate relative to the support structure 2315. Moreover, the rotation of the drive shaft 2371 rotates both the drive sprocket 2378 and the drive wheel 2385.

[1140] The drive sprocket 2378 is configured to engage the belt 2389. More specifically, the drive sprocket 2389 includes a set of teeth 2379 that engage a set of teeth (not shown) that extend from an inner surface of the belt 2389. The belt 2389 is further coupled the transfer sprocket 2381. The transfer sprocket 2381 includes a set of teeth 2382 that engage the teeth of the belt 2389. In this manner, the rotation of the drive sprocket 2378 (described above) rotates the belt 2389, which, in turn, rotates the transfer sprocket 2381. The transfer sprocket 2381 defines an opening 2383 configured to receive the transfer axle 2388 (see e.g., FIG. 16). More specifically, the transfer axle 2388 can be fixedly coupled to the transfer sprockets 2381 of each drive wheel assembly 2370 such that a rotation of the transfer sprocket 2381 of the first drive wheel assembly 2370 (e.g., the drive wheel assembly 2370 coupled to the output shaft 2312 of the motor 2311) rotates the transfer sprocket 2381 of the second drive wheel assembly 2370. Thus, when the

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motor 2311 is activated to rotate the output shaft 2312, both the drive wheels 2385 of both the drive wheel assemblies 2370 are urged to rotate.

[1141] In some embodiments, the side members 2320 and the base 2340 of the support structure 2315 can be arranged such that the spring 2324 of the side members 2320 is in a preloaded configuration (e.g., partially compressed without an additional external force being applied to one or both of the side members 2320). More specifically, each spring 2324 can exert a force (e.g., due to the preload) on the surface of the corresponding spring protrusion 2344 of the base 2340 to place the corresponding side member 2320 in a desired position relative to the base 2340. Moreover, with the drive bearings 2376 fixedly disposed within the bearing opening 2321 of the corresponding side members 2320 and with the transfer axle 2388 being disposed within the opening 2347 defined by the axle portion 2346 of the base 2340, the belt 2379 disposed about the drive sprocket 2378 and the transfer sprocket 2381 can be placed in tension. Thus, the arrangement of the side members 2320 being movably coupled to the base 2340 can retain the belt 2379 in a suitable amount tension such that the belt 2379 does not substantially slip along the teeth 2379 of the drive sprocket 2378 and/or along the teeth 2382 of the transfer sprocket 2381.

[1142] As shown in FIG. 21, the first drive assembly 2310 includes the secondary wheel assembly 2390. The secondary wheel assembly 2390 includes a lever arm 2391, a secondary wheel 2393, and a spring 2394. The lever arm 2391 is a substantially angled member that includes an axle portion 2392, a pivot portion 2395, and an engagement portion 2396. The axle portion 2392 is disposed at a first end of the lever arm 2391 and is movably coupled to the secondary wheel 2393 such that the secondary wheel 2393 rotates about the axle portion 2392. The pivot portion 2395 is movably coupled to a portion of the leading support member 2350 that defines the lever arm notch 2351. For example, in some embodiments, the pivot portion 2395 of the lever arm 2391 can include an opening configured to receive, for example, a pivot pin (not shown) included in the leading support member 2350. In this manner, the pivot pin can define an axis about which the pivot portion 2395 can pivot or rotate.

[1143] The engagement portion 2396 is configured to engage a portion of the spring 2394. More specifically, as shown in FIG. 22, a first end portion of the spring 2394 is in contact with

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the spring recess 2352 defined by the leading support member 2350 and a second end portion of the spring 2394 is in contact with the engagement portion 2396. In this manner, the spring 2394 can exert a force on the engagement portion 2396 to pivot the lever arm 2391 about the pivot portion 2395. Expanding further, as shown in FIGS. 22, the force exerted by the spring 2394 can pivot the lever arm 2391 such that the secondary wheel 2393 is pivoted towards the drive wheel 2385. Therefore, when the first drive assembly 2310 is disposed about the support track 2050, the secondary wheel 2393 can be placed in contact with a bottom surface of the horizontal portion 2051 of the support track 2050. Moreover, the force exerted by the spring 2394 can be such that the drive wheel 2385 and the secondary wheel 2393 exert a compressive force on a top surface and the bottom surface, respectively, of the horizontal portion 2051 of the support track 2051. This arrangement can, for example, increase the friction between the drive wheel 2385 and the horizontal portion 2051 of the support track 2050.

[1144] FIGS. 24-26 illustrate the second drive assembly 2400. The second drive assembly 2400 can function similarly to the first drive assembly 2310, thus, some portions of the second drive assembly 2400 are not described in further detail herein. The second drive assembly 2400 includes a support structure 2405, a set of guide wheel assemblies 2430, a set of primary wheel assemblies 2440, a coupler 2460, and an encoder 2470. As shown, at least a portion of the second drive assembly 2400 is substantially symmetrical about a longitudinal plane (not shown) defined by the second drive assembly 2400. In this manner, each side of the second drive assembly 2400 includes similar components, thereby increasing versatility and decreasing manufacturing costs. For example, while the second drive assembly 2400 is shown including two side members 2420 with the coupler 2460 and encoder 2470 being coupled to a particular side member 2420, in other embodiments, the coupler 2460 and encoder 2470 can be coupled to the other side member 2420.

[1145] The support structure 2405 includes two side members 2410, a base 2420, a set of leading support members 2431, a set of trailing support members 2432, and a set of transverse support members 2433. As shown in FIGS. 24-26, the side members 2410 are the same (e.g., due to the symmetry of the first drive assembly 2400). The side members 2410 each define a bearing opening 2411 that receives a bearing 2454 (FIG. 25) included in the drive wheel assembly 2470. More specifically, the bearing 2454 can be disposed within the bearing opening

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2411 such that an outer surface of the drive bearing 2454 forms a friction fit with a surface of the side member 2410 that defines the bearing opening 2411. Similarly stated, the drive bearing 2454 and the surface of the side 2410 defining the bearing opening 2411 form a press fit to retain the drive bearing 2454 within the bearing opening 2411.

[1146] The base 2420 is configured to be fixedly coupled to the side members 2410. The base 2420 includes a mounting plate 2421 configured to extend from a top surface and from a bottom surface of the base 2420 to couple the second drive assembly 2400 to the base 2210 of the housing 2200 (e.g., via any suitable mounting hardware such as, for example, mechanical fasteners or the like). The arrangement of the mounting plate 2421 can be such that when the second drive assembly 2400 is disposed about the support track 2050, the mounting plate 2421 can substantially limit a movement of the second drive mechanism 2400 in transverse direction relative to the longitudinal centerline (not shown) of the support track 2050. In some embodiments, the mounting plate 2421 can include any suitable surface finish that can be sufficiently smooth to slide along a bottom surface of the horizontal portion 2051 of the support track 2050. In other embodiments, the mounting plate 2421 can be formed from a material such as, for example, nylon or the like that facilitates the sliding of the mounting plate 2421 along the bottom surface of the support track 2050.

[1147] The leading support members 2431, the trailing support members 2432, and the transverse support members 2433 can be arranged similar to the leading support members 2350, the trailing support members 2354, and the transverse support members 2358 described above with reference to FIGS. 17-19. In this manner, the side members 2410 and the support members 2431, 2432, and 2433 can define a space configured to substantially enclose at least a portion of the primary wheel assemblies 2440. Moreover, the transverse support members 2433 can define an opening configured to receive a bearing 2454 of the primary wheel assembly 2350 in a similar manner as the transverse member 2333 described above. As shown in FIGS. 24-26, the leading support members 2431, the trailing support members 2432, and the transverse support members 2433 can differ, however, in that the leading support members 2431, the trailing support members 2432, and the transverse support members 2433 need not include one or more notches and/or recesses to accommodate any portion of the second drive assembly 2400.

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[1148] The second drive assembly 2400 includes four guide wheel assemblies 2440. The guide wheel assemblies 2440 each include a mounting bracket 2441 and a guide wheel 2443. More specifically, each of the guide wheels 2443 are rotatably coupled to one of the mounting brackets 2441 such that the guide wheels 2443 can rotate relative to the mounting brackets 2441. The guide wheel assemblies 2440 are each configured to be coupled to a portion of the support structure 2405. Expanding further, as shown in FIGS. 24-26, the mounting bracket 2441 of each guide wheel assembly 2440 is coupled to one of the leading support members 2431 or one of the trailing support members 2432. Similarly stated, both of the leading support members 2431 are coupled to the mounting bracket 2441 included in one of the guide wheel assemblies 2440 and both of the trailing support members 2432 are coupled to the mounting bracket 2441 included in one of the guide wheel assemblies 2440. The guide wheel assemblies 2440 are coupled to the support structure 2405 such that a portion of the guide wheel 2443 extends into the space defined between the transverse members 2433. In this manner, the guide wheels 2443 can roll along a surface of the vertical portion 2052 of the support track 2050 when the second drive assembly 2400 is coupled thereto (see e.g., FIG. 26). As described above with reference to the first drive assembly 2310, the guide wheel assemblies 2440 can be arranged in any suitable configuration to limit a rotational movement of the second drive assembly 2400 about the longitudinal centerline of the support track 2050.

[1149] The primary wheel assemblies 2450 each include a primary wheel 2451 having a hub 2452 and an axle 2453, and the bearings 2454. As described above, the axle 2453 can be disposed within the bearings 2354 while the bearings 2354 are coupled to the side members 2410 and the transverse members 2433. In this manner, each primary wheel 2451 can rotate about the corresponding axle 2453 relative to the support structure 2405. As shown in FIG. 26, the second drive assembly 2400 is disposed about the support track 2050 such that the primary wheels 2451 roll along the top surface of the horizontal portion 2051. Similarly, the guide wheels 2443 roll along a surface of the vertical portion 2052 of the support track 2050.

[1150] As shown in FIGS. 24 and 26, the axle 2453 is configured to extend through the bearing 2454 disposed within the opening 2411 of the side members 2410. In this manner, the coupler 2460 can couple to the axle 2453 to couple the axle 2453 to the encoder 2470. Thus, the encoder 2470 can receive and/or determine information associated with the rotation of the

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primary wheel 2451. For example, the encoder 2470 can determine position, rotational velocity, rotational acceleration, or the like. Furthermore, the encoder 2470 can be in electrical communication (e.g., via a wired communication or a wireless communication) with a portion of the electronic system 2700 and can send information associated with the second drive assembly 2400 to the portion of the electronic system 2700. Upon receiving the information from the encoder 2470, a portion of the electronic system 2700 can send a signal to any other suitable system associated with performing an action (e.g., increasing or decreasing the power of one or more motors or the like), as described in further detail herein. In some instances, the electronic system 2700 can determine the position of the trolley 2100 relative to the support track 2050 based at least in part on the information sent from the encoder 2470 associated with the second drive assembly 2400. In such instances, a user (e.g., doctor, physician, nurse, technician, or the like) can input a set of parameters associated with a portion of the support track 2050 along which the trolley 2100 moves. In this manner, the user can define a desired path along the support track 2050 for a therapy session.

[1151] FIGS. 27-33 illustrate the support mechanism 2500 included in the trolley 2100. As shown in FIG. 27, the support mechanism 2500 includes a tether 2505, a winch assembly 2510, a guide mechanism 2540, a first pulley 2563, a second pulley 2565, and a cam mechanism 2570. The tether 2505 can be, for example, a rope or other long flexible member that can be formed from any suitable material such as nylon or other suitable polymer. The tether 2505 includes a first end portion 2506 that is coupled to a portion of the winch assembly 2510 and a second end portion 2507 that can be coupled to any suitable patient attachment mechanism such as, for example, the patient attachment mechanism 2800 shown in FIG. 34. The tether 2505 is configured to engage a portion of the winch assembly 2510, the guide mechanism 2540, the cam mechanism 2570, the first pulley 2563, and the second pulley 2565 such that the support mechanism 2500 actively supports at least a portion of the body weight of a patient, as described in further detail herein.

[1152] As shown in FIGS. 29 and 30, the winch assembly 2510 includes a motor 2511, a mounting flange 2515, a coupler 2520, a drum 2525, and encoder assembly 5230. The motor 2511 is coupled to the coupler 2520 and is in electrical communication with a portion of the electronic system 2700. The motor 2511 includes an output shaft 2512 that engages an input

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portion (not shown) of the coupler 2520 such that rotation of the output shaft 2512 of the motor 2511 rotates an output member 2521 of the coupler 2520. More specifically, the motor 2511 receives an activation signal (e.g., a flow of electrical current) from the electronic system 2700 to cause the motor 2511 to rotate the output shaft 2512 in a first rotational direction or in a second rotational direction, opposite the first rotational direction. The output shaft 2512, in turn, rotates the output member 2521 of the coupler 2520 in the first rotational direction or the second rotational direction, respectively.

[1153] The mounting flange 2515 is disposed about a portion of the coupler 2520 and includes a portion that can be coupled to the third side member 2250 of the housing 2200. In this manner, the motor 2511 is supported by the mounting flange 2515 and the housing 2200. The output member 2521 of the coupler 2520 is coupled to a mounting plate 2522 of the drum 2525 such that when the output shaft 2512 of the motor 2511 is rotated in the first direction or the second direction, the drum 2525 is rotated in first direction or the second direction, respectively. While not shown, in some embodiments, the coupler 2520 can include one or more gears that can be arranged in any suitable manner to define a desirable gear ratio. In this manner, the rotation of the output shaft 2512 can be in the first direction or the second direction with a first rotational velocity and the rotation of the drum 2525 can be in the first direction or the second direction, respectively, with a second rotational velocity that is different from the first rotational velocity of the output shaft 2525 (e.g., a greater or lesser rotational velocity). In some embodiments, the coupler 2520 can include one or more clutches that can be configured to reduce and/or dampen an impulse (i.e., a force) that can result from the electronic system 2700 sending a signal to the motor 2511 that is associated with changing the rotational direction of the output shaft 2512.

[1154] The drum 2525 is disposed between the mounting plate 2522 and an end plate 2529. As described in further detail herein, an encoder drum 2531 of the encoder assembly 2530 is coupled to the end flange 2529 such that a least a portion of the encoder assembly 2530 is disposed within an inner volume 2528 defined by the drum 2525. The drum 2525 has an outer surface 2526 that defines a set of helical grooves 2527. The helical grooves 2527 receive a portion of the tether 2505 and define a path along which the tether 2505 can wrap to coil and/or uncoil around the drum 2525. For example, the motor 2511 can receive a signal from the electronic system 2700 to rotate the output shaft 2512 in the first direction. In this manner, the

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drum 2525 is rotated in the first direction and the tether 2505 can be, for example, coiled around the drum 2525. Conversely, the motor 2511 can receive a signal from the electronic system 2700 to rotate the output shaft 2512 in the second direction, thus, the drum is rotated in the second direction and the tether 2505 can be, for example, uncoiled from the drum 2525.

[1155] The encoder assembly 2530 includes the encoder drum 2531, a mounting flange 2532, a bearing bracket 2533, a bearing 2535, a coupler 2536, an encoder 2537, and an encoder housing 2538. As described above, a first end portion of the encoder drum 2531 is coupled to the end flange 2529 of the drum 2525 such that a portion of the encoder assembly 2530 is disposed within the inner volume 2528 of the drum 2525. The mounting flange 2532 is coupled to a second end portion of the encoder drum 2531 and is further coupled to the bearing bracket 2533. The bearing bracket 2533 includes an axle 2534 about which the bearing 2535 is disposed. The coupler 2536 is coupled to the axle 2534 of the bearing bracket 2533 and is configured to couple the encoder 2537 to the bearing bracket 2533. As shown in FIG. 28, the coupler 2536 and the encoder 2537 are disposed within the encoder housing 2538. More specifically, the coupler 2536 is movably disposed within the encoder housing 2538 and the encoder 2537 is fixedly coupled to the encoder housing 2538. Moreover, a first end portion of the encoder housing 2538 is disposed about the bearing 2535 and a second end portion of the encoder housing 2538 is in contact with and fixedly coupled to the recessed portion 2244 of the second side member 2240 of the housing 2240. In this manner, the encoder drum 2531, the mounting flange 2532, the bearing bracket 2533, and the coupler 2536 are configured to rotate concurrently with the drum 2525, relative to the encoder 2537 and the encoder housing 2538. Thus, the encoder 2537 can receive and/or determine information associated with the rotation of the drum 2525. For example, the encoder 2537 can determine position, rotational velocity, rotational acceleration, feed rate of the tether 2505, or the like. Furthermore, the encoder 2537 can be in electrical communication (e.g., via a wired communication or a wireless communication) with a portion of the electronic system 2700 and can send information associated with the winch assembly 2510 to the portion of the electronic system 2700. Upon receiving the information from the encoder 2537, a portion of the electronic system 2700 can send a signal to any other suitable system associated with performing an action (e.g., increasing or decreasing the power of one or more motors or the like), as described in further detail herein.

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[1156] Referring back to FIG. 27, the guide mechanism 2540 of the support mechanism 2500 is at least partially disposed within the guide mechanism opening 2215 of the base 2210 included in the housing 2200. More specifically, the guide mechanism 2540 includes a set of mounting brackets 2541 that are coupled to the mounting tabs 2216 of the base 2210. In this manner, at least a portion of the guide mechanism 2540 is suspended within the guide mechanism opening 2215. As shown in FIG. 31, the guide mechanism 2540 includes the mounting brackets 2541, a guide drum assembly 2545, a stopper bracket 2550, a stopper 2551, a roller assembly 2554, a coupler 2559, a support bracket 2560, and an encoder 2561. As described above, the mounting brackets 2541 are coupled to the mounting tabs 2216 of the base 2210. The mounting brackets 2541 each include a first mounting portion 2542 that is movably coupled to a portion of the guide drum assembly 2545, a second mounting portion 2543 that is fixedly coupled to the stopper bracket 2550, and a pivot portion 2544 that is movably coupled to a portion of the roller assembly 2554. The stopper bracket 2550 is further coupled to the stopper 2551 and is configured to limit a movement of the guide drum assembly 2545 relative to the mounting brackets 2541.

[1157] The guide drum assembly 2545 includes a guide drum 2546, a set of pivot plates 2547, and a stopper plate 2549. The guide drum 2546 is movably coupled to the pivot plates 2547. For example, while not shown in FIG. 31, the pivot plates 2547 can each include an opening configured to receive an axle about which the guide drum 2546 can rotate. The pivot plates 2547 each include a pivot axle 2548 that can be disposed within an opening (not shown) defined by the first mounting portion 2542 of the mounting brackets 2541. In this manner, the guide drum assembly 2545 can pivot about the pivot axles 2548 relative to the mounting brackets 2541. The stopper plate 2549 is coupled to the pivot plates 2547 and is configured to engage a portion of the stopper 2551 to limit the pivoting motion of the guide drum assembly 2545 relative to the mounting brackets 2541. More specifically, with the stopper bracket 2550 fixedly coupled to the mounting brackets 2541 and to the stopper 2551, the guide drum assembly 2545 can pivot toward the stopper bracket 2550 (e.g., in response to a force exerted on tether 2505, as described in further detail herein) such that the stopper plate 2549 is placed in contact with the stopper 2551. The stopper 2551 can be any suitable shape, size, or configuration. For example, in some embodiments, the stopper 2551 can be an elastomeric member configured to absorb a

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portion of a force exerted by the guide drum assembly 2545 when the stopper plate 2549 is placed in contact with the stopper 2551.

[1158] The roller assembly 2554 includes a set of swing arms 2555 and a set of rollers 2558. The swing arms 2555 include a first end portion 2556 and a second end portion 2557. The first end portion 2556 of the swing arms 2555 are movably coupled to the rollers 2558. More specifically, the rollers 2558 can be arranged such that a spaced defined between the rollers 2558 can receive a portion of the tether 2505. Thus, when the tether 2505 is moved relative to the rollers 2558, the rollers 2558 can rotate relative to the swing arms 2555. The second end portion 2557 of the swing arms 2555 are coupled to the pivot portion 2543 of the mounting brackets 2541. For example, as shown in FIG. 31, the pivot portion 2543 can include a set of axles disposed within a bearing. In this manner, the second end portion 2557 of the swing arms 2555 can couple to the axles such that the roller assembly 2554 and the axles can pivot relative to the mounting brackets 2541 (e.g., in response to a force exerted on tether 2505, as described in further detail herein).

[1159] The coupler 2559 included in the guide mechanism 2540 is coupled to the axle of the pivot portion 2543 of one of the mounting brackets 2541. The coupler 2559 is further coupled to an input shaft of the encoder 2561. More specifically, the support bracket 2560 is coupled to the base 2210 of the housing 2200 and is also coupled to a portion of the encoder 2561 to limit the movement of a portion of the encoder 2561 relative to the base 2210. Thus, the encoder 2561 can receive and/or determine information associated with the pivoting motion of the roller assembly 2554 relative to the mounting brackets 2541. For example, the encoder 2561 can determine position, rotational velocity, rotational acceleration, feed rate of the tether 2505, or the like. Furthermore, the encoder 2561 can be in electrical communication (e.g., via a wired communication or a wireless communication) with a portion of the electronic system 2700 and can send information associated with the guide mechanism 2540 to the portion of the electronic system 2700. Upon receiving the information from the encoder 2561, a portion of the electronic system 2700 can send a signal to any other suitable system associated with performing an action (e.g., increasing or decreasing the power of one or more motors 2311 and 2511, changing the direction of one or more of the motors 2311 and 2511, or the like).

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[1160] As shown in FIG. 32, the first pulley 2563 and the second pulley 2565 are rotatably coupled to a first pulley bracket 2564 and a second pulley bracket 2565, respectively. The first pulley bracket 2564 and the second pulley bracket 2565 are further coupled to the base 2210 of the housing 2200. In this manner, the first pulley 2563, the second pulley 2565, and at least a portion of the cam mechanism 2570 can be engage the tether 2505 to provide a mechanical advantage to the winch assembly 2510, as described in further detail herein.

[1161] As shown in FIGS. 32 and 33, the cam mechanism 2570 includes a cam pulley assembly 2571, a cam 2580, a coupler 2585, a coupler housing 2586, an encoder 2587, and a bias mechanism 2588. The cam pulley assembly 2571 includes a cam pulley 2572, a cam arm 2574, a cam axle 2575, and a spacer 2576. The cam arm 2574 includes a first end portion that is rotatably coupled to the cam pulley 2572 and a second end portion that is rotatably coupled to the cam axle 2575. The cam axle 2575 extends through the cam pivot opening 2220 (defined by the base 2210), the spacer 2576, and the cam 2580 to be coupled to the coupler 2585. The spacer 2576 is coupled to the base 2210 and is disposed between the second side 2212 of the base 2210 and a surface of the cam 2580. The spacer 2576 can be formed from a material having a relatively low friction coefficient such as, for example, polyethylene, nylon, or the like to allow the cam 2580 to move relatively easily along a surface of the spacer 2576. In this manner, the cam 2580 is spaced a sufficient distance from the second side 2212 of the base 2210 to allow a portion of the bias mechanism 2588 to be disposed therebetween, as described in further detail herein.

[1162] The cam 2580 of the cam assembly 2570 defines an opening 2581, and includes a mounting portion 2582 and an engagement surface 2583. The engagement surface 2583 of the cam 2580 is in contact with a portion of the bias mechanism 2588, as described in further detail herein. The opening 2581 defined by the cam 2580 receives a bearing 2584. When disposed within the opening 2581, the bearing 2584 allows the cam 2580 to rotate about the cam axle 2575. The mounting portion 2582 of the cam 2580 is at least partially disposed within the cam pulley opening 2219 and is coupled to the cam pulley 2572. For example, as shown in FIG. 33, the mounting portion 2582 is a threaded rod extending from a surface of the cam 2580 that can be received by a threaded opening (not shown) defined by the cam pulley 2572. In this manner, movement of the cam pulley assembly 2571, in response to a change in force exerted on the

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tether 2505 (e.g., an increase or a decrease of force), rotates the cam 2580 about the cam axle 2575 (as described above).

[1163] The coupler housing 2586 is coupled to a surface of the cam 2580 that is opposite the side adjacent to the spacer 2576. In other words, the coupler housing 2586 extends away from the base 2210 when coupled to the cam 2580. The coupler housing 2586 is further coupled to the encoder 2587. Thus, when the cam 2580 is rotated about the cam axle 2575, the coupler housing 2586 and the encoder 2587 are also rotated about the cam axle 2575. The coupler 2585 is disposed within the coupler housing 2586 and is coupled to both the cam axle 2575 and an input portion (not shown) of the encoder 2575. Therefore, with the coupler 2585 coupled the to the cam axle 2575 and the input portion of the encoder 2587, the rotation of the cam 2580 and the coupler housing 2586 rotates the encoder 2587 about its input portion. In this manner, the encoder 2587 can receive and/or determine information associated with the pivoting motion of the cam 2580 and/or the cam pulley assembly 2571 relative to the cam axle 2575. For example, the encoder 2587 can determine position, rotational velocity, rotational acceleration, feed rate of the tether 2505, or the like. Furthermore, the encoder 2587 can be in electrical communication (e.g., via a wired communication or a wireless communication) with a portion of the electronic system 2700 and can send information associated with the cam mechanism 2570 to the portion of the electronic system 2700. Upon receiving the information from the encoder 2587, a portion of the electronic system 2700 can send a signal to any other suitable system associated with performing an action (e.g., increasing or decreasing the power of one or more motors 2311 and 2511, changing the direction of one or more of the motors 2311 and 2511, or the like).

[1164] The bias mechanism 2588 includes an axle 2589, a mounting flange 2590, a first pivot arm 2591, a second pivot arm 2595, a guide member 2596, a bias member 2597, and a mounting post 2598. The axle 2589 is movably disposed within the mounting flange 2588 and is configured to extend through the bias mechanism opening 2217 defined by the base 2210 to be fixedly disposed within an axle opening 2592 defined by the second pivot arm 2591. Expanding further, a portion of the mounting flange 2589 extends through the bias mechanism opening 2217 and beyond the second side 2212 of the base 2210 to be in contact with a surface of the second pivot arm 2591. In this manner, the surface of the second pivot arm 2591 is offset from the second side 2212 of the base 2210. Moreover, the arrangement of the spacer 2576 (described

above) is such that when the axle 2589 is disposed within the axle opening 2592, a second surface of the first pivot arm 2591 is offset from a surface of the cam 2580. Thus, the first pivot arm 2591 can pivot relative to the base 2210 with a relatively low amount of friction. In some embodiments, at least the portion of the mounting flange 2590 that extends through the bias mechanism opening 2217 can be made from a material having a relatively low coefficient of friction such as, for example, polyethylene, nylon, or the like.

[1165] The first pivot arm 2591 defines the axle opening 2592 and a guide member opening 2593, and includes an engagement member 2594. The guide member opening 2593 is configured to receive a portion of the guide member 2596 to couple the guide member 2596 to the first pivot arm 2591. The guide member 2596 extends from a surface of the first pivot arm 2591 toward the base 2210 such that a portion of the guide member 2596 extends through the guide member opening 2218 defined by the base 2210. In some embodiments, the guide member 2596 can include a sleeve or the like configured to engage the base 2210. In such embodiments, the sleeve can be formed from a material having a relatively low friction coefficient such as, for example, polyethylene, nylon, or the like. Thus, the guide member 2596 can move within the guide member track 2218 when the first pivot arm 2591 is moved relative to the base 2210.

[1166] The engagement member 2594 of the first pivot arm 2591 extends from a surface of the first pivot arm 2591 toward the cam 2580. In this manner, the engagement member 2594 can be moved along the engagement surface 2583 of the cam 2580 when the cam 2580 is moved relative to the base 2210, as described in further detail herein. In some embodiments, the engagement member 2594 can be rotatably coupled to the first pivot arm 2591 and can be configured to roll along the engagement surface 2583. In other embodiments, the engagement member 2594 and/or the engagement surface 2583 can be formed from a material having a relatively low friction coefficient. In such embodiments, the engagement member 2594 can be slid along the engagement surface 2583.

[1167] The second pivot arm 2595 of the bias mechanism 2588 has a first end portion that is fixedly coupled to the axle 2589 and a second end portion that is coupled to a first end portion of the bias member 2597. The mounting post 2598 is fixedly coupled to the base 2210 and is

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further coupled to a second end portion of the bias member 2597. Therefore, the second pivot arm 2595 can pivot relative to the mounting flange 2590 between a first position, where the bias member 2597 is in a first configuration (undeformed configuration), and a second position, where the bias member 2597 is in a second configuration (deformed configuration). For example, in some embodiments, the bias member 2597 can be a spring that can be moved between an uncompressed configuration (e.g., the first configuration) and a compressed configuration (e.g., the second configuration). In other embodiments, the bias member 2597 can be a spring that can be moved between an unexpanded and an expanded configuration. In other words, the bias member 2597 can be either a compression spring or an expansion spring, respectively. In still other embodiments, the bias member 2597 can be any other suitable biasing mechanism and/or energy storage device such as, for example, a gas strut or the like.

[1168] When the cam 2580 is rotated from a first position to a second position in response to a force exerted on the tether 2505 (as described above), the bias member 2597 can exert a reaction force that resists the rotation of the cam 2580. More specifically, with the engagement member 2594 in contact with the engagement surface 2583 of the cam 2580, the bias member 2587 exerts the reaction force that resists the movement of the engagement member 2594 along the engagement surface 2583. Therefore, in some instances, relatively small changes in the force exerted on the tether 2505 may not be sufficiently large to rotate the cam 2580 and the cam pulley assembly 2571. This arrangement can reduce undesirable changes in the amount of body weight supported by the support system 2000 in response to minor fluctuations of force exerted on the tether 2505.

[1169] 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.

[1170] 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

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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.

[1171] 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.

[1172] 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.

[1173] 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.

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[1174] 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.

[1175] 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.

[1176] 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.

[1177] 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.

[1178] 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.

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[1179] 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.

[1180] Upon receiving the signals from the encoders 2561 and 2587, the processor can execute a set of instructions included in the memory associated the cam assembly 2570. For example, the processor can determine the position of the cam 2580 or the guide mechanism 2540, the velocity and the acceleration of the cam 2580 or the guide mechanism 2540, or the like. Based on the determining of the changes in the guide mechanism 2540 and the cam assembly 2570 configurations, the processor can send a signal to the motor 2311 of the first drive assembly 2310 and/or the motor 2511 of the winch assembly 2510 to change the current state of the drive system 2300 and/or the patient support mechanism 2500. In some instances, the magnitude of change in the state of the drive system and/or the patient support mechanism 2500 is based at least in part on a proportional-integral-derivative (PID) control. In such instances, the electronic system 2700 (e.g., the processor or any other electronic device in communication with the processor) can determine the changes of the patient support mechanism 2500 and model the changes based on the PID control. Based on the result of the modeling the processor can determine the suitable magnitude of change in the drive system 2300 and/or the patient support mechanism 2500.

[1181] After a relatively short time period (e.g., much less than a second, for example, after one or a few clock cycles of the processor) the processor can receive a signal from the encoder 2470 of the drive system 2300, the encoder 2537 of the winch assembly 2510, the encoder 2561 of the guide mechanism 2540, and/or the encoder 2587 of the cam assembly 2570 associated with a change in configuration of the drive system 2300, the winch assembly 2510, the guide mechanism 2540, and/or the cam assembly 2570, respectively. In this manner, one or more of

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the electronic devices included in the electronic system 2700, including but not limited to the processor, execute a set of instructions stored in the memory associated with the feedback associated with the encoders 2470, 2537, 2561, and 2587. 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.

[1182] 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.

[1183] 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

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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.

[1184] 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.

[1185] 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.

[1186] 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.

[1187] In use, the patient can be coupled to the support system 3900 (as described above) such that the support system 3900 supports at least a portion of the body weight of the patient. In this manner, the patient can walk along a path associated with the support track (not shown). With the support system 3900 coupled to the patient, the movement of the patient moves the

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support system 3900 along the support track. Similarly stated, the patient pulls the support system 3900 along the support track. In some instances, a patient may stumble while walking, thereby increasing the amount of force exerted on the support system 3900. In such instances, the increase in force exerted on the support system 3900 can be sufficient to cause the energy storage member 3960 to move from its first configuration towards its second configuration (e.g., compress). In this manner, the piston 3950 can move relative to the cylinder 3941 and the energy storage member 3960 can absorb at least a portion of the increase in the force exerted on the support structure 3900. Thus, if the patient stumbles the support system 3900 can dampen the impulse experienced by the patient that would otherwise result in known passive support systems 3900.

[1188] Although the support system 3900 is described as including an energy storage member, in other embodiments, the support system 3900 need not include the energy storage member. For example, in some embodiments, the support system 3900 can be coupled to, for example, the attachment mechanism 2800 described above with reference to FIG. 34. In this manner, the attachment mechanism 2800 can be used to dampen at least a portion of a change in force exerted on the support system 3900. For example, in some instances a patient coupled to the support system 3900 may stumble, thereby increasing the force exerted on the support system 3900. In such instances, the increase in force can move the first arm 2820 towards the second arm 2840 (see e.g., FIG. 34), thereby moving the energy storage member 2850 towards their second configuration. Thus, at least a portion of the increase in force can be absorbed by the attachment mechanism 2800.

[1189] Although not shown in FIG. 2-36, one or more active support system (e.g., the support system 2000) and/or one or more passive support system (e.g., the support system 3900) can be disposed about a similar support track and can be utilized at the same time. For example, FIG. 37 is a schematic illustration of a support system 4000 according to an embodiment. The support system 4000 includes a support track 4050, a first support member 4100, and a second support member 4900. The support system 4000 can be used to support at least a portion of the body weight of one or more patients during, for example, gait therapy (e.g., after injury), gait training (e.g., low gravity simulation), and/or the like. The support track 4050 is configured to support the weight of the first support member 4100 and the second support member 4900 and

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the weight of the patient utilizing the first support member 4100 and/or the second support member 4900.

[1190] As shown in FIG. 37, the support track 4050 can form a closed loop track. The support track 4050 can be similar to or the same as the support track 2050, described above with reference to FIGS. 2 and 3; the first support member 4100 can be similar to or the same as the trolley 2100, described above with reference to FIGS. 2-33; and the second support member 4900 can be similar to or the same as the support system 3900, described above with reference to FIGS. 35 and 36. In this manner, the first support member 4100 and the second support member 4900 can be hung from the support track 4050, as described in detail above.

[1191] In some embodiments, a first patient (not shown in FIG. 37) can be coupled to the first support member 4100 and a second patient (not shown in FIG. 37) can be coupled to the second support member 4900 with both being suspended from the support tack 4050. As shown in FIG. 37, the first support member 4100 can move in the direction of the arrow **A** in response to a movement of the first patient coupled thereto. Similarly, the second support member 4900 can be moved in the direction of the arrow **B** in response to a movement of the second patient coupled thereto. Expanding further, the first support member 4100 can be an active support member and can be configured to move in accordance with the movement of the first patient, as described in detail above. Conversely, the second support member 4900 can be a passive support member and can be moved by the second patient coupled thereto, as described in detail above.

[1192] Although the support system 4000 is shown and described as including the first support member 4100 and the second support member 4900, in other embodiments, the support system 4000 can include any suitable number of support members movably coupled to the support track 4050. Moreover, any combination of active support members and passive support members can be included in the support system 4000. For example, while shown as including an active support member (e.g., the first support member 4100) and a passive support member (e.g., the second support member 4900), in other embodiments, the support system 4000 can include two active support members, two passive support members, two active support members and two passive support members, or any other suitable combination thereof.

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[1193] Although not shown in FIG. 37 the support system 4000 (i.e., the first support member 4100 and/or the second support member 4900) can include a collision management system that is configured to prevent and/or mitigate the impact, force, or effect of a collision between the first support member 4100 and the second support member 4900. For example, in some embodiments, the first support member 4100 can include a sensor (e.g., an ultrasonic proximity sensor or the like) configured to sense the position of the first support member 4100 relative to the second support member 4900. Thus, when the distance between the first support member 4100 and the second support member 4900 approaches a predetermined threshold (e.g., a minimum distance), an electronic system (e.g., similar to or the same as the electronic system 2700 described above) included in the first support member 4100 can send a signal to a drive system (not shown) to increase or decrease a rotational velocity of one or more drive wheels. Thus, a collision of the first support member 4100 and the second support member 4900 can be avoided. In other embodiments, the collision management system can increase or decrease the velocity of one or more drive wheels to substantially reduce a force associated with a collision between the first support member 4100 and the second support member 4900.

[1194] While the first support member 4100 is described above as including a sensor and/or the like that is configured to sense the position of the first support member 4100 relative to the second support member 4900, in other embodiments, a support system can include any suitable member, device, mechanism, assembly, and/or the like that is configured to substantially maintain a distance between a first support member and a second support member included therein and/or otherwise reduce a force associated with or a likelihood of a collision. In other embodiments, a support system can include and/or can be coupled to any suitable member, device, mechanism, assembly, and/or the like that is configured to prevent direct contact between a first support member and a second support member (e.g., is disposed and/or coupled therebetween). For example, FIGS. 38-40 illustrate a support system 5000 according to an embodiment. The support system 5000 includes a first support member 5100, a second support member 5100', a collision management assembly 5080, and a support track 5050. The support track 5050 can be similar to or the same as the support track 2050 (described above with reference to FIGS. 2 and 3) and/or the support track 4050 (described above with reference to FIG. 37). The first support member 5100 and the second support member 5100' can be substantially similar to each other and can each be substantially similar to or the same as the

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trolley 2100, described above with reference to FIGS. 2-33. As such, the first support member 5100 (e.g., a first trolley) and the second support member 5100' (e.g., a second trolley) can each be active support systems that are hung from the support track 5050. More specifically, as shown in FIG. 38, the support track 5050 includes a horizontal portion 5051 and a vertical portion 5052 about which a drive mechanism of the support members 5100 and 5100' can be disposed, thereby allowing the support members 5100 and 5100' to move along a length of the support track 5050 in response to a motion of a supported patient, as described in detail above. Thus, the form and function of the support members 5100 and 5100' are not described in further detail herein.

[1195] The collision management assembly 5080 of the support system 5000 can be coupled to and/or otherwise disposed between the first support member 5100 and the second support member 5100'. In some embodiments, the collision management assembly 5080 can be coupled to the first support member 5100 or the second support member 5100'. For example, as shown in FIG. 38, the collision management assembly 5080 includes a coupling portion 5090 that is coupled to the first support member 5100 and a trolley portion 5085 that is movably disposed about the support track 5050. The trolley portion 5085 can be substantially similar in form and/or function as the first coupling portion 3910 of the support system 3900 described above with reference to FIG. 35. As such, the trolley portion 5085 includes a set of wheels 5086 that are configured to roll along the horizontal portion 5051 or the vertical portion 5082 of the support track 5050, as described in detail above.

[1196] The trolley portion 5085 also includes a set of bumpers 5087 that extend from a surface of the trolley portion 5085. In some embodiments, the bumpers 5087 can be formed from a relatively elastic material (e.g., rubber, silicone, polyethylene, polypropylene, polyurethane, and/or the like including copolymers and combinations thereof) that can be configured to absorb at least a portion of a force when placed in contact with an object. More specifically, in some instances, a force can be exerted that can move the trolley portion 5085 along the support track 5085 to place the bumpers 5087 in contact with an object (e.g., the second support member 5100'). The arrangement of the bumpers 5087 can be such that when the bumpers are placed in contact with the object, at least a portion of the force exerted to move the trolley portion 5085 along the support track 5050 is absorbed by the bumpers 5087, resulting

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in a deformation (e.g., an elastic or non-permanent deformation) thereof. In some instances, the deformation of the bumpers 5087 can be such that a portion of the force transmitted through the bumpers 5087 and onto the object (e.g., the second support member 5100') is reduced, which can reduce damage to and/or fatigue of a portion of the object. Similarly stated, the bumpers 5087 can be formed from and/or can otherwise include a material that can absorb at least a portion of an impact force between the trolley portion 5085 and an object (e.g., a wall, a support member, and/or the like).

[1197] As described above, the coupling portion 5090 is coupled to a portion of the first support member 5100. More particularly, a first end portion 5092 of the coupling portion 5090 is rotatably coupled to the portion of the first support member 5100. For example, the first end portion 5092 can include a rotatable eyelet or the like that can be coupled to the portion of the first support member 5100 via, for example, a bolt, pin, post, and/or the like, thereby defining an axis about which the first eyelet can rotate. Similarly, a second end portion 5094 of the coupling portion 5090 can be rotatably coupled to a portion of the trolley portion 5085. Thus, the coupling portion 5090 can couple or otherwise form a linkage between the first support member 5100 and the trolley portion 5085 such that movement of the first support member 5100 along the support track 5050 moves the trolley portion 5085 along the support track 5050. For example, the coupling portion 5090 can be configured to transmit, transfer, and/or otherwise exert at least a portion of a force, associated with movement of the first support member 5100 along the support track 5050, on the trolley portion 5085. Moreover, the rotatable coupling of the coupling portion 5090 to the first support member 5100 and the trolley portion 5085 can be such that the first support member 5100 can push the trolley portion 5085 along a support track that is substantially nonlinear, as shown in FIG. 38.

[1198] The coupling portion 5090 can be any suitable member, device, and/or mechanism. For example, in some embodiments, the coupling portion 5090 can be a substantially rigid rod or the like that is configured to maintain a substantially fixed distance between the trolley portion 5085 and the first support member 5100. In other embodiments, the coupling portion 5090 can be substantially non-rigid wherein a distance between the first support member 5100 and the trolley portion 5085 can be varied (i.e., non-fixed). For example, in some embodiments, a first portion 5091 of the coupling portion 5090 can be configured to move relative to a second portion

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5092 of the coupling portion 5090. Moreover, in some embodiments, the coupling portion 5090 can be configured to absorb at least a portion of a force (associated with movement of the first support member 5100 along the support track 5050) that would otherwise be exerted on the trolley portion 5085. For example, as shown in FIGS. 38-40, the coupling portion 5090 can be a piston-cylinder configuration, wherein a region of the first portion 5091 (e.g., a piston) is movably disposed in the second portion 5093 (e.g., a cylinder). Furthermore, an energy storage member 5095 (e.g., a spring or the like) can be disposed in the second portion 5093 of the coupling portion 5090, as shown in FIG. 40. In this manner, movement of the first portion 5091 relative to the second portion 5093 can increase a potential energy of the energy storage member 5095. For example, in some embodiments, the energy storage member 5095 can be a spring that can be transitioned from a substantially non-compressed configuration (i.e., a relatively lower potential energy) to a substantially compressed configuration (i.e., a relatively higher potential energy) when the first portion 5091 is moved relative to the second portion 5093. The energy storage member 5095 can be configured to allow the first portion 5091 to move relative to the second portion 5093, for example, up to about 0.5 inches (0.5"), about 1", about 1.5", about 2", about 2.5", about 3", about 4", about 5", about 7", about 10", or any suitable distance or fraction therebetween. Thus, the coupling portion 5090 can be configured to absorb at least a portion of energy and/or force that would otherwise be transferred and/or transmitted between the first support member 5100 and the trolley portion 5085. Although the energy storage member 5095 is shown and described as being a spring, in other embodiments, the energy storage member 5095 can be any suitable device, member, and/or volume such as, for example, a volume of a compressible gas and/or the like.

[1199] In use, the collision management assembly 5080 can be included in the support system 5000 to substantially prevent a collision between the first support member 5100 and the second support member 5100' (see e.g., FIG. 38). Similarly stated, the collision management assembly 5080 can be included in the support system to substantially prevent direct contact between the first support member 5100 and the second support member 5100'. For example, in some instances, it can be desirable to maintain a distance between the first support member 5100 and the second support member 5100' that is greater than a predetermined minimum distance and/or a distance threshold. In this manner, the collision management assembly 5080 can be coupled to the first support member 5100 such that when the first support member 5100 and the

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second support member 5100' move along the support track 5050 substantially independent from one another, a distance therebetween is maintained that is greater than the predetermined minimum distance and/or distances threshold. For example, in some instances, the first support member 5100 can move relative to the second support member 5100' such that a distance therebetween is reduced to an extent that places the bumpers 5087 of the trolley portion 5085 in contact with a portion of the second support member 5100'. Thus, the collision management assembly 5080 can maintain the first support member 5100 and the second support member 5100' at a distance that is greater than the minimal distance, thereby preventing direct contact (i.e., a direct collision) therebetween. Moreover, the arrangement of the bumpers 5087 and the coupling portion 5090 is such that as the collision management assembly 5080 is brought into contact with the portion of the second support member 5100' at least a portion of a force associated with the impact is absorbed (e.g., the bumpers 5087 can be transitioned from a non-deformed to a deformed configuration and/or the energy storage member 5095 can be transitioned from a lower potential energy configuration to a higher potential energy configuration). In this manner, an acceleration and/or a jerk (e.g., the rate of change in the acceleration) of the first support member 5100 and/or the second support member 5100' is not rapidly changed as the collision management assembly 5080 is brought into contact with the second support member 5100'. In some instances, once the collision management assembly 5080 is placed in contact with the second support member 5100', the first support member 5100 and the second support member 5100' can move along the support track 5050 substantially congruently. In other words, when the collision management assembly 5080 is placed in contact with the second support member 5100', the collision management assembly 5080 can push the second support member 5100' such that the first support member 5100, the second support member 5100', and the collision management assembly 5080 collectively move along the support track 5050 at substantially the same speed.

[1200] In some embodiments, the collision management assembly 5080 and/or a portion of the support members 5100 and/or 5100' can include, for example, one or more sensors or the like that can sense and/or detect one or more parameters associated with the collision management assembly 5080. For example, in some embodiments, the trolley portion 5085 of the collision management assembly 5080 can include a sensor such as, for example, an accelerometer or the like that can sense and/or otherwise detect and acceleration of the trolley portion 5085 when the

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bumper 5087 is placed in contact with the second support member 5100'. In some instances, the sensor can send a signal associated with the acceleration of the trolley portion 5085 to, for example, the electronic system of the first support member 5100. As such, the electronic system can be configured to control one or more systems (e.g., a drive system or the like) of the first support member 5100 based at least in part on the signal received from the sensor. For example, in some instances, the electronic system can reduce a velocity of the first support member 5100 based at least in part on information received from the sensor of the collision management assembly 5080.

[1201] Although the collision management assembly 5080 is shown and described as being coupled to the first support member 5100 and placed in contact the second support member 5100' (see e.g., FIG. 38), in other embodiments, the collision management assembly 5080 can be rotatably coupled to the second support member 5100' and placed in contact with the first support member 5100 in a similar manner as described above. In addition, while the second support member 5100' is shown and described as being substantially similar to the first support member 5100 (i.e., an active support member), in other embodiments, the second support member 5100 can be a passive support member such as, for example, the support system 3900 described above with reference to FIGS. 35 and 36.

[1202] While the support system 5000 is described above as including the collision management assembly 5080 to substantially maintain a distance between the first support member 5100 and the second support member 5100, in other embodiments, a support system can include any suitable member, device, mechanism, assembly, and/or the like that is configured to absorb at least a portion of energy that is associated with a collision between a support member and another object (e.g., a second support member, a wall, and/or any other obstruction). For example, FIGS. 41-42 illustrate a support system 6000 according to an embodiment. The support system 6000 includes a support member 6900 movably disposed about a support track 6050. The support track 6050 can be similar to or the same as the support track 2050 (described above with reference to FIGS. 2 and 3) and/or the support track 4050 (described above with reference to FIG. 37). The support member 6900 can be substantially similar to the support system 3900, described above with reference to FIGS. 35-36. As such, the support member 6900 can be, for example, a passive support system that is hung from the support track 6050. More

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specifically, as shown in FIGS. 41 and 42, the support track 6050 includes a horizontal portion 6051 and a vertical portion 6052 about which a drive mechanism 6910 (e.g., similar to or the same as the first coupling portion 3910 of the support system 3900 described above) of the support member 6900 can be disposed, thereby allowing the support member 6900 to move along a length of the support track 6050 in response to a motion of a supported patient, as described in detail above. Thus, the form and function of the support member 6900 is not described in further detail herein.

[1203] As shown in FIGS. 41 and 42, the support member 6900 can be coupled to and/or can otherwise include a collision plate 6020. The collision plate 6020 (e.g., a collision management assembly or member) can be any suitable shape, size, or configuration. For example, although the collision plate 6020 is shown as having a substantially circular perimeter, in other embodiments, a collision plate can be any suitable shape such as, square, rectangular, oblong, elliptical, and/or the like. As shown in FIG. 42, the collision plate 6020 can be coupled to a portion of the support member 6900 such that a surface of the collision plate 6020 in contact with the support member 6900 is substantially parallel to the horizontal portion 6051 of the support track 6050. Moreover, although not shown in FIGS. 41 and 42, the arrangement of the support member 6900 can be such that the collision plate 6020 is disposed between the drive portion 6910 and a coupling portion (e.g., such as the second coupling potion 3940 included in the support system 3900 described above with reference to FIG. 36).

[1204] As shown, the collision plate 6020 is configured to extend beyond a perimeter of the support member 6900. The collision plate 6020 can be formed from and/or can include any suitable material that can be substantially rigid such as, for example, wood, medium density fiber (MDF), plywood, and/or a metal or alloy thereof (e.g., aluminum, aluminum alloy, steel, steel alloy, etc.). In other embodiments, the collision plate 6020 can be formed from and/or can include any suitable material that can be substantially elastic such as, for example, rubber, silicone, polyethylene, polypropylene, polyurethane, nylon, and/or the like including copolymers and/or combinations thereof. The collision plate 6020 includes a bumper 6021 that is coupled to and/or that is otherwise configured to extend from a peripheral surface, as shown in FIGS. 41 and 42. The bumper 6021 can be any suitable shape, size, and/or configuration. For example, in some embodiments, the bumper 6021 can be formed from and/or can include, for example,

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expanded foam neoprene, ethylene propylene diene monomer (EPDM) rubber, ethylene-vinyl acetate (EVA) foam, polypropylene (PP) foam, high-density polyethylene (HDPE) foam, low-density polyethylene (LDPE) foam, linear-low-density polyethylene (LLPDE) foam, and/or any other suitable thermoplastic elastomer (TPE) foam, and/or the like. In this manner, the bumper 6021 can be configured to absorb at least a portion of energy that is associated with, for example, an impact. By way of example, in some instances, the support member 6900 can move along the support track 6050 relative to another support member and/or other object until the bumper 6021 of the collision plate 6020 is placed in contact with the other support member and/or other object. More specifically, the support member 6900 can be moved along the support track 6050 with a force resulting from a patient, coupled thereto, dragging or towing the support member 6900 (as described above). In some instances, the support member 6900 can be moved relative to another object on or supported by the support track 6050 in such a manner that the support member 6900 and the other object (e.g., a second support member or the like) collide. Thus, with the collision plate 6020 coupled to the support member 6900 and the bumper 6021 extending beyond the support member 6900, the bumper 6021 is placed in contact with the other object, resulting in an elastic deformation of the bumper 6021 in response to at least a portion of a force associated with the collision. As such, the bumper 6021 can absorb at least a portion of the energy associated with the collision to, for example, protect and/or otherwise minimize damage to the support member 6900 and/or other object that can otherwise result from the collision.

[1205] Although the support track 4050 is shown and described above as being a substantially closed-loop track, in other embodiments, a support track can be an open-loop track. By way of example, in some embodiments, a support track can have a first end portion that is substantially discrete from a second end portion (i.e., an open-loop configuration). In some embodiments, such a support track can include, for example, an end stop or the like that can be configured to substantially limit movement of a support member, support system, trolley, etc., prior to reaching the end of the support track. For example, FIGS. 43 and 44 illustrate a support track 7050 including a track stop 7060, according to an embodiment. The support track 7050 can be substantially similar to the support track 2050 described above. As such, the support track 7050 can include a horizontal portion 7051 and a vertical portion 7052 and can be configured to support a support system such as, for example, the trolley 2100 and/or the support system 3900.

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[1206] The track stop 7060 includes a trolley portion 7065 and a coupling portion 7070. The trolley portion 7065 can be substantially similar in form and/or function as the trolley portion 5085 included in the collision management assembly 5080 described above with reference to FIGS. 38-40. As such, the trolley portion 7065 includes a set of wheels 7066 that are configured to roll along the horizontal portion 7051 or the vertical portion 7062 of the support track 7050, as described in detail above. The trolley portion 7065 also include at least one bumper 7067 that extends from a surface of the trolley portion 7065 (e.g., away from an end surface of the support track 7050). In some embodiments, the bumper 7067 can be formed from a relatively elastic material (e.g., rubber, silicone, polyethylene, polypropylene, polyurethane, and/or the like including copolymers and combinations thereof) that can be configured to absorb at least a portion of a force when placed in contact with an object, as described in detail above. The arrangement of the bumper 7067 can be such that when placed in contact with, for example, a support member, at least a portion of the force exerted to move the support member along the support track 7050 is absorbed by the bumper 7067, resulting in a deformation (e.g., an elastic or non-permanent deformation) thereof, which can reduce damage to and/or fatigue of a portion of the support member, as described in detail above.

[1207] The coupling portion 7070 is coupled to the end portion of the support track 750 and a portion of the trolley portion 7065, as shown in FIG. 43. More particularly, a mounting bracket 7075 is coupled to the end portion of the support track 7050 and is configured to couple and/or otherwise mount the coupling portion 7070 to the support track 7050. The coupling portion 7070 can be any suitable member, device, and/or mechanism. For example, in some embodiments, the coupling portion 7070 can be a piston-cylinder device, a strut, and/or the like. As such, the coupling portion 7070 includes a first member 7071 (e.g., a piston) that can be moved relative to a second member 7073 (e.g., a cylinder). For example, at least a portion of the first member 7071 can be movably disposed in the second member 7073. More particularly, an attachment member 7072 of the first member 7071 is rotatably coupled to the trolley portion 7065 (as described above) and in turn, the first member 7071 is configured to move substantially concurrently with the trolley portion 7065. Similarly stated, the attachment member 7072 rotatably couples the first member 7071 to the trolley portion 7065 such that as the trolley portion 7065 is moved along the support track 7050, the first member 7071 is moved in an axial direction. The second member 7073 of the coupling portion 7070 is fixedly coupled to the

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mounting bracket 7075, which is configured to maintain the second potion 7073 in a substantially fixed position relative to the support track 7050. Thus, movement of the trolley portion 7065 along the support track 7050 moves the first member 7071 of the coupling portion 7070 relative to the second member 7073, as described in further detail herein.

[1208] As shown in FIG. 44, an energy storage member 7074 (e.g., a spring or the like) is disposed in the second portion 7093 of the coupling portion 7070 and is configured to engage and/or be in contact with at least a surface of the first member 7071. In this manner, movement of the first member 7071 relative to the second member 7073 can increase a potential energy of the energy storage member 7074. For example, in some embodiments, the energy storage member 7074 can be a spring (as shown in FIG. 44) that can be transitioned from a substantially non-compressed configuration (i.e., a relatively lower potential energy) to a substantially compressed configuration (i.e., a relatively higher potential energy) when the first member 7071 is moved relative to the second member 7073. The energy storage member 7074 can be configured to allow the first member 7071 to move relative to the second member 7073, for example, up to about 0.5 inches (0.5"), about 1", about 1.5", about 2", about 2.5", about 3", about 4", about 5", about 7", about 10", or any suitable distance or fraction therebetween. Thus, the coupling portion 7070 can be configured to absorb at least a portion of energy and/or force, as described in further detail herein. Although the energy storage member 7074 is shown and described as being a spring, in other embodiments, the energy storage member 7074 can be any suitable device, member, and/or volume such as, for example, a volume of a compressible gas and/or the like.

[1209] In use, the track stop 7060 can be included in the support system 7000 to substantially prevent a support member and/or trolley (not shown in FIGS. 43 and 44) from reaching an end of a support track 7050 when moving along a length thereof. For example, a support member can move along the support track 7050 and towards the end portion to a position in which a portion of the support member is placed in contact with the bumper 7067 of the trolley portion 7065. Thus, the support member exerts a force on the bumper 7067 that can transition the bumper 7067 from a non-deformed configuration to a deformed configuration, thereby absorbing at least a portion of the force and/or kinetic energy. Moreover, the force exerted by the support member can move the trolley portion 7065 along the support track 7050, which in turn, moves the first

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member 7071 of the coupling portion 7070 relative to the second member 7073 of the coupling portion 7070. Accordingly, with the first member 7071 in contact with the energy storage member 7074, the movement of the first member 7071 relative to the second portion 7072 can transition the energy storage member 7074 from a lower potential energy configuration to a higher potential energy configuration. In this manner, an acceleration and/or a jerk (e.g., the rate of change in the acceleration) of the support member is not rapidly changed as the track stop 7060 limits further movement of the support member along the support track 7050. Furthermore, by absorbing at least a portion of the kinetic energy and/or force exerted by the support member, damage to the support member that can otherwise result from the support member hitting a "hard stop" (e.g., a stop mechanism with little or no energy absorption).

[1210] Although the trolley 2100 is described above as including the encoder 2470 of the drive system 2300, the encoder 2561 of the guide mechanism 2540, and the encoder 2587 of the cam assembly 2570, which are collectively used to determine one or more system parameters (e.g., position, velocity, acceleration, etc.), in other embodiments, a trolley and/or the like can include any suitable device, mechanism, and/or system configured to determine one or more system parameters. For example, FIGS. 45-47 are schematic illustrations of a trolley 8100 including an optical tracking system 8720, according to an embodiment. The trolley 8100 (e.g., a support member) can be substantially similar to or the same as the trolley 2100, described above with reference to FIGS. 2-33. As such, the trolley 8100 is an active support system that is hung from a support track (not shown in FIGS. 45-47). The trolley 8100 can differ from the trolley 2100, however, with the inclusion of the optical tracking system 8720, as described in further detail herein.

[1211] The optical tracking system 8720 includes at least an imaging device 8725 and a tracking member 8860. As shown in FIG. 45, the tracking member 8860 can be coupled to and/or included in a patient attachment mechanism 8800, which can otherwise be substantially similar to the patient attachment mechanism 2800 described above with reference to FIG. 34. The patient attachment mechanism 8800 is operably coupled to the trolley 8100 by a tether 8505. The tether 8505 can be substantially similar to or the same as the tether 2505 included in the support system 2500 described above with reference to FIGS. 27-33. The tracking member 8860 can be any suitable shape, size, and/or configuration. For example, in some embodiments, the

tracking member 8860 can be a substantially spherical or oblong ball. Although not shown in FIGS. 45-47, the tracking member 8860 can include a surface finish that can facilitate an optical tracking. For example, in some embodiments, the tracking member 8860 can include a surface having a color and/or pattern that can be used to identify, for example, position information such as relative linear position, relative angular position, absolute position, etc. Moreover, information associated with the color, the pattern, the size, the shape, and/or the like of the tracking member 8860 can be stored, for example, in a memory included in an electronic system (e.g., substantially similar to the electronic system 2700 of the trolley 2100 (not shown in FIGS. 45-47)) of the trolley 8100.

[1212] The imaging device 8725 of the optical tracking system 8720 can be any suitable imaging device. For example, in some embodiments, the imaging device 8725 can be a camera and/or the like that can capture discrete pictures and/or can continuously record a video stream. The imaging device 8725 is coupled to the trolley 8100 and is maintained in a fixed position relative thereto. Although not shown in FIGS. 45-47, the imaging device 8725 is operably coupled to the electronic system of the trolley 8100. Thus, the imaging device 8725 can be configured to send a signal representing data associated with captured images and/or video streams and, upon receipt, the electronic system can store the data in, for example, the memory and/or the like. Furthermore, the memory of the electronic system can store data associated with the position of the imaging device 8725 or a portion of the imaging device 8725 (e.g., a lens, aperture, focal point, charge-coupled device (CCD) sensor, a complementary metal-oxide-semiconductor (CMOS) sensor, and/or the like), relative to a portion of the trolley 8100. As such, the electronic system of the trolley 8100, and more specifically, a processor and/or module can determine, for example, a reference coordinate system relative to the imaging device 8725 and/or a portion of the trolley 8100.

[1213] In some instances, the imaging device 8725 can be used to capture one or more images and/or video streams of the tracking member 8860 while in use during, for example, gait training and/or the like. For example, as shown in FIGS. 46 and 47, the optical tracking system 8720 can be used to determine a first position P and a second position P' of the tracking member 8860 and thus, the patient attachment mechanism 8800. More specifically, in some instances, a patient (not shown) can be coupled to the patient attachment mechanism 8800 (e.g., via a harness

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or the like, as described above) and can perform a gait training therapy session, thereby moving the patient attachment mechanism 8800 relative to the trolley 8100 and the trolley along the support track (not shown in FIGS. 45-47). During use, the imaging device 8725 can capture one or more images and/or video streams of the tracking member 8860 to determine, for example, the first position P and the second position P' of the tracking member 8860. More specifically, as shown in FIG. 46, the imaging device 8725 can capture one or more images and/or video streams and can send a signal representing data associated with the one or more images and/or video streams to the processor and/or to a module (e.g., a processing module) included in the electronic system. The processor and/or module can, for example, analyze the image and can calculate a distance D of the image of the tracking member 8860 from a reference plane R and a size S of the image of the tracking member 8860. Based at least in part on the calculated distance D and the calculated size S, the processor and/or module can determine and/or calculate an angle A of the tether 8505, a length L of the tether 8505, and a distance H of the tracking member 8860 from the trolley 8100 (FIG. 47), thereby determining the first position P of the tracking member 8860 and the patient attachment mechanism 8800. Similarly, when the patient moves from the first position P, the imaging device 8725 can capture one or more images and/or video streams and can send a signal representing data associated with the new images and/or video streams to the processor and/or module. As such the processor and/or module can, for example, analyze the image and can calculate a second distance D' of the image of the tracking member 8860' from the reference plane R and a second size S' of the image of the tracking member 8860'. Based at least in part on the calculated second distance D' and the calculated second size S', the processor and/or module can determine and/or calculate a second angle A' of the tether 8505', a second length L' of the tether' 8505, and a second distance H' of the tracking member 8860' from the trolley 8100 (FIG. 47), thereby determining the second position P' of the tracking member 8860' and the patient attachment mechanism 8800'.

[1214] Although the trolley 2100 is described above as including the encoder 2470 of the drive system 2300, the encoder 2561 of the guide mechanism 2540, and the encoder 2587 of the cam assembly 2570, which are collectively used to determine one or more system parameters (e.g., position, velocity, acceleration, etc.), and the trolley 8100 is described above as including the optical tracking system 8720 to determine the one or more system parameters, in other embodiments, a trolley and/or support system can use any suitable combination of an encoder

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system and an optical tracking system. For example, in some embodiments, a trolley can use data from any number of encoders (e.g., of a drive system, guide mechanism, and/or cam assembly) and an optical tracking system.

[1215] While the trolleys 2100 and 8100 are described above as including an electronic system (e.g., the electronic system 2700) that actively controls the operating condition of the trolleys 2100 and 8100 to support at least a portion of the weight of the patient, in some embodiments, a trolley can include an electronic system, which, in addition to controlling the operating condition of the trolley, can determine one or more characteristics associated with the patient's gait during use. By way of example, a trolley such as the trolley 2100 and/or 8100 can include a set of encoders, sensors, and/or the like that can determine a set of operating conditions associated with a portion of the trolley. Specifically, in some embodiments, the trolley can include a drive system similar to the drive system 2300 in FIGS. 12-26, a patient support mechanism similar to the patient support mechanism 2500 in FIGS. 27-33, and an electronic system similar to the electronic system 2700 in FIGS. 10 and 11, which can be used collectively to determine the set of operating conditions associated with the trolley. In turn, the electronic system can determine, based on the set of operating conditions, the one or more characteristics associated with the patient's gait during use.

[1216] By way of example, in some embodiments, the patient support mechanism can include, inter alia, a winch assembly coupled to a tether, a guide mechanism, and a cam assembly. The winch assembly can have an encoder (e.g., similar to the encoder 2537), the guide mechanism can have an encoder (e.g., similar to the encoder 2561), and the cam assembly can have an encoder (e.g., similar to the encoder 2587). Similarly, the drive system can have an encoder (e.g., similar to the encoder 2470). The electronic system can include at least a processor and a memory configured to receive one or more signals from the encoders of the drive mechanism and the patient support mechanism. In some embodiments, the electronic system can also include an imaging device (e.g., similar to the imaging device 8725 in FIGS. 46 and 47) configured to capture and image or video stream of a tracking member (e.g., similar to the tracking member 8860).

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[1217] As described in detail above, when a patient using the patient support system begins to walk, the drive mechanism can move the trolley along the support track in response to his or her movement. The encoder of the drive mechanism can, in turn, sense one or more characteristics associated with the operation of the drive mechanism. For example, the encoder can sense a position of the drive mechanism relative to the support track, a translational velocity of the drive mechanism along the support track, a translational acceleration of the drive mechanism along the support track, a rotational velocity of one or more wheels, a rotational acceleration of one or more wheels, an angular orientation of one or more wheels, a motor speed and/or direction, a voltage associated with at least a portion of the motor, and/or the like. The encoder can then send a signal associated with the one or more characteristics of the drive mechanism to the electronic system, which in response, can cause the processor to determine and/or or update an operating condition of the drive mechanism based at least in part on a change in the one or more characteristics of the drive mechanism relative to a previously defined operating condition of the drive mechanism (e.g., stored in a memory or the like), as described in detail above with reference to the trolley 2100.

[1218] Similarly, in response to the walking of the patient, the encoder of the winch assembly, the guide mechanism, and/or the cam assembly (as well as the imaging device if included therein) can sense and/or determine one or more characteristics associated with the operation of the patient support mechanism. For example, in some instances, the patient may walk faster than the trolley, thereby changing the angle of the tether and the guide mechanism relative to the trolley. The encoder of the guide mechanism can sense the angular deflection of the guide mechanism and can send a signal associated with the angle of the guide mechanism to the electronic system. Upon receipt, the electronic system can cause the processor to determine and/or update an operating condition of the guide mechanism.

[1219] In some instances, the movement of the patient may, for example, increase a length of a portion of the tether. As such, a portion of the tether can be unspooled from a drum or the like included in the winch assembly. More specifically, at least a portion of a force exerted by the patient on the tether can rotate the drum or the like, which in turn, results in an unspooling of the tether (i.e., an increase in a length of a portion of the tether between the patient and the winch assembly). The encoder of the winch assembly can sense one or more characteristics associated

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with the operation of the winch assembly. For example, the encoder can sense an angular position of the drum, a rotational velocity of the drum, an acceleration of the drum, a speed and/or direction of a motor included in the winch assembly, a voltage associated with at least a portion of the motor of the winch assembly, and/or the like. The encoder can then send a signal associated with the one or more characteristics of the winch assembly to the electronic system, which in response, can cause the processor to determine and/or or update an operating condition of the winch assembly based at least in part on a change in the one or more characteristics of the winch assembly relative to a previously defined operating condition of the winch assembly (e.g., stored in a memory or the like), as described in detail above with reference to the trolley 2100. In some instances, based at least in part on the updated operating condition of the winch assembly, the processor can determine a length of the portion of the tether disposed between the patient and the winch assembly. In some embodiments, the tether can be coupled to a load cell or the like configured to sense a force exerted by the patient on the tether (e.g., by measuring a stress, tension, strain, and/or the like along and/or within a portion of the tether). The load cell can be configured to send a signal to the electronic system associated with a load (e.g., force) exerted on the tether, which in turn, can cause the processor to determine a force exerted by the patient.

[1220] In some instances, an amount of force exerted on the tether by the patient may increase or decrease in a substantially sudden manner. For example, if a patient stumbles, an amount of force exerted on the tether may increase relatively suddenly. In such instances, the increase of force exerted on the tether may pivot the guide mechanism and/or increase a length of a portion of the tether (as described above), as well as rotate a cam and/or cam arm included in the cam assembly (e.g., as described with reference to the cam assembly 2570 in FIGS. 32 and 33). In other words, at least a portion of the cam assembly can be configured to rotate in response to a relatively fast movement and/or deflection of the tether. The encoder of the cam assembly can sense one or more characteristics associated with a movement of the cam and/or cam arm such as, for example, position, velocity, acceleration, jerk, orientation, alignment, force, and/or the like. The encoder of the cam assembly can then send a signal associated with the one or more characteristics of the cam assembly to the electronic system, which in response, can cause the processor to determine and/or update an operating condition of the cam assembly based at least in part on a change in the one or more characteristics of the cam assembly relative to a

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previously defined operating condition of the cam assembly (e.g., stored in memory), as described above with reference to the trolley 2100.

[1221] By defining, determining, and/or updating one or more operating conditions of the drive mechanism and/or the patient support mechanism, the electronic system (e.g., at least the processor of the electronic system) can actively control the trolley to support at least a portion of a weight of the patient using the patient support system. As described above, in some instances, the magnitude of change in the operating condition of the drive system and/or the patient support mechanism is based at least in part on a proportional-integral-derivative (PID) control. In such instances, the electronic system (e.g., the processor or any other electronic device in communication with the processor) can determine the changes of the patient support mechanism and model the changes based on the PID control. Based on the result of the modeling the processor can determine the suitable magnitude of change in the operating condition of the drive system and/or the patient support mechanism.

[1222] For example, FIG. 48 is a schematic illustration of a control diagram according to an embodiment. In this embodiment, the electronic system (described above) can be configured to control the drive system and/or the patient support mechanism based at least in part on a tension within and/or along a portion of the tether. Specifically, a nurse, technician, therapist, doctor, physician, etc. can define a predetermined value associated with a target tether tension T* (e.g., commanded tether tension). With the commanded tether tension T* stored, for example, in memory, the processor of the electronic system can compare an actual tension T within and/or along the portion of the tether against the commanded tether tension T* to determine a tension error. In some instances, the processor can then perform a derivative control operation 101 on the tension error, the output of which can be added to one or more proportional control operation outputs (described in further detail below) to determine, for example, a motor speed command ω_M* for controlling motor and drive dynamics 102 associated with a motor included in the drive system and/or the patient support mechanism.

[1223] As shown in FIG. 48, a proportional control operation 103 can be performed on a value associated with an actual motor speed ω_M of the motor included in the drive system and/or patient support mechanism. In addition, the actual motor speed ω_M can be evaluated with a value

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Z associated with a downward motion of the tether (e.g., in response to a force exerted by a patient) for controlling spring mechanism dynamics 104 associated with, for example, the cam assembly of the patient support mechanism. As a result, the processor can define (1) an updated value of the actual tension T within and/or along the portion of the tether, and (2) a cam unloading rotation speed ω_C. An equivalent motor speed can be determined by evaluating a rotational speed associated with a portion of the cam and a rotational speed associated with, for example, the drum of the winch assembly (represented in FIG. 48 by the reference numeral 105). A proportional control operation 106 can be performed on the equivalent motor speed, an output of which can then be added to an output of the proportional control operation 103. As described above, the sum of the proportional control operations 103 and 106 can be added to the output of the derivative control operation 101 to define the motor speed command ω_M^*. Thus, in this embodiment and as described above, the electronic system (e.g., or at least the processor included therein) can control the trolley, in response to movement of a patient, based at least in part on a PID control feedback loop and/or the like.

[1224] In some instances, the electronic system can determine one or more characteristic associated with a patient's gait based at least in part on an operating condition and/or a change in operating condition of the drive mechanism and/or the patient support mechanism. For example, FIG. 49 is a graph 200 illustrating a displacement of a center of mass of a patient according to an embodiment. As shown, a patient's center of mass shifts during a gait cycle (e.g., up to about 5 centimeters (cm)), which in turn, results in a shifting and/or changing force exerted on the tether when the patient is using the patient support system. For example, the center of mass of the patient can be at a lowest point (i.e., closest to a surface on which the patient is walking) at about 5% and about 55% of the gait cycle, which corresponds to a termination of a swing phase of the gait cycle. The center of mass of the patient can be at a highest point (i.e., furthest away from the surface on which the patient is walking) at about 30% and about 80% of the gait cycle, which corresponds to the patient's center of mass passing over his or her weight bearing leg. Similarly, the center of mass of the patient can shift in a lateral direction during the gait cycle, as shown in FIG. 49. With at least a portion of the weight of the patient supported by the patient support mechanism, the shifting of the center of mass of the patient results in a corresponding shift and/or change in the force exerted on the tether by the weight of the patient. Therefore, based on

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one or more operating conditions associated with the drive system and/or the patient support mechanism, the processor can determine a set of characteristics associated with the patient's gait.

[1225] By way of example, FIGS. 50-53 are graphs illustrating operating conditions associated with the patient support mechanism in response to a patient's movement. In this instance, the operating conditions associated with the patient support mechanism relate to a tether position and a cam angle of the cam included in the cam assembly, which in turn, can be used to determine one or more characteristics associated with the patient's gait. More specifically, the processor of the electronic system can determine the tether position based on a signal received from one or more encoders (e.g., the encoder of the winch assembly, the guide member, and/or any other suitable encoder) and can determine the cam angle based on, for example, the encoder of the cam assembly.

[1226] As shown in FIG. 50, the tether position and cam angle are graphed in response to a relatively slow movement of a normal or healthy patient's gait. Specifically, graph 301 illustrates a position of a portion of the tether, with and without factoring in a position associated with the cam, in response to the patient's gait; graph 302 illustrates a cam angle of the cam in response to the patient's gait; graph 303 illustrates a change in the tether position plus a change in the cam angle in response to the patient's gait; and graph 304 illustrates the speed and acceleration associated with the tether in response to the patient's gait. In some instances, the position of the portion of the tether, as shown in graph 301, can change in response to a relatively slow, gradual, and/or substantial change in the patient's movement, while the cam angle of the cam, as shown in graph 302, can change in response to a relatively fast, sudden, and/or abrupt movement of the tether. In some instances, the change in cam angle in response to the relatively fast movement of the tether can, for example, reduce noise or the like that might otherwise alter a determination of the tether position. As shown in graph 303, the change in the tether position and the change in the cam angle can be determined, which in turn, can be used to determine a speed and acceleration associated with the tether position, as shown in graph 304. Moreover, by determining the tether position, velocity, and acceleration, the processor of the electronic system can determine one or more characteristics associated with the patient's gait. For example, in some instances, the gait of a healthy patient may have and/or define a substantially symmetric characteristic when comparing movement of the patient's left leg to movement of the patient's

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right leg. Thus, by determining the position, velocity, and acceleration of the tether, the processor can determine gait characteristics such as, for example, a number of steps, a distance traveled, a stride length, a velocity, a difference between gait characteristics associated with the left leg and the right leg, and/or any other suitable characteristic.

[1227] In a similar manner, FIG. 51 illustrates graphs showing the tether position and cam angle in response to a relatively fast movement of the normal or healthy patient's gait. Specifically, graph 401 illustrates a position of a portion of the tether, with and without factoring in a position associated with the cam, in response to the patient's gait; graph 402 illustrates a cam angle of the cam in response to the patient's gait; graph 403 illustrates a change in the tether position plus a change in the cam angle in response to the patient's gait; and graph 404 illustrates the speed and acceleration associated with the tether in response to the patient's gait. As can be seen in FIG. 50 and 51, the speed associated with the patient's movement can result in a different response of the tether position and the cam angle. Thus, the processor of the electronic system can determine any suitable gait characteristic associated with the patient's relatively fast gait, which can be different from a corresponding gait characteristics associated with the patient's relatively slow gait.

[1228] While the graphs in FIGS. 50 and 51 illustrate the tether position and the cam angle relative to a normal or healthy patient's gait, FIGS. 52 and 53 illustrate a tether position and cam angle relative to an impaired patient's gait and more specifically, to the gait of a patient with an impairment resulting in a dragging of one of his or her legs. For example, in FIG. 52, graph 501 illustrates a position of a portion of the tether, with and without factoring in a position associated with the cam relative to the impaired patient's gait; graph 502 illustrates a cam angle of the cam relative to the impaired patient's gait; graph 503 illustrates a change in the tether position plus a change in the cam angle relative to the impaired patient's gait; and graph 404 illustrates the speed and acceleration associated with the tether relative to the impaired patient's gait. Similarly, in FIG. 53, graph 601 illustrates a position of a portion of the tether, with and without factoring in a position associated with the cam relative to circumduction movement of the impaired patient's gait; graph 602 illustrates a cam angle of the cam relative to circumduction movement of the impaired patient's gait; graph 603 illustrates a change in the tether position plus a change in the cam angle relative to circumduction movement of the impaired patient's gait; and

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graph 604 illustrates the speed and acceleration associated with the tether relative to circumduction movement of the impaired patient's gait.

[1229] As can be seen in FIGS. 52 and 53, the impairment causing the patient to drag one leg during his or her gait results in a response of the tether position and the cam angle that is more erratic, abrupt, and/or otherwise more irregular relative to the response of the tether position and the cam angle resulting from a non-impaired patient's gait. In some instances, the position, velocity, and/or acceleration of the tether position resulting from the impaired patient's gait can be compared to the position, velocity, and/or acceleration of the tether position resulting from the non-impaired patient's gait. As such, the processor of the electronic system can determine, predict, and/or otherwise analyze the characteristics of the impaired patient's gait, which in turn, can be used to define a therapeutic treatment plan, a therapeutic progress report, a diagnostic method, and/or the like.

[1230] In some instances, the patient support system (and/or any of the patient support systems described herein) can be used in conjunction with any other suitable device configured to determine, provide, and/or define characteristics associated with a patient's gait. In some instances, the analysis of the one or more operating conditions of the drive mechanism and/or patient support mechanism can be used in conjunction with an analysis of data associated with an electric stimulator configured, for example, to improve an impaired patient's gait. For example, the patient support system can be used to support a patient donning an electric stimulator, configured to facilitate the gait of a patient experiencing drop foot or the like, such as those described in U.S. Patent Publication No. 2014/0303705 entitled, "Orthosis for a Gait Modulation System," filed April 4, 2014, the disclosure of which is incorporated herein by reference in its entirety. As shown in FIG. 54, the electric stimulator can define one or more operating conditions associated with the electric stimulator and/or the impaired patient's gait. For example, the electric stimulator can sense and/or determine an anterior or posterior motion, a lateral motion, a total motion (e.g., a combination of the lateral motion and the anterior or posterior motion), and/or a pressure associated with a heel on or heel off event, as shown in FIG. 54. In this instance, graph 701 illustrates an acceleration associated with the operation of the electric stimulator; graph 702 illustrates a speed associated with the operation of the electric stimulator; graph 703 illustrates a rotation associated with the operation of the electric

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stimulator; and graph 704 illustrates an angle associated with the operation of the electric stimulator.

[1231] In some embodiments, the electric stimulator can send a signal associated with one or more of its operating conditions to the electronic system of the patient support system. As such, the processor can determine one or more gait characteristics of the impaired patient based on data received from the drive system and/or patient support mechanism as well as the electric stimulator. By way of example, FIG. 55 illustrates graphical representations of a set of gait characteristics of a patient, which were determined based at least in part on data associated with the patient support system and the electric stimulator (as described in detail above). Specifically, graph 801 illustrates a swing and stance duration of the patient's gait; graph 802 illustrates a swing to stance ratio of the patient's gait; graph 803 illustrates a cadence of the patient's gait; graph 804 illustrates an anterior and lateral range of motion (ROM) associated with one or both of the patient's legs; graph 805 illustrates an anterior to lateral ratio associated with one or both of the patient's legs; and graph 806 illustrates a stride length and height of the patient's gait. Thus, the operating conditions associated with the patient support system and any other suitable device can be used to determine one or more characteristics of the patient's gait. Moreover, the electronic system can be configured to send a signal to any suitable output device (e.g., a monitor, a laptop, a personal computer, a hand held controller, a smartphone, and/or the like) that is indicative of an instruction to output data associated with the one or more characteristics of the patient's gait.

[1232] 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.

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[1233] 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.

[1234] In some embodiments, the patient support system and/or an electronic device in communication therewith can include memory and/or at least one module that stores data associated with one or more predetermined exercises, routines, tests, and/or the like. For example, the memory and/or module can include data associated with a set of exercises to analyze the patient's current and/or previous gait tests or analysis to track and help improve the patient's ability to walk. In some instances, the patient support system and/or the electronic device in communication therewith can graphically represent data associated with the exercises, routines, tests, and/or the like.

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[1235] For example, FIG. 56 is a screenshot 901 illustrating a graphical representation of data associated with an asymmetry exercise. The screenshot 901 of the asymmetry exercise visually shows a patient's vertical asymmetry (leaning more on one side than on the other side) and his or her horizontal asymmetry (difference between step durations). As shown, the symmetry can be displayed in position symmetry bar graphs as well as radio dials, which can be complemented by real time graphs showing a history of, for example, changing tether positions and walking speeds. During and after the asymmetry test, the patient support system and/or the electronic device can send a signal or instruction such that data associated with an average, minimum, and/or maximum walking speed, a vertical and/or horizontal symmetry, and/or the like is graphically represented on the display.

[1236] By way of another example, FIG. 57 is a screenshot 902 illustrating a graphical representation of data associated with a timed-up-and-go (TUG) exercise. The screenshot 902 of the TUG exercise can graphically represent data defined by the patient support system and/or the electronic device associated with the time it takes a patient to stand up from a seated position, walk a predetermined distance, and then sit down. During and after the TUG exercise, the patient support system and/or the electronic device can send a signal or instruction such that data associated with an average, minimum, and/or maximum speed during the TUG training exercises is graphically represented on the display. In addition, the patient support system and/or the electronic device can cause data to be graphically represented on the display such as real time graphs showing the history of the stand-up, walking, and sit down process, tether positions (included in a patient support mechanism of the patient support system, as described in detail above), and/or time durations, as well as the walking speeds during the exercise. Based at least in part on the time duration results, a fall risk (e.g., high or low) can be determined for the patient. Moreover, the data associated with the TUG exercise can be compared to historical data (e.g., stored in memory) from that patient's previous TUG exercises, thereby allowing a clinician or therapist to keep track of improvements in patient's gait.

[1237] As another example, FIG. 58 is a screenshot 903 illustrating a graphical representation of data associated with a timed-distance exercise. For example, a user (e.g., clinician and/or patient) can select either a fixed distance (e.g., 10 meters) or a fixed time (e.g., 2 minutes). The patient then walks for that distance or that time and the patient support system

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and/or the electronic device can determine and/or define the patient's performance. For a fixed distance, the timed-distance exercise can determine a gait speed and duration. For a fixed time, the timed-distance exercise can determine a total travelled distance and/or a gait speed. The patient support system and/or the electronic device can cause data to be graphically represented on the display such as real time graphs showing the distance travelled and the walking speed, an average, minimum, and/or maximum walking speed, and/or the like.

[1238] As described above, any data associated with the exercises, routines, tests, etc. can be saved, for example, in memory, and can be replayed and/or otherwise presented for post exercise analysis. In addition, data associated with any given exercise can be saved as a baseline so it can be used to compare against future exercises to show the improvements in patient's gait. In some instances, a report can be defined (e.g., by the patient support system and/or the electronic device) and graphically represented on the display to provide details of a given exercise, including the gait speed, distance, time, time to stand, time to sit, cadence, symmetry indexes, or the like, as well as a Perry Ambulatory Category, a Functional Ambulation Category, and/or fall risk.

[1239] The patient support mechanism and/or the electronic device (or a processor, module, compute device, etc. included therein) can be configured to perform the exercises, routines, test, or the like, based on data associated with, for example, a tether position, a cam angle, a walking speed, a motor speed, a heel on or off event (and/or other gait phases), and/or the like. In some instances, the patient support mechanism and/or the electronic device can determine, for example, a change in the position of the tether (i.e., included in a patient support mechanism, as described in detail above) between two heel events to determine a vertical symmetry of the patient's gait. In some instances, the data can be based on both linear tether positions and/or cam angles (e.g., a linear graph) and a derivative thereof (e.g., slope or rate of change) of the tether position and/or cam angles (converted to linear length) to determine a gait pattern and/or characteristic.

[1240] Based on a determined gait pattern, the patient support mechanism and/or the electronic device can determine peaks and/or valleys associated with the gait events, which can be graphically represented as a linear graph or a derivative graph. In some instances, the patient

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support mechanism and/or the electronic device can use, for example, a midpoint logic to normalize the linear graph and/or derivative graph (e.g., remove a graph offset, or the like). In some instances, the peaks and valleys of the graphs (e.g., local minima and/or local maxima of the data) can be used determine the heel on or off events. Based on different predetermined gait patterns (e.g., a first category for normal walkers and a second category for pathological walkers) the peaks and valleys can be defined and/or determined differently. For example, for a normal walker, a valley (e.g., locally the shortest tether position) can be about mid stance (double support) of the gait. Conversely, for a pathological walker, a valley can be during a step.

[1241] Once the peaks and valleys are associated with the respective heel on or off events, the difference between the previous and current step tether positions can be determined to define the changes in the tether positions (e.g., determine vertical symmetry difference between the right and the left steps or the difference between the two subsequent steps). The previous and current step elapsed times can also be determined to define changes in the step duration (e.g., determine horizontal symmetry).

[1242] While the patient support system is described above as using one or more operating conditions to determine gait patterns and/or gait characteristics, in other instances, one or more operating conditions of the patient support system can be used to determine a current level or current amount of body weight support relative to a predetermined level or predetermined amount of body weight support. In some embodiments, a patient support system ("support system") can be programmed and/or set to provide a predetermined amount of body weight support (or to provide body weight support in a predetermined and/or preprogrammed manner) based on characteristics associated with the tether. For example, in some embodiments, the support system can be configured and/or programmed to provide support to a patient after, for example, a predetermined and/or predefined lengthening of the tether (e.g., in response to a patient falling or partially falling). In other words, the support system can be configured and/or programmed to support at least a portion of the patient's body weight after the patient has fallen beyond a predetermined threshold.

[1243] For example, FIGS. 59 and 60 are screenshots 904 and 904A, respectively, illustrating a graphical representation of data associated with a support system and more

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particularly, with a "fall prevention" configuration, setting, interface, and/or the like. As described above, in some instances, a support system can be configured to provide support of at least a portion of a patient's body weight based on a lengthening of the tether in response to the patient falling or beginning to fall. In some embodiments, for example the support system and/or an electronics assembly included therein can be configured to determine, define, and/or calculate an initial length of the tether (e.g., when the patient and/or user is stationary and/or not falling). As the patient and/or user begins to walk, the electronics assembly can receive data from one or more sensors, encoders, and/or the like that is associated with a current tether length. 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.

[1244] 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).

[1245] 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

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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.

[1246] 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).

[1247] In some instances, the support system can be configured to adjust and/or update the zero point during use. For example, in some instances, evaluating the amount of change in the tether length (or height of the patient attachment mechanism), the rate of change in the tether length, and/or a total duration of the change relative to the zero point can allow a patient to walk along a surface having a change in elevation or the like. For example, in some instances, the

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support system (or the electronic system thereof) can adjust and/or update the zero point or reference point in response to a relatively slow rate of change in the height and/or when the change is height is over a relatively long duration of time. In such instances, for example, the support system can determine that the patient is walking along a surface having a change in elevation and thus, can dynamically or actively adjust and/or update the "zero point" or reference point. Under such conditions, the support system can be configured to adjust and/or update the zero point prior to the amount of change in the tether length reaching and/or exceeding the fall limit or can adjust and/or update the zero point after the amount of change reaches and/or exceeds the fall limit. In other instances, the support system can provide support and/or can transition to a support configuration in response to an amount of change in the tether length reaching and/or exceeding the fall limit when the change in the height is at a relatively fast rate and/or when the change in height is over a relatively short time. In other words, the support system can provide support and/or can transition to the support configuration when the support system determines that the patient is falling rather than traveling along a surface having a change in elevation.

[1248] While the support system is described above as including and/or implementing a fall prevention system and/or method based on a distance or length of a portion of the tether (e.g., a fall limit or tolerance), in other embodiments, the support system can include and/or can implement a fall prevention system and/or method based on any suitable characteristic and/or parameter of the support system. For example, in some instances, the support system can be configured to receive an input from a user and/or clinician that is operable in placing the support system in an "active body control mode." In some instances, for example, the support system and/or the electronics assembly can receive an input operable in switching the support system from a "distance" or "fall limit mode" (see e.g., FIG. 60) to the "active body control mode" (see e.g., FIG. 61). That is to say, in some embodiments, a processor of the electronics assembly can be configured to execute a set of instructions and/or code (e.g., stored in the memory) to place the support system in the "fall limit mode" or in the "active body control mode."

[1249] In some embodiments, the active body control mode can be configured to dynamically support a portion of the patient's body weight based on, for example, a rate of change in the length of the tether (e.g., a velocity of the tether). In some instances, determining

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an amount of body weight to support based on a rate of change in the length of the tether can allow for a greater range of motion than when basing the amount of support on a length of the tether alone. Moreover, as described above with reference to the "distance" mode, the support system can be configured to evaluate a duration of the change in velocity to improve and/or tune a response of the support system.

[1250] As shown in FIG. 61, in some embodiments, the support system can be programmed and/or set to provide a "Minimum" level of support (configured to provide the lowest level of fall prevention), a "Moderate" level of support (configured to provide a moderate amount or mid-level of fall prevention, greater than the minimum level), or a "Maximum" level of support (configured to provide the highest level of fall prevention, greater than the moderate level). In other embodiments, a support system can be configured to provide more than three levels of support (e.g., four, five, six, seven, eight, nine, ten, or more levels of support).

[1251] As described above, the level of support can be based on a rate of change in tether length over a predetermined time. That is to say, the level of support can be a function of the rate of change in tether length (or height of the patient attachment mechanism) and the overall duration (time) of the change in tether length. In some instances, the patient support system can be configured to determine a rate of change in a length of the tether based on, for example, an operating condition associated with the cam assembly and/or the winch assembly. In some instances, a relatively fast rate of change in tether length (as determined by an operating condition of the cam assembly, winch assembly, and/or any other suitable portion of the support system) can be indicative of a patient falling and thus, can result in the support system updating one or more operating conditions of the support system (e.g., trolley) to actively support a portion of the patient's body weight.

[1252] In some instances, setting the fall prevention system and/or method to the "Maximum" amount of support can be such that the support system provides support in response to a relatively low rate of change in the length of the tether (e.g., a relatively low velocity criterion and/or threshold). In some instances, setting the fall prevention system and/or method to the "Moderate" amount of support can be such that the support system provides support in response to a rate of change in the length of the tether that is greater than the rate of change when

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the system is set to the "Maximum" amount of support. In other instances, setting the fall prevention system and/or method to a "Minimum" amount of support can be such that the support system provides support in response to a rate of change in the length of the tether that is greater than the rate of change when the system is set to the "Moderate" amount of support. Moreover, by evaluating and/or determining a duration of the change in tether length, the support system can be configured to determine, for example, if a rate of change in the tether length is the result of a user changing his or her rate of walking or running, a result of the user rising to a standing position from a sitting position, a result of the user falling, etc.

[1253] In some instances, the fall prevention and/or level of support can be at least partially based on the duration of the rate of change. For example, in some instances, when a rate of change in the tether length reaches and/or exceeds a predetermined threshold the support system can be configured to determine a duration of the change in the tether length. In some instances, setting the fall prevention system to the "Maximum" support level can be such that a tolerance and/or threshold associated with the duration is less than a tolerance and/or threshold associated with the duration when the fall prevention system is set to the "Minimum" support level. As such, the support system can be configured to provide support and/or can be configured to transition to a support configuration in response to an increase in the rate of change in tether length (or height of the patient attachment mechanism) over a predetermined duration.

[1254] In some embodiments, the support system can be configured to update the level of support based on a patient's and/or user's performance against a predetermined program and/or metric (e.g., a timed-up-and-go test, a sit-to-stand test, a predetermined minimum walking speed, a predetermined number of falls within a given time, etc.). The level of support can be manually updated by a therapist, administrator, and/or user. In other instances, a user or administrator can define a set of criteria or the like (e.g., a number of falls, etc.), which if satisfied, results in the support system automatically updating the amount of support (e.g., increasing or decreasing the amount or level of support). Moreover, in some instances, the support system and/or the fall prevention system can have a default mode or the like associated with each test. For example, in some instances, it may be desirable to automatically place the fall prevention system in the "Active Body Control" mode such that support is based on a rate of change in the length of the tether rather than the "Distance" mode.

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[1255] In some embodiments, the support system can be configured to "reset" the system after a fall or the like to place the patient attachment mechanism at the zero point. For example, in some instances, the support system and/or the fall prevention system can include and/or can perform an "Auto Recovery" as shown by the screen shot 905 in FIG. 63. In such instances, the system can be configured to reset to a default and/or previous setting (e.g., to predetermined and/or default tether length) after a user falls. In addition, in some instances, the support system can provide support as the user recovers (e.g., stands up) after falling or the like.

[1256] While the fall prevention system is described above as being based on an amount of change in the tether length, a rate of change in the tether length, and a duration of the change in tether length, in other instances, the fall prevention system can be disabled, suspended, turned off, etc. For example, referring back to FIG. 62, a screen shot 904C illustrates the fall prevention system in a "Disabled" mode. In such instances, it may be desirable to place the fall prevention system in the "Disabled" mode when preforming, for example, pre-gait and/or pre-use activities.

[1257] As described in detail above, the support system and/or the trolley can be configured to adjust one or more system parameters and/or operating conditions such that the trolley is maintained in a position substantially over-head of the user or patient. In some instances, the drive system of the trolley can be configured to move the trolley along the support track to maintain the trolley substantially over-head of the user or patient based on, for example, an angle of the tether or guide mechanism (e.g., the guide mechanism 2540). In some embodiments, the support system can also account for patient movement in a direction perpendicular to an axis of the support track. That is to say, the support system can be configured to account for lateral patient movement and/or sway during gait.

[1258] In some embodiments, the trolley and/or at least a portion thereof can be configured to move in a side-to-side motion (lateral motion) in addition to moving along a length of the support track. For example, in some embodiments, the trolley and/or the guide mechanism can have one or more slides, suspension members, and/or the like configured to allow the trolley and/or the guide mechanism, respectively, to move in the lateral direction (as the trolley moves along the axis of the support track or when the trolley is in a stationary position in along the axis of the support track). In this manner, the trolley or a portion thereof, can move with 2-degrees of

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freedom to maintain the tether in a position substantially over-head of the patient and/or patient attachment mechanism (e.g., extending at a 90° angle or substantially vertically from the trolley).

[1259] In other embodiments, the trolley and/or a portion thereof can include one or more sensors, encoders, gyroscopes, etc. configured to sense and/or determine an amount of side-to-side motion (lateral motion). For example, in some instances, the guide mechanism or the like can be configured to pivot about two axes and can include one or more sensors, gyroscopes, encoders, etc. configured to sense and/or determine a pivot position, velocity, and/or acceleration about each axis. In other words, the guide mechanism can allow for forward and aft movement (pivoting) as well as side-to-side movement (pivoting) and can include and/or can be operably coupled to one or more sensors or the like configured to sense and/or detect movement in each direction (e.g., a 2-degree of freedom sensor or the like). Thus, the angular position, velocity, and/or acceleration of the tether and/or guide mechanism in each direction can be determined and/or sensed and data received from the sensor or the like can be used along with data from the other sensors and/or encoders (described above) to determine and/or update one or more operating conditions of the patient support system.

[1260] As described above, the support system can include any suitable number of sensors, encoders, gyroscopes, transducers (e.g., force transducers), and/or the like (collectively referred to herein as "sensors"). The electronic system of the support system can receive data from the sensors and can determine and/or update one or more operating conditions of the support system to provide a predetermined and/or desired level or amount of support for the user or patient. In some instances, the data received from the sensors can be compared against predetermined and/or standard values or levels and errors therebetween can be used to determine an amount of dynamic and/or active body weight support.

[1261] Any of the patient support systems and/or body weight support systems can be used in conjunction with and/or can include any other suitable device configured to be used during a patient's gait or gait training. In some embodiments, such a device can be a secondary training device, an electronic device or computer, an orthosis or gait assist device, a moving platform, surface, or walkway (e.g., treadmill or the like), and/or any other suitable device. For example, a patient support system can include camera, infrared emitter and receiver, a visual light source

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and sensor, magnetic sensor, a force and/or pressure plate and sensor, and/or the like. In some embodiments, a patient support system can include, for example, a projector configured to project a graphical representation of data associated with a predetermined track or path along which the patient is to walk. In some instances, such a projector can project images such as stop signs, turn signs, obstacles to walk around, etc.). Moreover, in some instances, a patient reaching a target location projected onto a surface by the projector can be associated with a value or the like (e.g., a relatively high value) used to determine a patient performance score. On the other hand, failing to avoid an obstacle and/or failing to follow a predetermined path projected onto a surface by the projector can be associated with a value, score, and/or the like (e.g., a relatively low value). In some instances, such a projector can project a hologram of the patient walking so that they may see themselves walking either from the front or behind.

[1262] 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.

[1263] In embodiments in which a support system supports a user as the user is on or moves relative to the moving surface of a treadmill, an electronic device of the patient support system can receive data associated with one or more operating conditions of the treadmill and can use the data associated with the treadmill and data associated with the operating conditions of the patient support system to provide gait training for the user utilizing the treadmill, define one or more gait characteristics of the user, provide an analysis of data and/or information associated

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with the gait training or one or more training sessions, and/or the like. Moreover, the patient support system and/or any suitable electronic device can be configured to graphically represent data and/or information associated with the treadmill, the patient support system, and/or one or more gait training sessions on a display of the device.

[1264] For example, FIGS. 64-69 are screenshots 910-915, respectively, illustrating graphical representations of data associated with a support system being used in conjunction with a treadmill. As shown in FIGS. 64-66, the patient support system and/or the electronic device can present data associated with the trolley such as, for example, operating mode, an amount or level of dynamic unloading, a maximum change in tether length prior to providing support, any suitable session data or information (e.g., total running time, distance travel, walking speed, number of falls or number of falls prevented, tether position, etc.), and/or any other suitable data. In some instances, for example, the patient support system and/or the electronic device can graphically represent data similar to the data represented by the screenshots 904 and 904A, shown in FIGS. 59 and 60, respectively.

[1265] In addition to data associated with the trolley, the support system and/or electronic device can be configured to graphically represent data associated with the treadmill. For example, as shown in the screenshots 910 (FIG. 64), 911 (FIG. 65), 912 (FIG. 66), and 913 (FIG. 67), the support system and/or the electronic device can graphically represent data and/or controls associated with the treadmill. In some instances, the data graphically represented on the display can provide a user interface allowing a user to select and/or control one or more operating settings of the treadmill such as, for example, belt speed, incline, and/or the like. In other instances, the user can, for example, initiate a pairing or syncing of the treadmill with the trolley; start, stop, or pause operation of the treadmill (including an emergency stop); change the direction of the belt; change an incline or decline of the belt or treadmill; and/or the like. In some instances, the support system and/or the electronic device can be configured to control one or more operating conditions of the trolley based on data associated with one or more operating conditions of the treadmill and vice versa. For example, in some instances, the support system and/or the electronic device can be configured to stop the treadmill (e.g., stop the movement of the belt) in response to determining the user has fallen based on data associated with one or more operating conditions of the trolley. For example, in some instances, the trolley (and/or an

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electronic device in communication with the trolley) can determine a user has fallen based at least in part on a rapid or sudden change in a force exerted by the user on the tether and/or a rapid or sudden increase in a length of at least a portion of the tether. Thus, in some such instances, the support system, electronic device, and/or controller can be configured to stop or pause the operation of the treadmill based on determining that the user has fallen. Moreover, the system can resume the operation or movement of the trolley in response to determining that the user has recovered from the fall (e.g., is in a desired standing, walking, or neutral position).

[1266] In some embodiments, the electronic device configured to graphically represent data associated with the trolley and the treadmill can be the same electronic device that controls both the trolley and the treadmill. In such embodiments, the electronic device can receive signals from one or more sensors, motors, controllers, etc. and can perform one or more processes on data received via such signals. In other embodiments, an electronic device can be configured to graphically represent data and/or information associated with the trolley and the treadmill based on one or more signals received from an electronic device or a controller of the trolley and/or based on or more signals received from an electronic device or a controller of the treadmill. In other words, in some embodiments, an electronic device can be configured to receive and aggregate one or more analyzed or at least partially processed data sets from one or more components of the support system and can graphically represented the aggregated data on a display. Said another way, any of the support systems described herein can include a centralized electronic device and/or controller configured to control one or more components of the support system or can include a decentralized or distributed network of electronic devices and/or controllers. Moreover, in embodiments in which the support system includes a decentralized or distributed network of electronic device and/or controllers, the support system can include at least one electronic device and/or controller configured to compile and/or aggregate data received from one or more components of the support system and to graphically represent such compiled or aggregated data on a display.

[1267] As described above, the support system and/or electronic device in communication therewith can be configured to determine and/or define one or more characteristics associated with the user's gait based on data associated with the support system (e.g., the trolley) and any suitable device being used with the support system (e.g., the treadmill). For example, the

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screenshot 914 shown in FIG. 68 is an example of a session summary that can provide data and/or information associated with a user session or the like. Such data and/or information can include, for example, the date and time of the session; the total training time; a minimum, maximum, and/or average walking speed; a minimum, maximum, and/or average amount of unloading or support; a total distance traveled; a total number of falls or a total number of falls prevented; and/or any other suitable data and/or information. Moreover, the user or clinician can provide notes, information, data, and/or input that can be associated and/or stored with the session data. As illustrated by the screenshot 915 of FIG .69, the support system and/or electronic device can also be configured to define and display one or more graphs, plots, charts, etc. representing data associated with one or more user sessions. For example, as shown in FIG. 69, the support system and/or electronic device can define and display a graph illustrating a user fall profile during one or more sessions, a user speed and distance graph, and/or any other suitable graph, chart, and/or representation of data associated with one or more user sessions.

[1268] Any of the patient support systems and/or body weight support systems can be used with any suitable track and/or power rail such as those described herein. In some embodiments, a patient support system can include a track and/or power rail configured to allow for switching, diverting, and/or redirecting of a trolley movably coupled thereto. For example, FIG. 70 illustrates a first track portion 9620A and a second track portion 9620B, and a first power rail portion 9050A and a second power rail portion 9050A. In this embodiment, the first track portion 9620A and the second track portion 9620B are disposed perpendicular to each other. Similarly, the first power rail portion 9050A and the second power rail portion 9050B are disposed perpendicular to each other.

[1269] As shown in FIG. 70, a turntable 9625 includes a third track portion 9620C and a third power rail portion 9050C. The turntable 9625 is configured to be rotated relative to the track portions 9620A and 9620B and the power rails 9050A and 9050B, as indicated by the arrow AA. For example, in some embodiments, the turntable 9625 can be manually turned (e.g., a user exerts a force on a portion of the turntable 9625 such as a handle or the like (not shown in FIG. 70)). In other embodiments, the turntable 9625 can include a motor or the like (not shown in FIG. 70) that can receive a signal from a controller or the like and based on that signal, can rotate the turntable 9625. Therefore, in use, the turntable 9625 can rotate to a position relative to

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the track portions 9620A and 9620B and the power rails 9050A and 9050B to place the third track portion 9620C in line with the first track portion 9620A, and to place the third power rail portion 9050C in line with the first power rail portion 9050A, as shown in FIG. 70. More particularly, when the third track portion 9620C is placed in line with the first track portion 9620A, the first track portion 9620A and the third track portion 9620C collectively form a substantially continuous track along which a trolley can move.

[1270] Similarly, the first power rail portion 9050A and the third power rail portion 9050B can collectively form a substantially continuous power rail configured to power the trolley suspended from the track, collectively formed by the first track portion 9620A and the third track portion 9620C. Specifically, in this embodiment, the turntable 9625 can be disposed in a position such that the first power rail portion 9050A and the third power rail 9050C are in electric communication. Thus, an electric current can flow from a power source (not shown), along a first length of the first power rail portion 9050A, along the third power rail portion 9050C, and along a second length of the first power rail portion 9050A. Moreover, in some embodiments, the ends of the power rail portions 9050A, 9050B, and 9050C can include a transfer section or the like (e.g., a flared or flanged end) that can allow for a given amount of misalignment between the first power rail portion 9050A or the second power rail portion 9050B and the third power rail portion 9050C.

[1271] In use, a user (e.g., a patient, a therapist, a technician, a doctor, etc.) may want to redirect a trolley disposed along, for example, a length of the first track portion 9620A. As such, the user can cause the trolley to move from a position along the first track portion 9620A to a position along the third track portion 9620C. With the trolley suspended from the third track portion 9620C and with the trolley in electrical communication with the third power rail 9050C, the user can rotate (e.g., either manually or electrically) the turntable 9625 to a position in which the third track portion 9620C is substantially in line with the second track portion 9620B and in which the third power rail portion 9050C is in line with the second power rail portion 9050B. When the third track portion 9620C is substantially aligned with the second track portion 9620B and the third power rail portion 9050C is substantially aligned with the second power rail portion 9050B, the user can cause the trolley to move from the position along the third track portion 9620C to a position along the second track portion 9620B. In this manner, the trolley can be

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turned, switched, rotated, and/or otherwise redirected. Similarly stated, the turntable can be rotated from a first position to a second position to rotate, switch, turn, and/or otherwise redirect the trolley.

[1272] While the patient support system 2000 is described above as including the power rail 2620 configured to provide electrical power to the trolley 2100, in other embodiments, a patient support system can include any suitable power system. For example, FIG. 71 is a schematic illustration of a body weight support system 10000 according to an embodiment. The body weight support system 10000 (also referred to herein as "support system") can be substantially similar in form and/or function to any of the support systems described herein. For example, the support system 10000 includes a trolley 10100 movably suspended from a support track 10050. The support track 10050 and the trolley 10100 can be substantially similar to the support track 2050 and trolley 2100, respectively, described above with reference to FIGS. 2-34. Thus, the support track 10050 and the trolley 10100 are not described in further detail herein.

[1273] The support system 10000 can differ from the support system 2000, however, in the arrangement of the power system 10600. For example, the support system 2000 includes a power rail 2620 that is substantially parallel to the support track 2050 and that is in electrical communication with the trolley 2100 to provide electric power thereto, as described above. In the embodiment shown in FIG. 71, however, the power system 10600 includes a central power source and/or supply 10610 and a power rail 10620 configured to rotate relative to the power source 10610 in response to a movement of the trolley 10100 along the support track 10050, as indicated by the arrow C in FIG. 71. For example, in some embodiments, the power rail 10620 can be a telescoping power rail or the like having a length that is configured to extend or retract (as indicated by the arrow D in FIG. 71) as the trolley 10100 moves along the support track 10050. In other embodiments, the power rail 10620 can be a flexible and/or extendable cable or the like. In this manner, the power rail 10620 can pivot about the power source 10610, to provide substantially continuous electrical power as the trolley 10100 moves along the support track 10050. While the support track 10050 is particularly shown in FIG. 71, it should be understood that the power system 10600 can be used with a support track 10050 having any suitable shape. For example, the power system 10600 can be used with a linear or straight support track, an oval or circular support track, and/or a support track having an irregular shape.

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That is to say, the rotatable and telescoping arrangement of the power rail 10620 can allow the power system 10600 to be used with any suitable support track having any suitable shape.

[1274] The power rail 10620 can include any suitable power conductor, surface, wire, and/or the like. For example, in some embodiments, the power rail 10620 can include one or more inner conductive surfaces similar to the power rail 2620. In other embodiments, the power rail 10620 can be a conduit or the like configured to house a power cable or wire (and/or any suitable electronic communication cable or wire). In still other embodiments, the power rail 10620 can be any suitable tether or the like configured to conduct and/or transmit electric power. By way of example, FIG. 72 illustrates a power rail 11620 according to an embodiment. In such embodiments, the power rail 11620 is a substantially hollow tube including and/or having at least one conductive inner surface 11621. As such, a collector 11770 and/or any other suitable conductive portion of a trolley or support system can be at least partially disposed within the power rail 11620 to place the collector 11770 (or conductor of the trolley) in electric contact with the conductive inner surface 11621 of the power rail 11620, as described in detail above with reference to the support system 2000.

[1275] Alternatively, FIG. 73 illustrates a power rail 12620 according to a different embodiment. As shown, the power rail 1620 is a substantially flat or otherwise unenclosed power rail 1620 having at least one conductive surface 12621 that is substantially open or exposed. In such embodiments, a collector 12770 and/or any suitable conductive portion of a trolley or support system can be disposed adjacent to and/or otherwise can be positioned such that the collector 12770 (or conductor of the trolley) is in electric contact with the exposed and/or otherwise available conductive surface 12621 of the power rail 12620. In some embodiments, such an arrangement can allow, for example, the power rail 12620 to be coupled to and/or integrated with a support track (not shown in FIG. 73) along which the trolley moves. In other embodiments, the power rail 12620 can be offset from a support track as described, for example, with reference to the support system 2000.

[1276] While the power rails 2620, 10620, 11620, and/or 12620 are specifically described above as being independent of a corresponding support track, in other embodiments, a support track can include one or more conductive surfaces and/or members configured to supply electric

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power to a portion of a trolley suspended therefrom. Moreover, while the power rails 2620, 10620, 11620, and 12620 are described above as providing electric power to the respective support systems, in some embodiments, a support system can include one or more batteries, battery systems, capacitors, energy storage devices, uninterruptible power supplies (UPS), and/or the like configured to store and/or provide electric power to one or more components or devices of the support system. For example, as described above, a support system can include a UPS electrically connected in any suitable position and/or configuration within the support system to provide a primary or a backup flow of electric power to one or more components or devices (e.g., a power supply, a trolley, a compute device, a controller, a secondary training device such as a treadmill, etc.). Thus, such a UPS (or any other suitable form of energy storage or backup device) can be configured to provide uninterrupted electric power to the support system and/or at least a portion thereof.

[1277] While various embodiments have been described above, it should be understood that they have been presented by way of example only, and not limitation, and as such, various changes in form and/or detail may be made. For example, while the trolley 2100 is described above with reference to FIGS. 2-33 as having a particular shape, size, and/or configuration, it should be understood that changes in size, shape, configuration, and/or arrangement of one or more components can be made without altering the functionality thereof. By way of example, FIGS. 74-76 illustrate a trolley 12100 according to an embodiment. The trolley 12100 can be substantially similar in form and/or function to the trolley 2100 described above with reference to FIGS. 2-33. For example, the trolley 2100 includes a drive system 12300 configured to movably suspend the trolley 12100 from a support track (not shown in FIGS. 74-76) and a support mechanism 12500 that includes a tether 12505 configured to attach to a harness or the like worn by a user to couple the user to the support mechanism 12500. In this embodiment, the drive system 12300 and the support mechanism 12500 can be substantially similar in at least form and/or function to the drive system 2300 and support mechanism 2500, respectively, of the trolley 2100.

[1278] The trolley 12100 shown in FIGS. 74-76 can differ from the trolley 2100 shown in FIGS. 2-33, however, by including a cover 12260 having a size, shape, and/or configuration that is different from the cover 2260 of the trolley 2100. For example, the cover 12260 defines a

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notch 12267 configured to receive a portion of the support mechanism 12500 (e.g., a portion of a cam assembly or the like), as shown in FIGS. 74 and 75. In addition, the cover 12260 defines an opening 12266 through which at least a portion of the tether 12505 can extend to allow an end portion of the tether 12505 to be coupled to a patient attachment mechanism and/or harness worn by the user and/or patient, as shown in FIG. 76. Accordingly, while the cover 12260 shown in FIGS. 74-76 varies in shape, size, and/or configuration from the cover 2260 (see e.g., FIGS. 4-9), the covers 2260 and 12260 can function in a substantially similar manner to enclose, cover, and/or house at least a portion of the trollies 2100 and 12100, respectively.

[1279] As another example, while the attachment mechanism 2800 is described above with reference to FIG. 34 as including energy storage members 2850, in other embodiments, an attachment mechanism need not include an energy storage member. In such embodiments, the attachment mechanism can be coupled to, for example, the trolley 2100 and the further coupled to a harness or the like worn by a patient. In such embodiments, the trolley 2100 can function in a substantially similar manner as described above.

[1280] Although the trolley 2100 is described above with reference to FIGS. 2-33 as including a motorized drive system 2300 and an active support mechanism 2500, in other embodiments, a trolley can include either a motorized drive system or an active support mechanism. Similarly stated, the drive system 2300 and the support mechanism 2500 can be mutually exclusive and can independently function in a similar manner to those described above.

[1281] Any portion of the apparatus and/or methods described herein may be combined in any suitable combination, unless explicitly expressed otherwise. For example, in some embodiments, the patient support mechanism 2500 of the trolley 2100 included in the support system 2000 can be replaced with a system similar to the support system 3900. In such embodiments, a cylinder, a piston, and an energy storage member can extend, for example, from the base 2210 of the housing 2200 of the trolley 2100. Expanding further, the kinetic and potential energy of the energy storage member (e.g., storage member 3960) could be actively controlled via a feedback system similar to the system described above with reference to the trolley 2100. For example, the energy storage member 3960 could be compressed air, the pressure of which could be controlled in response to a force exerted on the piston.

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[1282] Any of the systems and/or devices described herein can be used in any suitable method to provide support to a user, for example, during gait training and/or the like. For example, FIG. 77 is a flowchart illustrating a method 10 of using a body weight support system according to an embodiment. The body weight support system can be similar to any of the support systems described herein. In some embodiments, for example, the support system can be substantially similar to the support system 2000 described in detail above with reference to FIGS. 2-33. As such, the support system can include a trolley (e.g., similar to the trolley 2100) or the like configured to be movably suspended from a support track. The support system can include a patient support mechanism (e.g., similar to the support mechanism 2500) that has a tether configured to be coupled to an attachment device worn by or otherwise coupled to a user. As such, coupling the tether to the attachment device, in turn, can couple the user to the body weight support system and/or at least the trolley included therein.

[1283] The method 10 includes defining a reference length of the tether when the tether is coupled to the attachment device and the attachment device is in an initial position, at 11. For example, as described above with reference to FIGS. 59 and 60, a user, therapist, trainer, etc. can input, provide, and/or otherwise define a "zero point" or reference point associated with a neutral position of the attachment device, which in turn, is associated with and/or corresponds to a determined or determinable length of the tether. In addition, 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, at 12.

[1284] As described in detail above, the body weight support system is configured to support at least a portion of the user's weight during use (e.g., gait training). As shown in FIG. 77, the method 10 includes providing a first amount of body weight support during the gait training as the user moves relative to and/or on a surface (e.g., the floor or ground, or along or on a training device such as a treadmill) and the length of the tether is less than the threshold length of the tether, at 13. For example, as described above, the first amount of body weight support can be an amount of support provided to the user when the user is standing, walking, running, and/or otherwise not actively falling. In some embodiments, the first amount of body weight support can be, for example, zero support. That is to say, the tether can couple the user to the body weight support system but, in some instances, the body weight support system may not provide

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support unless the user is falling and/or unless the system is otherwise engaged to do so. In other embodiments, the first amount of support can be a non-zero portion of the user's weight including, for example, some or substantially all of the user's weight.

[1285] A second amount of body weight support is provided during the gait training as the user moves relative to and/or on the surface and the length of the tether is greater than the threshold length of the tether, at 14. For example, as described above, the body weight support system can be configured to respond, react, and/or otherwise support a user in response to a change in force applied by the user on the tether, in response to the user moving relative to the body weight support system, in response to the user falling, and/or the like. More particularly, in this example, the body weight support system can be configured to provide the second amount of body weight support in response to a change (e.g., an increase) in the length of the tether such that the length is greater than the threshold length. That is to say, the body weight support system can be configured to provide the second amount of body weight support in response to the user falling.

[1286] The method 10 further includes displaying data associated with the gait training on a display of an electronic device included in the body weight support system, at 15. For example, as described above with reference to FIGS. 50-69, the body weight support system can be configured present data in the form of graphs, charts, user interfaces, etc. that can provide a user and/or a therapist or trainer with information regarding one or more training sessions (as described in detail above). Accordingly, the user, therapist, trainer, etc. can review the data to determine, for example, one or more characteristics associated with the user's gait and/or his or her performance, improvement, deficits, strengths, etc. during the gait training.

[1287] FIG. 78 is a flowchart illustrating a method 20 of using a body weight support system according to another embodiment. The body weight support system can be similar to any of the support systems described herein (e.g., the support system 2000 described in detail above with reference to FIGS. 2-33). As such, the support system can include a trolley (e.g., similar to the trolley 2100) or the like configured to be movably suspended from a support track. The support system can include a patient support mechanism (e.g., similar to the support mechanism 2500) that has a tether configured to be coupled to an attachment device worn by or otherwise coupled

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to a user. As such, coupling the tether to the attachment device, in turn, can couple the user to the body weight support system and/or at least the trolley included therein.

[1288] The method 20 includes defining a reference length of the tether when the tether is coupled to the attachment device and the attachment device is in an initial position, at 21. For example, as described above with reference to FIGS. 59 and 60, a user, therapist, trainer, etc. can input, provide, and/or otherwise define a "zero point" or reference point associated with a neutral position of the attachment device, which in turn, is associated with and/or corresponds to a determined or determinable length of the tether. In addition, the user, therapist, trainer, etc. can provide an input, selection, instruction, etc. operable to cause the support system to define a first criterion associated with a change in a length of the tether, at 22; can provide an input, selection, instruction, etc. operable to cause the support system to define a second criterion associated with a change in a length of the tether, at 23; and can provide an input, selection, instruction, etc. operable to cause the support system to define an amount of bodyweight support to provide in response to the user falling during the gait training, at 24. For example, in some embodiments, the first criterion can be a rate of change in the length of the tether and the second criterion can be a duration of the change in the length of the tether. In other embodiments, the first criterion and the second criterion can be any suitable criteria(ion). The amount of body weight to support can be any suitable portion of the user's body weight. In some instances, for example, the amount of body weight support can be expressed as a percentage of the user's weight (e.g., 0%, 10%, 20%, 30%, etc.). In other instances, the amount of the body weight support can be expressed as a weight term (e.g., in pounds or kilograms).

[1289] The method 20 includes determining whether a fall has occurred based on the first criterion and the second criterion being satisfied, at 25. For example, during gait training, the user may move relative to and/or walk on a surface, which in turn, can result in a change in force exerted on the tether (as described in detail above). In some instances, the user falling during gait training can result in an increase in the force exerted by the user on the tether that results in a relatively high rate of change in a length of at least a portion of the tether, which in turn, can be sufficient to satisfy the first criterion. In some instances, however, a similar rate of change in the length of the tether may result from the user's movement when not falling (e.g., if the user sits down or stands up, bends down, ascends or descends a ramp, stairs, or platform, and/or the like).

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Thus, to avoid falsely defining or falsely determining the occurrence of a fall, the support system can be configured such that a fall is defined and/or determined in response to satisfying both the first criterion (e.g., the rate of change in the length of the tether) and the second criterion (e.g., a duration of the change in the length of the tether or the amount of time it takes for the change in the length of the tether). Furthermore, the amount of body weight support can be provided when the first criterion and the second criterion are satisfied, at 26.

[1290] FIG. 79 is a flowchart illustrating a method 30 of using a body weight support system according to another embodiment. The body weight support system can be similar to any of the support systems described herein (e.g., the support system 2000 described in detail above with reference to FIGS. 2-33). As such, the support system can include a trolley (e.g., similar to the trolley 2100) or the like configured to be movably suspended from a support track. The support system can include a patient support mechanism (e.g., similar to the support mechanism 2500) that has a tether configured to be coupled to an attachment device worn by or otherwise coupled to a user. As such, coupling the tether to the attachment device, in turn, can couple the user to the body weight support system and/or at least the trolley included therein.

[1291] The method 30 includes defining a reference length of the tether when the tether is coupled to the attachment device and the attachment device is in an initial position, at 31. For example, as described above with reference to FIGS. 59 and 60, a user, therapist, trainer, etc. can input, provide, and/or otherwise define a "zero point" or reference point associated with a neutral position of the attachment device, which in turn, is associated with and/or corresponds to a determined or determinable length of the tether. In addition, 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, at 32; and can provide an input, selection, instruction, etc. operable to cause the support system to define a threshold number of falls during the gait therapy, at 33.

[1292] The method 30 includes providing a predetermined amount of body weight support during the gait training as the user moves relative to and/or on a surface (e.g., the floor or ground, or relative to or on a training device such as a treadmill) and the number of falls is less

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than the threshold number of falls, at 34. For example, as described above, the predetermined amount of body weight support can be an amount of support provided to the user when the user is standing, walking, running, and/or otherwise not actively falling. In some embodiments, the first amount of body weight support can be, for example, zero support. That is to say, the tether can couple the user to the body weight support system but, in some instances, the body weight support system may not provide support unless the user is falling and/or unless the system is otherwise engaged to do so. In other embodiments, the first amount of support can be a non-zero portion of the user's weight including, for example, some or substantially all of the user's weight (e.g., expressed or represented as a percentage of the user's weight or as a weight value in pounds or kilograms).

[1293] In some instances, the predetermined amount of body weight support provided to the user during the gait training is increased in response to the threshold number of falls being met, at 35. For example, in some instances, repeated falls by the user may indicate that the user would benefit from more body weight support. Thus, the body weight support system can increase the amount of support provided to the user. In some instances, the amount of increase can be predetermined increase in the amount of support (e.g., a 1% increase, a 5% increase, a 10 % increase, a 20% increase, etc.). In other instances, the amount of increase can be calculated based on characteristics associated with the user's performance during the gait training. In sill other instances, the amount of increase can be input by the user, therapist, trainer, etc.

[1294] The method 30 further includes displaying data associated with the gait training on a display of an electronic device included in the body weight support system, at 35. For example, as described above with reference to FIGS. 50-69, the body weight support system can be configured present data in the form of graphs, charts, user interfaces, etc. that can provide a user and/or a therapist or trainer with information regarding one or more training sessions (as described in detail above). Accordingly, the user, therapist, trainer, etc. can review the data to determine, for example, one or more characteristics associated with the user's gait and/or his or her performance, improvement, deficits, strengths, etc. during the gait training.

[1295] Where methods and/or schematics described above indicate certain events and/or flow patterns occurring in certain order, the ordering of certain events and/or flow patterns may

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be modified. Additionally, certain events may be performed concurrently in parallel processes when possible, as well as performed sequentially.

[1296] Some embodiments described herein relate to a computer storage product with a non-transitory computer-readable medium (also can be referred to as a non-transitory processor-readable medium) having instructions or computer code thereon for performing various computer-implemented operations. The computer-readable medium (or processor-readable medium) is non-transitory in the sense that it does not include transitory propagating signals (e.g., propagating electromagnetic wave carrying information on a transmission medium such as space or a cable). The media and computer code (also referred to herein as code) may be those designed and constructed for the specific purpose or purposes. Examples of non-transitory computer-readable media include, but are not limited to: magnetic storage media such as hard disks, optical storage media such as Compact Disc/Digital Video Discs (CD/DVDs), Compact Disc-Read Only Memories (CD-ROMs), magneto-optical storage media such as optical disks, carrier wave signal processing modules, and hardware devices that are specially configured to store and execute program code, such as Application-Specific Integrated Circuits (ASICs), Programmable Logic Devices (PLDs), Read-Only Memory (ROM) and Random-Access Memory (RAM) devices. Other embodiments described herein relate to a computer program product, which can include, for example, the instructions and/or computer code discussed herein.

[1297] Examples of computer code include, but are not limited to, micro-code or micro-instructions, machine instructions, such as produced by a compiler, code used to produce a web service, and files containing higher-level instructions that are executed by a computer using an interpreter. For example, embodiments may be implemented using imperative programming languages (e.g., C, FORTRAN, etc.), functional programming languages (Haskell, Erlang, etc.), logical programming languages (e.g., Prolog), object-oriented programming languages (e.g., Java, C++, etc.), or other programming languages and/or other development tools. Additional examples of computer code include, but are not limited to, control signals, encrypted code, and compressed code.

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What is claimed is:

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 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; 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 4, wherein the body weight support system includes a drive assembly configured to movably 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

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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.

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

7. The method of claim 6, wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill.

8. A method of using a body weight support system to provide body weight support during gait training, the body weight support system including 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;

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.

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

10. The method of claim 8, wherein the second criterion is a duration during which the length of the tether is changed.

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

12. The method of claim 8, 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 bodily 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.

13. The method of claim 8, further comprising:

redefining the reference length of the tether in response to a change in the length of the tether that does not satisfy at least one of the first criterion or the second criterion.

14. A method of using a body weight support system to provide body weight support during gait training, the body weight support system including 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, the threshold length of the tether being associated with the user falling during the gait training;

defining a threshold number of falls during the gait training;

providing a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls;

increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met; and

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

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15. The method of claim 14, wherein the surface relative to which the user moves is a stationary surface.

16. The method of claim 15, wherein the body weight support system includes a drive assembly configured to movably 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.

17. The method of claim 14, wherein the surface relative to which the user moves is a moving surface included in a treadmill.

18. The method of claim 17, wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill.

19. The method of claim 14, wherein providing the predetermined amount of body weight support during the gait training as the user moves relative to the surface is in response to a length of the tether exceeding the threshold length of the tether.

20. The method of claim 14, wherein the reference length of the tether is a first reference length of the tether, the method further comprising:

defining a second reference length of the tether in response to the threshold number of falls being met, the second reference length of the tether being shorter than the first reference length of the tether.

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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. A second amount of body weight support is provided during the gait training as the user moves relative to the surface and the length of the tether is greater than the threshold length. The method further includes displaying data associated with the gait training on a display of an electronic device.

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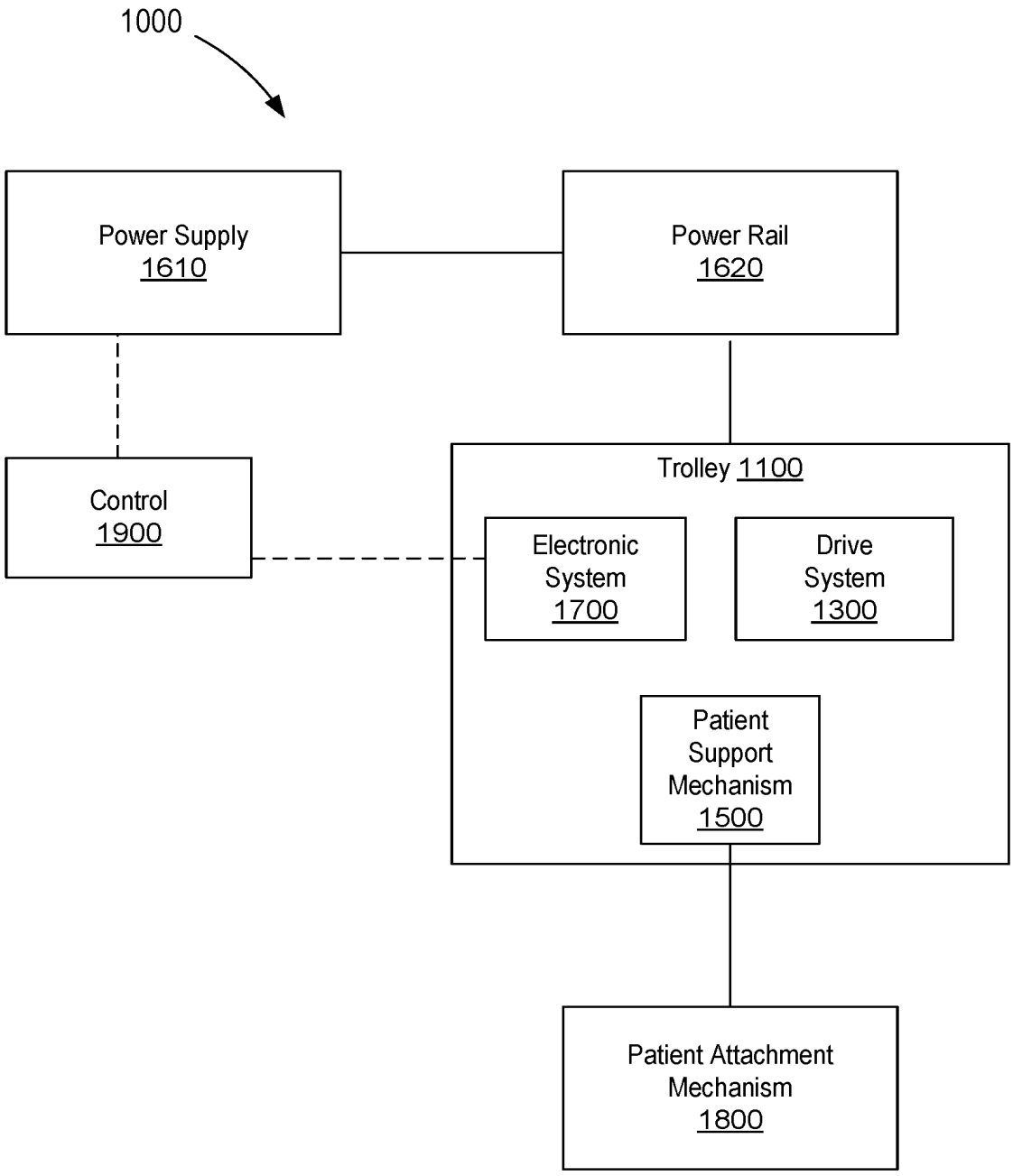

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1610
Power Rail
1620
Control
1900
Trolley 1100
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Drive
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1300
Patient
Support
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1500
Patient Attachment
Mechanism
1800

FIG. 1

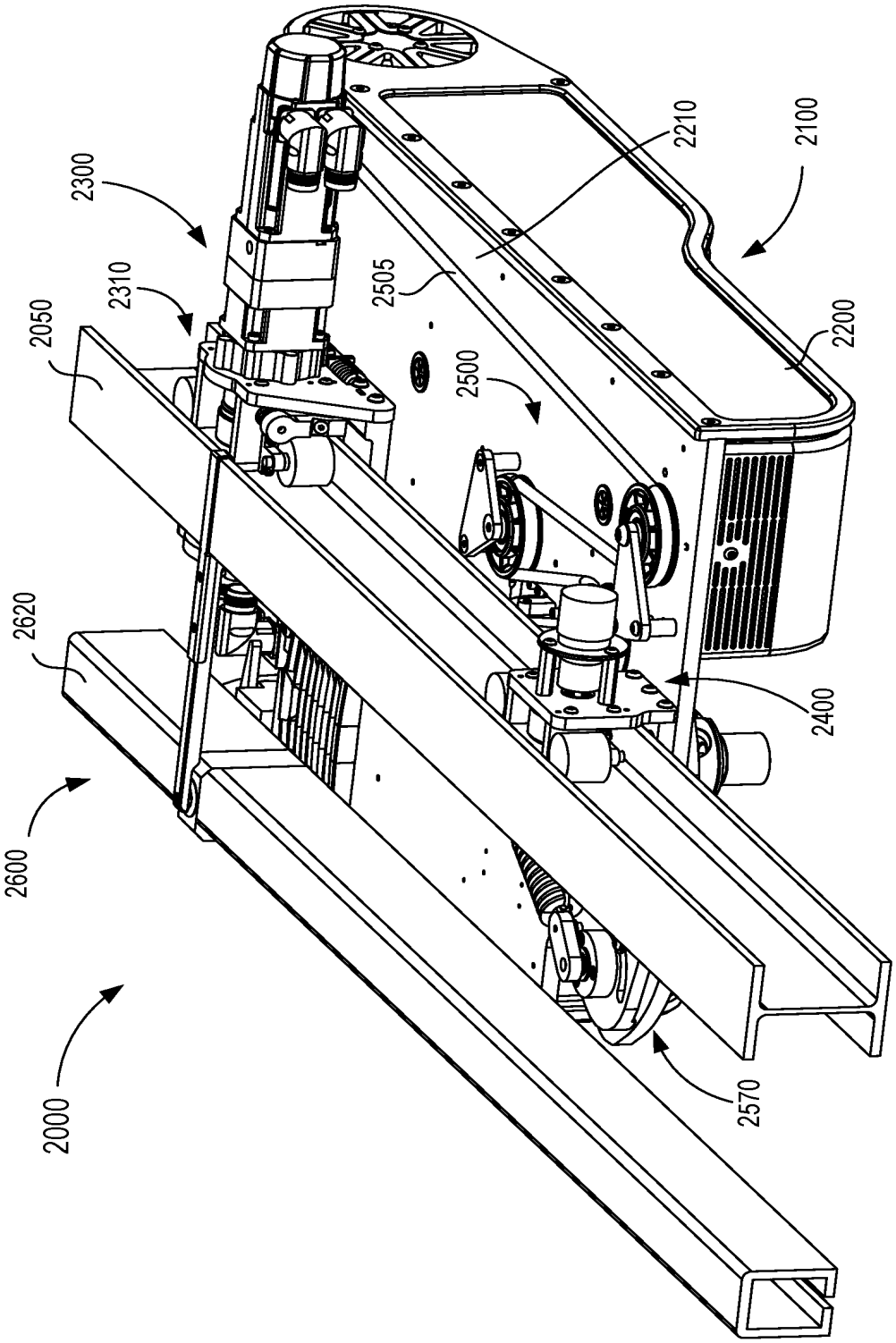

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FIG. 2

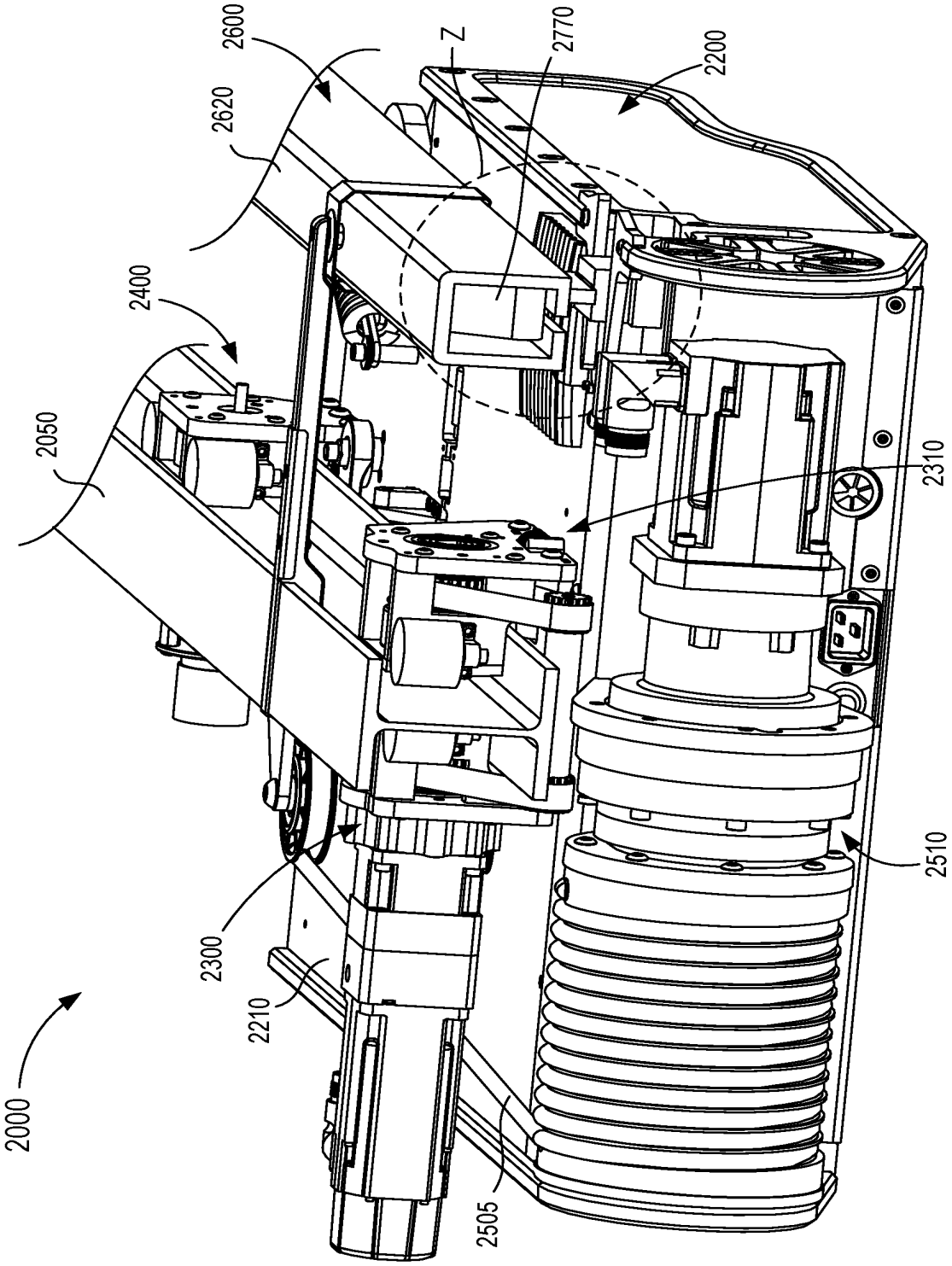


FIG. 3

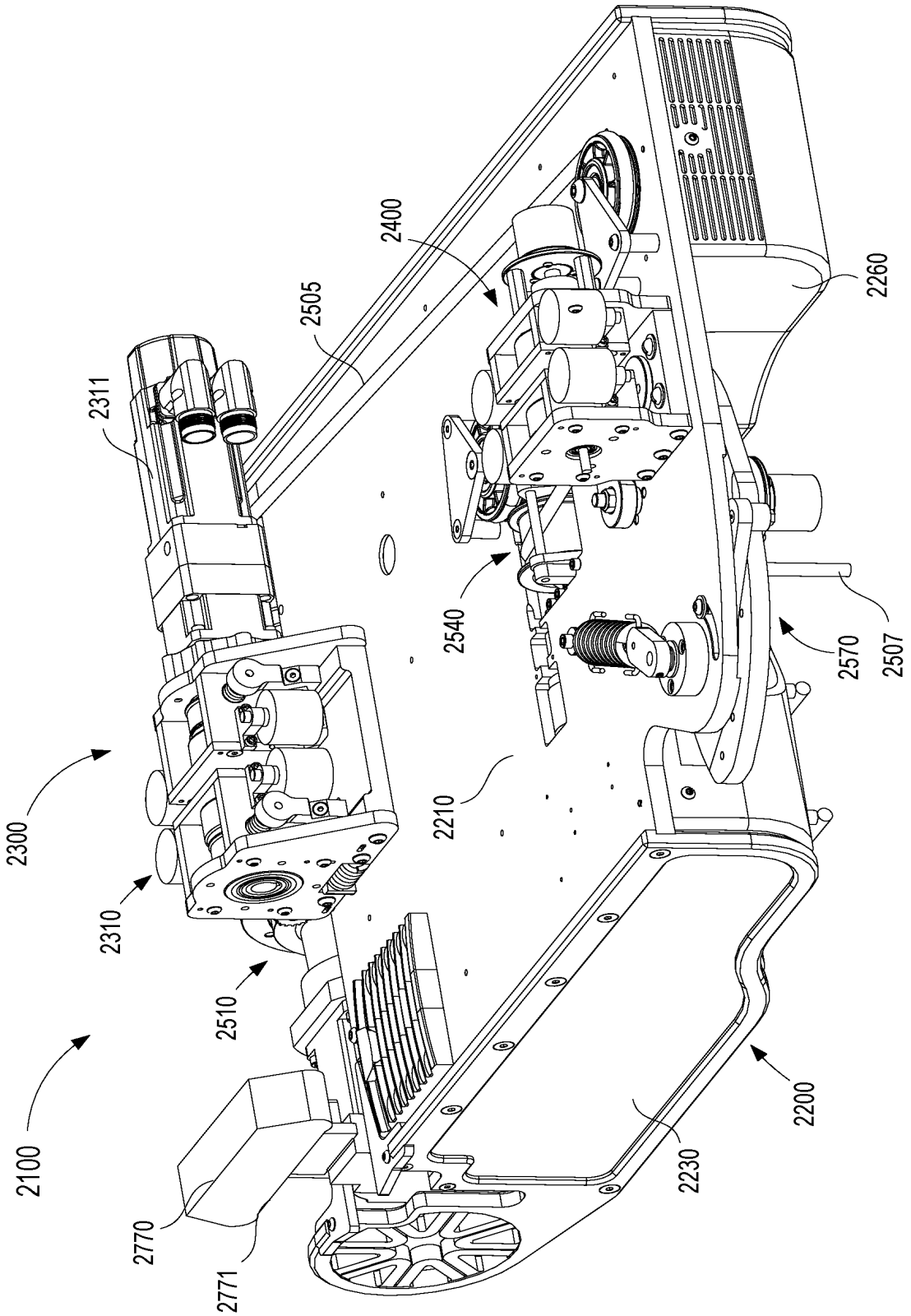

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FIG. 4

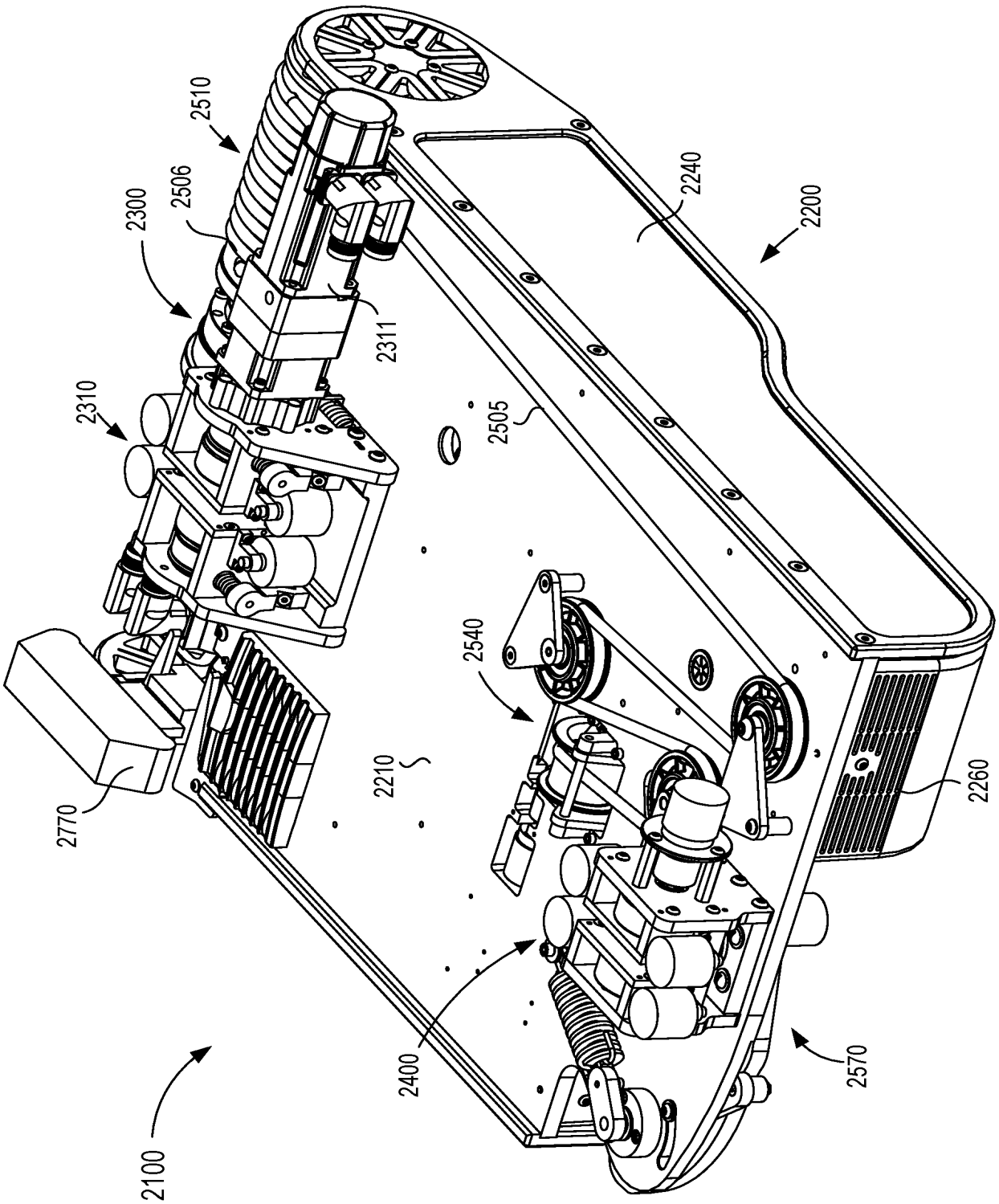

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FIG. 5

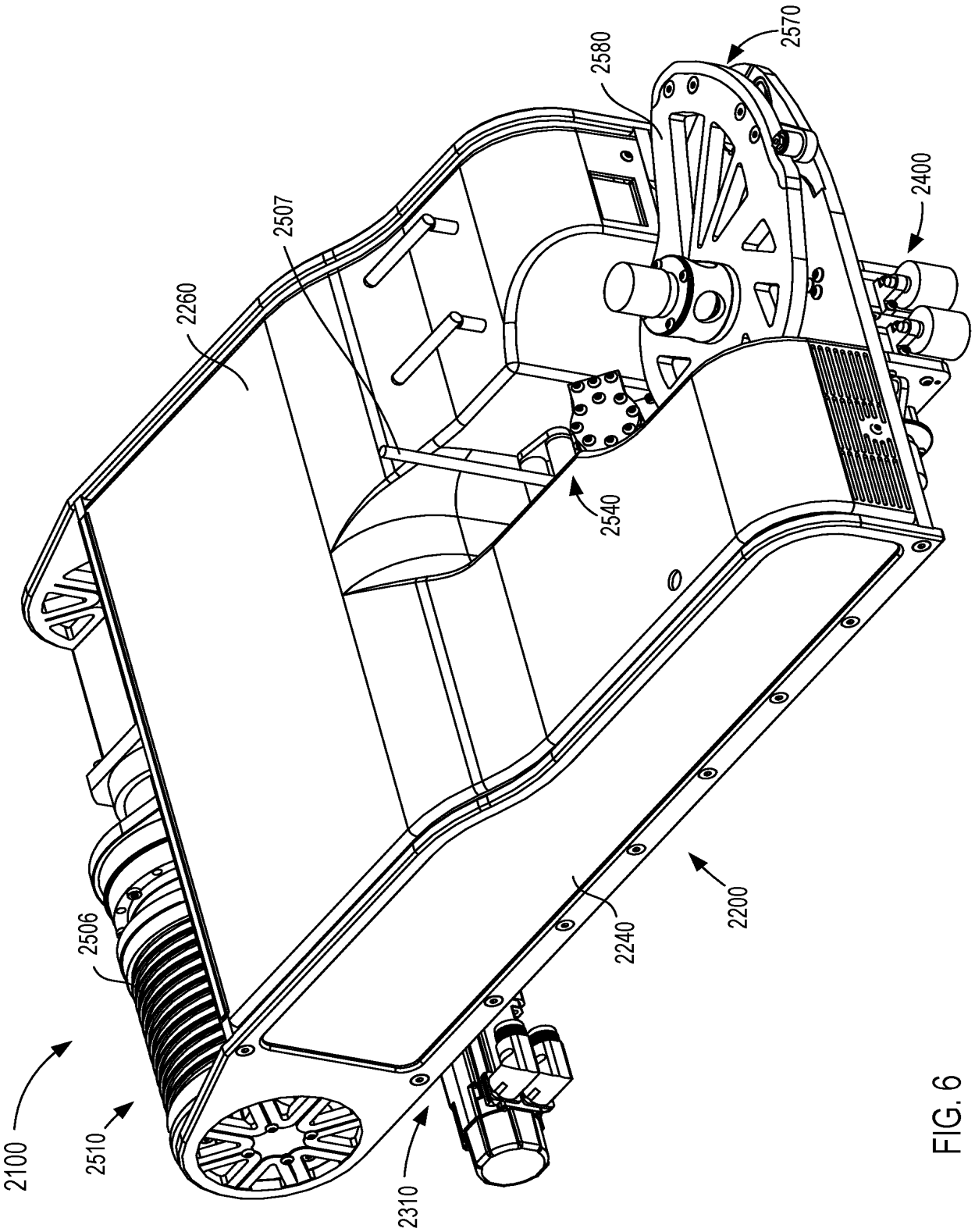


FIG. 6

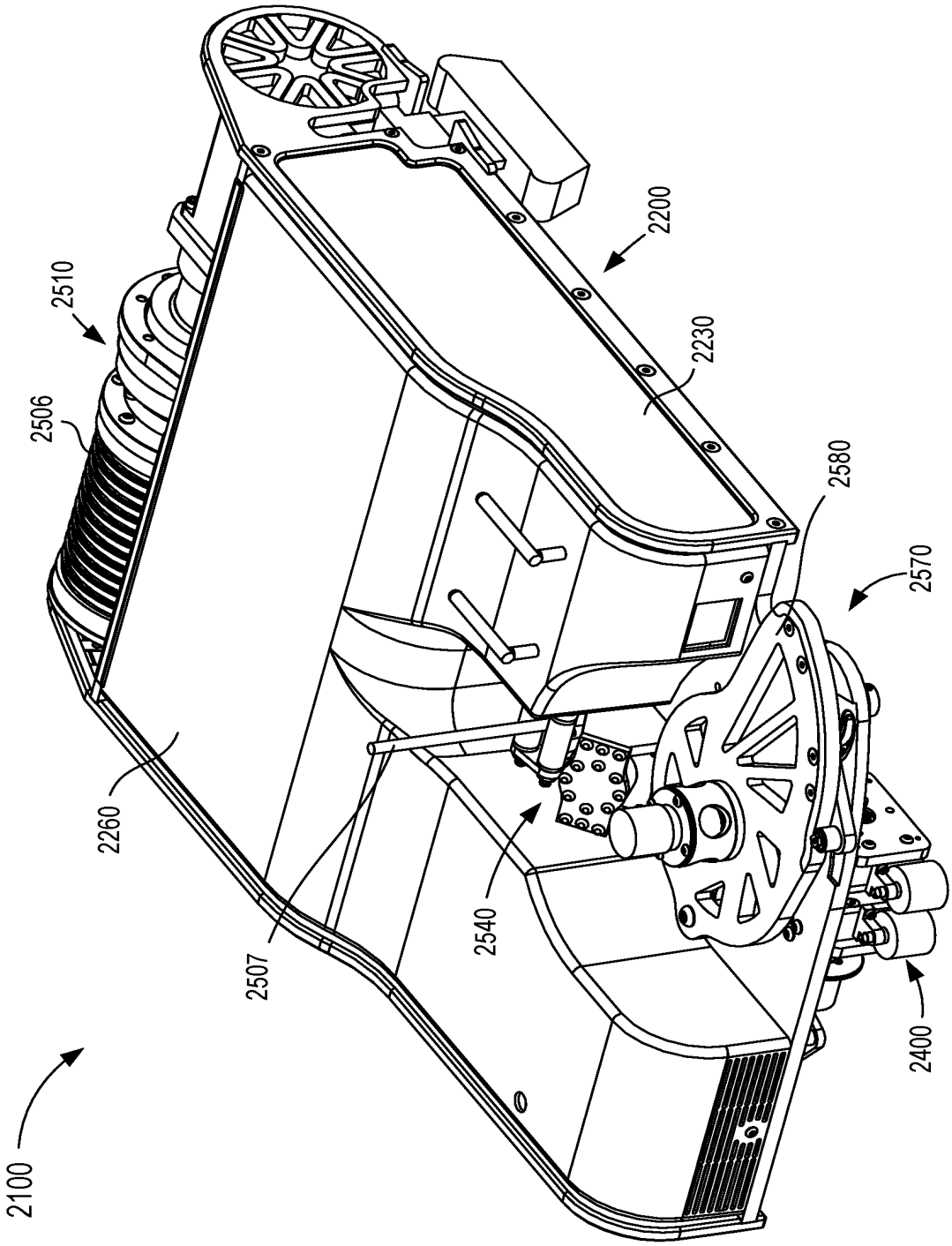


FIG. 7

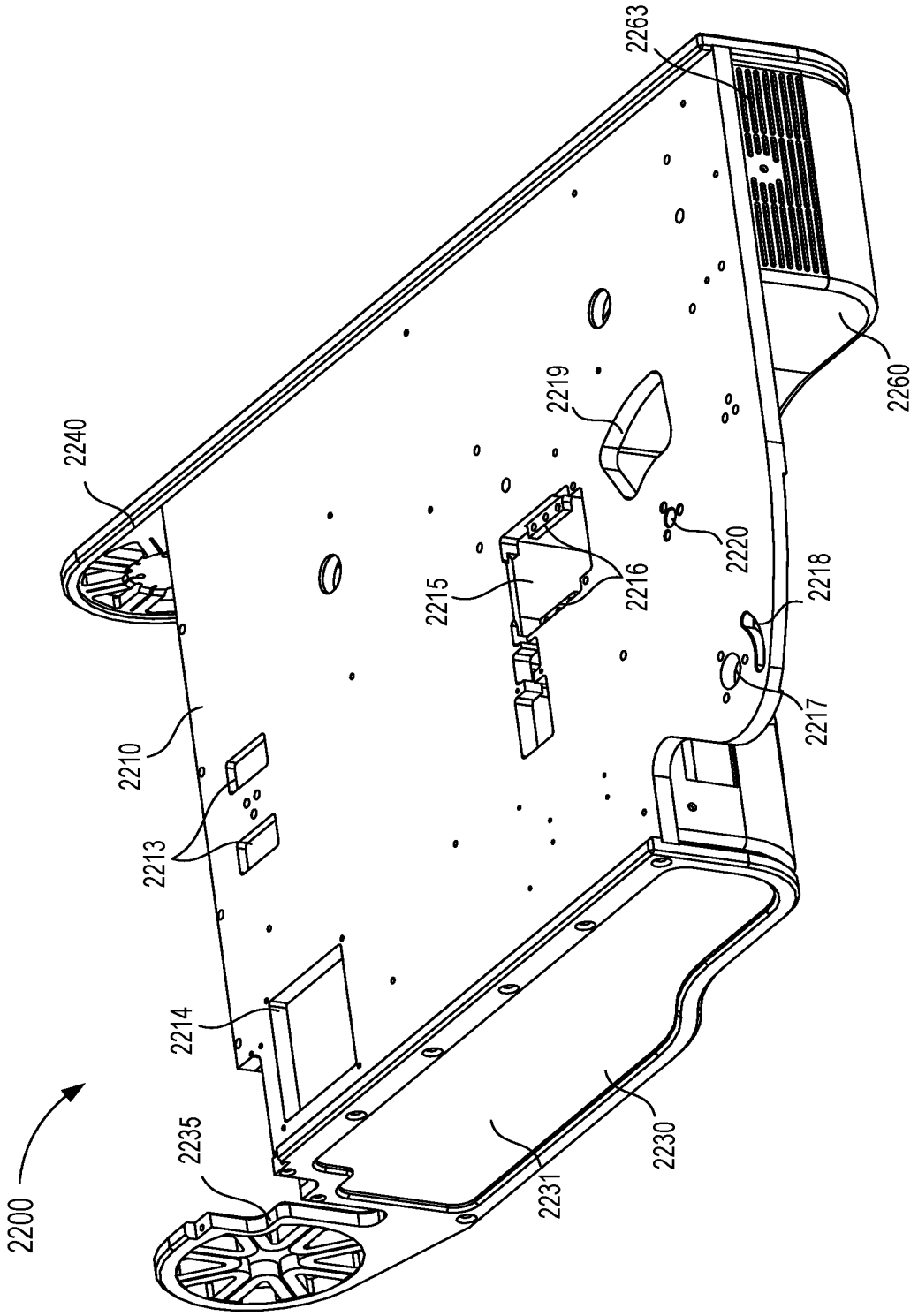

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FIG. 8

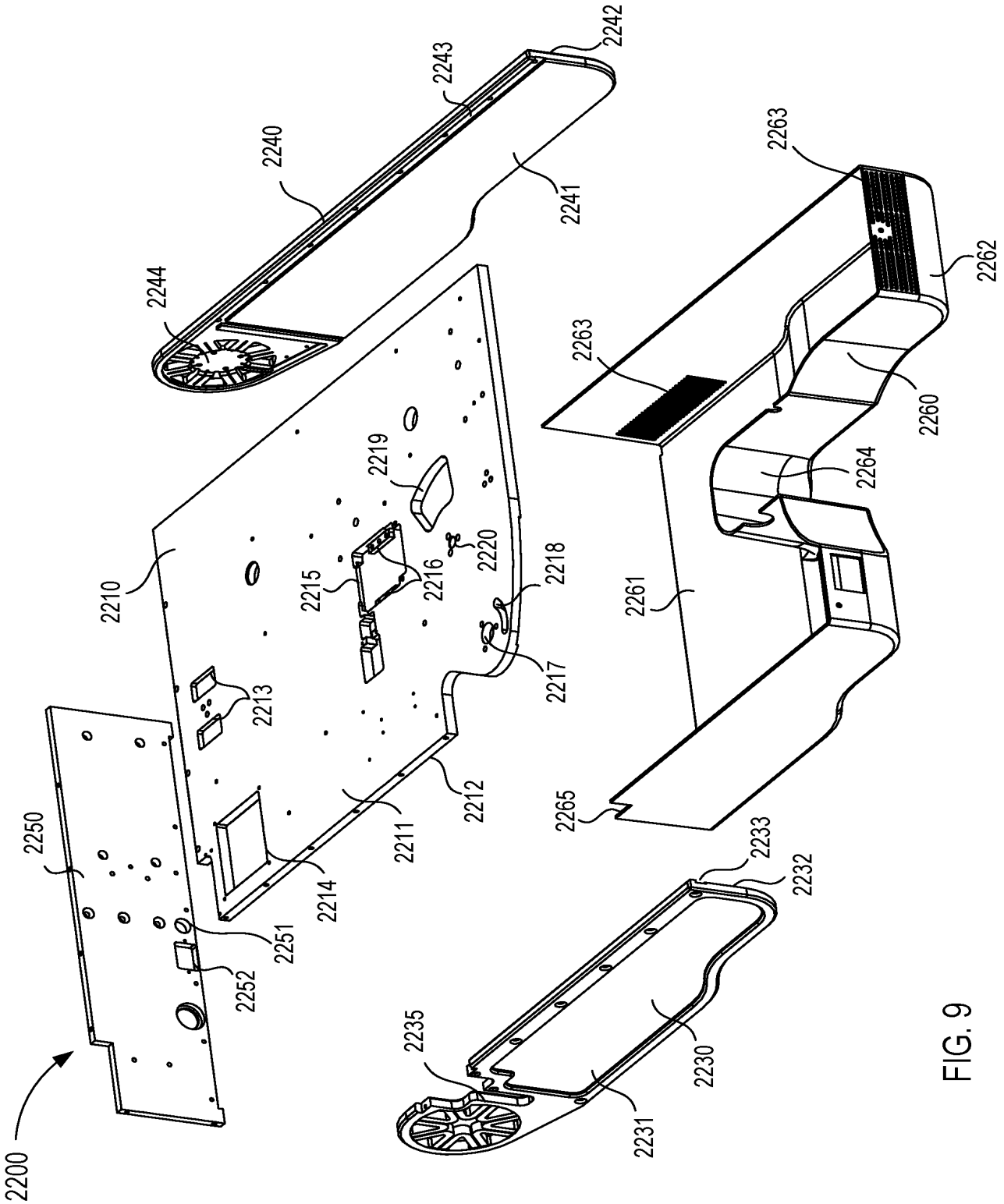

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FIG. 9

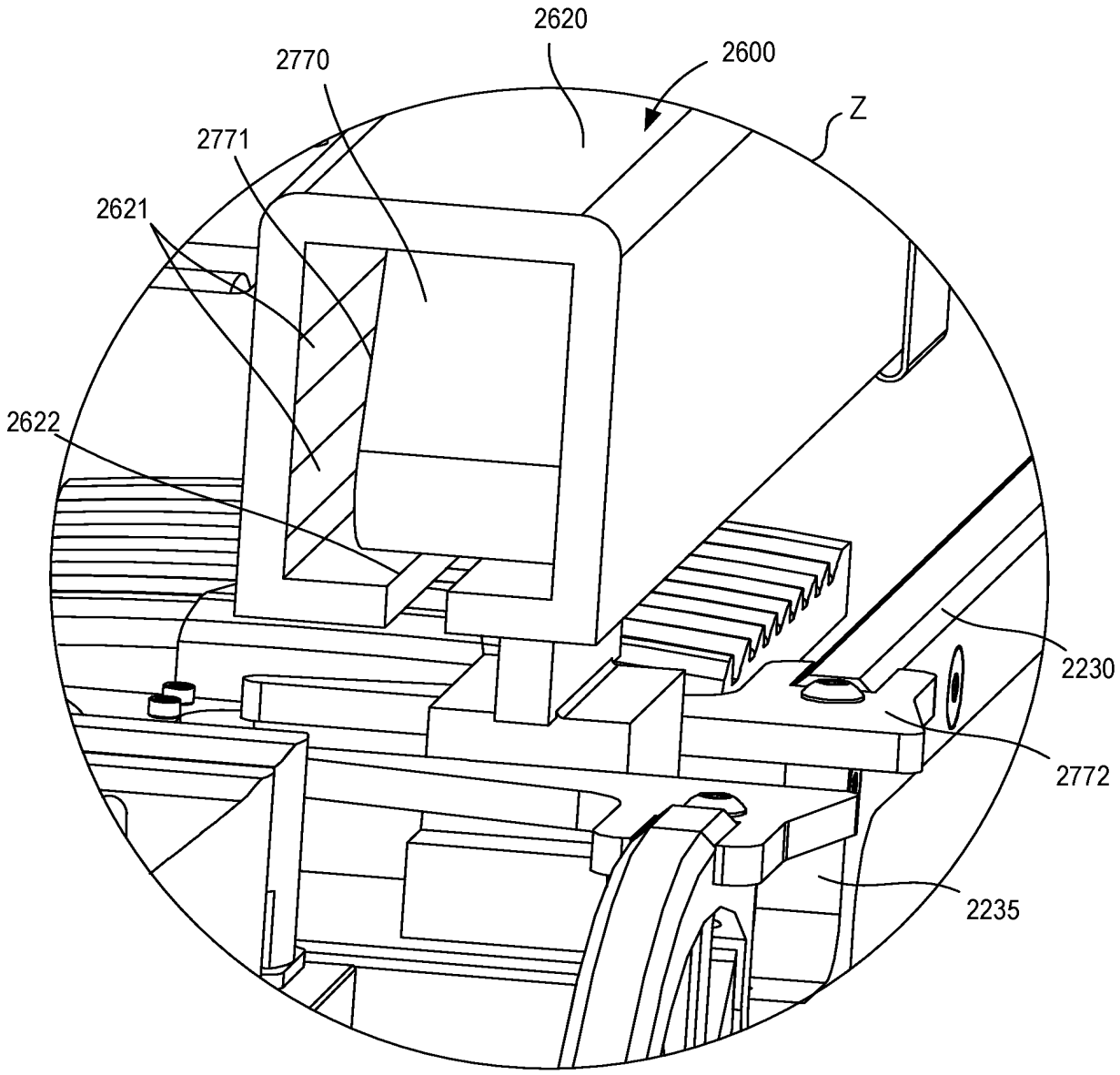


FIG. 10

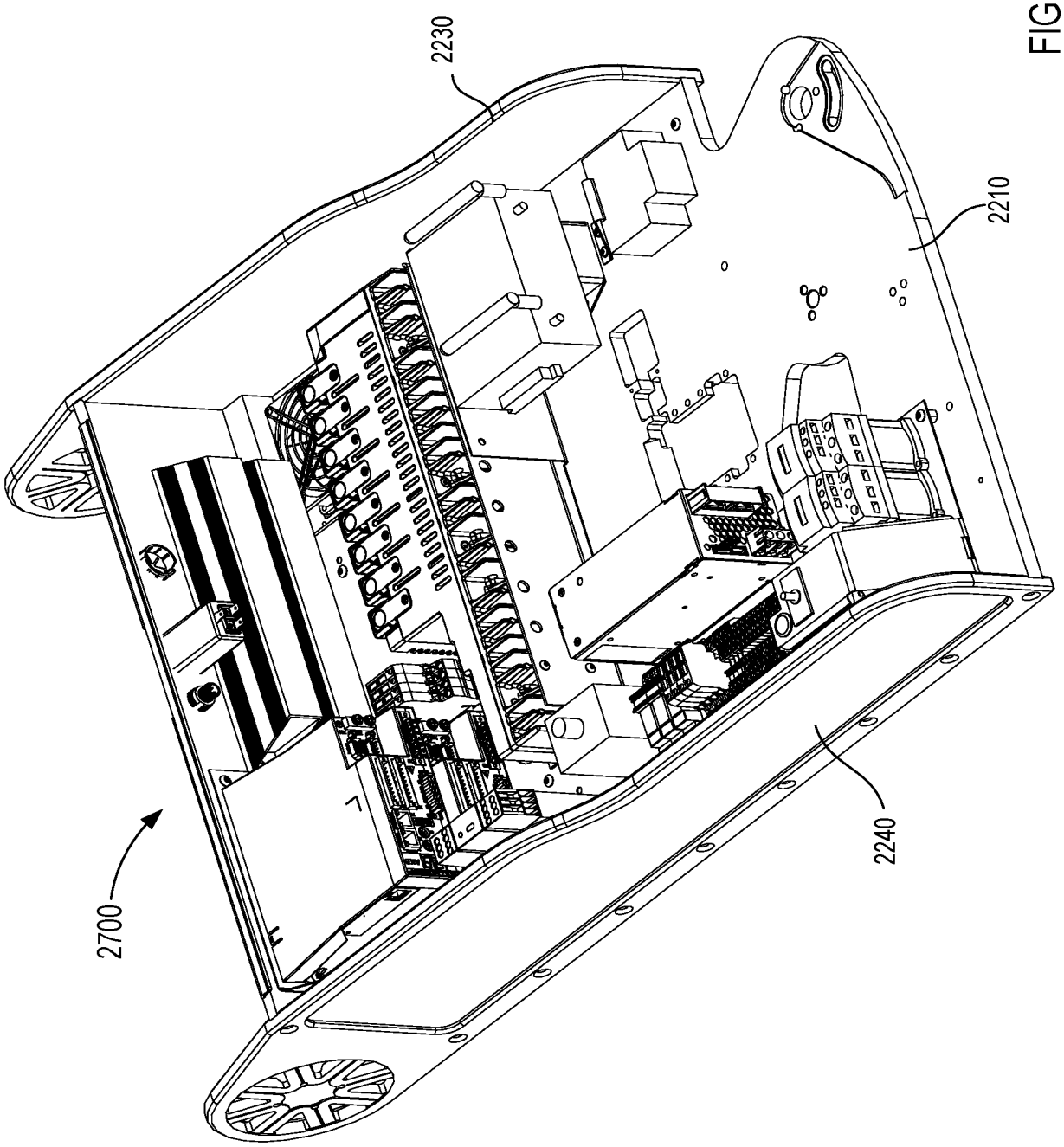


FIG. 11

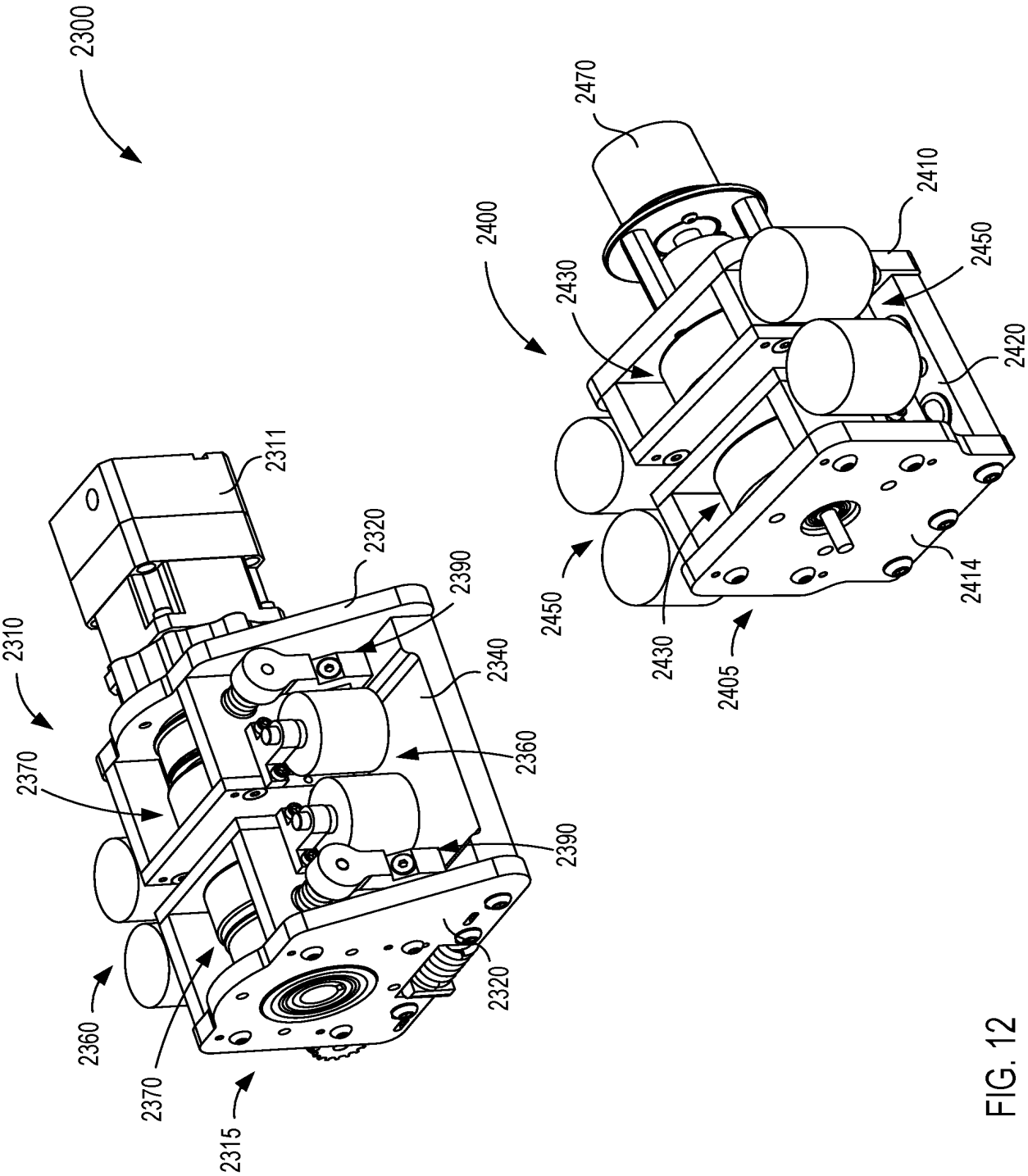

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FIG. 12

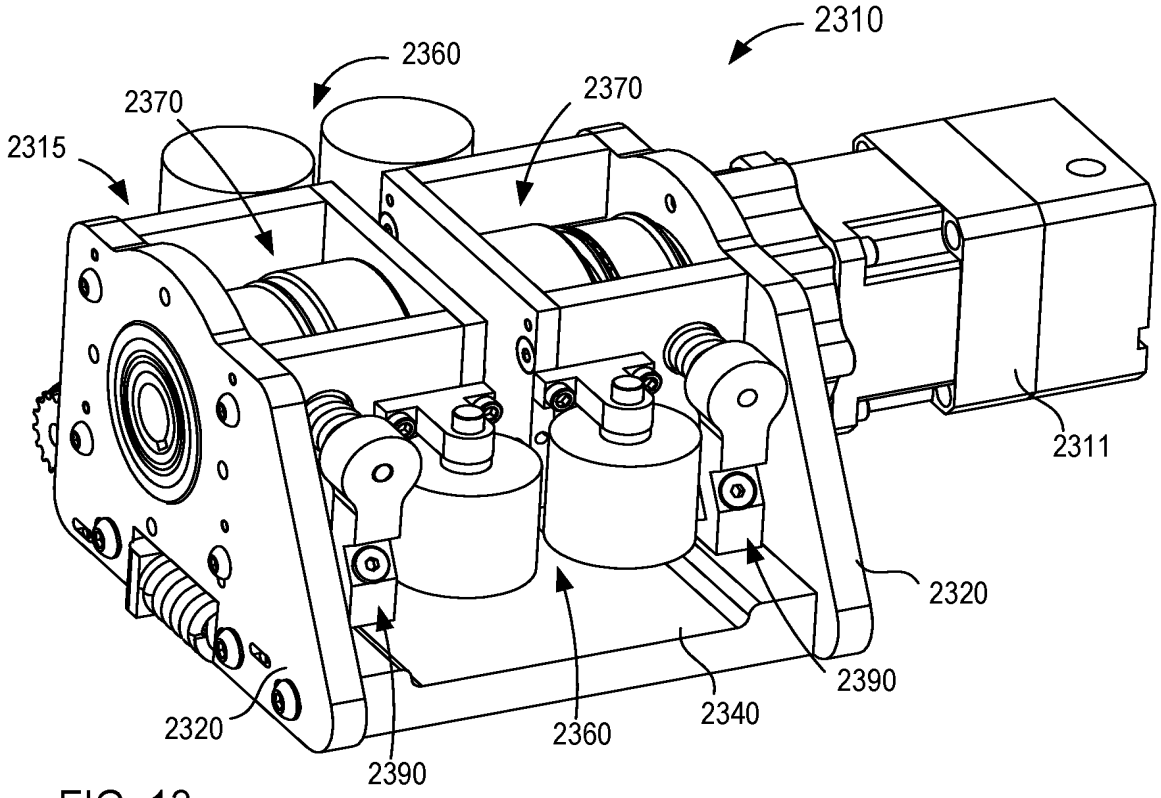

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2390

FIG. 13

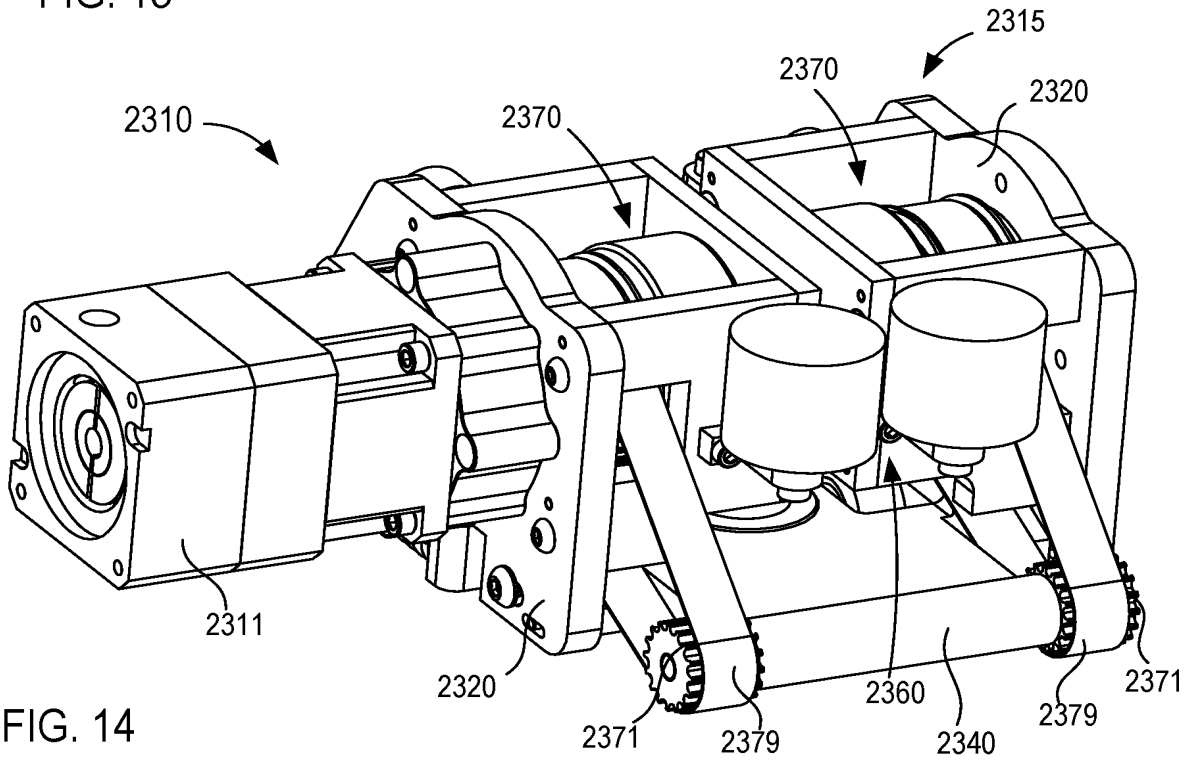

2315
2370
2320
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2311
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2379
2360
2340
2379
2371

FIG. 14

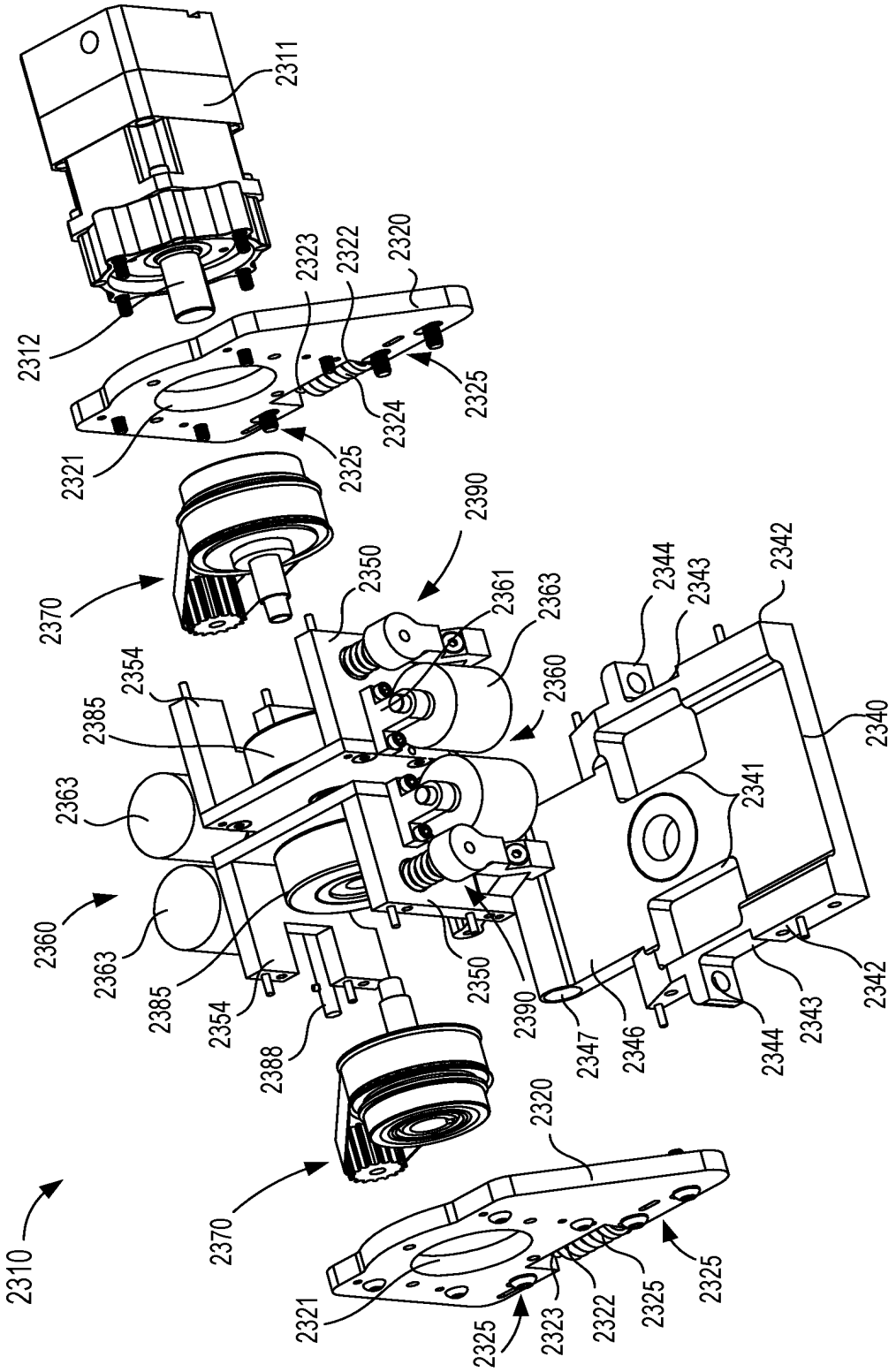

2310
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FIG. 15

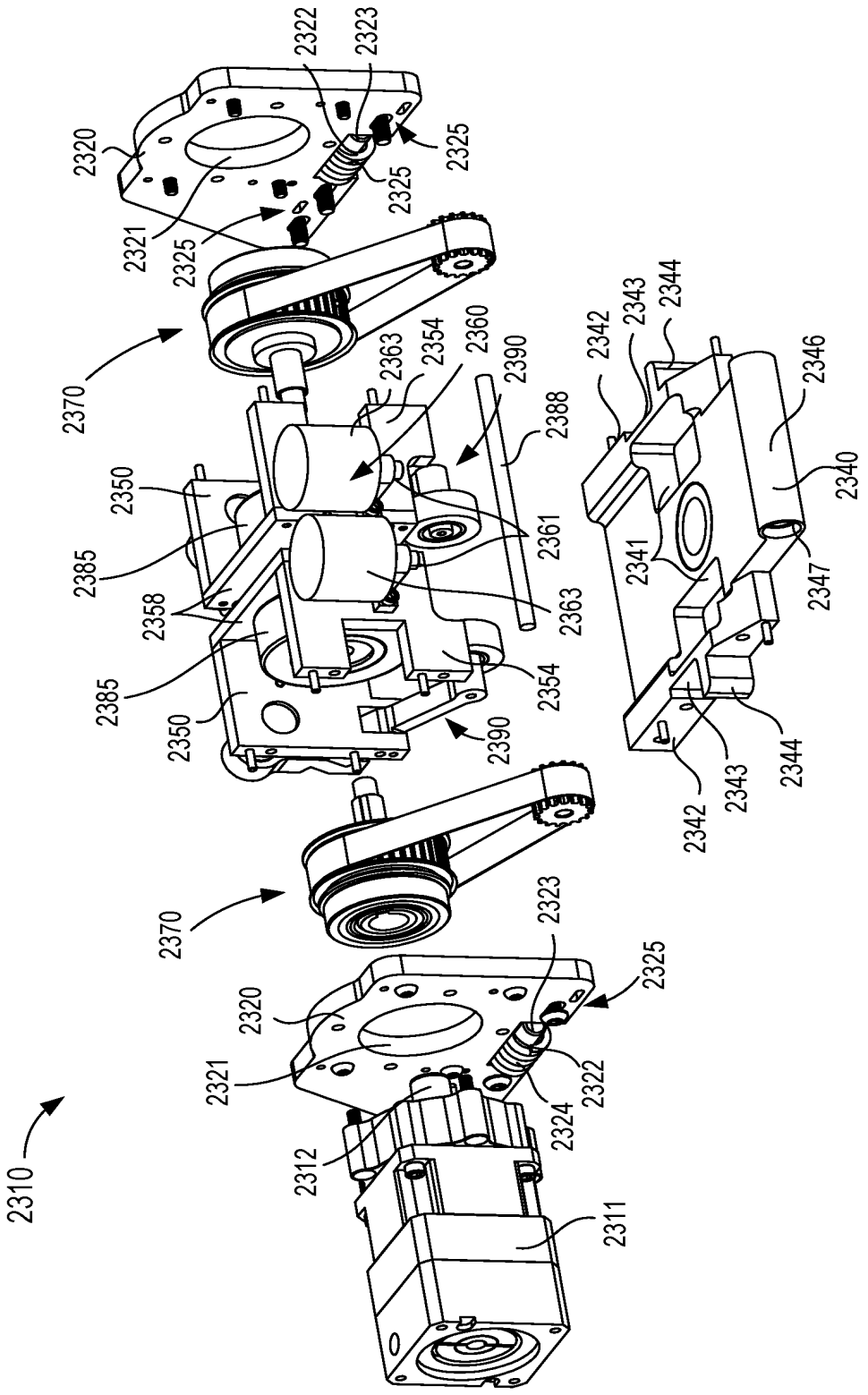

2310
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2361
2363
2370
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2390

FIG. 16

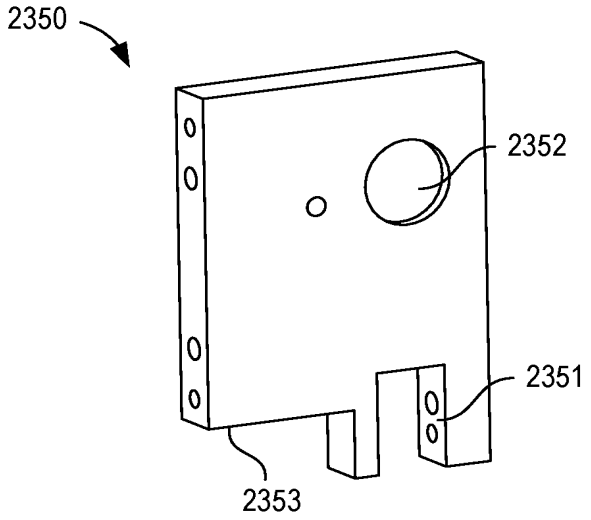


FIG. 17

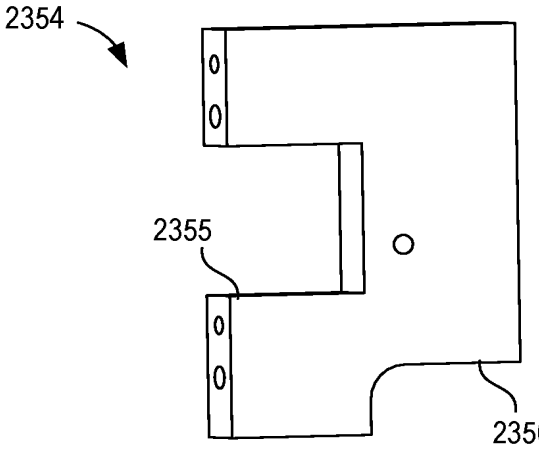


FIG. 18

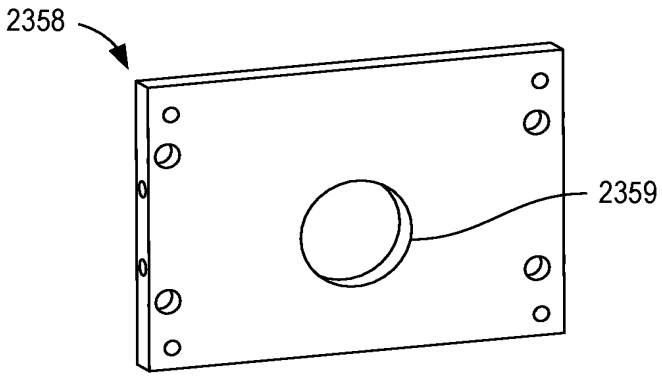


FIG. 19

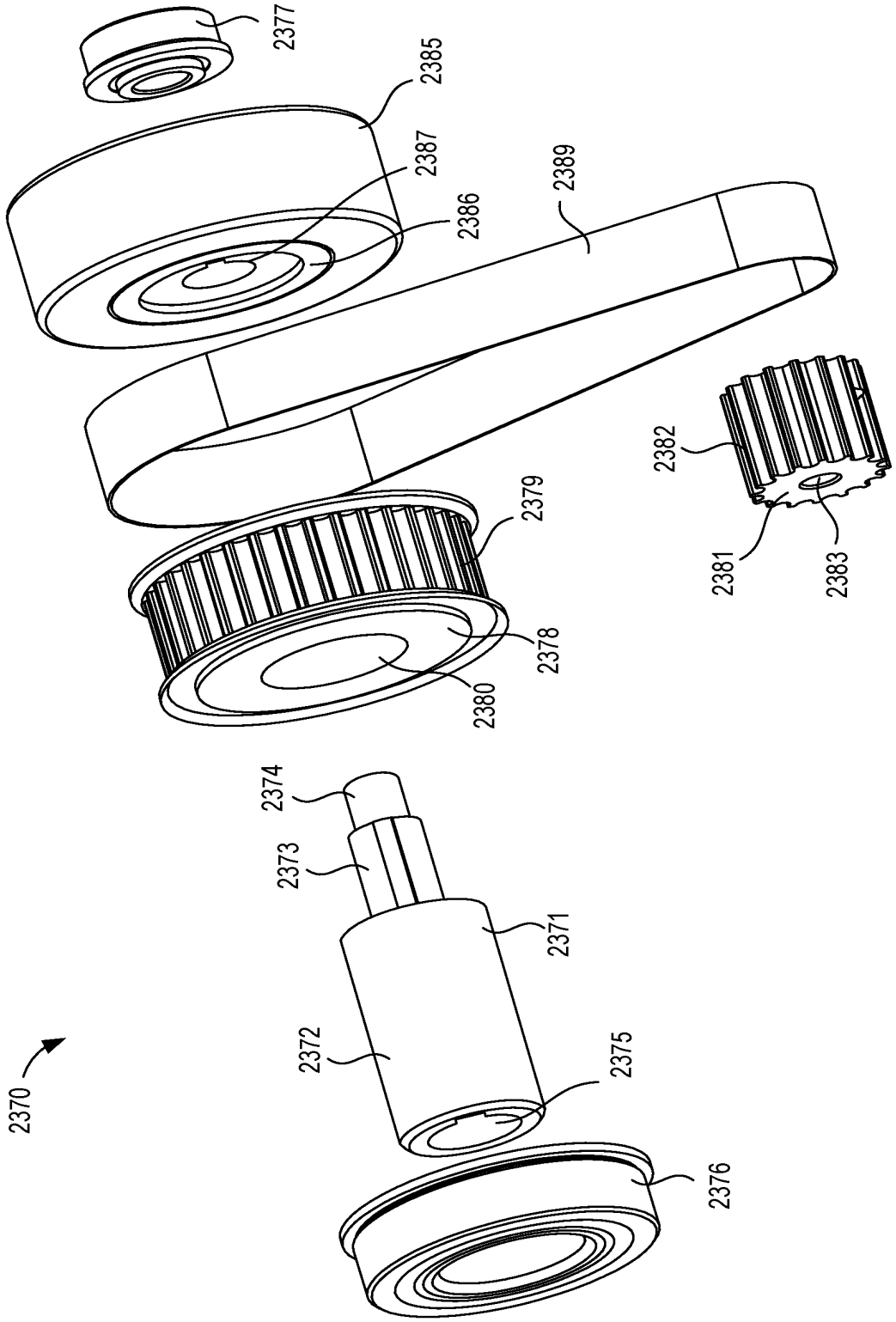

2370
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FIG. 20

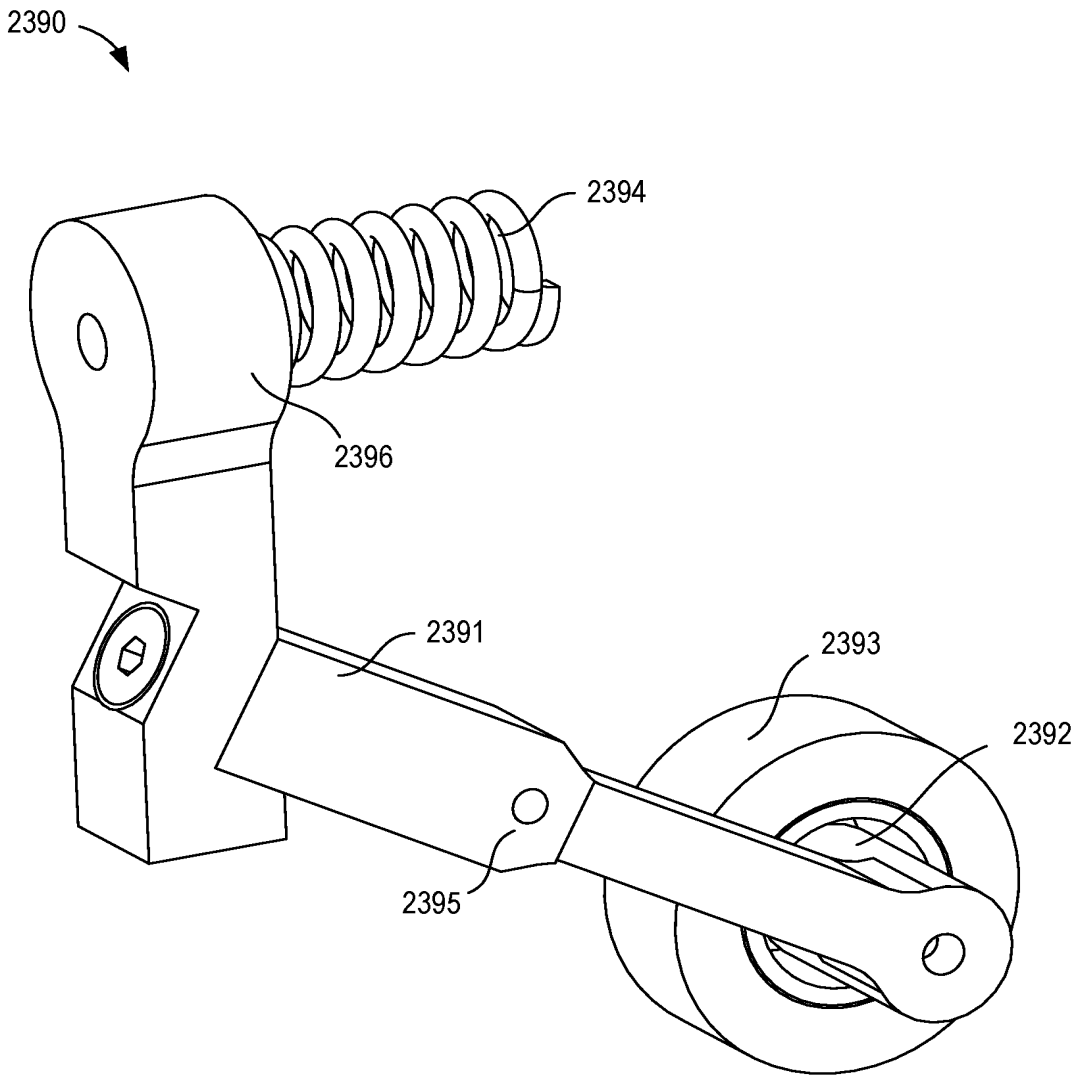


FIG. 21

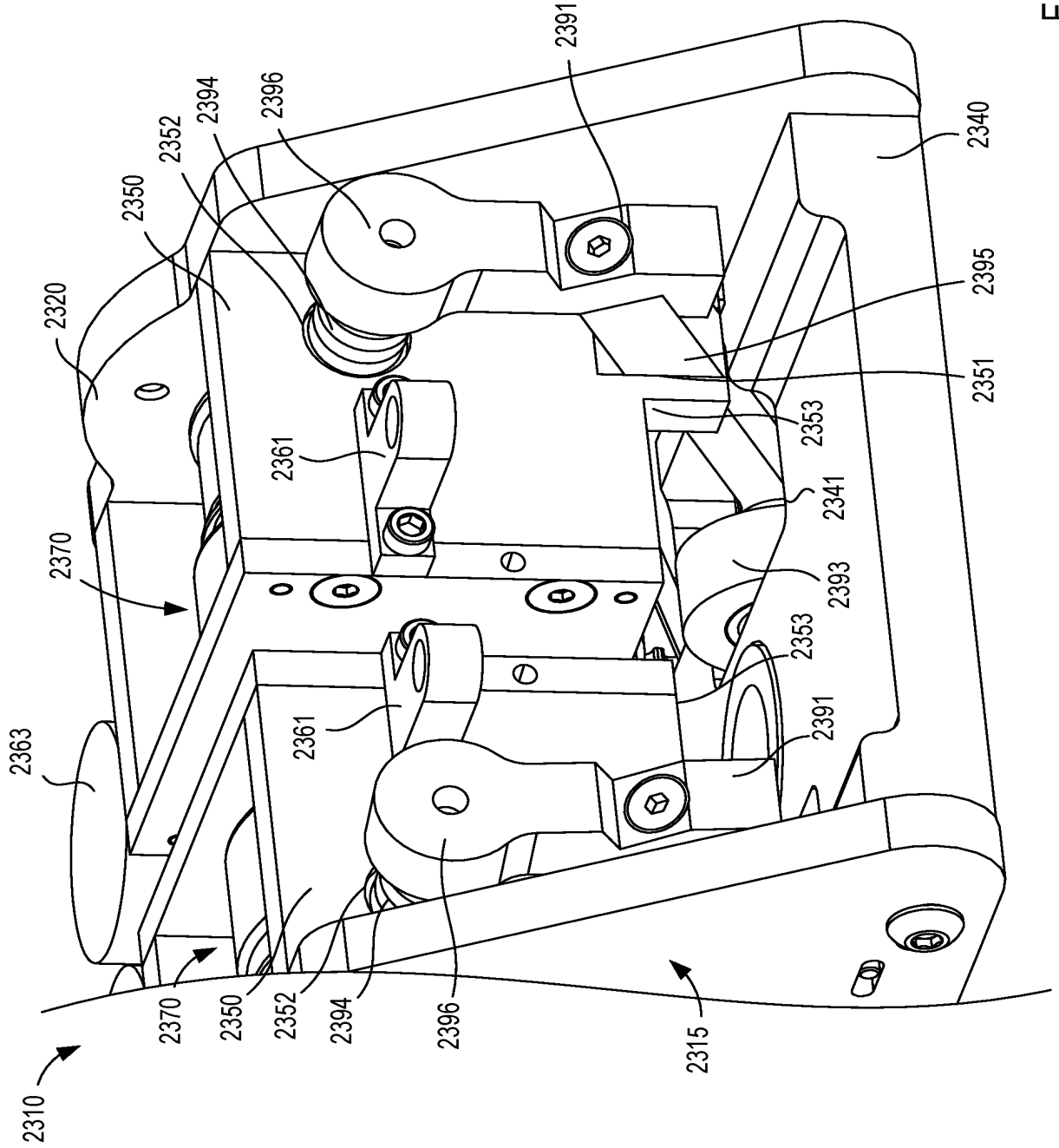

2391
2394
2396
2352
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2353
2363
2361
2391
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2350
2352
2394
2396
2315
2310

FIG. 22

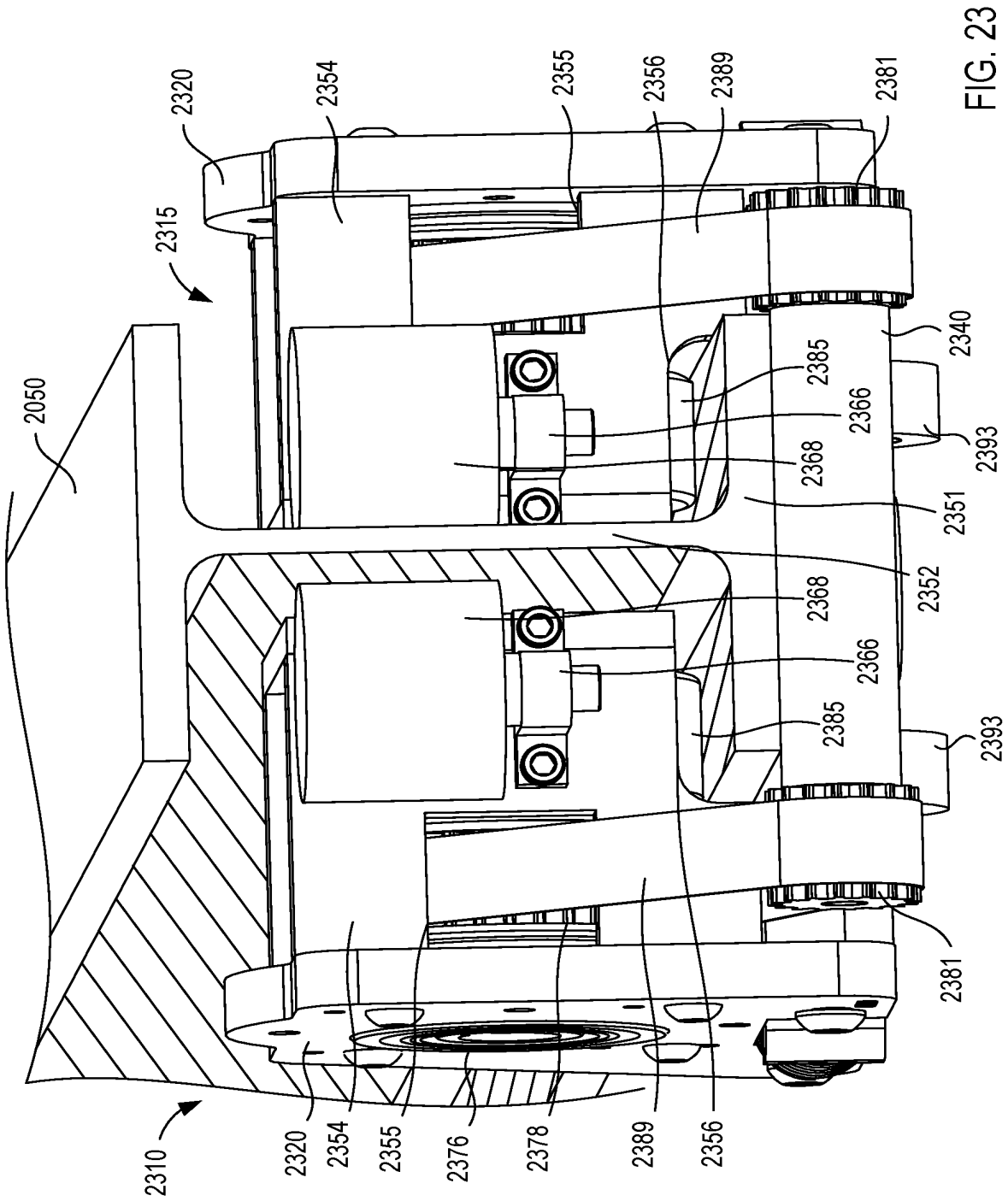

2320
2354
2355
2356
2389
2381
2315
2340
2385
2366
2368
2393
2351
2352
2050
2310
2376
2378

FIG. 23

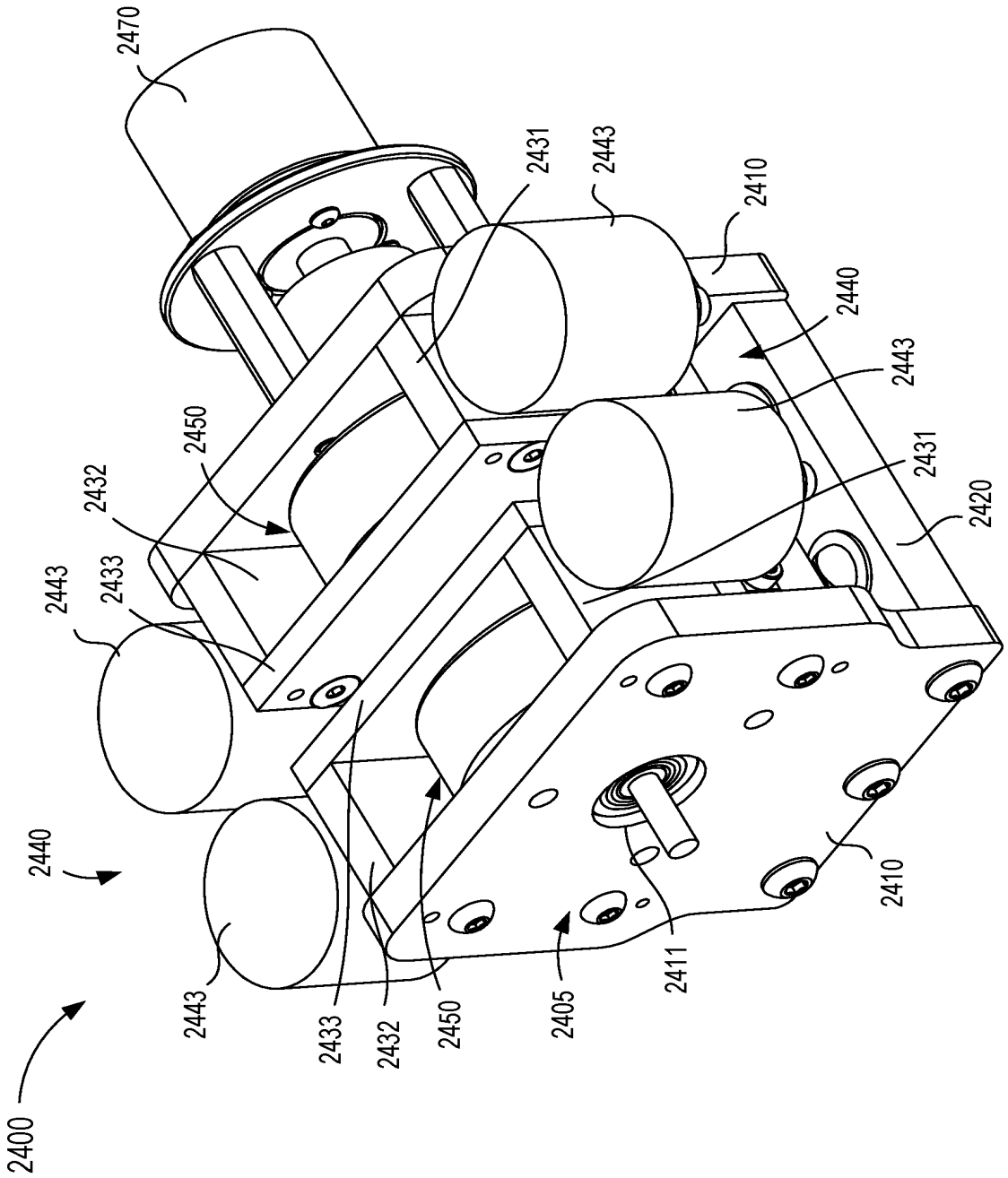

2400
2440
2443
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2432
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2405
2411
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2410
2443
2431
2470
2450
2432
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2440

FIG. 24

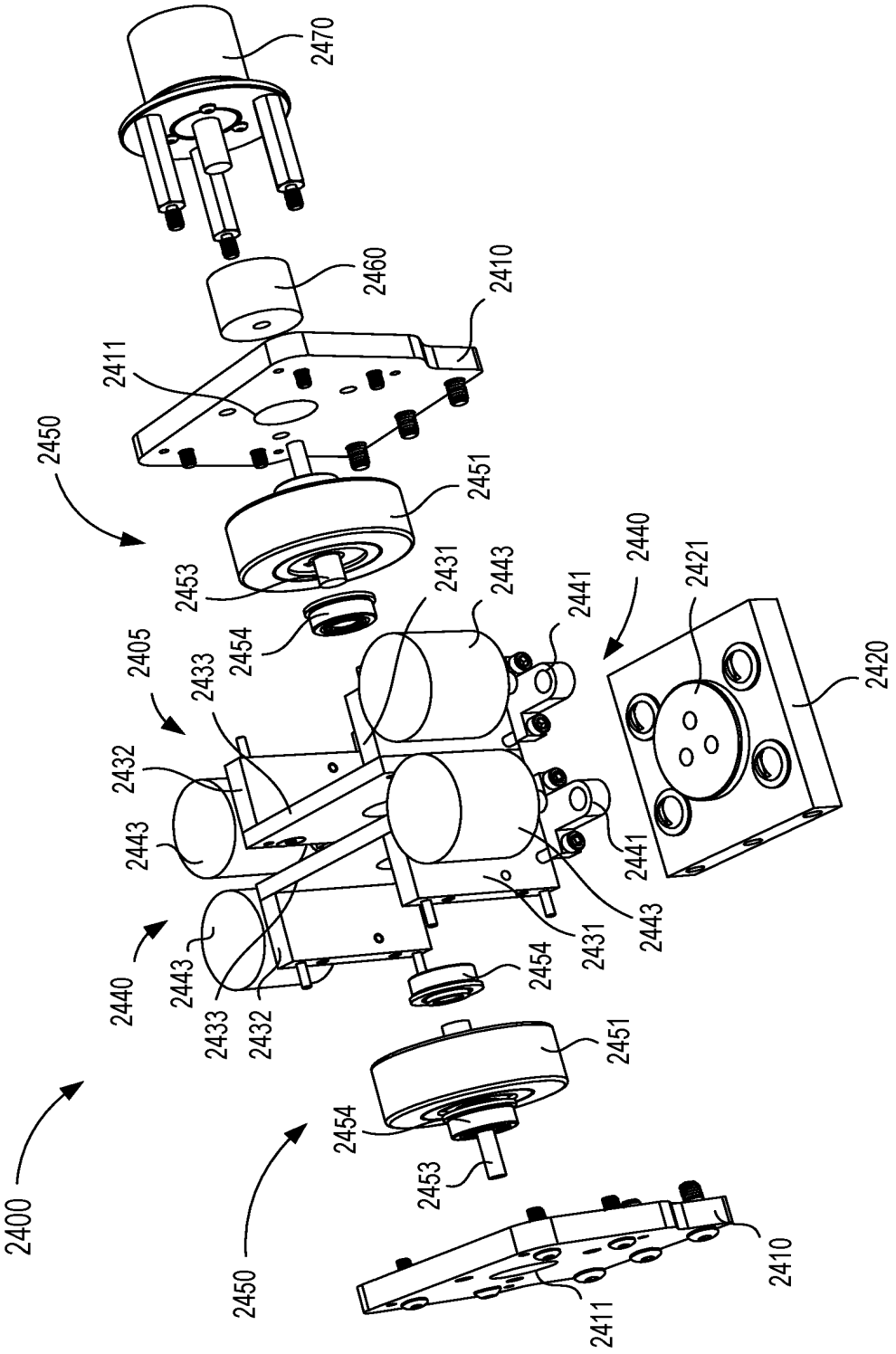

2470
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2454
2405
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2440
2421
2420
2432
2443
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2454
2440
2443
2433
2432
2451
2454
2453
2400
2450
2410
2411

FIG. 25

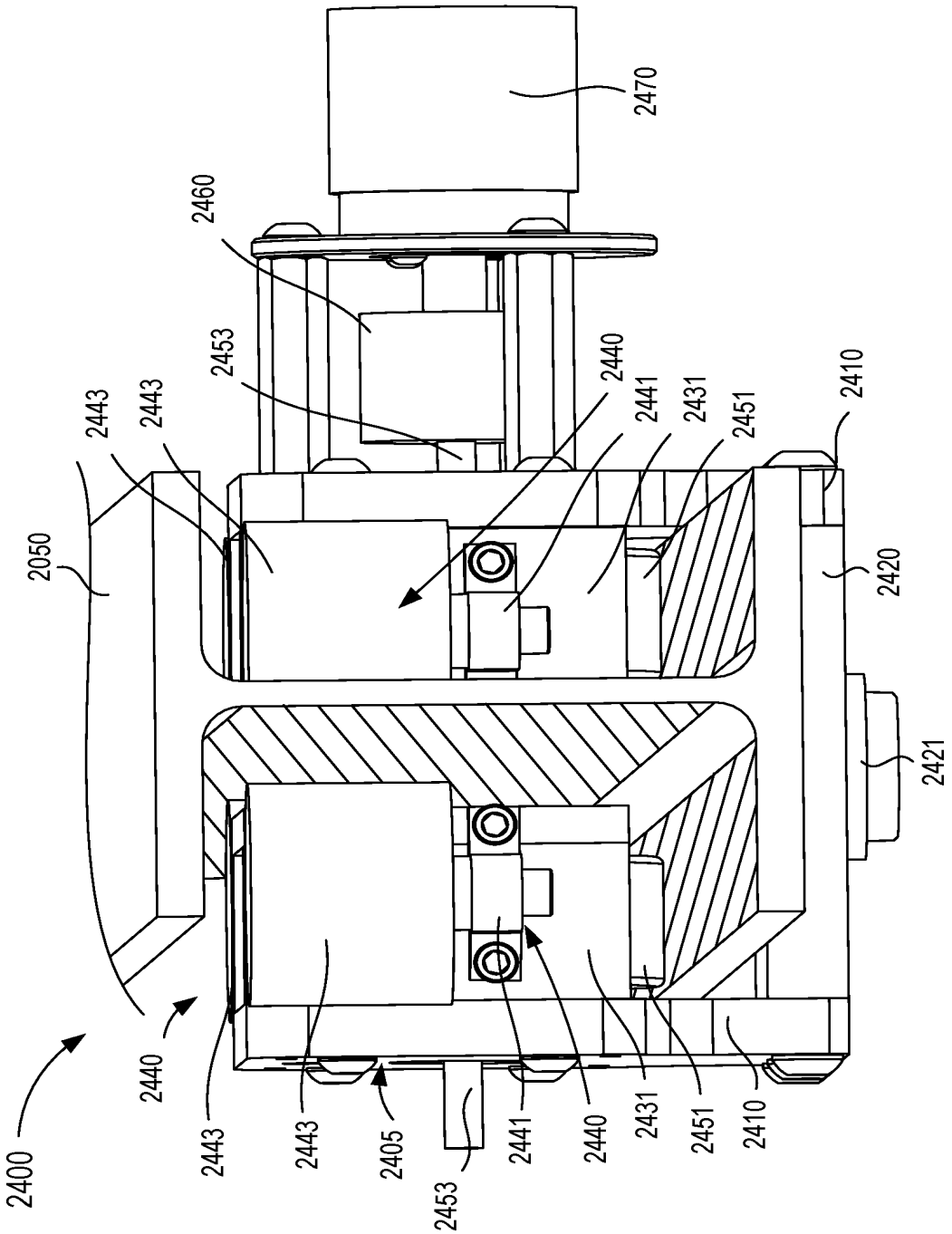

2470
2460
2453
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2443
2440
2441
2431
2451
2410
2050
2420
2421
2400
2440
2443
2443
2405
2453
2441
2440
2431
2451
2410

FIG. 26

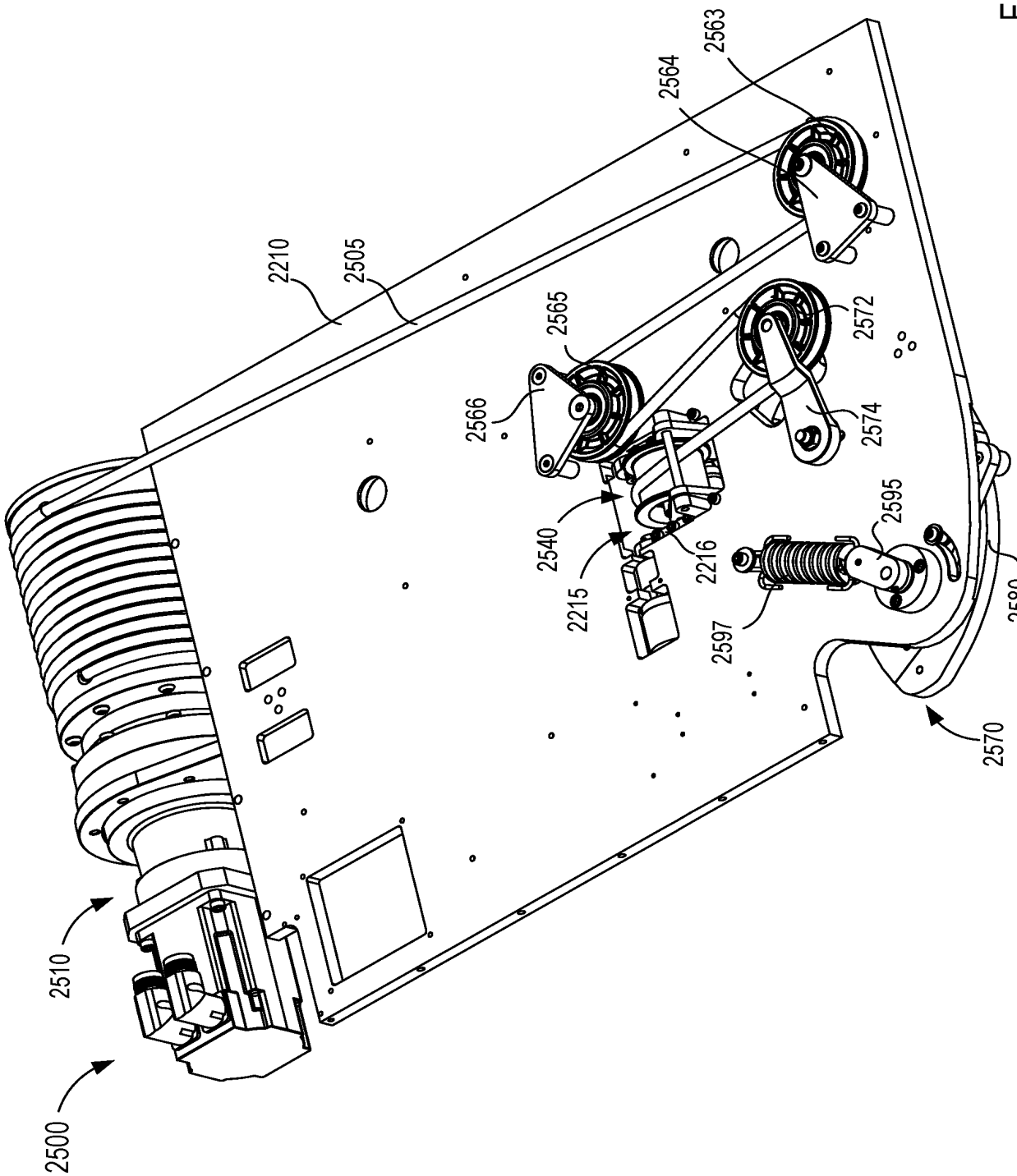

2500
2510
2210
2505
2563
2564
2565
2572
2566
2574
2540
2595
2216
2215
2597
2580
2570

FIG. 27

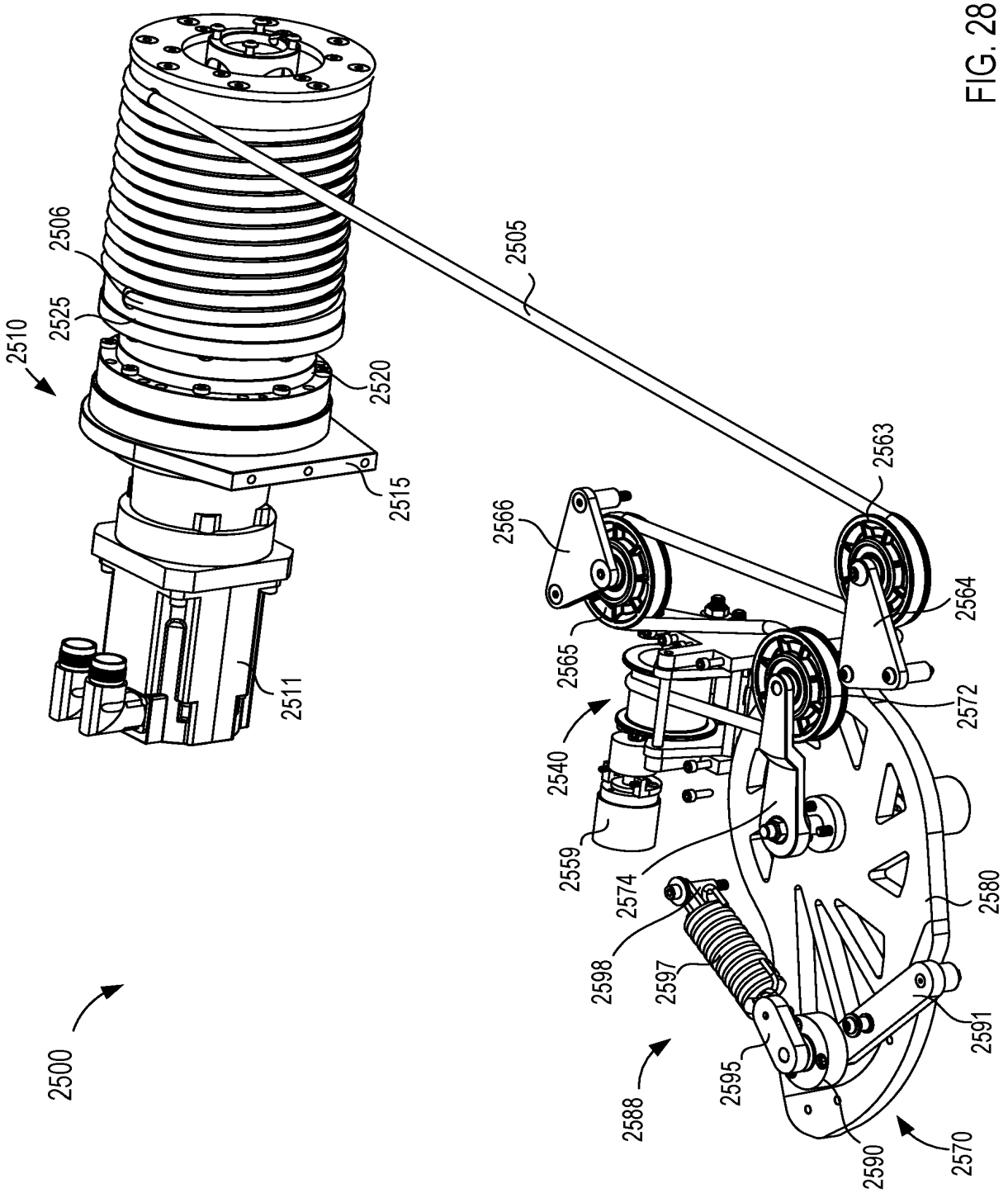

2500
2510
2506
2525
2520
2515
2511
2505
2563
2566
2564
2565
2572
2540
2559
2574
2580
2598
2597
2591
2595
2588
2590
2570

FIG. 28

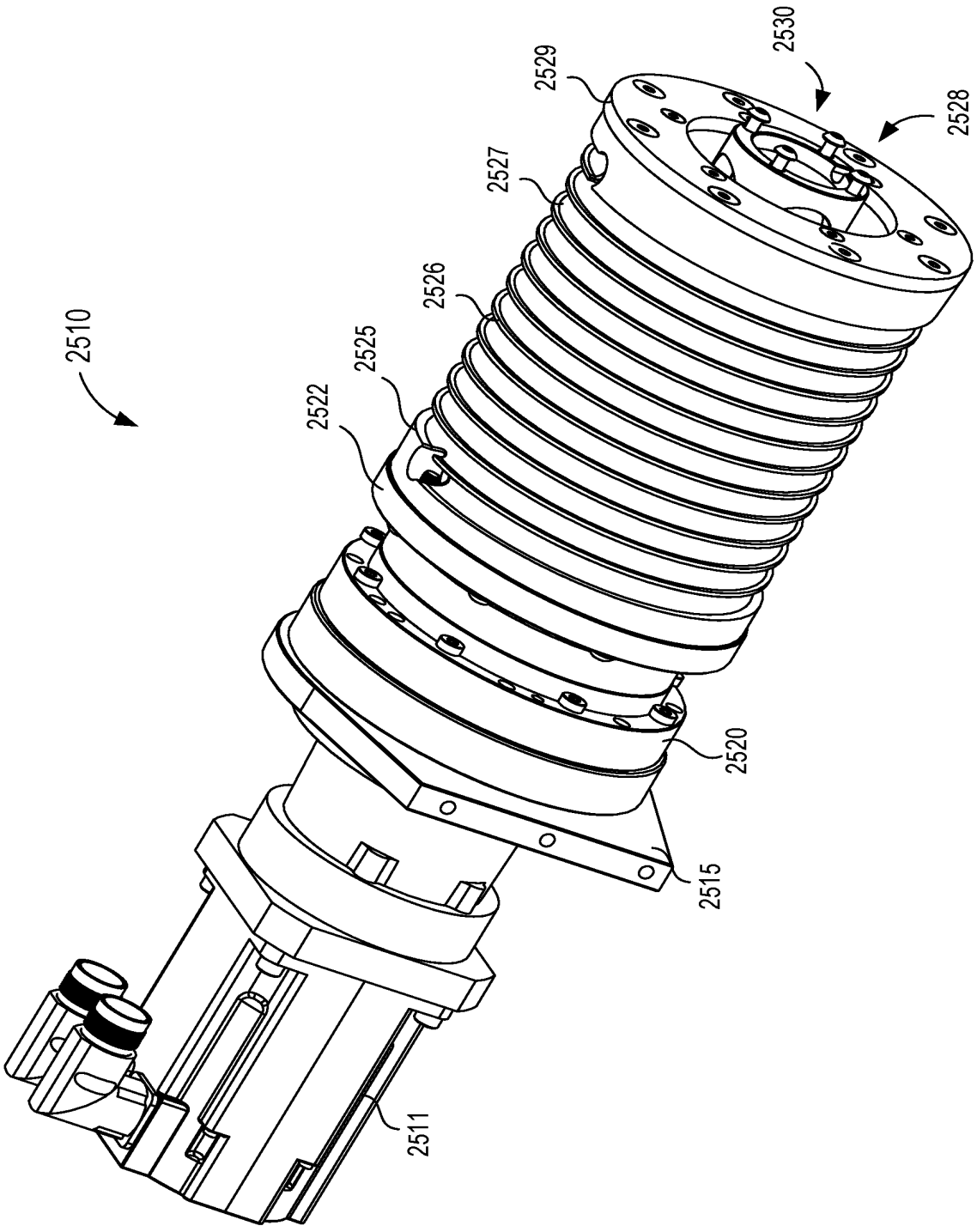


FIG. 29

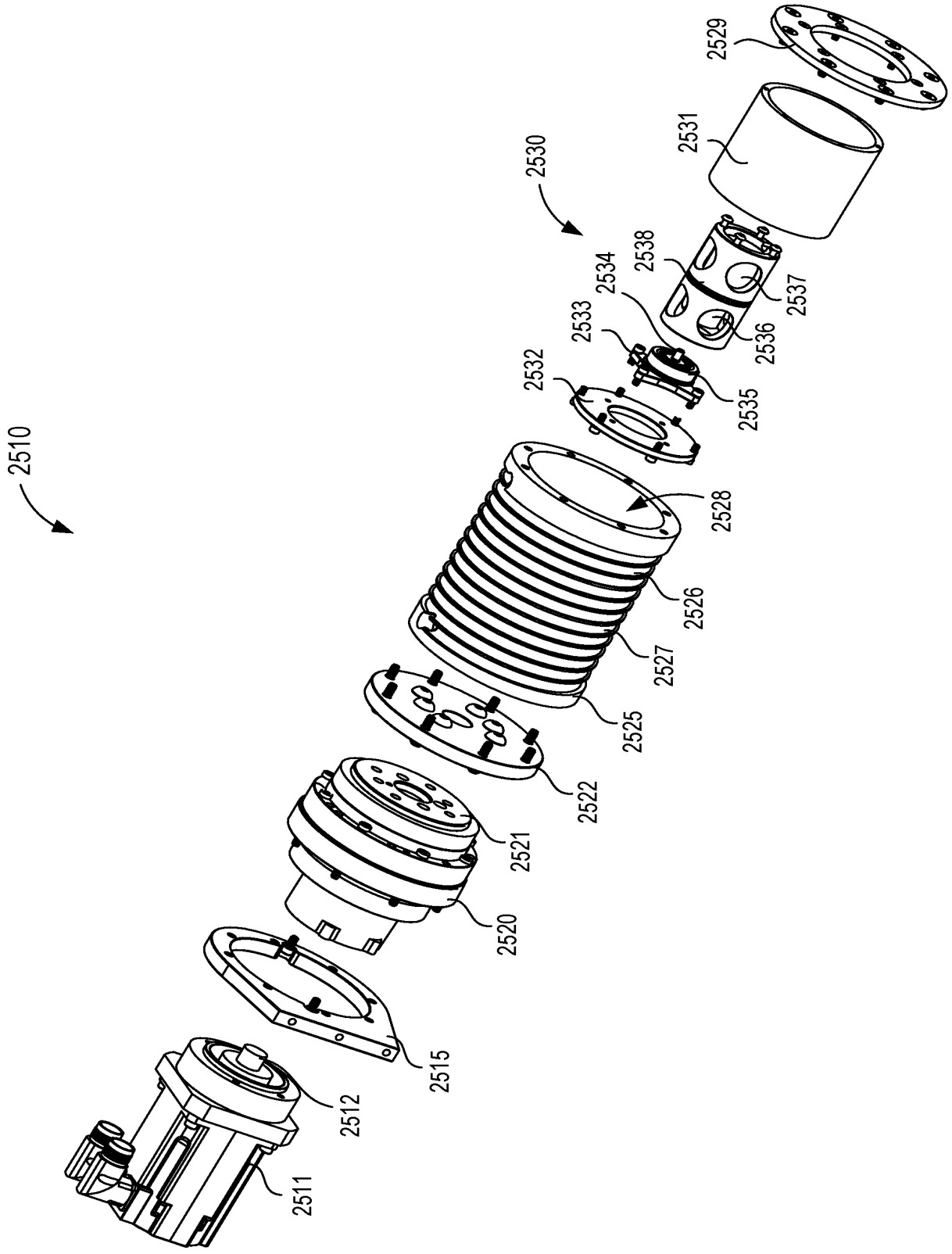

2510
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2532
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2534
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2538

FIG. 30

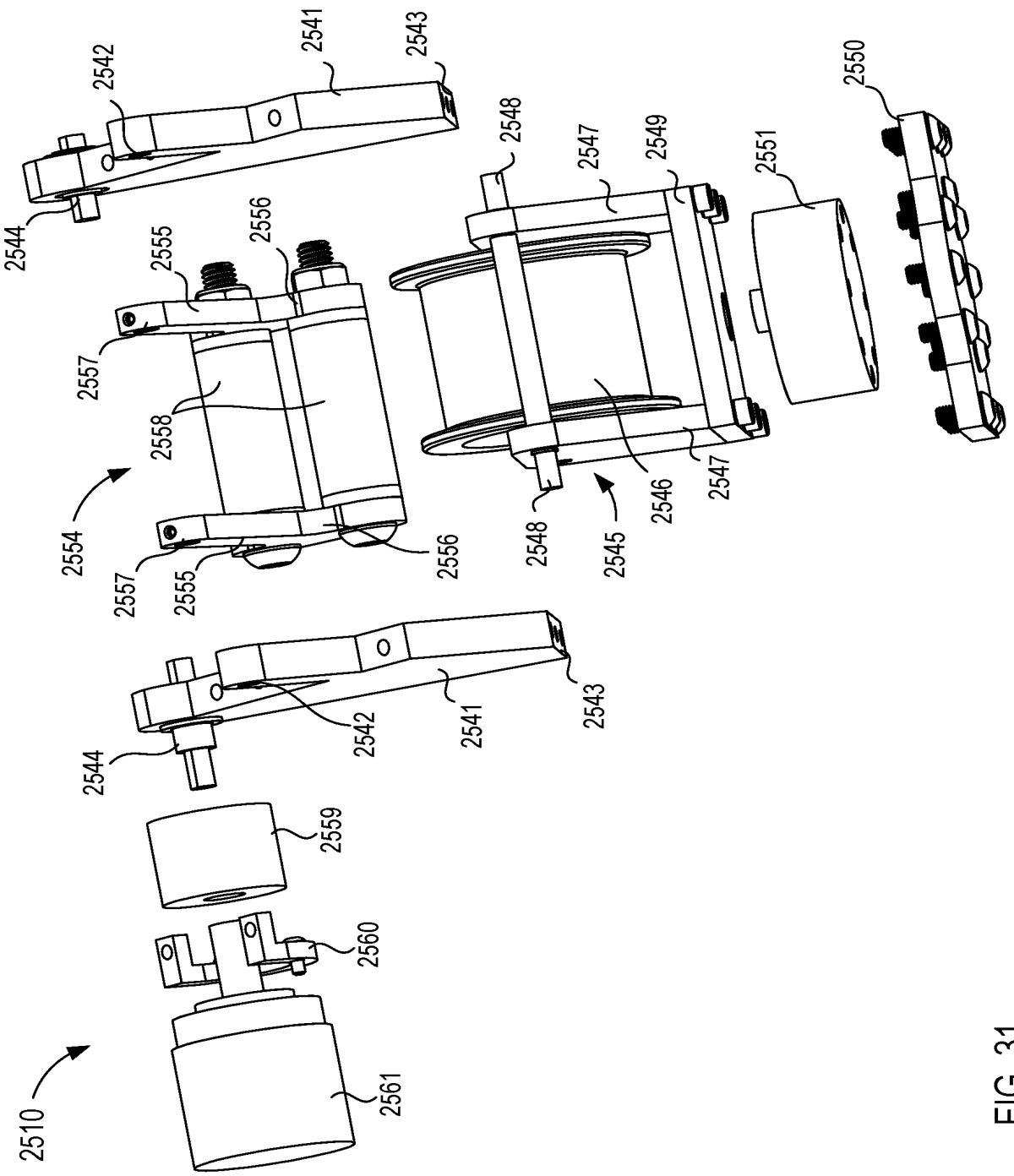

2510
2541
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2556
2557
2558
2559
2560
2561

FIG. 31

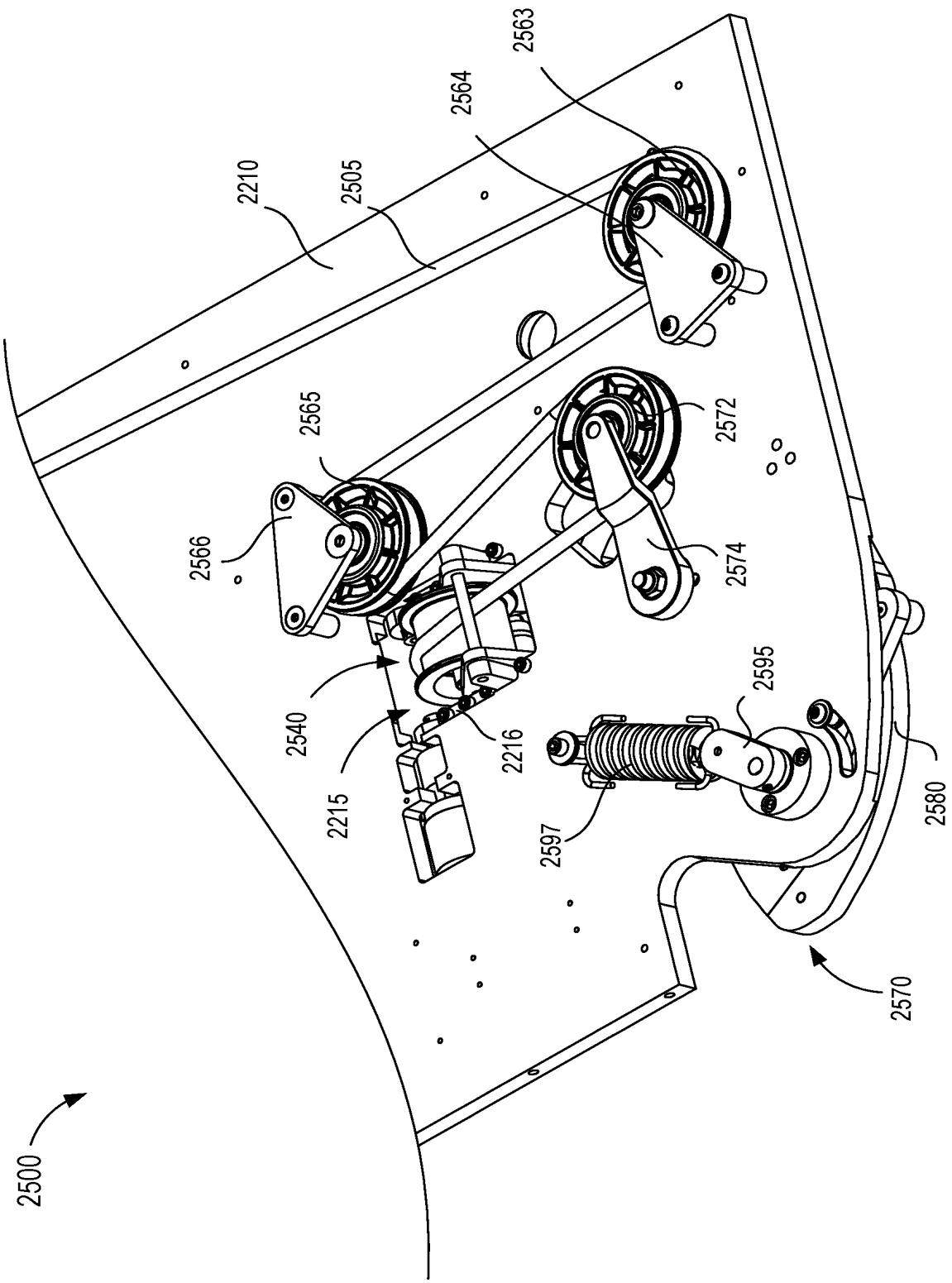

2500
2210
2505
2563
2564
2565
2566
2572
2574
2540
2215
2216
2595
2597
2580
2570

FIG. 32

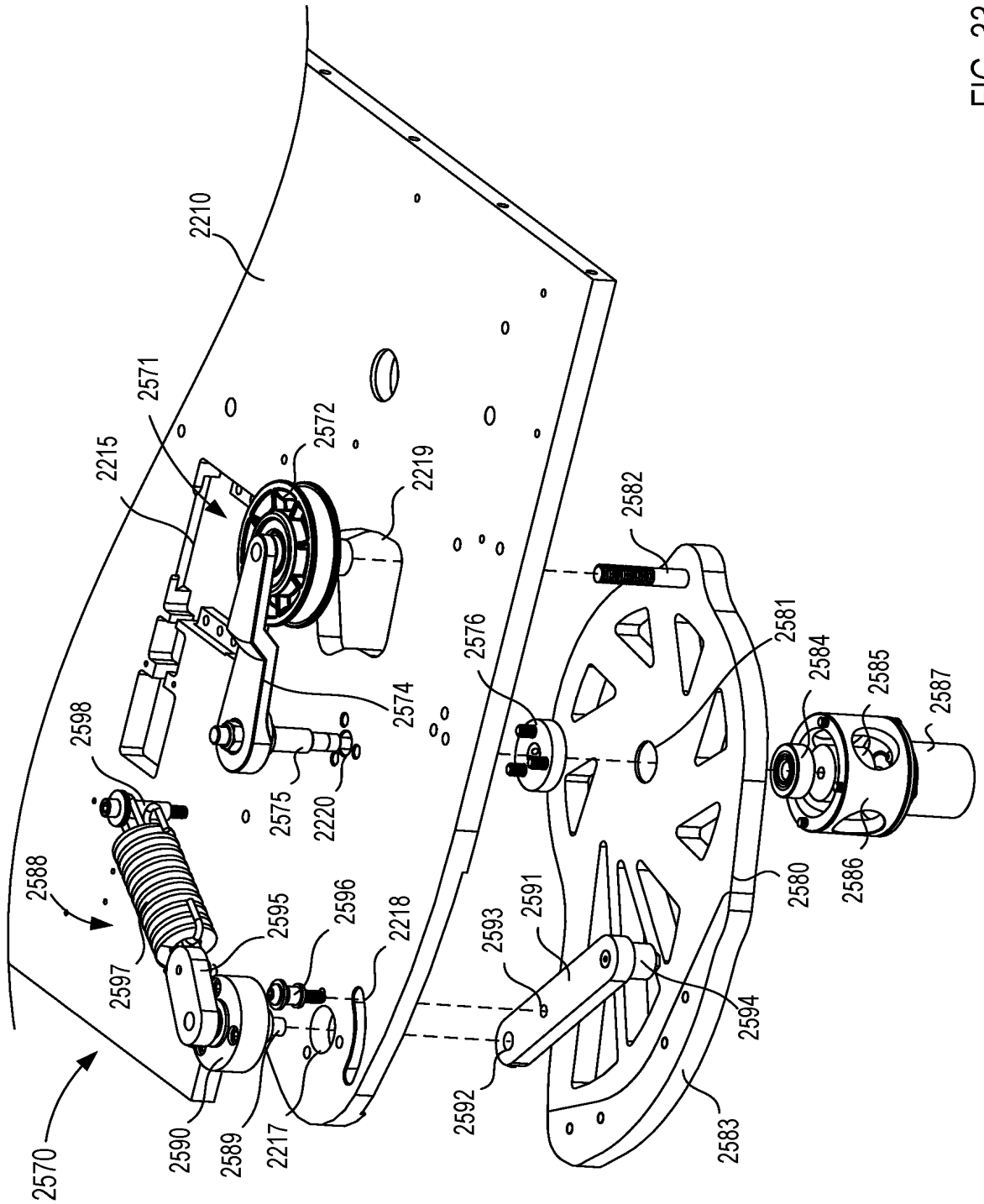

2210
2571
2572
2215
2219
2582
2581
2576
2584
2585
2587
2574
2598
2575
2220
2588
2595
2596
2218
2591
2593
2580
2586
2597
2594
2592
2590
2589
2217
2583
2570

FIG. 33

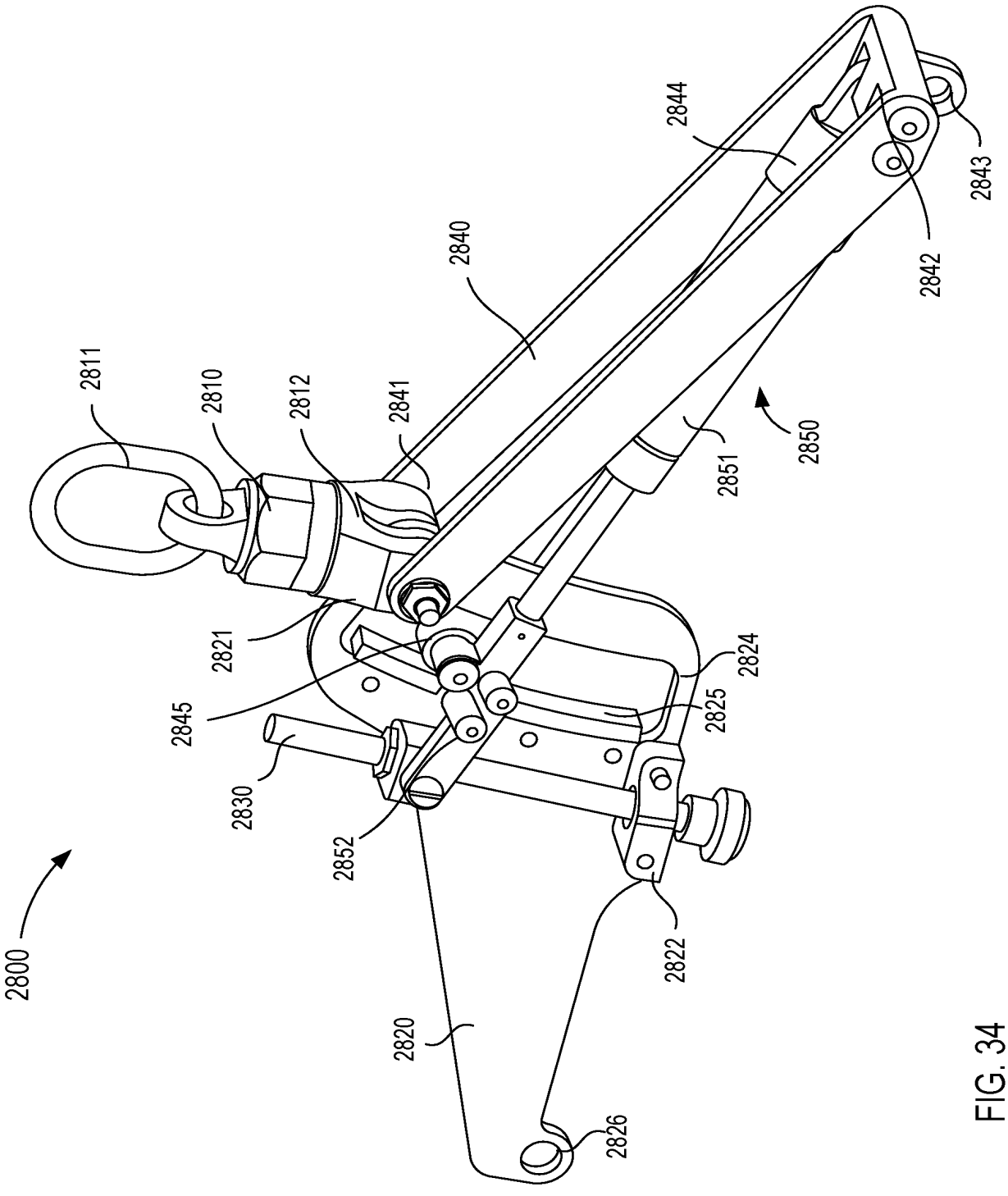

2800
2811
2810
2812
2841
2840
2844
2843
2842
2850
2851
2821
2845
2824
2825
2830
2852
2822
2820
2826

FIG. 34

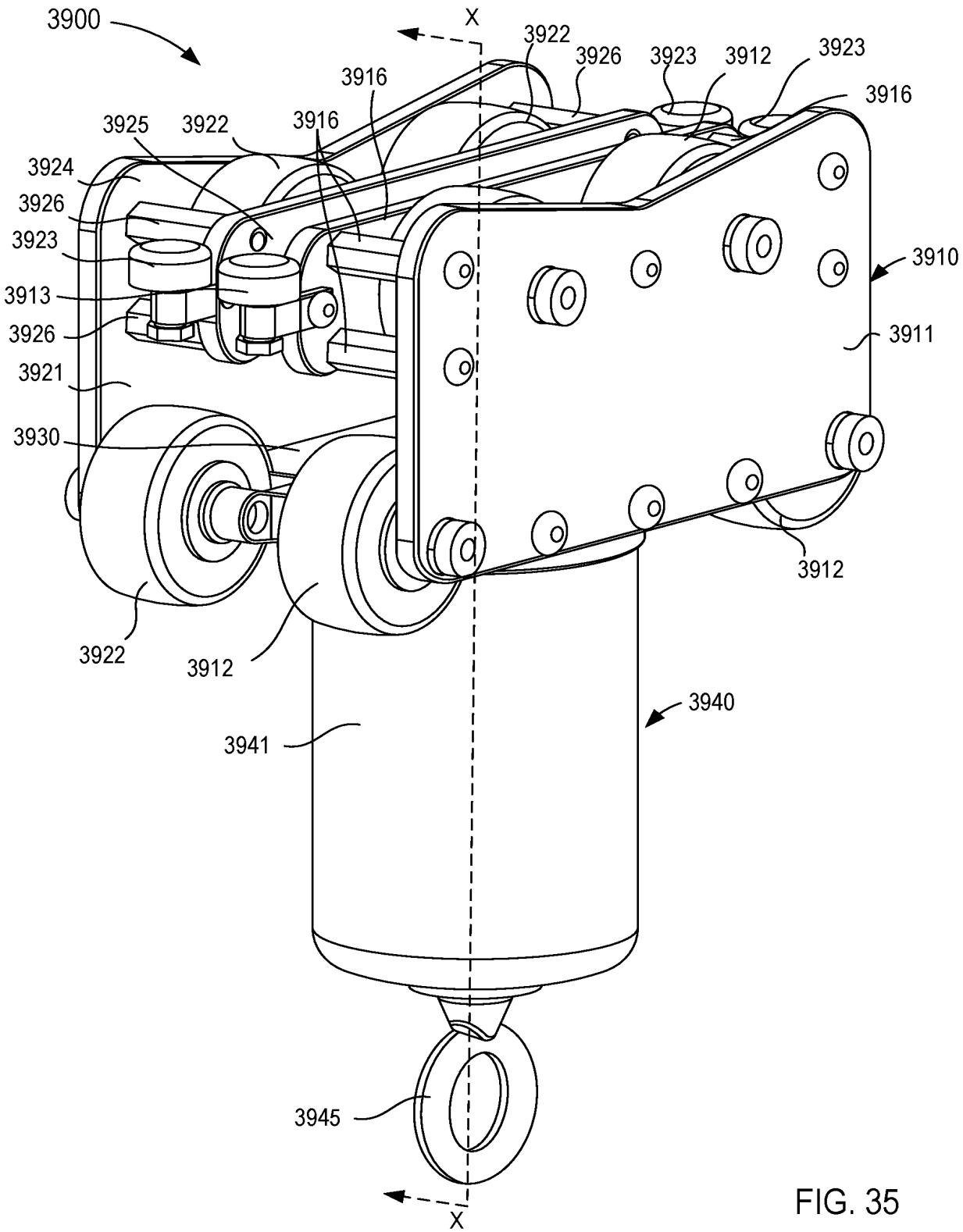

3900
X
3922
3926
3923
3912
3923
3916
3916
3925
3922
3916
3924
3926
3923
3913
3926
3921
3930
3910
3911
3912
3922
3912
3940
3941
3945
X

FIG. 35

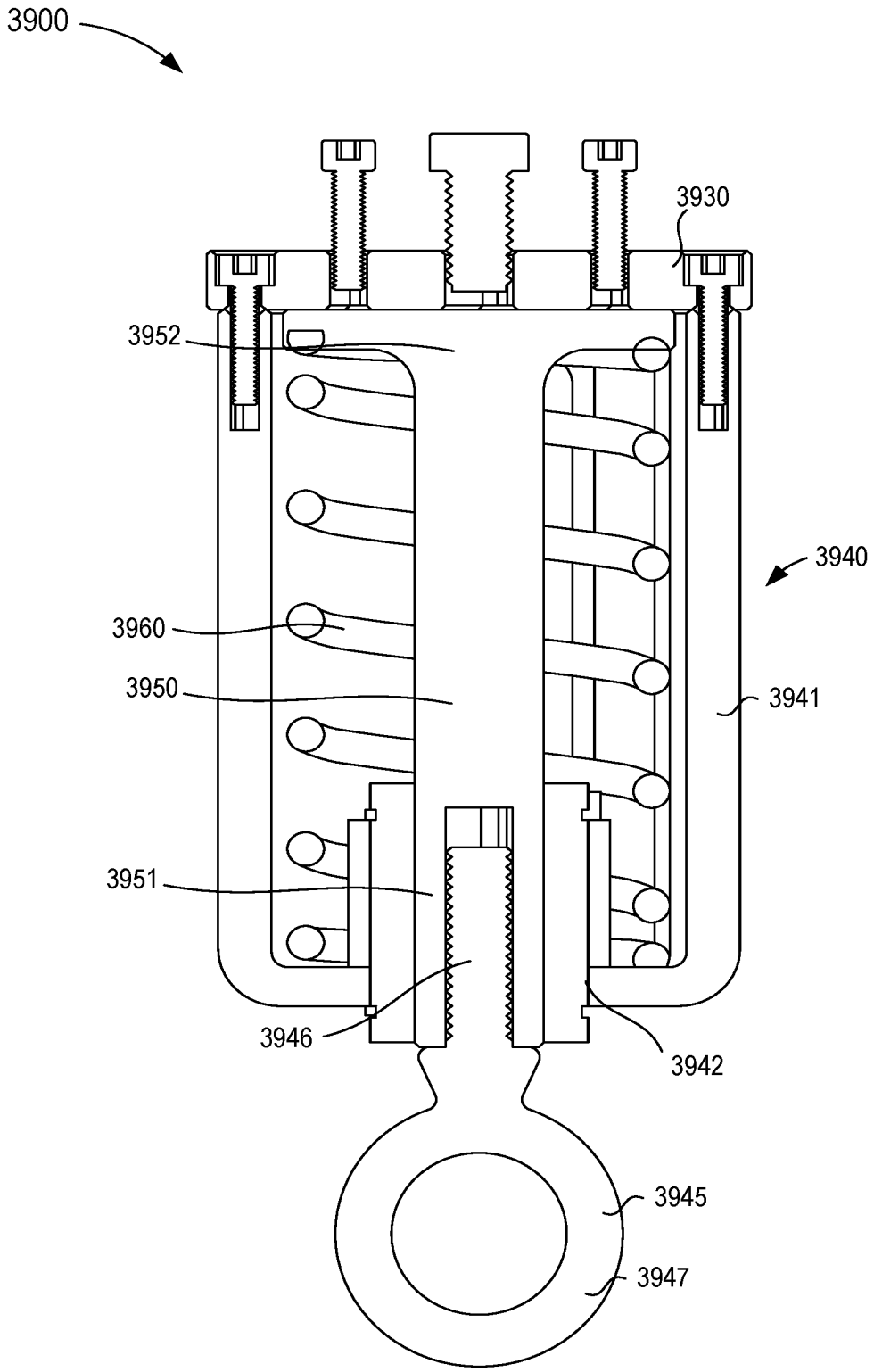


FIG. 36

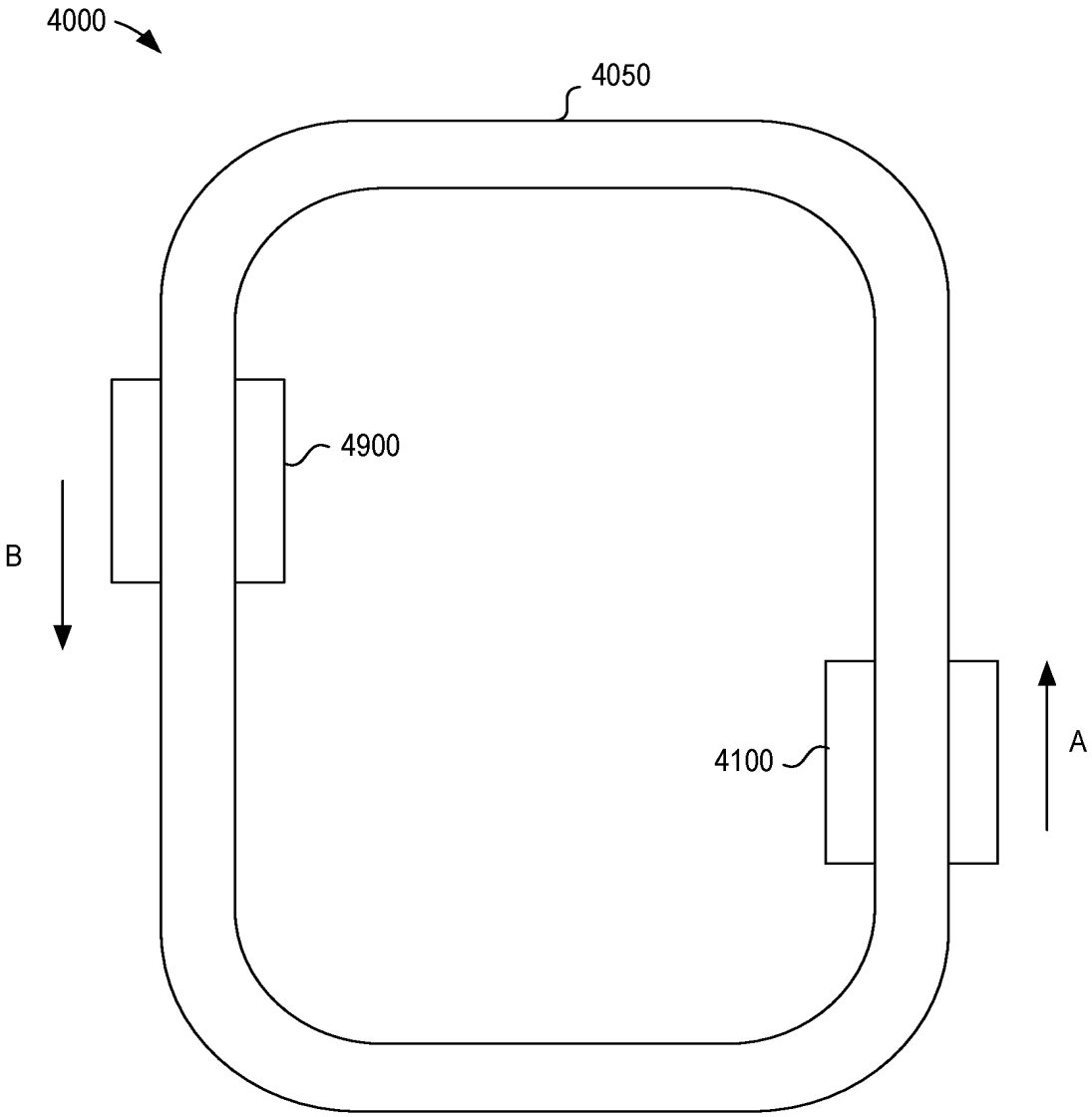


FIG. 37

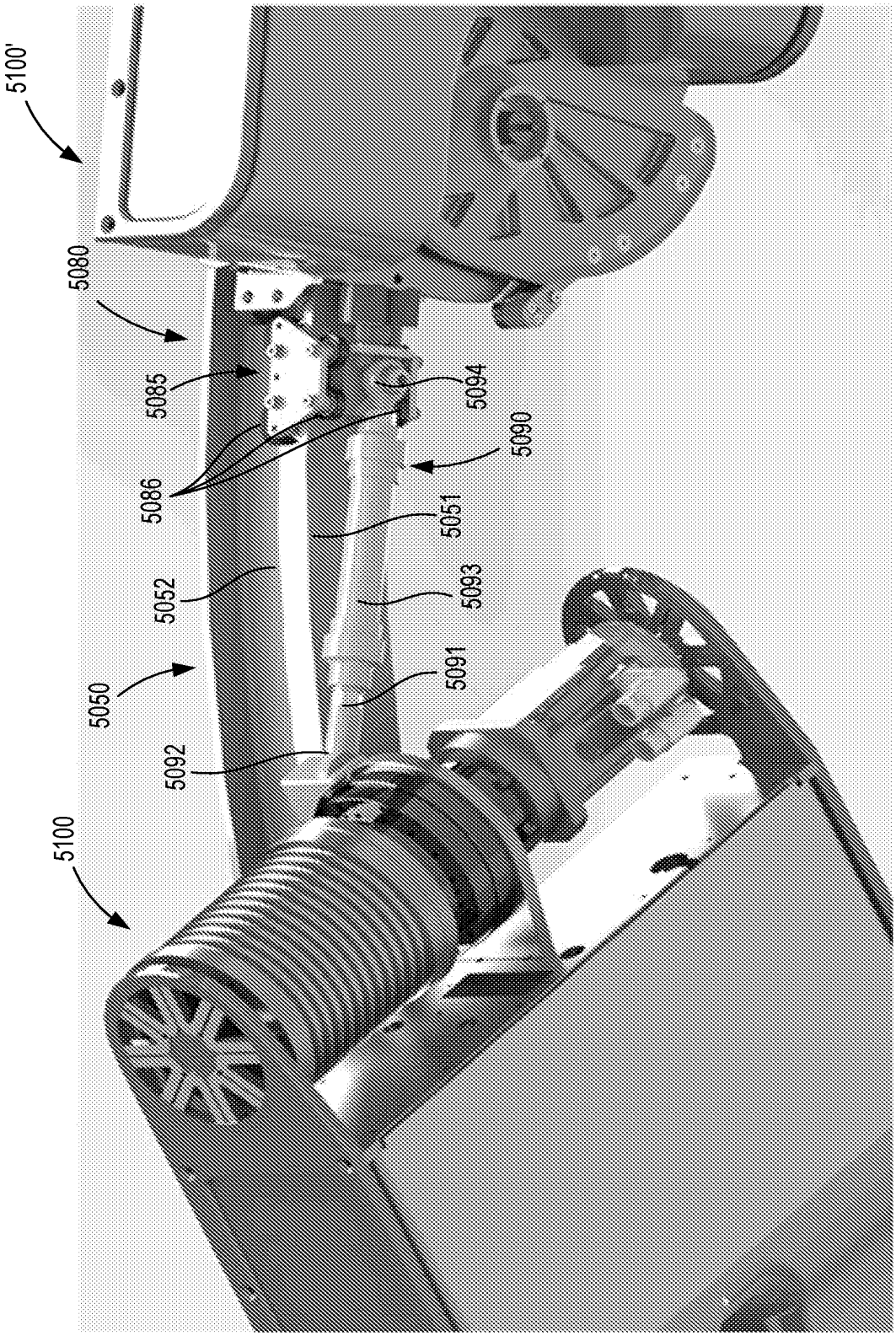

5100'
5080
5085
5086
5052
5050
5092
5100
5094
5090
5051
5093
5091

FIG. 38

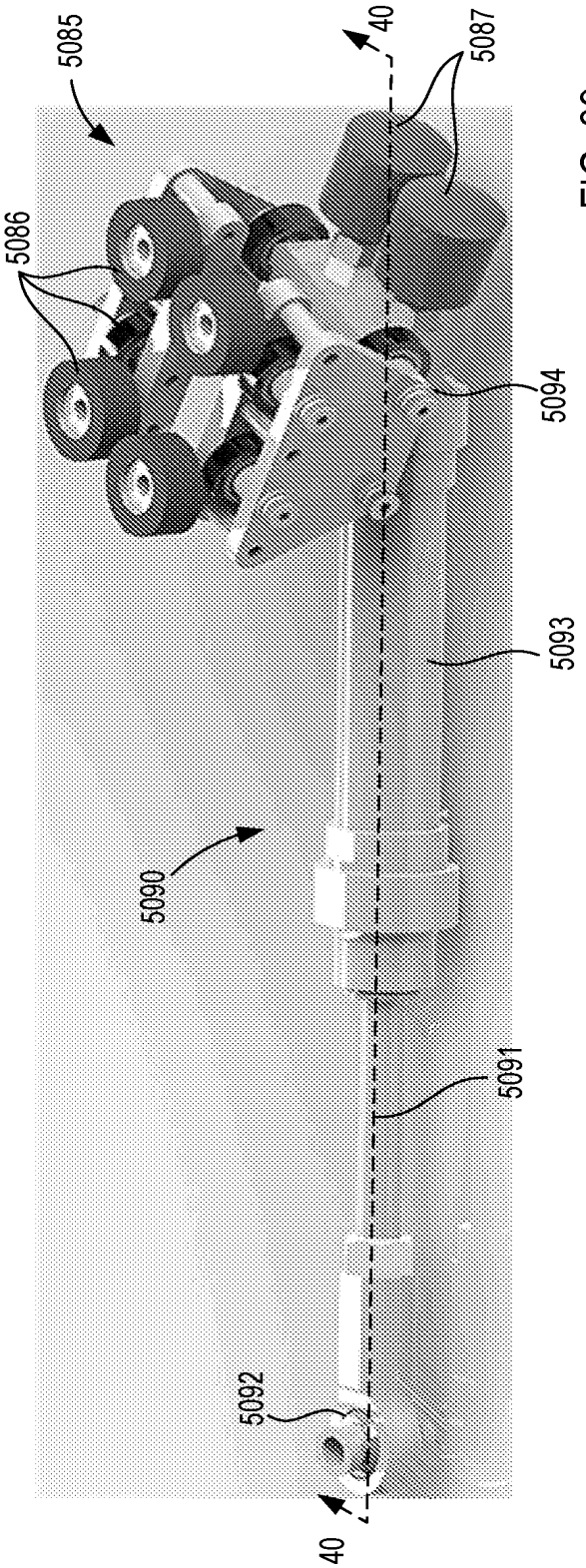

5085
40
5087
5086
5094
5093
5090
5091
5092
40

FIG. 39

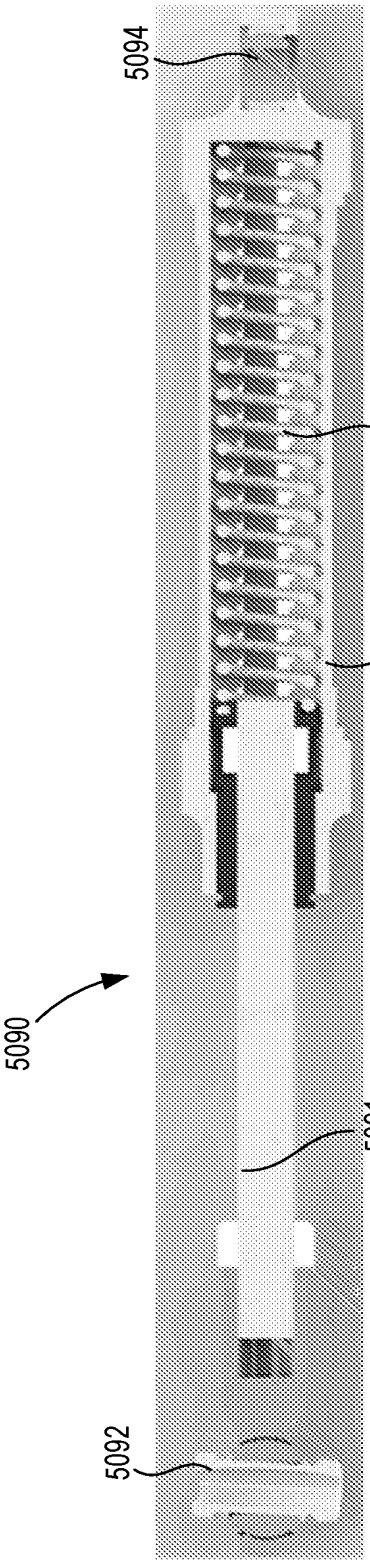

5094
5095
5093
5090
5091
5092

FIG. 40

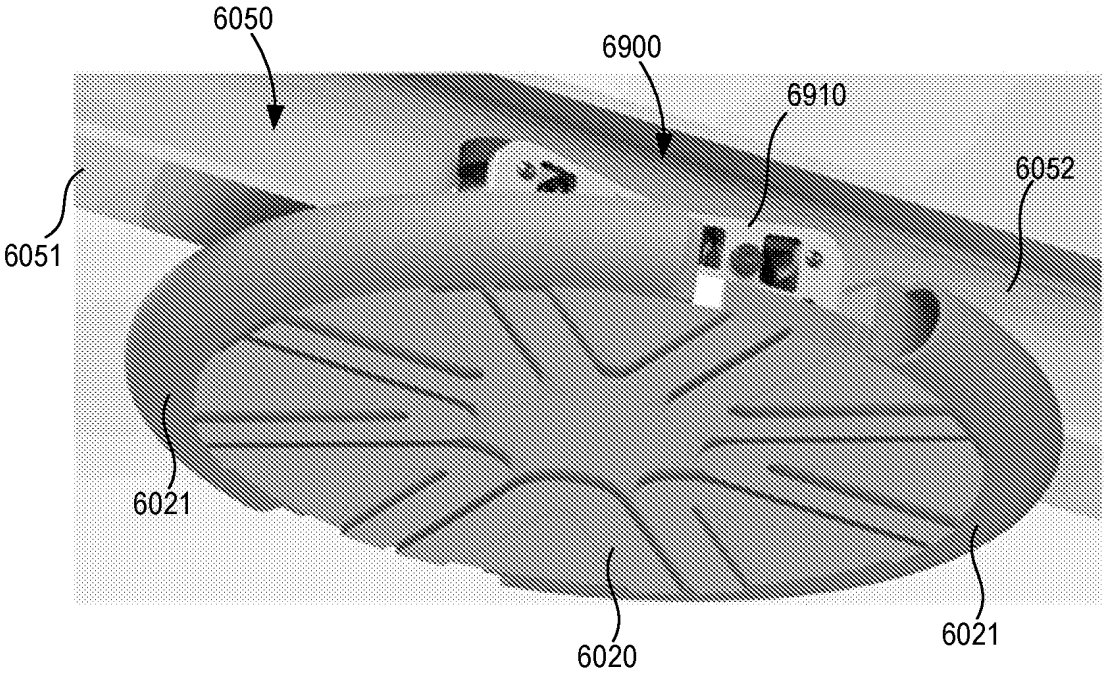

6050
6900
6910
6052
6051
6021
6020
6021

FIG. 41

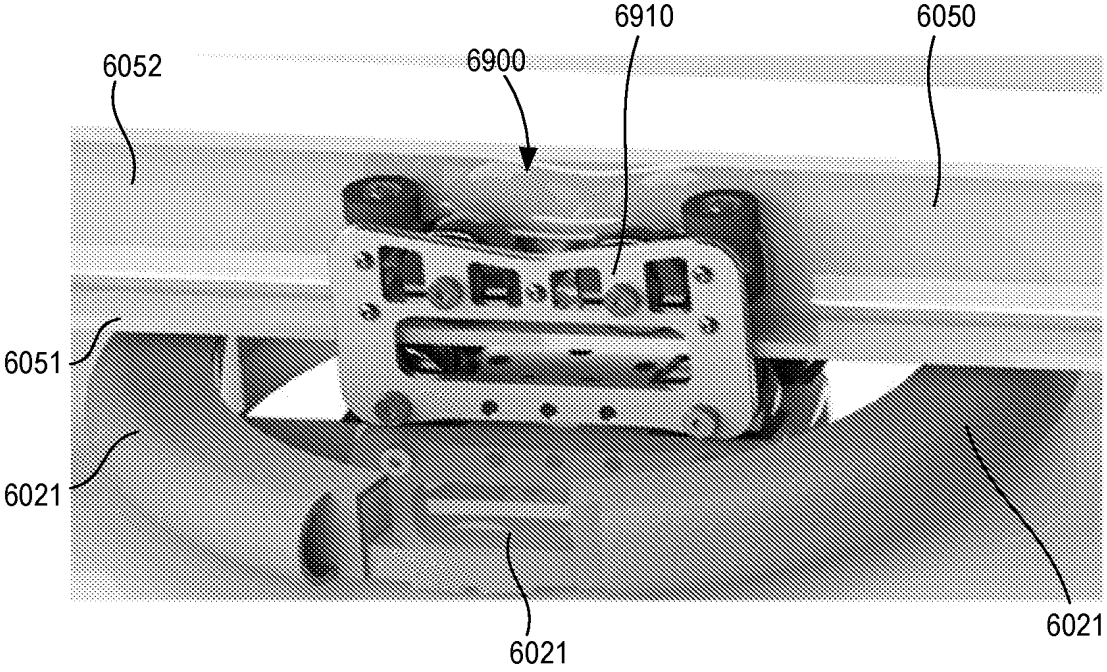

6910
6050
6052
6900
6051
6021
6021
6021

FIG. 42

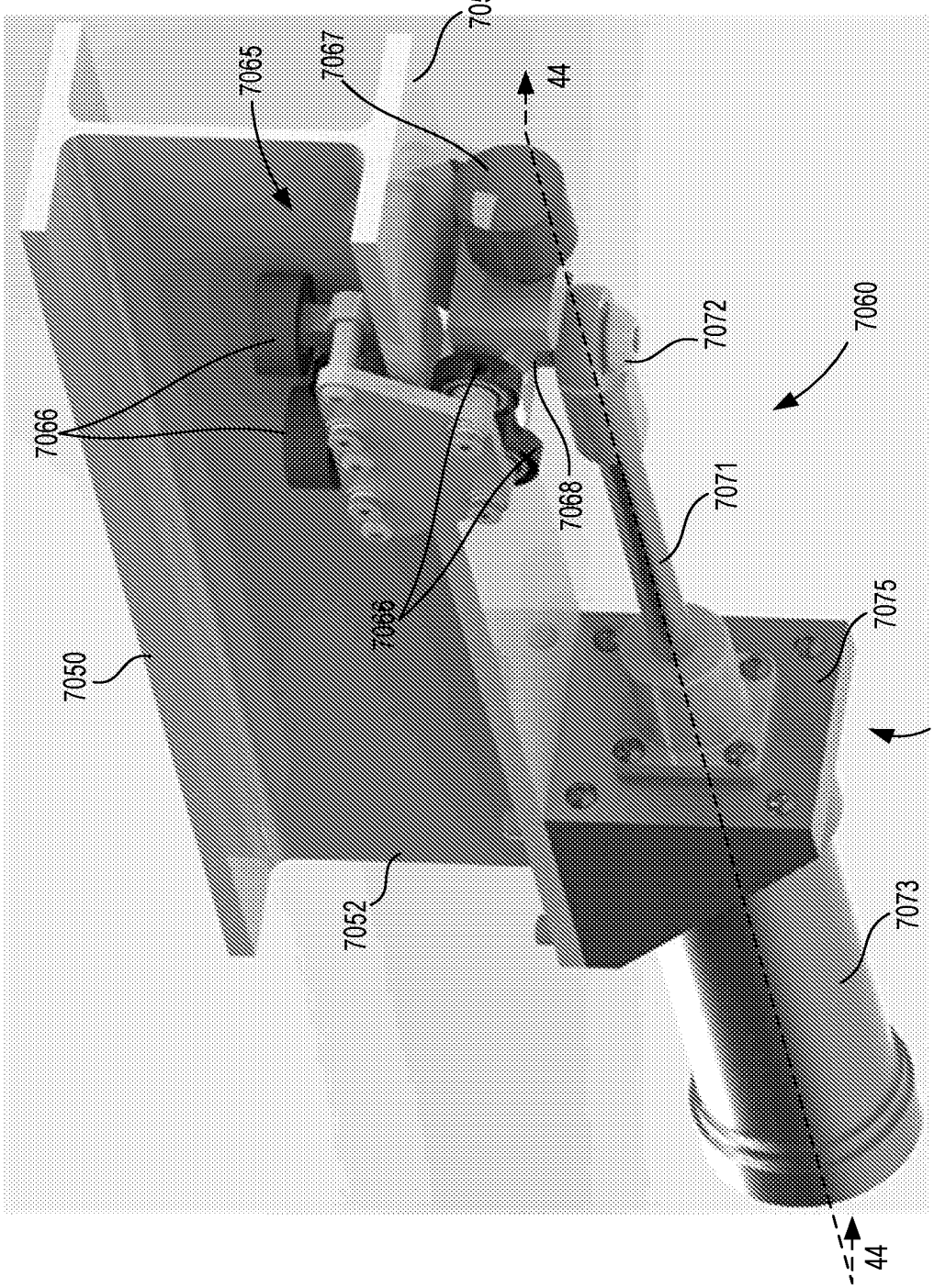

7051
7067
7065
44
7066
7072
7060
7068
7071
7075
7050
7070
7052
7073
44

FIG. 43

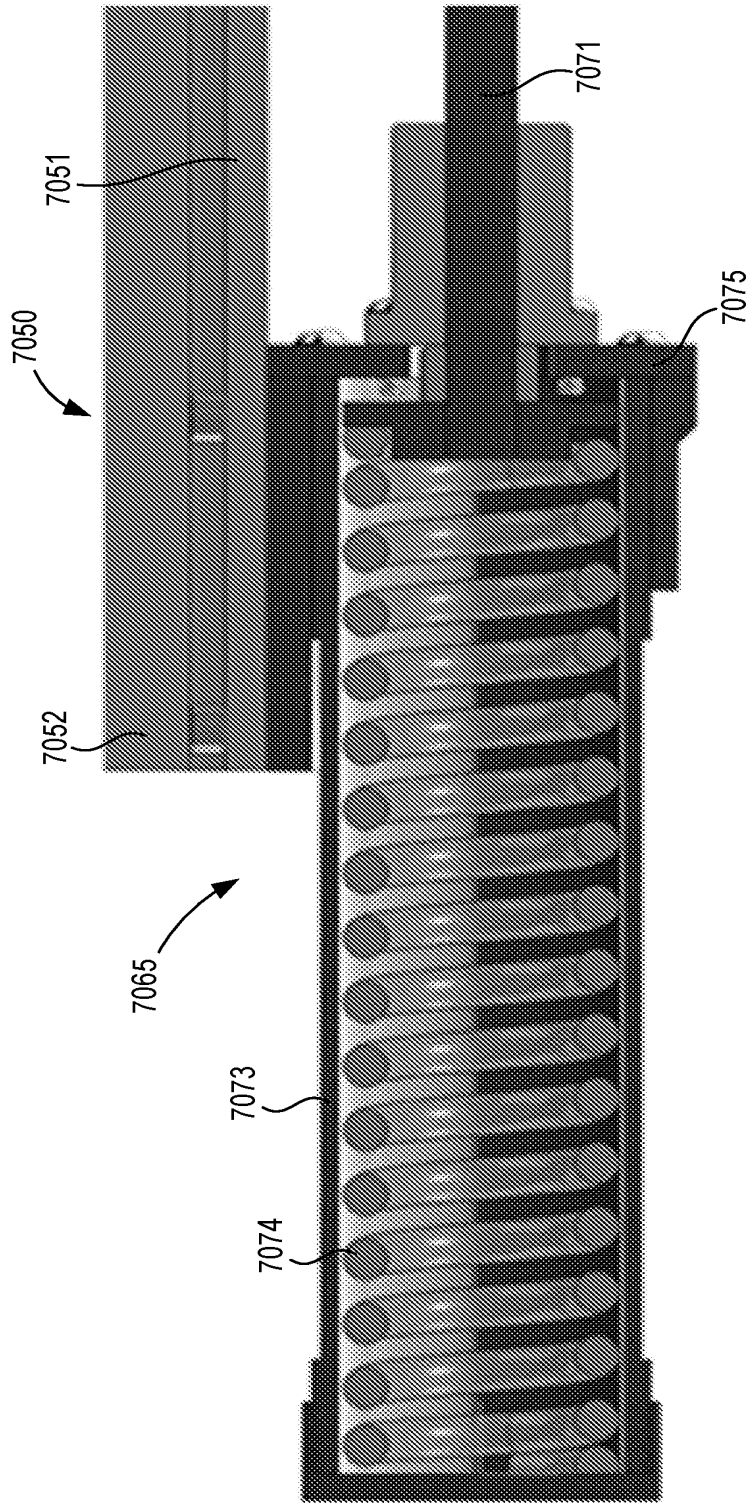


FIG. 44

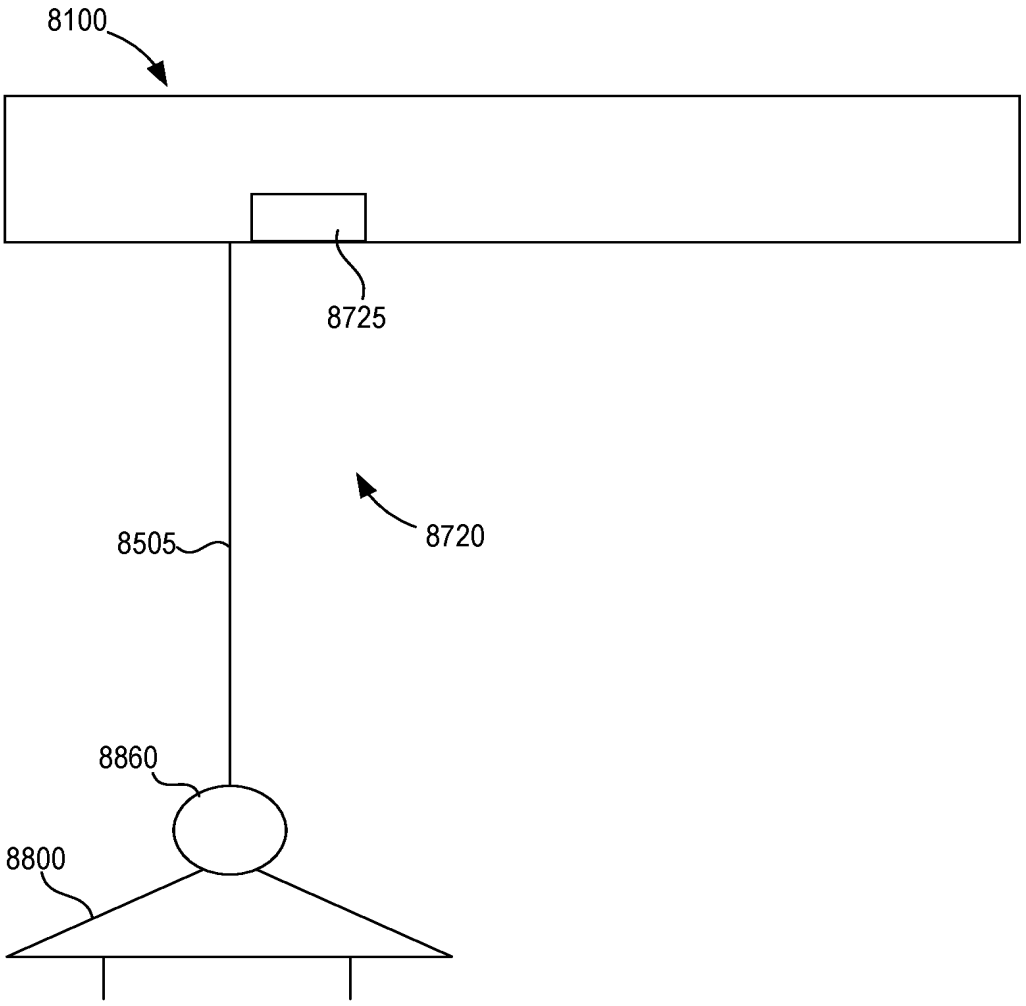


FIG. 45

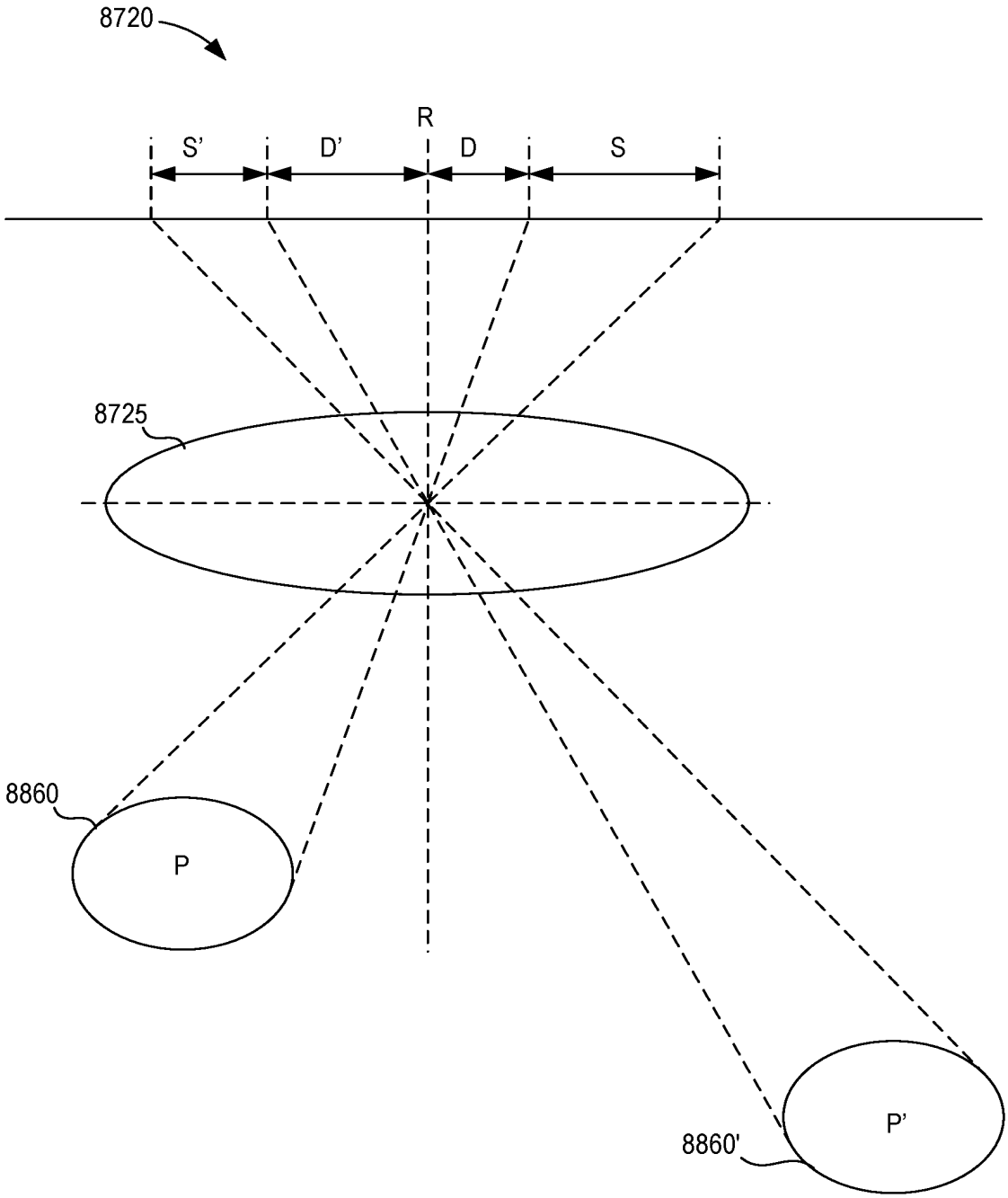


FIG. 46

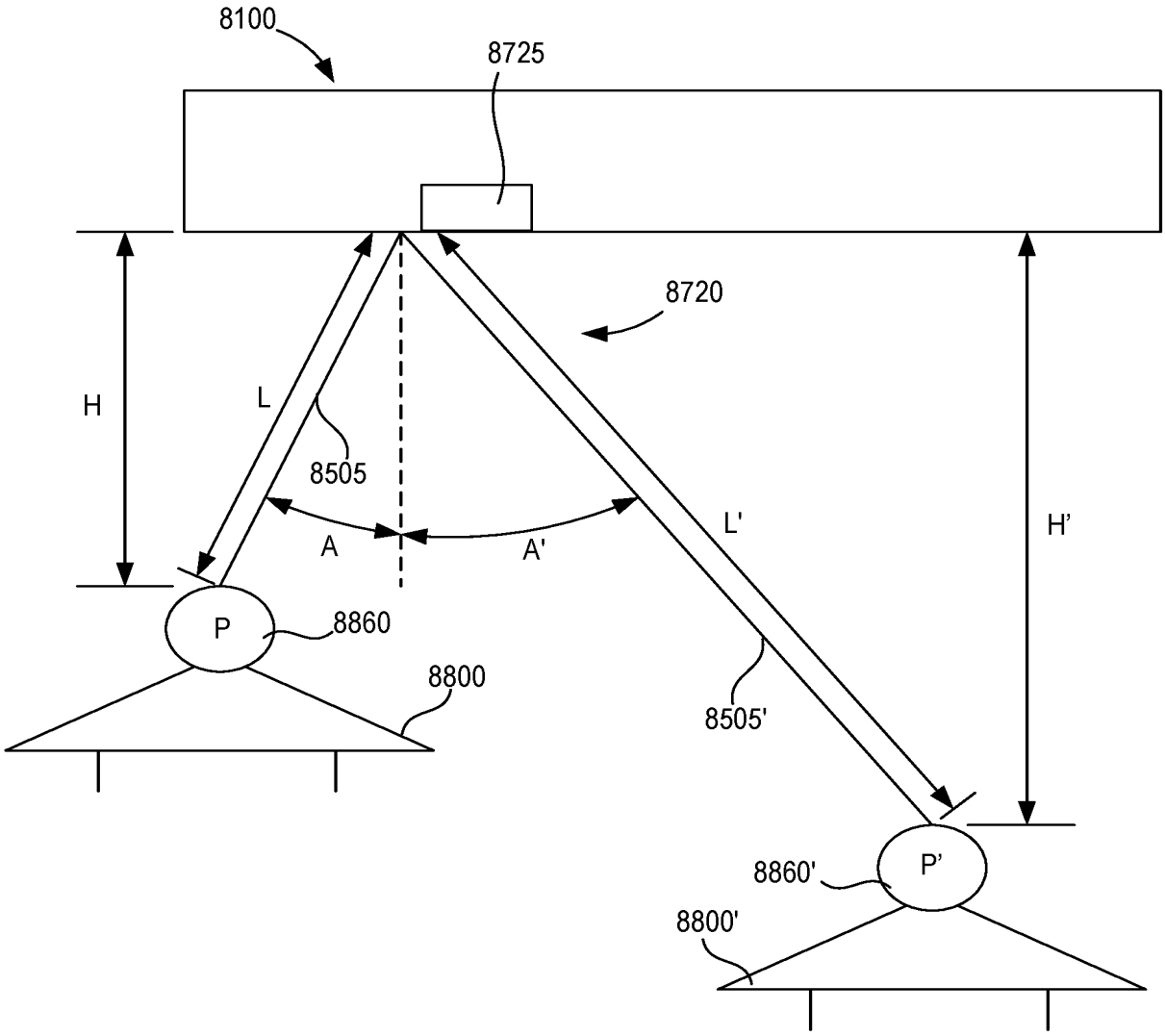


FIG. 47

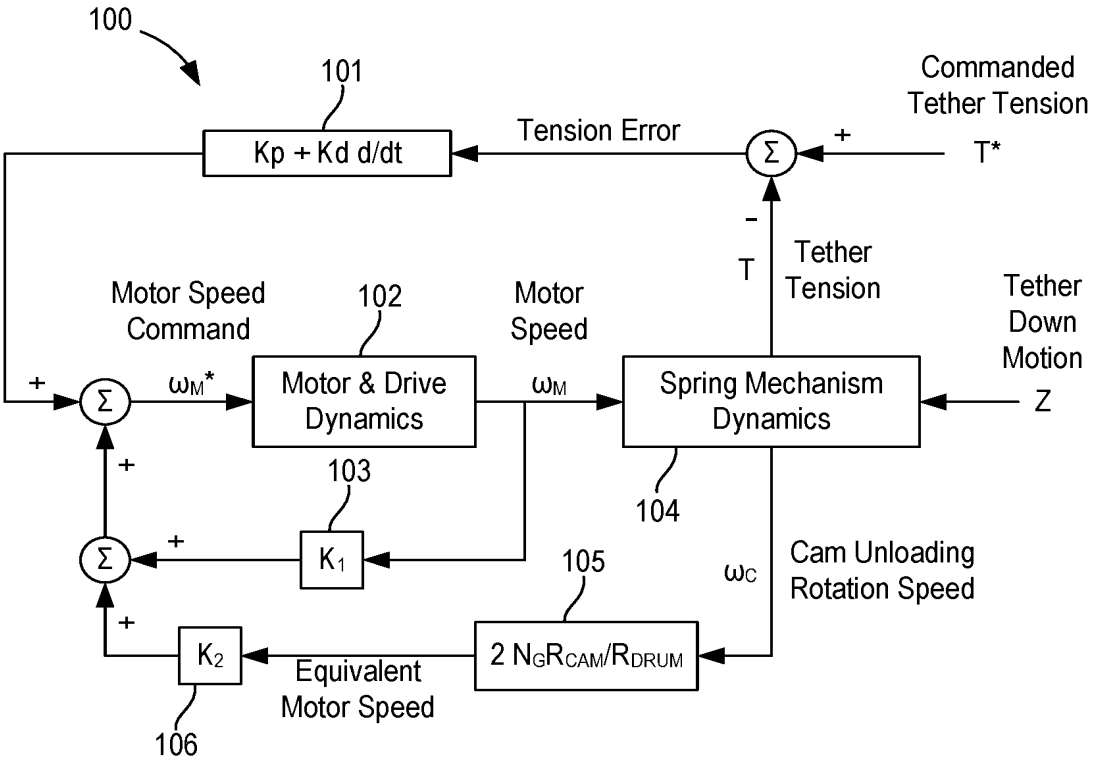

100
101
Kp + Kd d/dt
Tension Error
Commanded
Tether Tension
T*
+
-
T
Tether
Tension
Motor Speed
Command
102
Motor
Speed
Tether
Down
Motion
Z
+
ωM*
Motor & Drive
Dynamics
ωM
Spring Mechanism
Dynamics
+
103
104
+
K1
105
ωC
Cam Unloading
Rotation Speed
+
K2
2 NGRCAM/RDRUM
Equivalent
Motor Speed
106

FIG. 48

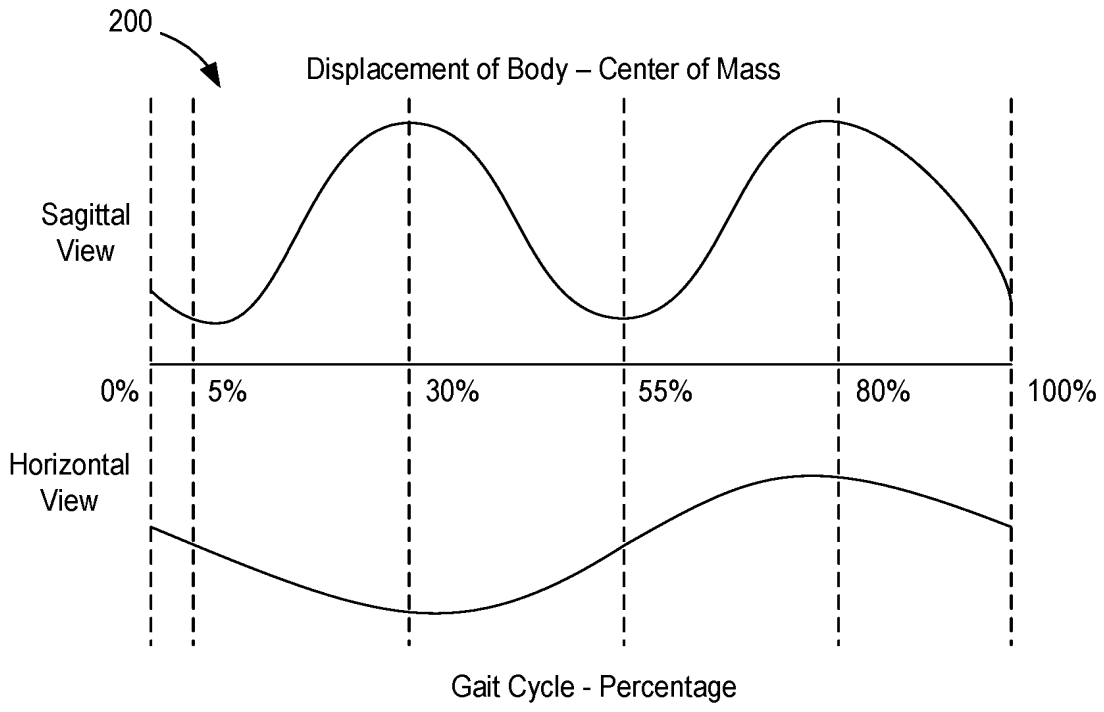

200
Displacement of Body – Center of Mass
Sagittal
View
0%
5%
30%
55%
80%
100%
Horizontal
View
Gait Cycle - Percentage

FIG. 49

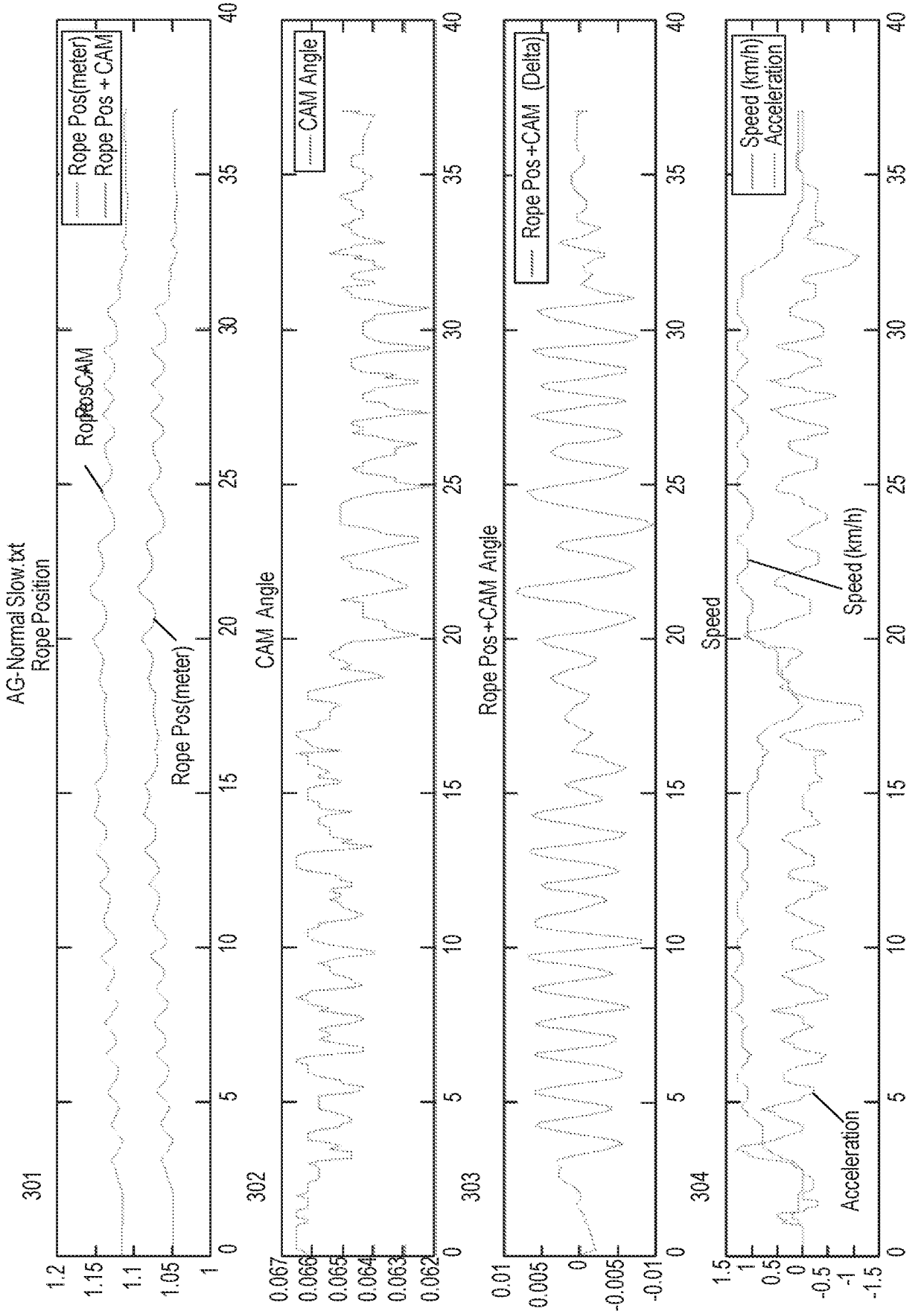

AG-Normal Slow.txt
Rope Position
Rope Pos(meter)
Rope Pos + CAM
Rope Pos(meter)
Rope Pos+CAM
301
CAM Angle
CAM Angle
302
Rope Pos+CAM Angle
Rope Pos +CAM (Delta)
303
Speed
Speed (km/h)
Acceleration
Speed (km/h)
Acceleration
304

FIG. 50

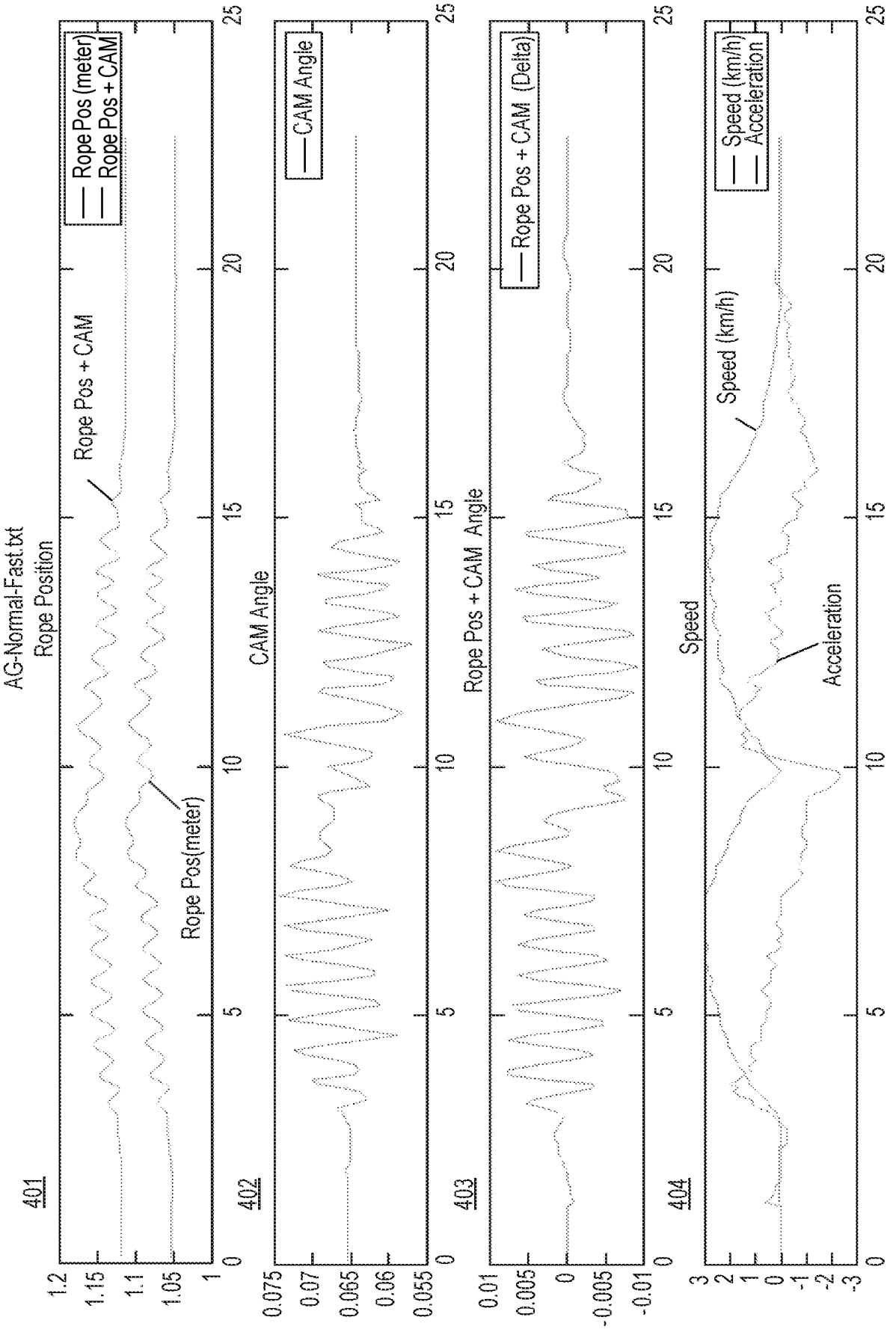

AG-Normal-Fast.txt
Rope Position
401
Rope Pos (meter)
Rope Pos + CAM
Rope Pos + CAM
Rope Pos(meter)
1.2
1.15
1.1
1.05
1
CAM Angle
402
CAM Angle
0.075
0.07
0.065
0.06
0.055
Rope Pos + CAM Angle
403
Rope Pos + CAM (Delta)
0.01
0.005
0
-0.005
-0.01
Speed
404
Speed (km/h)
Acceleration
Speed (km/h)
Acceleration
3
2
1
0
-1
-2
-3
0
5
10
15
20
25

FIG. 51

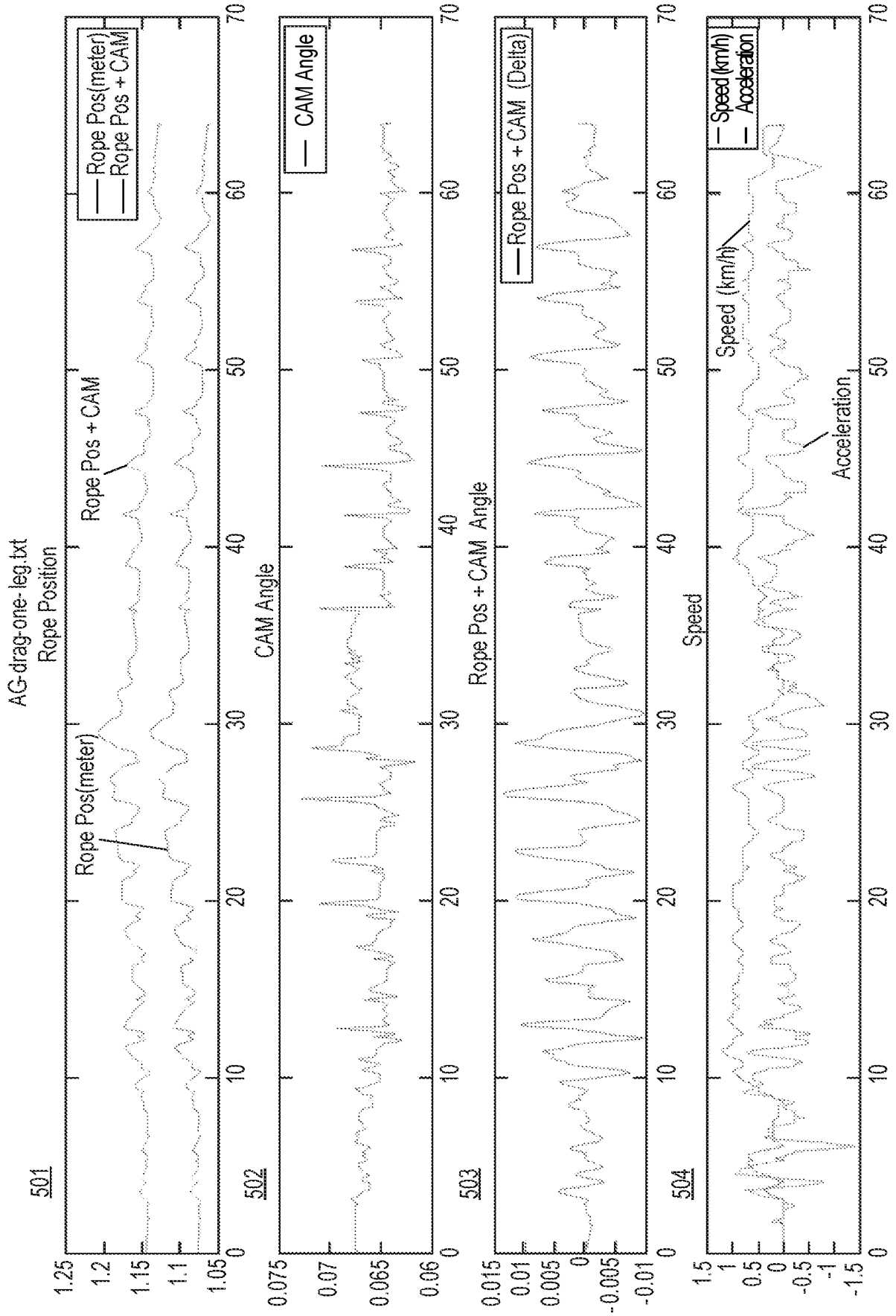

AG-drag-one- leg.txt
Rope Position
501
Rope Pos(meter)
Rope Pos + CAM
Rope Pos(meter)
Rope Pos + CAM
1.25
1.2
1.15
1.1
1.05
0
10
20
30
40
50
60
70
CAM Angle
502
CAM Angle
0.075
0.07
0.065
0.06
Rope Pos + CAM Angle
503
Rope Pos + CAM (Delta)
0.015
0.01
0.005
0
-0.005
-0.01
Speed
504
Speed (km/h)
Acceleration
Speed (km/h)
Acceleration
1.5
1
0.5
0
-0.5
-1
-1.5

FIG. 52

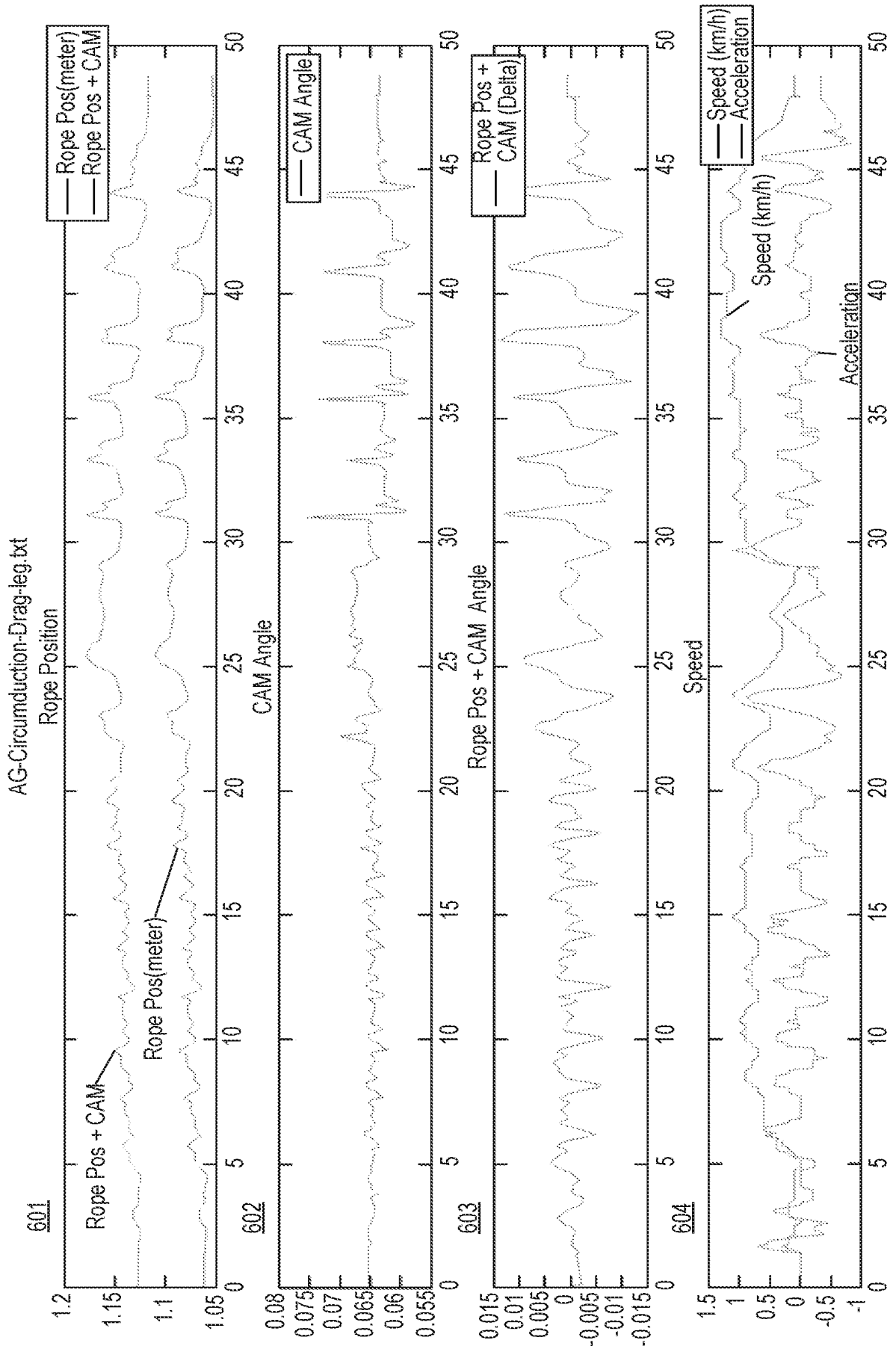

AG-Circumduction-Drag-leg.txt
601
Rope Position
Rope Pos(meter)
Rope Pos + CAM
Rope Pos + CAM
Rope Pos(meter)
602
CAM Angle
CAM Angle
603
Rope Pos + CAM Angle
Rope Pos + CAM (Delta)
604
Speed
Speed (km/h)
Acceleration
Speed (km/h)
Acceleration

FIG. 53

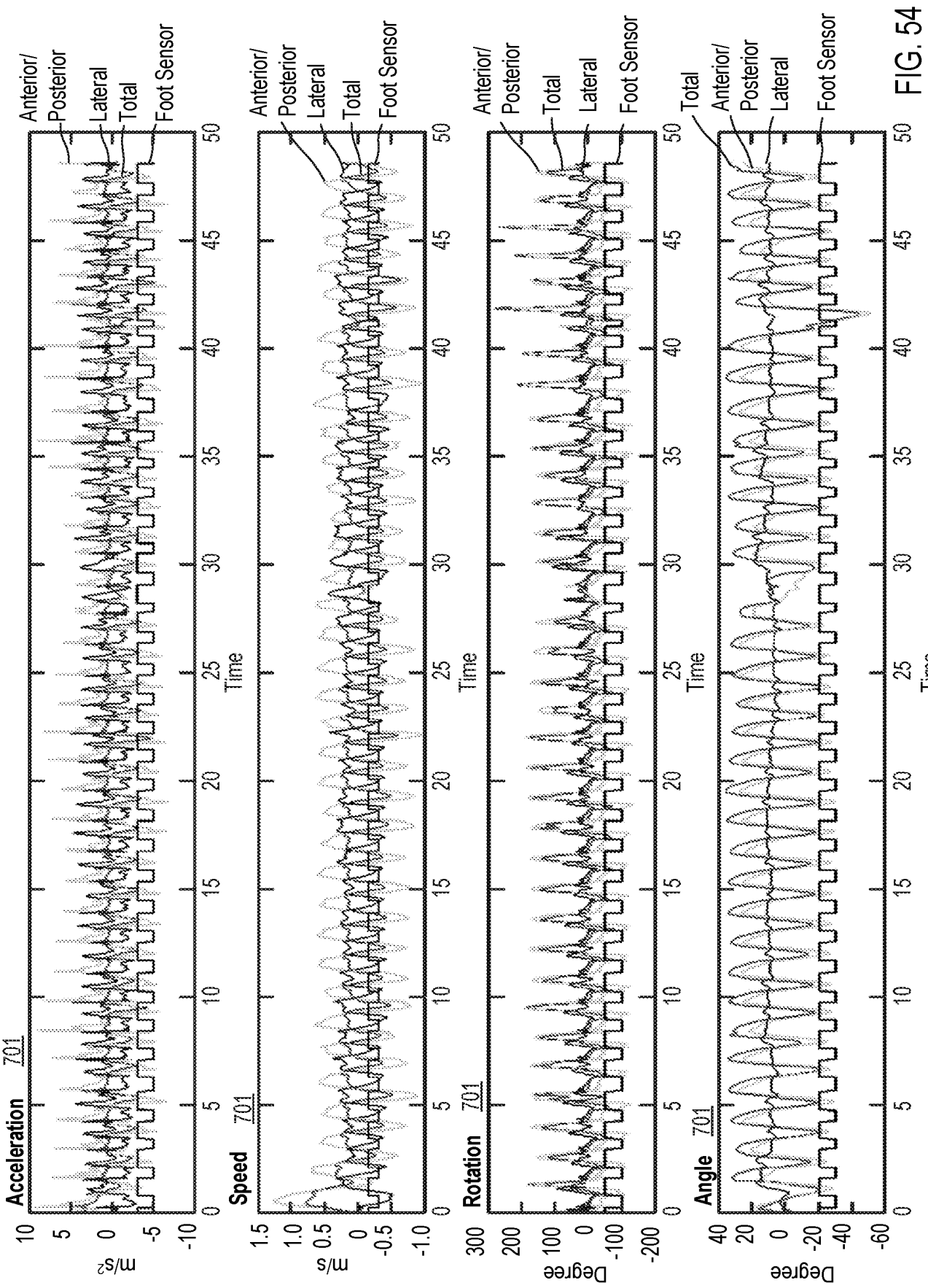

Acceleration 701
Anterior/ Posterior
Lateral
Total
Foot Sensor
m/s²
Time
Speed 701
Anterior/ Posterior
Lateral
Total
Foot Sensor
m/s
Time
Rotation 701
Anterior/ Posterior
Total
Lateral
Foot Sensor
Degree
Time
Angle 701
Total
Anterior/ Posterior
Lateral
Foot Sensor
Degree
Time

FIG. 54

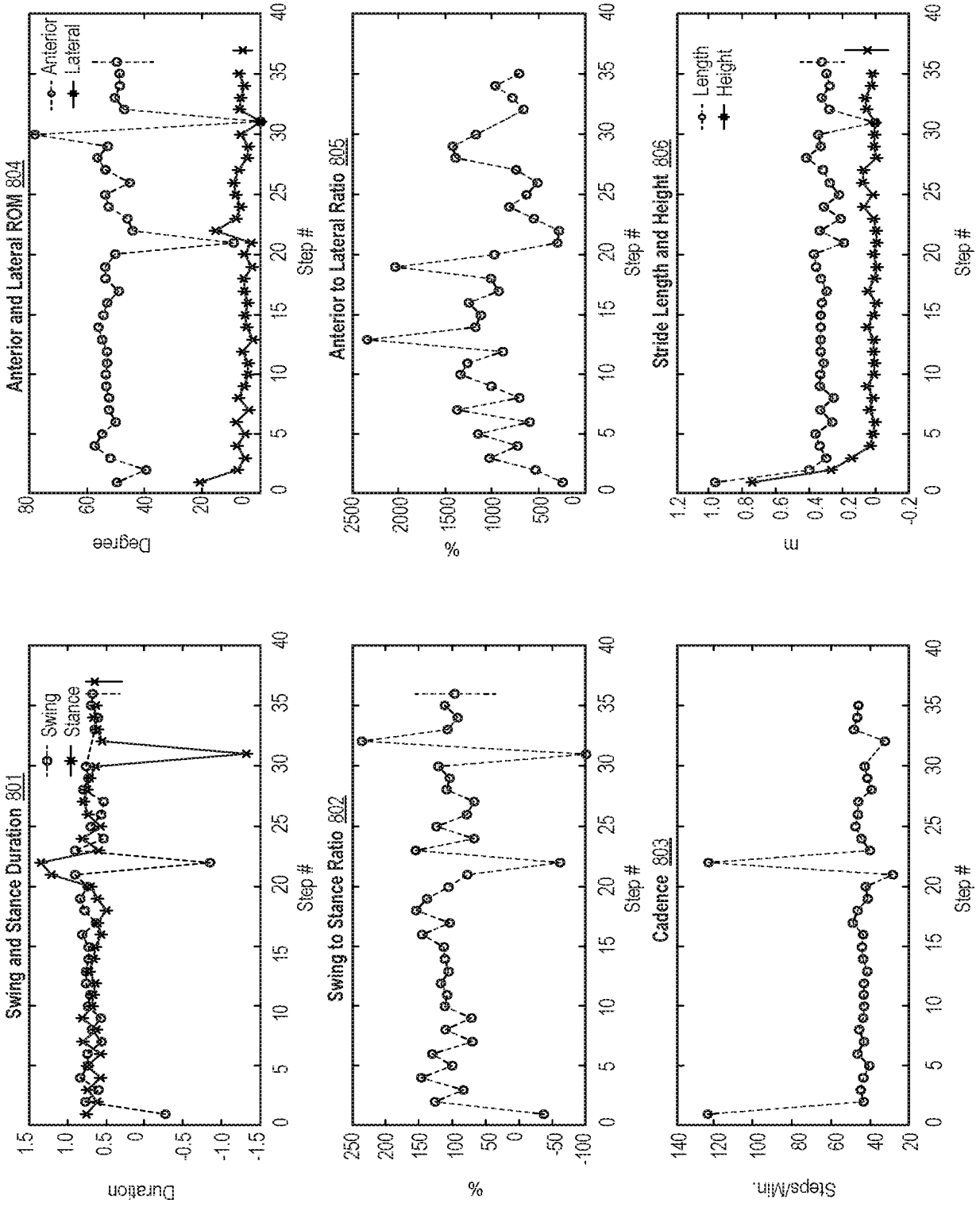

Swing and Stance Duration 801
Swing
Stance
Duration
Step #
Swing to Stance Ratio 802
%
Step #
Cadence 803
Steps/Min.
Step #
Anterior and Lateral ROM 804
Anterior
Lateral
Degree
Step #
Anterior to Lateral Ratio 805
%
Step #
Stride Length and Height 806
Length
Height
m
Step #

FIG. 55

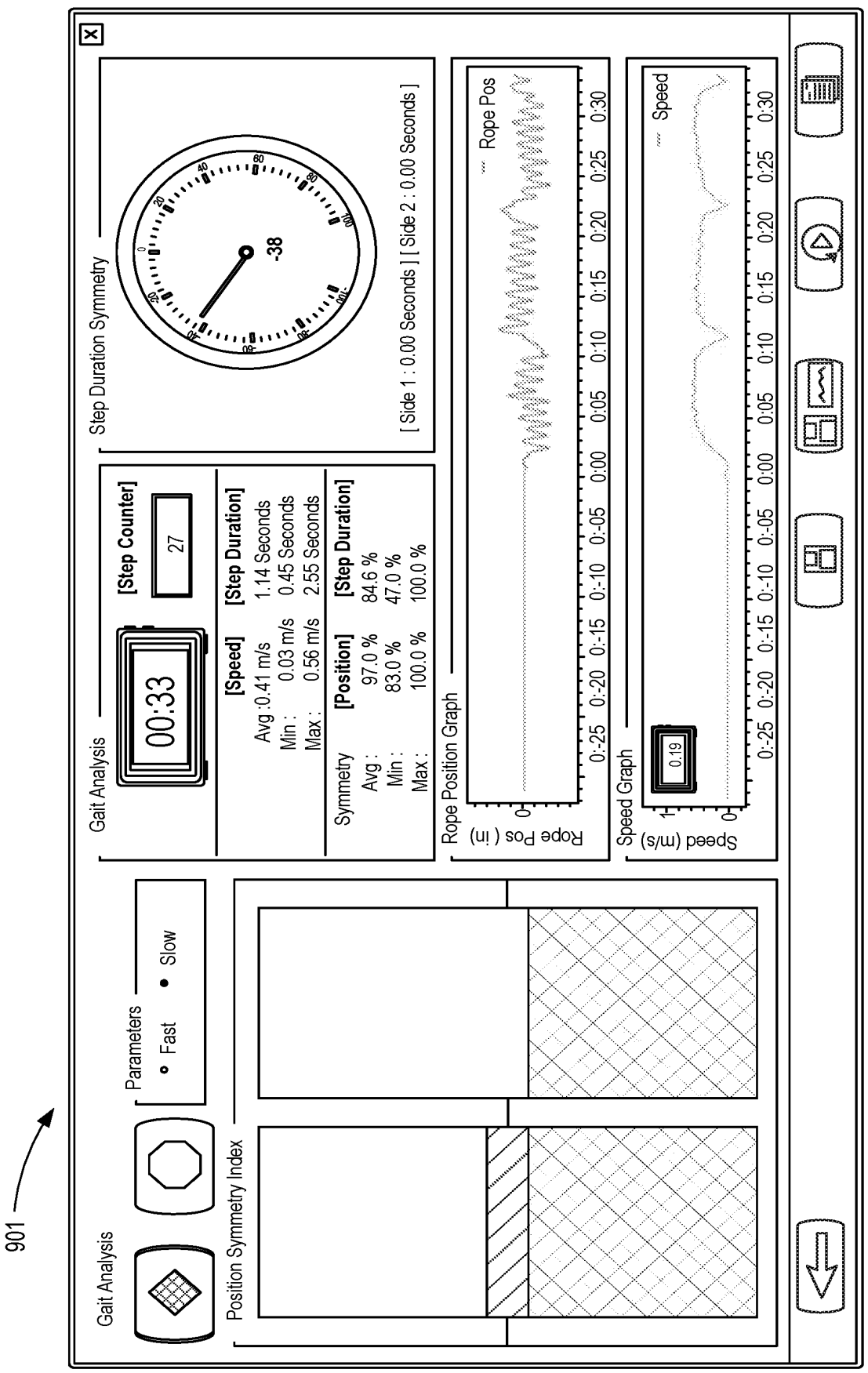

901
Gait Analysis
Gait Analysis
Parameters
Fast
Slow
Position Symmetry Index
Gait Analysis
00:33
[Step Counter]
27
[Speed]
Avg :0.41 m/s
Min : 0.03 m/s
Max : 0.56 m/s
[Step Duration]
1.14 Seconds
0.45 Seconds
2.55 Seconds
Symmetry
[Position]
Avg : 97.0 %
Min : 83.0 %
Max : 100.0 %
[Step Duration]
84.6 %
47.0 %
100.0 %
Step Duration Symmetry
-38
[Side 1 : 0.00 Seconds] [Side 2 : 0.00 Seconds]
Rope Position Graph
Rope Pos
Rope Pos (in)
0:-25 0:-20 0:-15 0:-10 0:-05 0:00 0:05 0:10 0:15 0:20 0:25 0:30
Speed Graph
Speed
0.19
Speed (m/s)
0:-25 0:-20 0:-15 0:-10 0:-05 0:00 0:05 0:10 0:15 0:20 0:25 0:30

FIG. 56

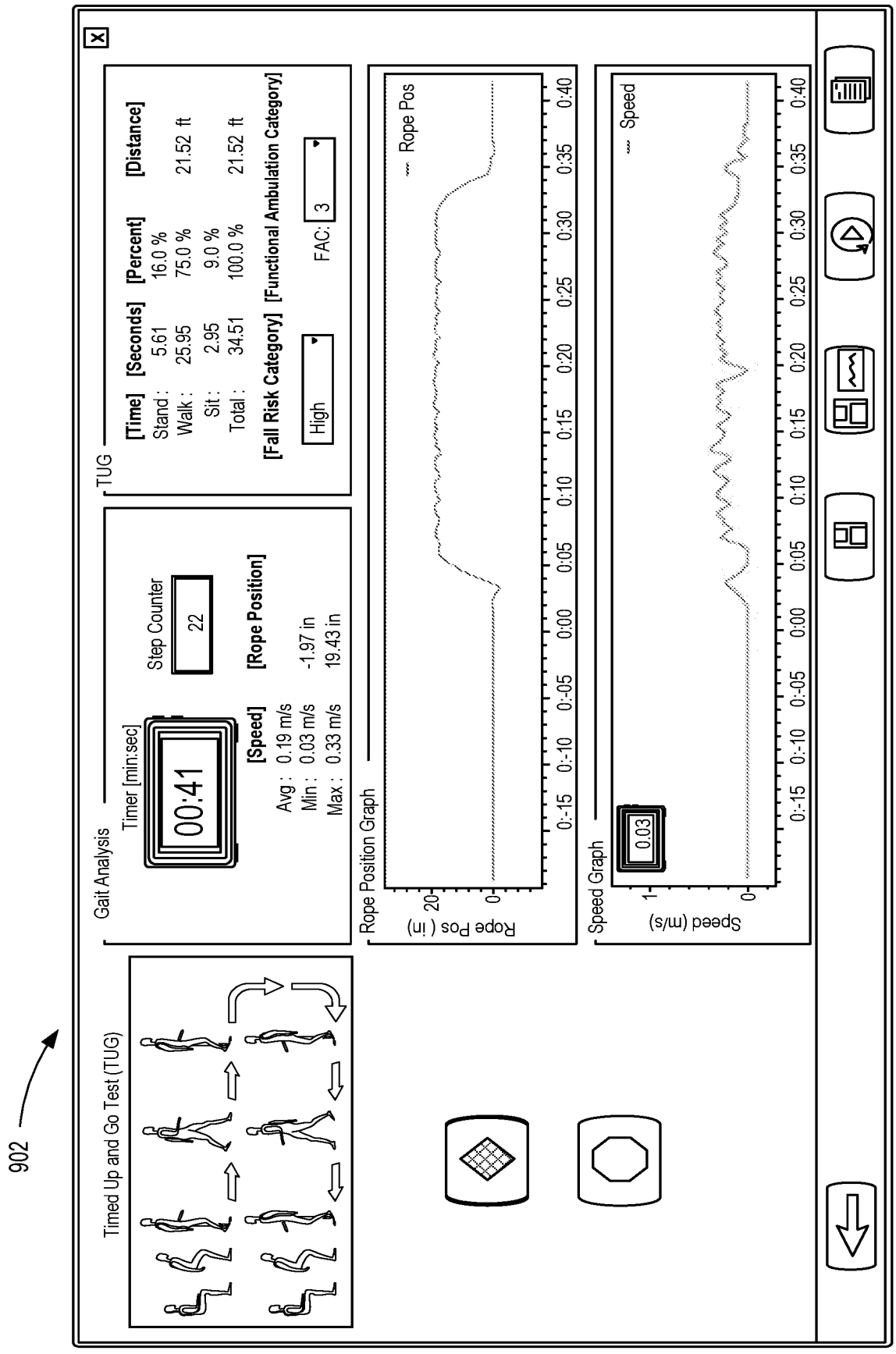

902
Timed Up and Go Test (TUG)
Gait Analysis
Timer [min:sec]
00:41
Step Counter
22
[Speed]
Avg : 0.19 m/s
Min : 0.03 m/s
Max : 0.33 m/s
[Rope Position]
-1.97 in
19.43 in
TUG
[Time] [Seconds] [Percent] [Distance]
Stand : 5.61 16.0 %
Walk : 25.95 75.0 % 21.52 ft
Sit : 2.95 9.0 %
Total : 34.51 100.0 % 21.52 ft
[Fall Risk Category] [Functional Ambulation Category]
High
FAC: 3
Rope Position Graph
Rope Pos
Rope Pos (in)
20
0
0:-15 0:-10 0:-05 0:00 0:05 0:10 0:15 0:20 0:25 0:30 0:35 0:40
Speed Graph
Speed
0.03
Speed (m/s)
1
0
0:-15 0:-10 0:-05 0:00 0:05 0:10 0:15 0:20 0:25 0:30 0:35 0:40

FIG. 57

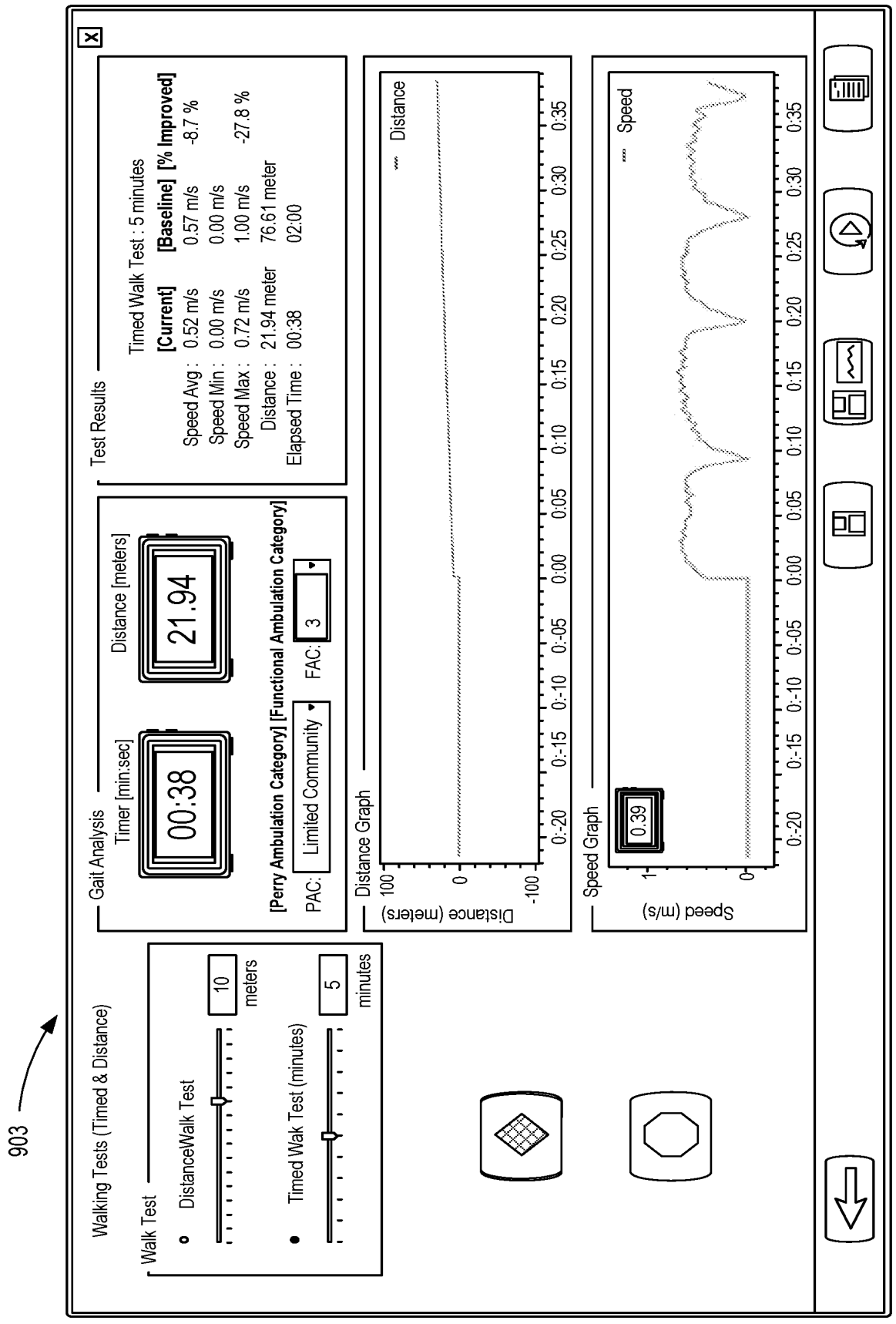

903
Walking Tests (Timed & Distance)
Walk Test
DistanceWalk Test
10
meters
Timed Wak Test (minutes)
5
minutes
Gait Analysis
Timer [min:sec]
00:38
Distance [meters]
21.94
[Perry Ambulation Category] [Functional Ambulation Category]
PAC: Limited Community
FAC: 3
Test Results
Timed Walk Test : 5 minutes
[Current] [Baseline] [% Improved]
Speed Avg : 0.52 m/s 0.57 m/s -8.7 %
Speed Min : 0.00 m/s 0.00 m/s
Speed Max : 0.72 m/s 1.00 m/s -27.8 %
Distance : 21.94 meter 76.61 meter
Elapsed Time : 00:38 02:00
Distance Graph
Distance
Distance (meters)
100
0
-100
0:-20
0:-15
0:-10
0:-05
0:00
0:05
0:10
0:15
0:20
0:25
0:30
0:35
Speed Graph
Speed
0.39
Speed (m/s)
1
0

FIG. 58

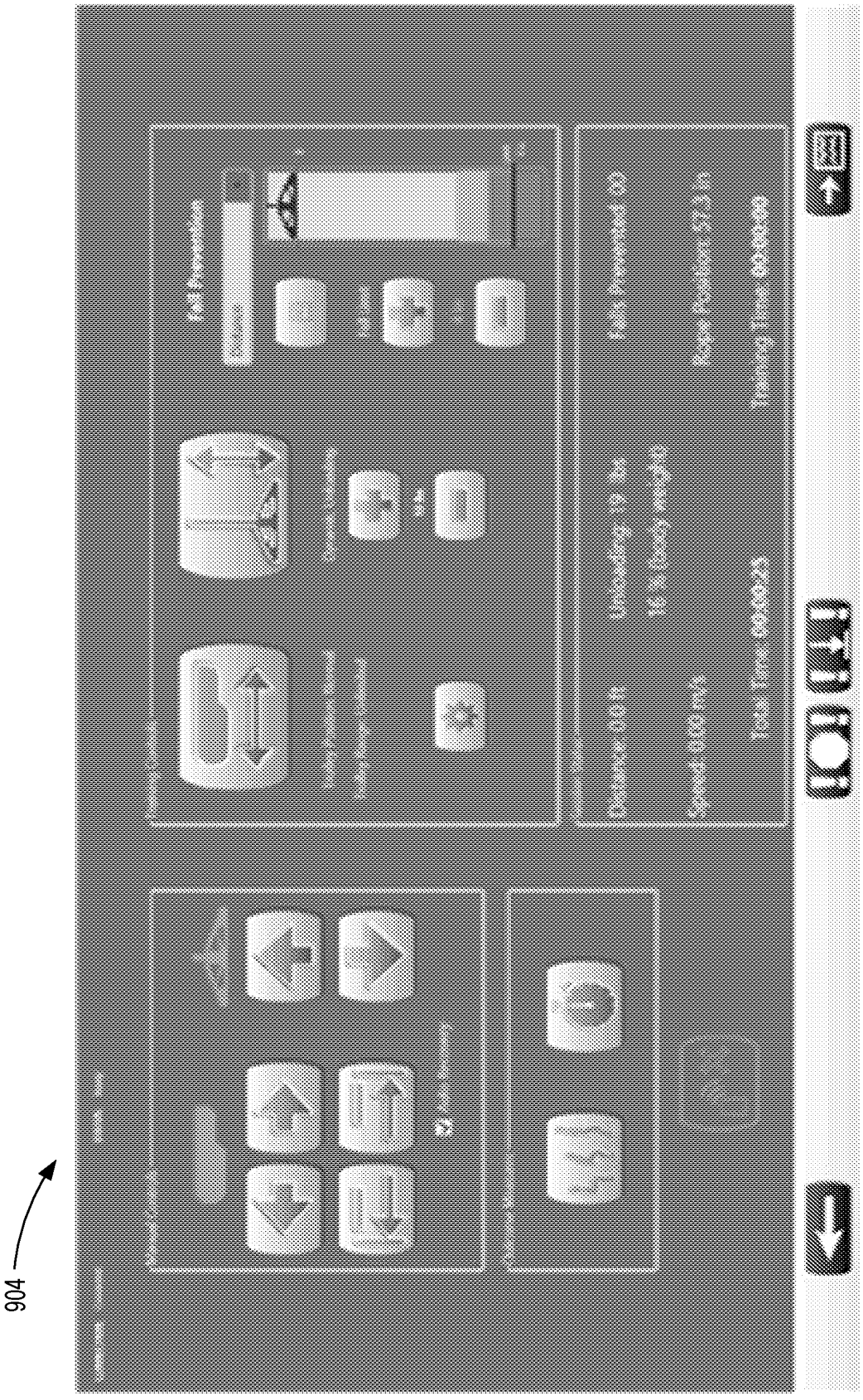
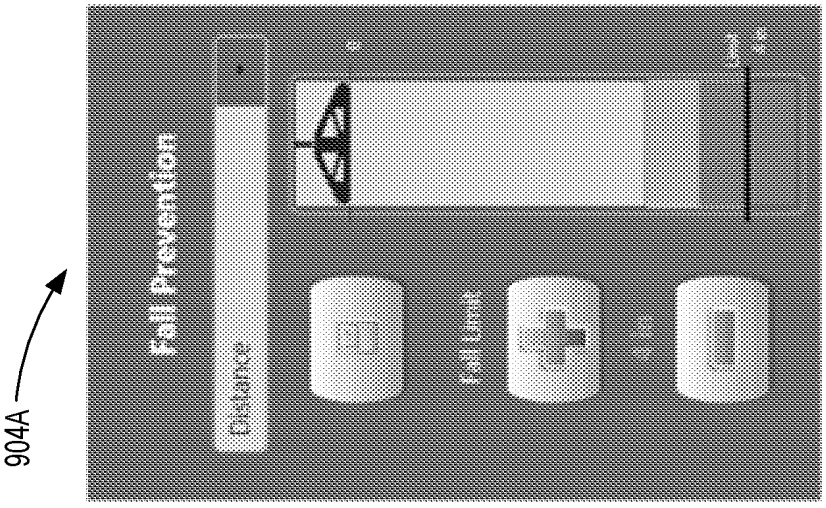
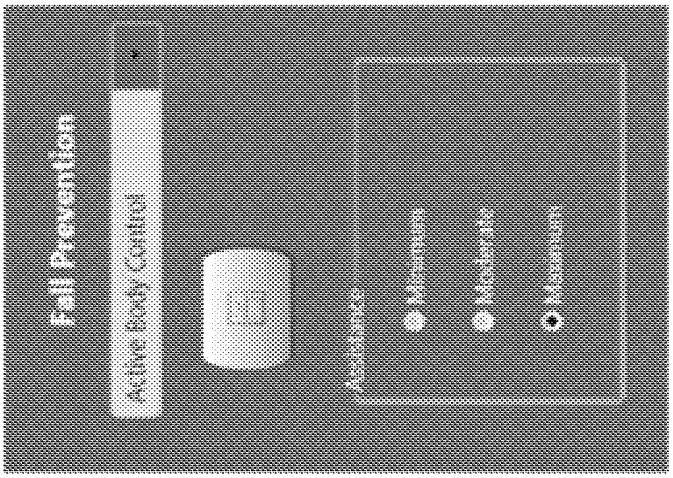


FIG. 59



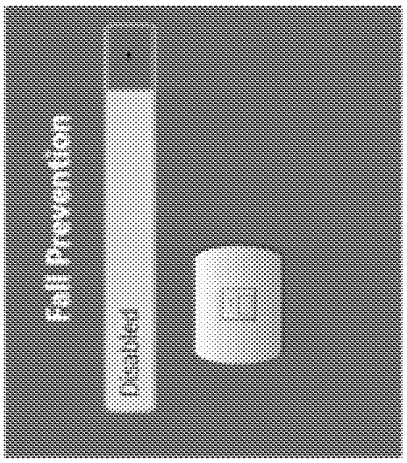
904A

FIG. 60



904B

FIG. 61



904C

FIG. 62

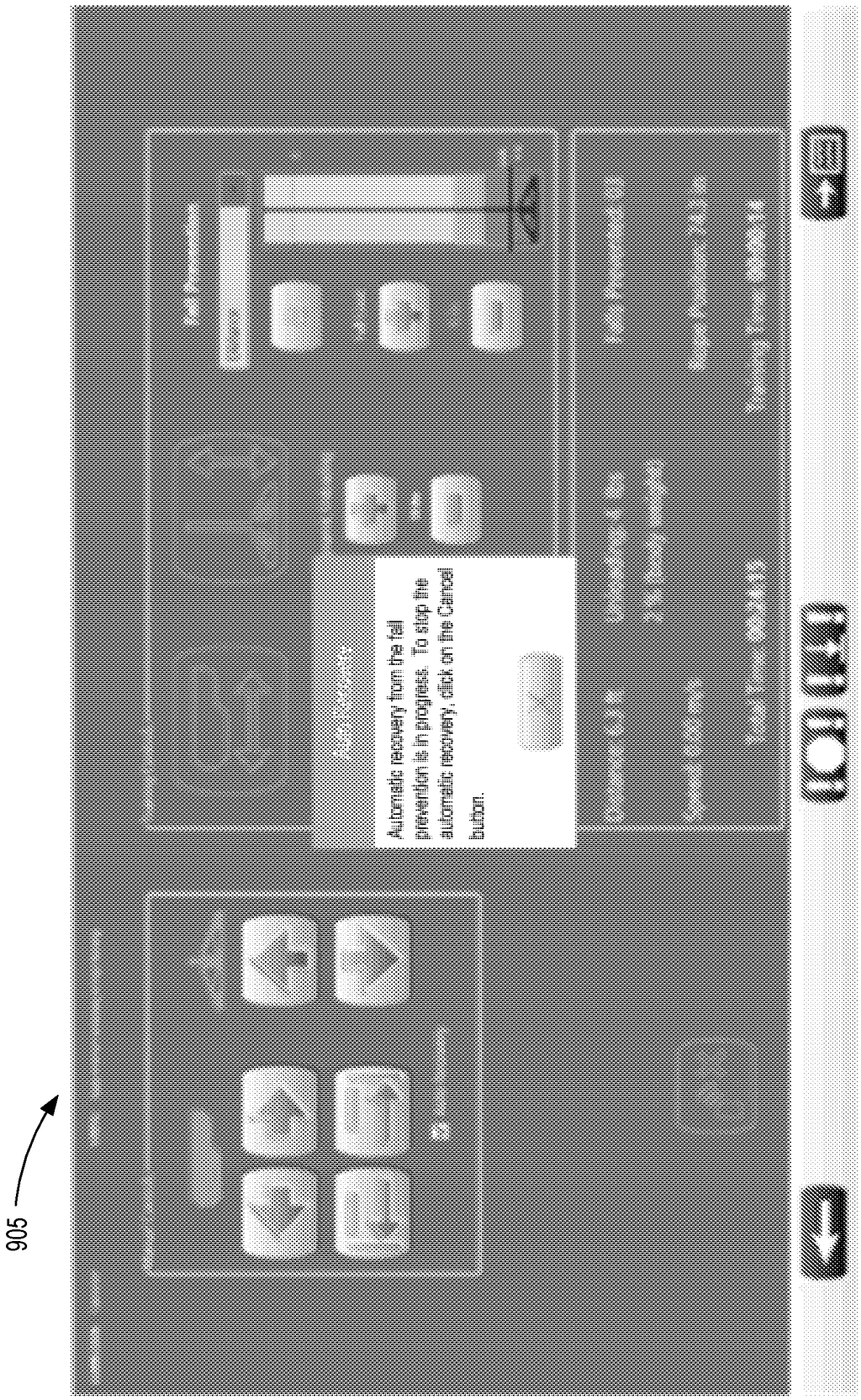

905
Automatic recovery from the fall prevention is in progress. To stop the automatic recovery, click on the Cancel button.

FIG. 63

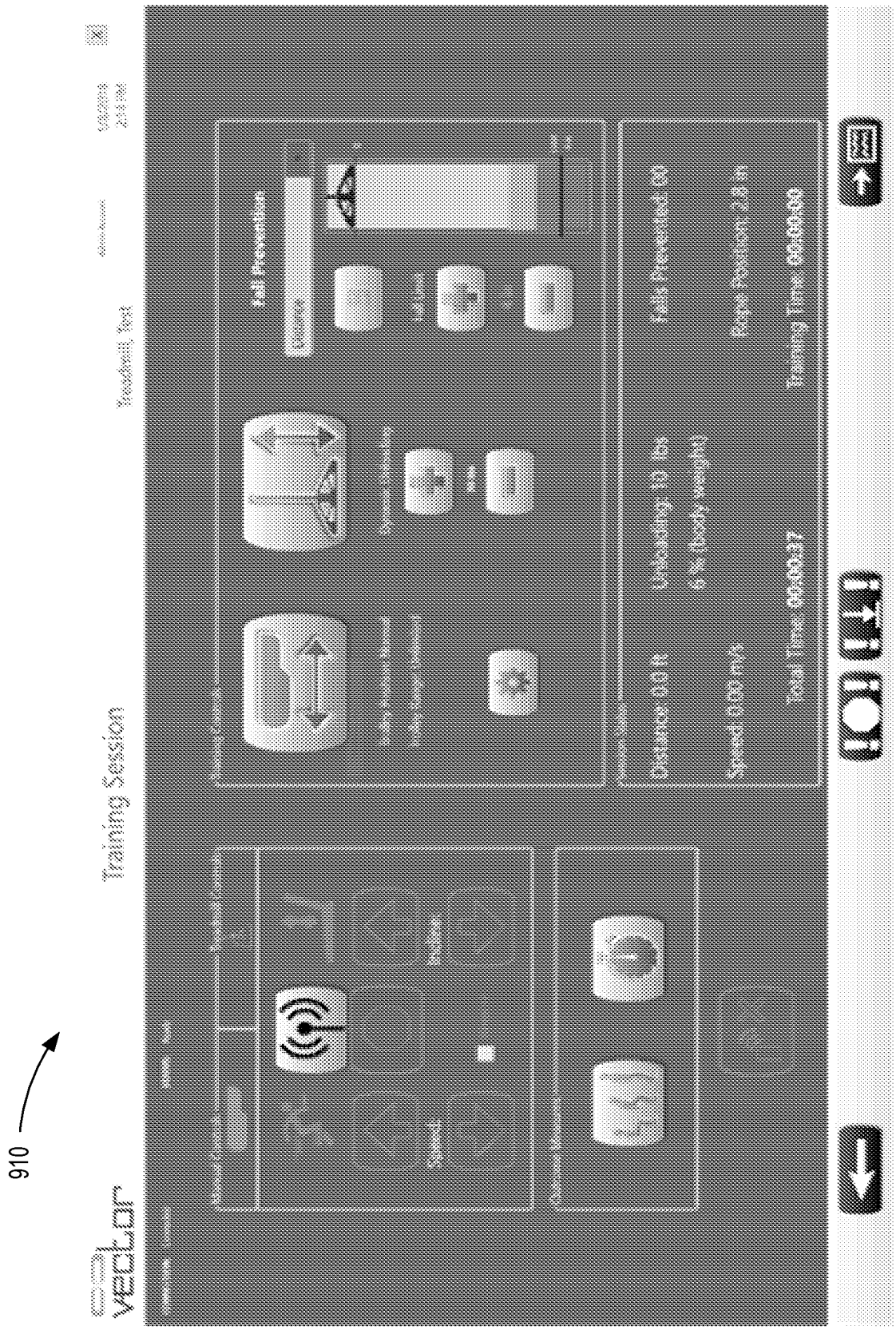


FIG. 64

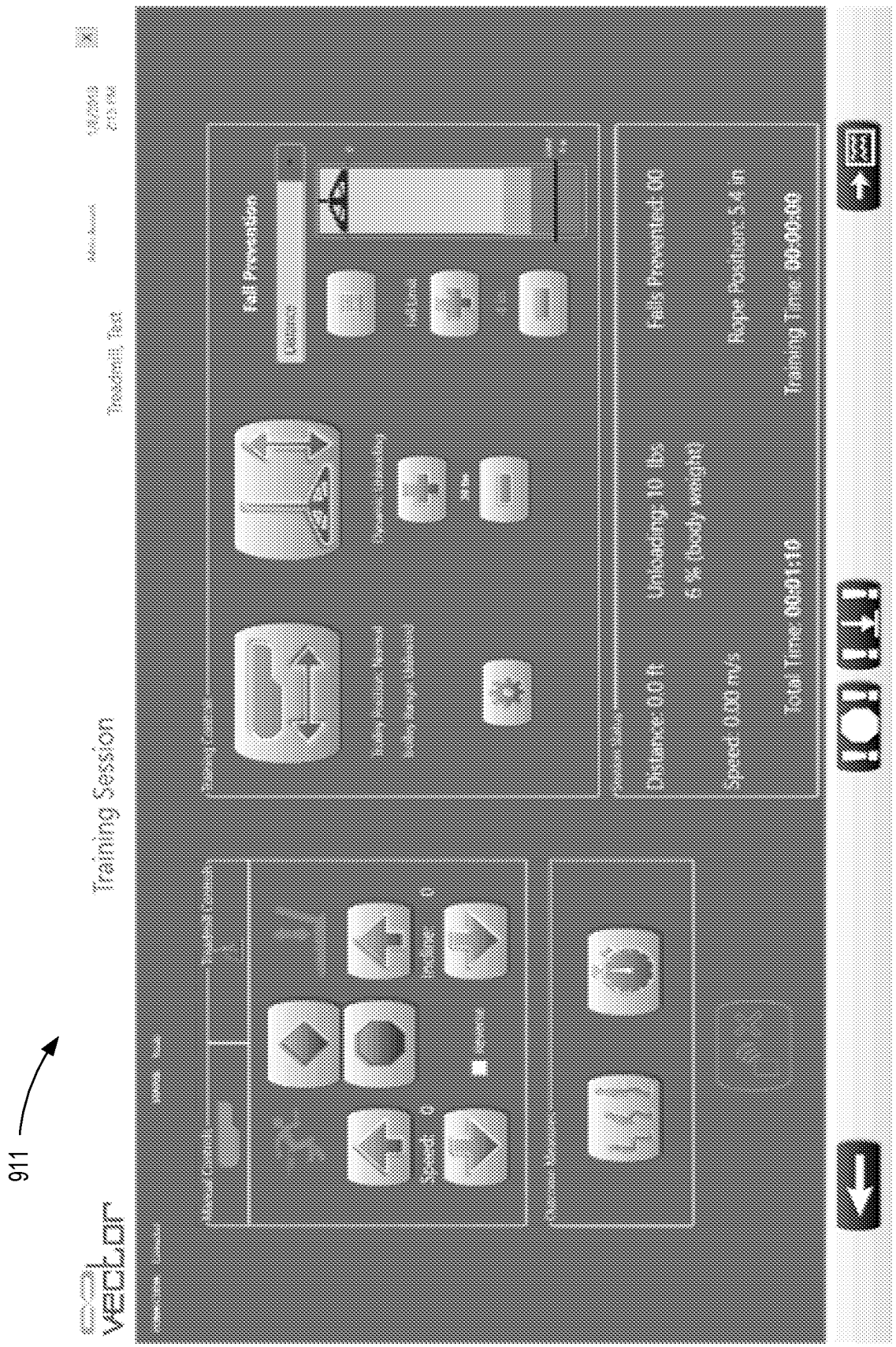

911
Training Session
Treadmill, Test
Fall Prevention
Total Time: 00:01:10
Training Time: 00:00:00
Distance: 0.01 ft
Speed: 0.00 ft/s
Paper Position: 5.4 in
Fall Threshold: 0.0
Distance: 0.0 ft
Fall Prevention: 0.0 lbs
Body Weight: 0.0 %
Paper Position: 5.4 in

FIG. 65

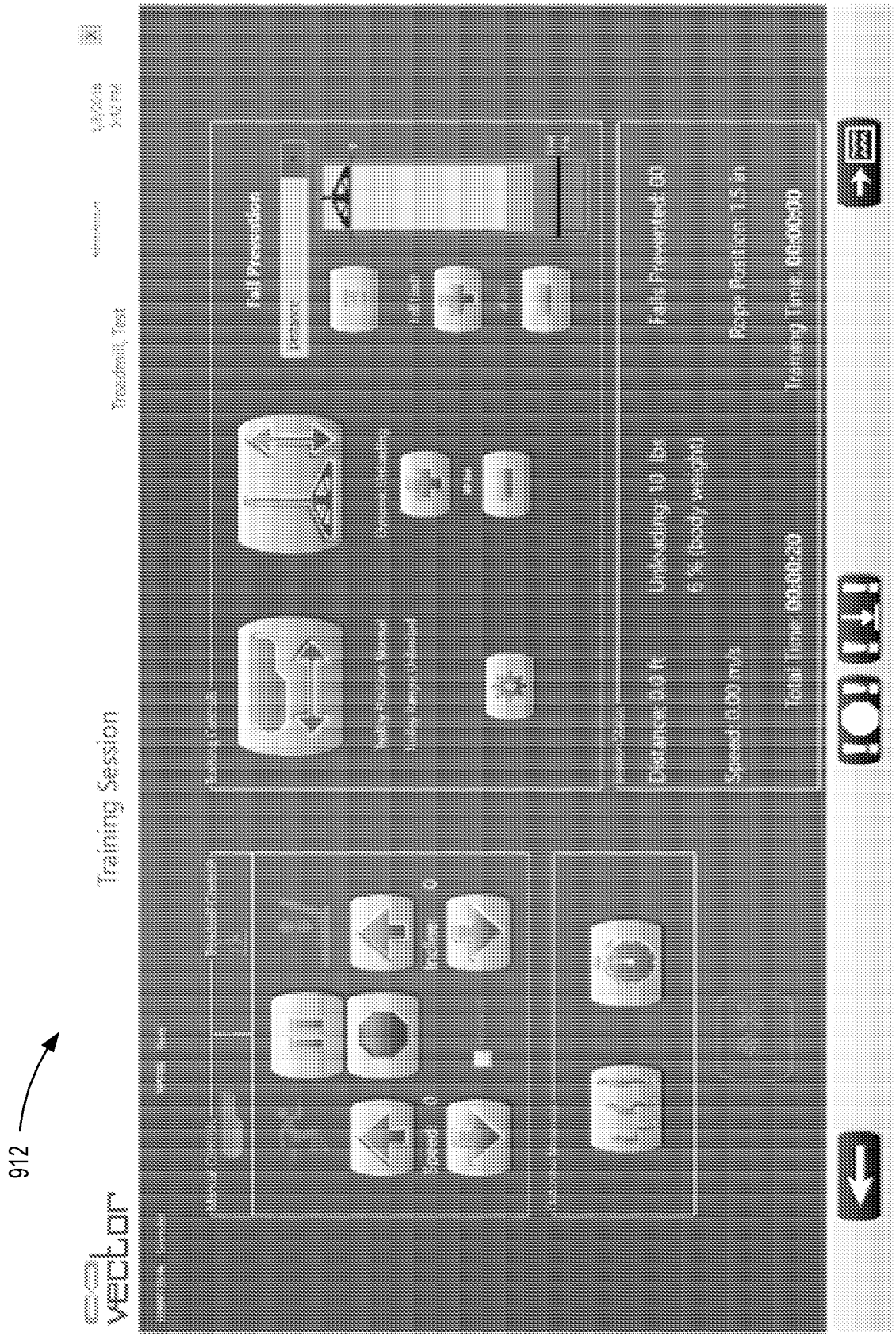

912
Training Session
Total Time: 00:00:00
Training Time: 00:00:00
Speed: 000 RPM
Distance: 0.0 in
Duration: 0.0 s
Power Position: 1.5 in
Target Power: 0 lbf
Target Position: 0.0 in
Pull Preparation
Pull
Release
Push
Prepare
Ready

FIG. 66

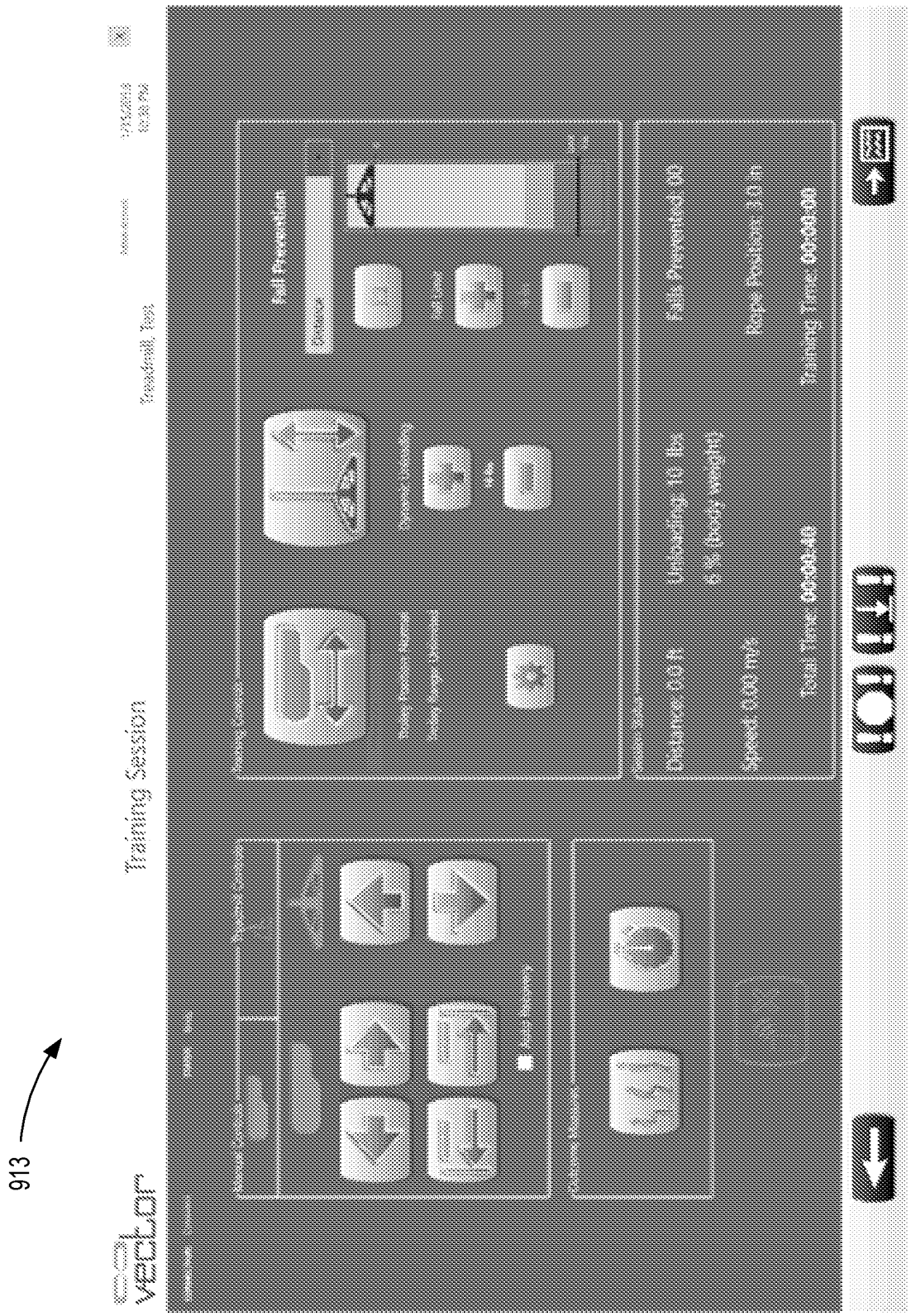


FIG. 67

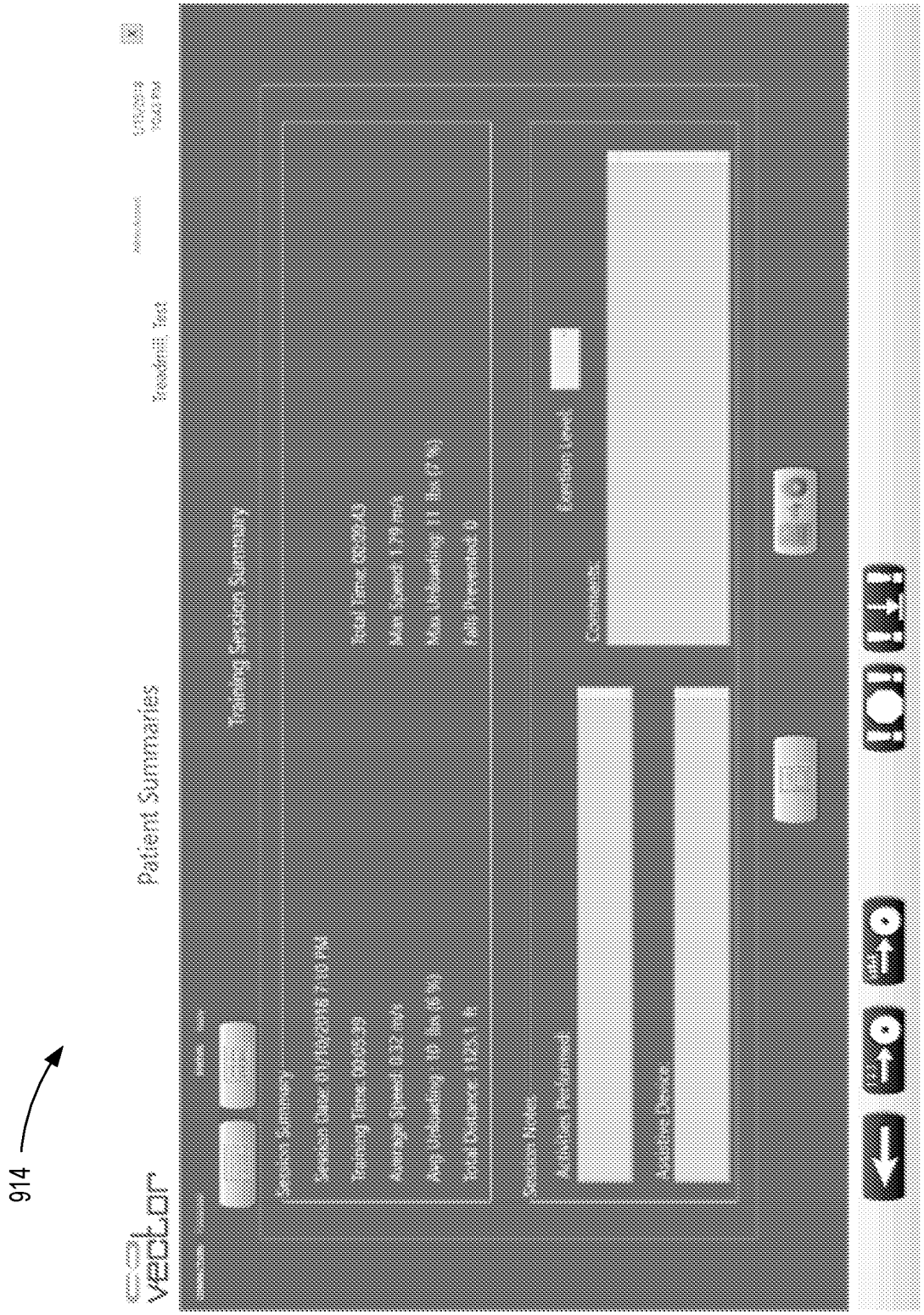


FIG. 68

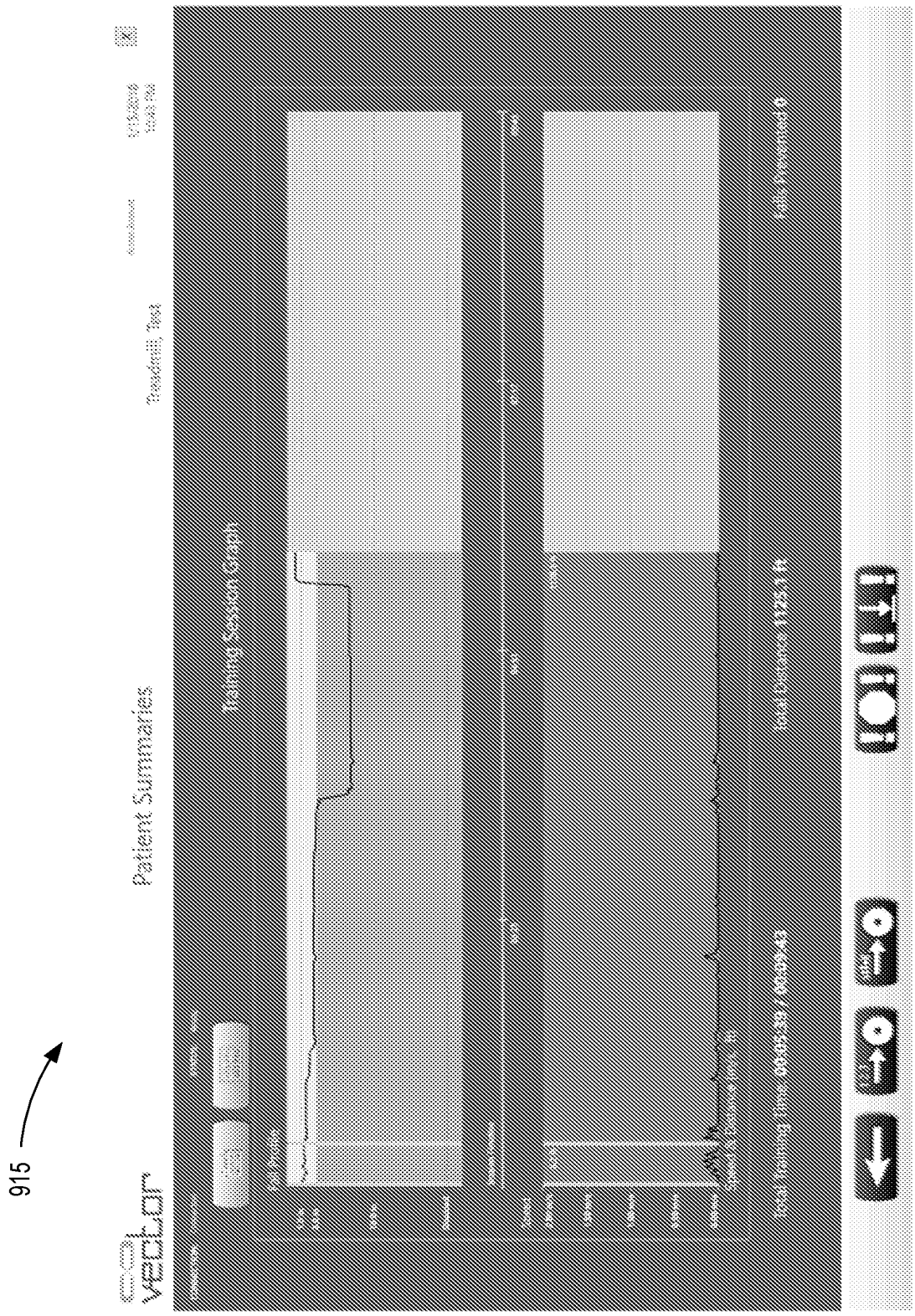


FIG. 69

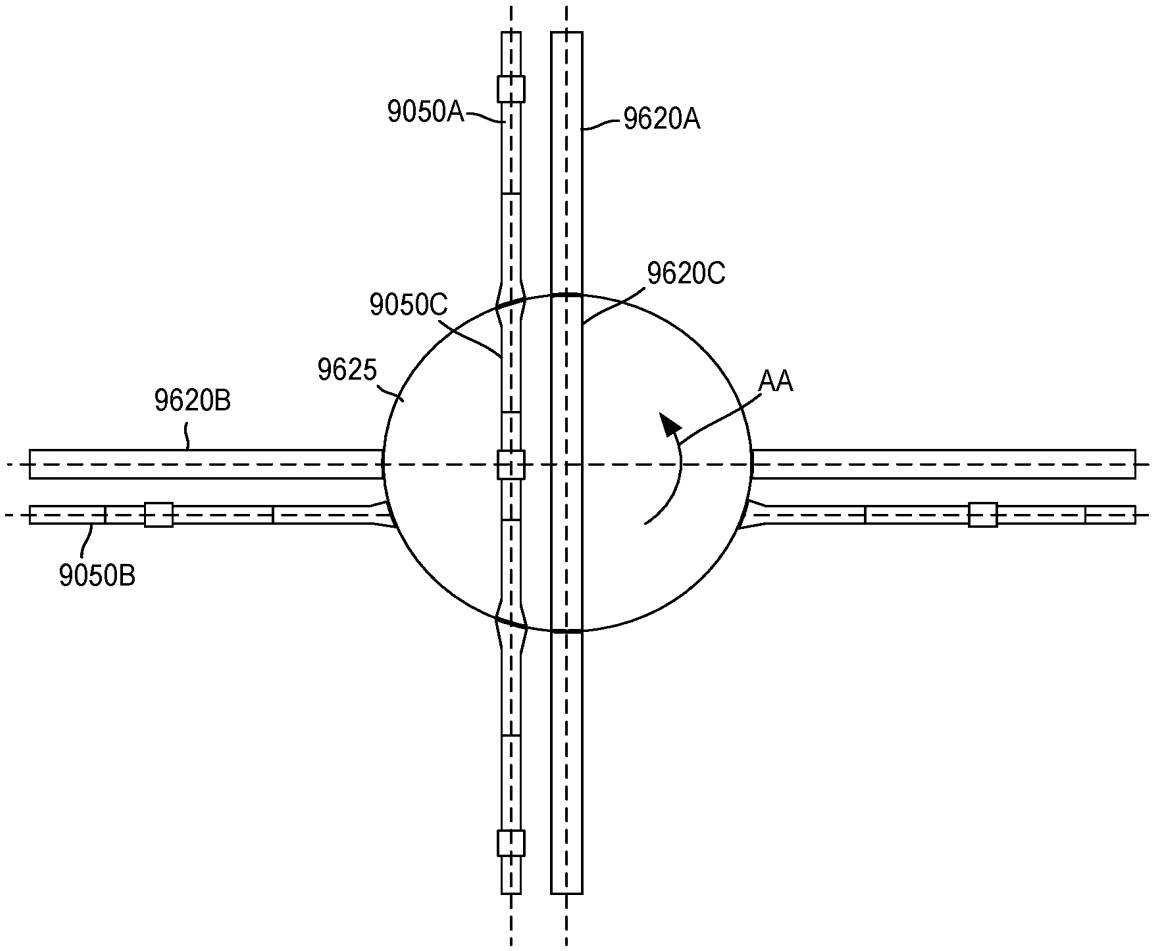


FIG. 70

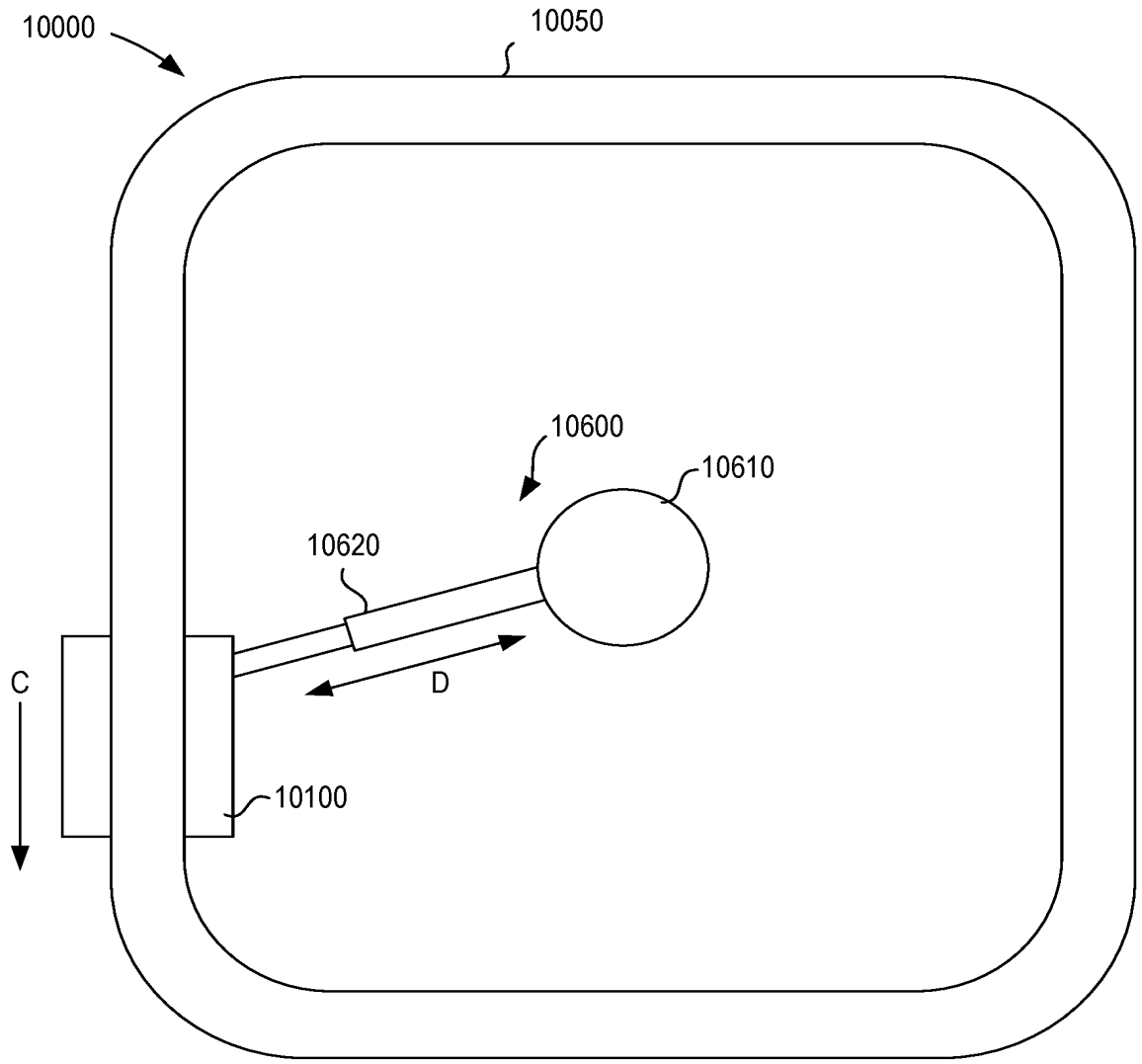


FIG. 71

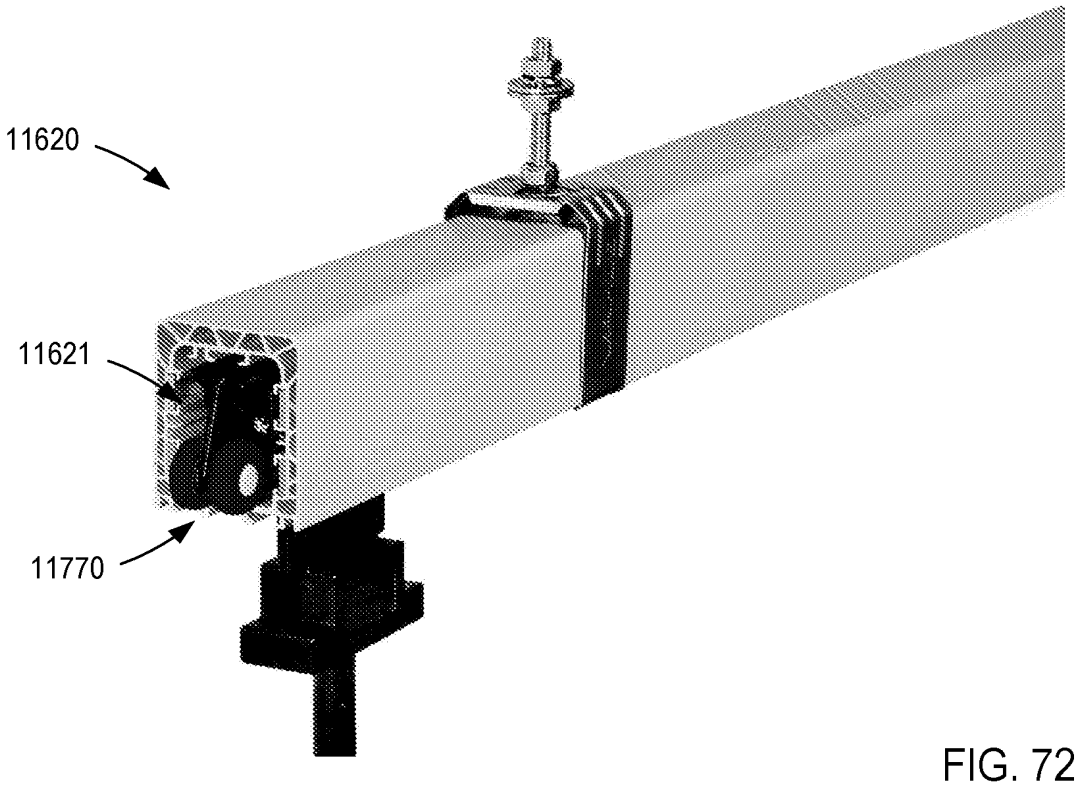


FIG. 72

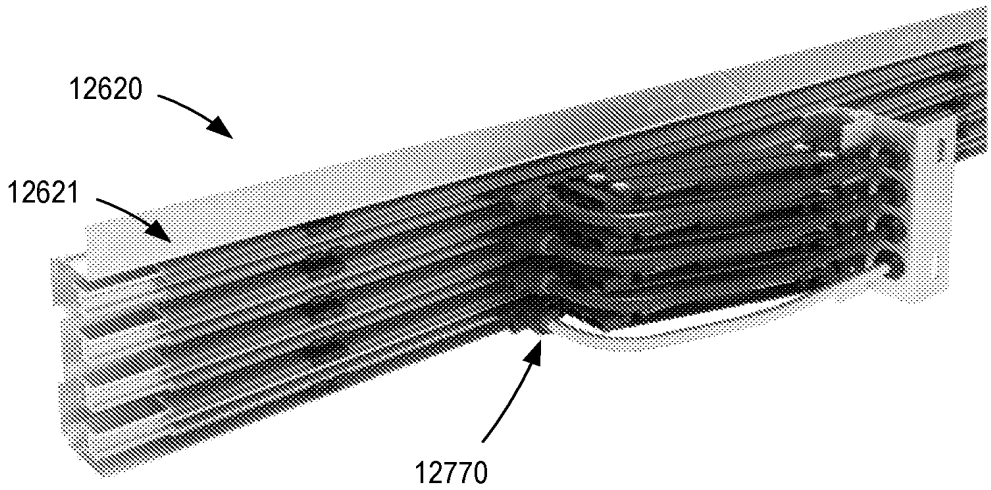


FIG. 73

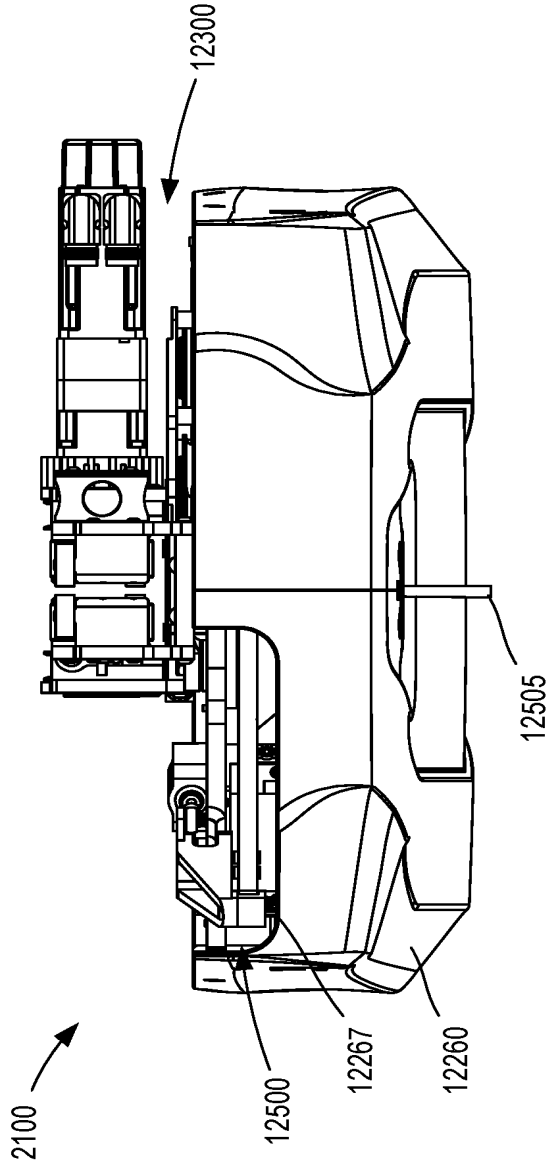

12300
12505
12100
12500
12267
12260

FIG. 74

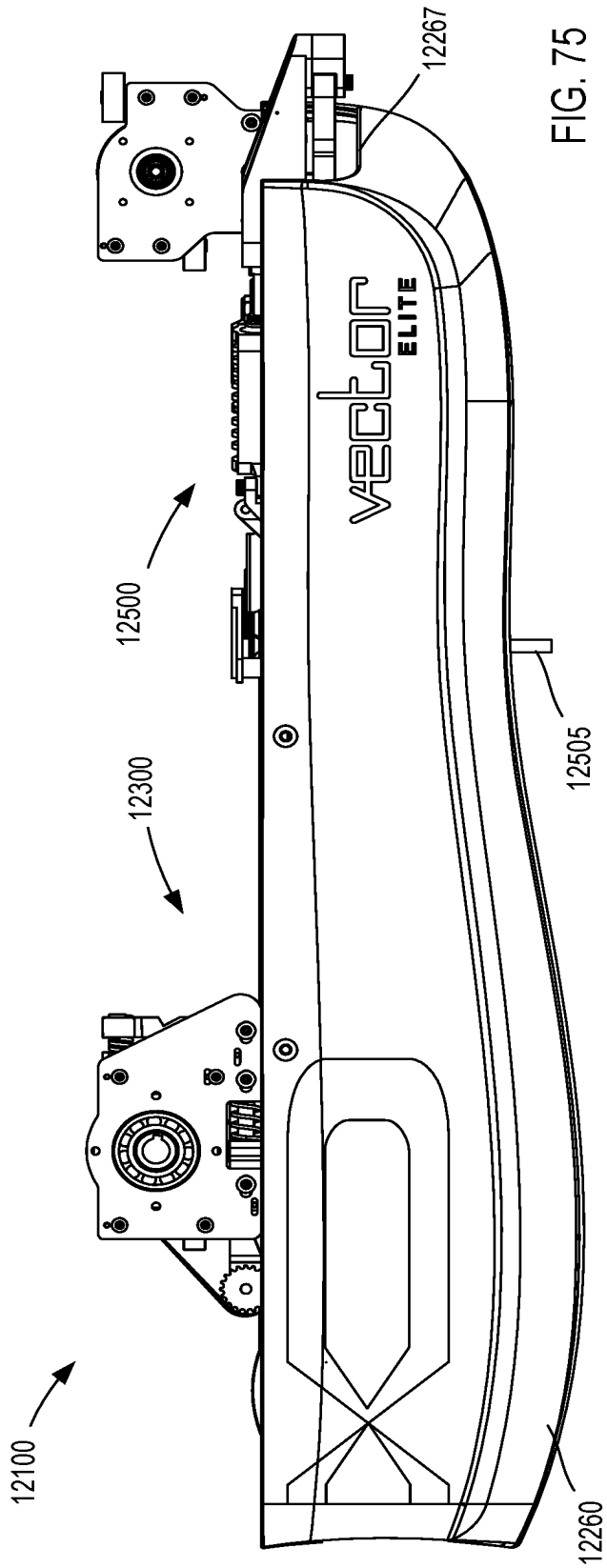

12267
vector
ELITE
12500
12505
12300
12100
12260

FIG. 75

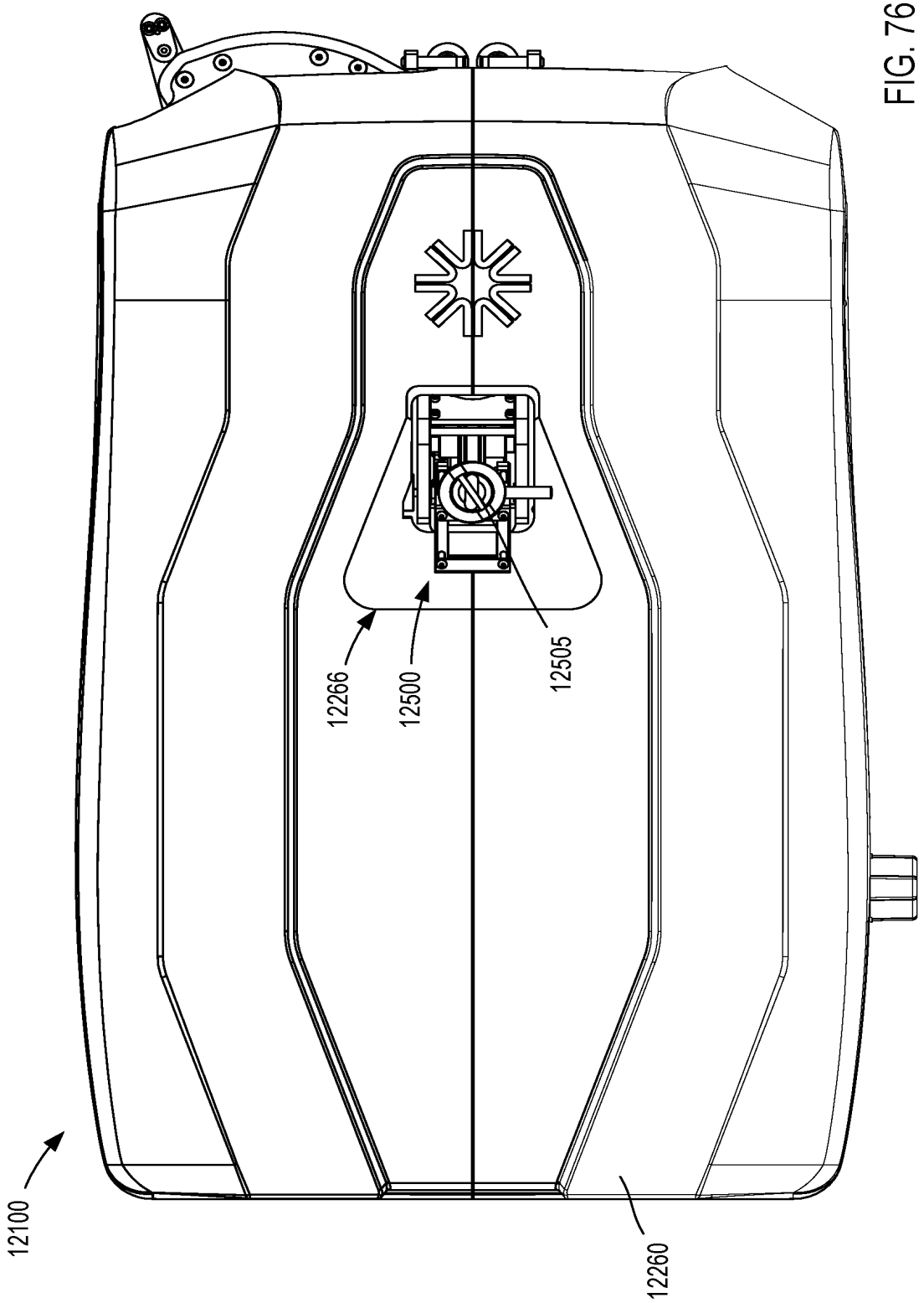


FIG. 76

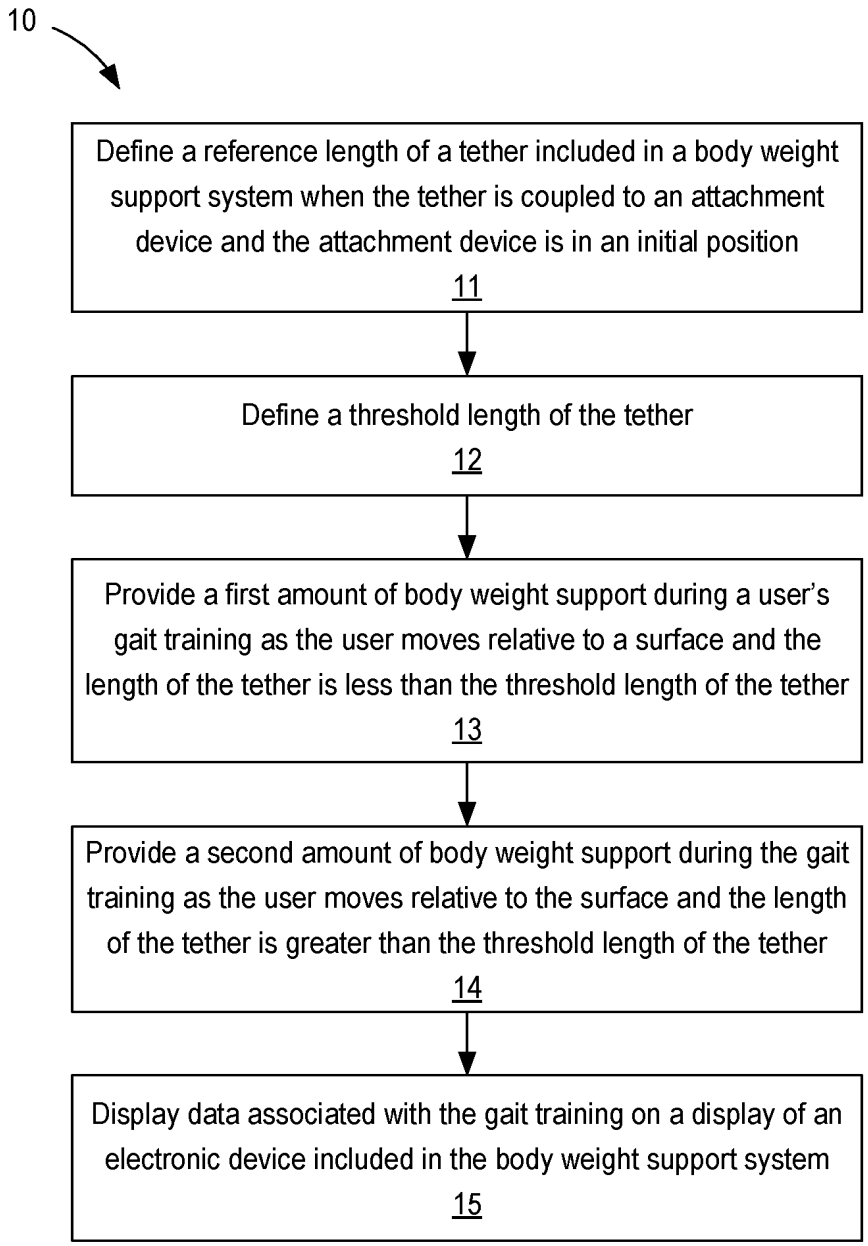

10
Define a reference length of a tether included in a body weight support system when the tether is coupled to an attachment device and the attachment device is in an initial position
11
Define a threshold length of the tether
12
Provide a first amount of body weight support during a user's gait training as the user moves relative to a surface and the length of the tether is less than the threshold length of the tether
13
Provide 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
14
Display data associated with the gait training on a display of an electronic device included in the body weight support system
15

FIG. 77

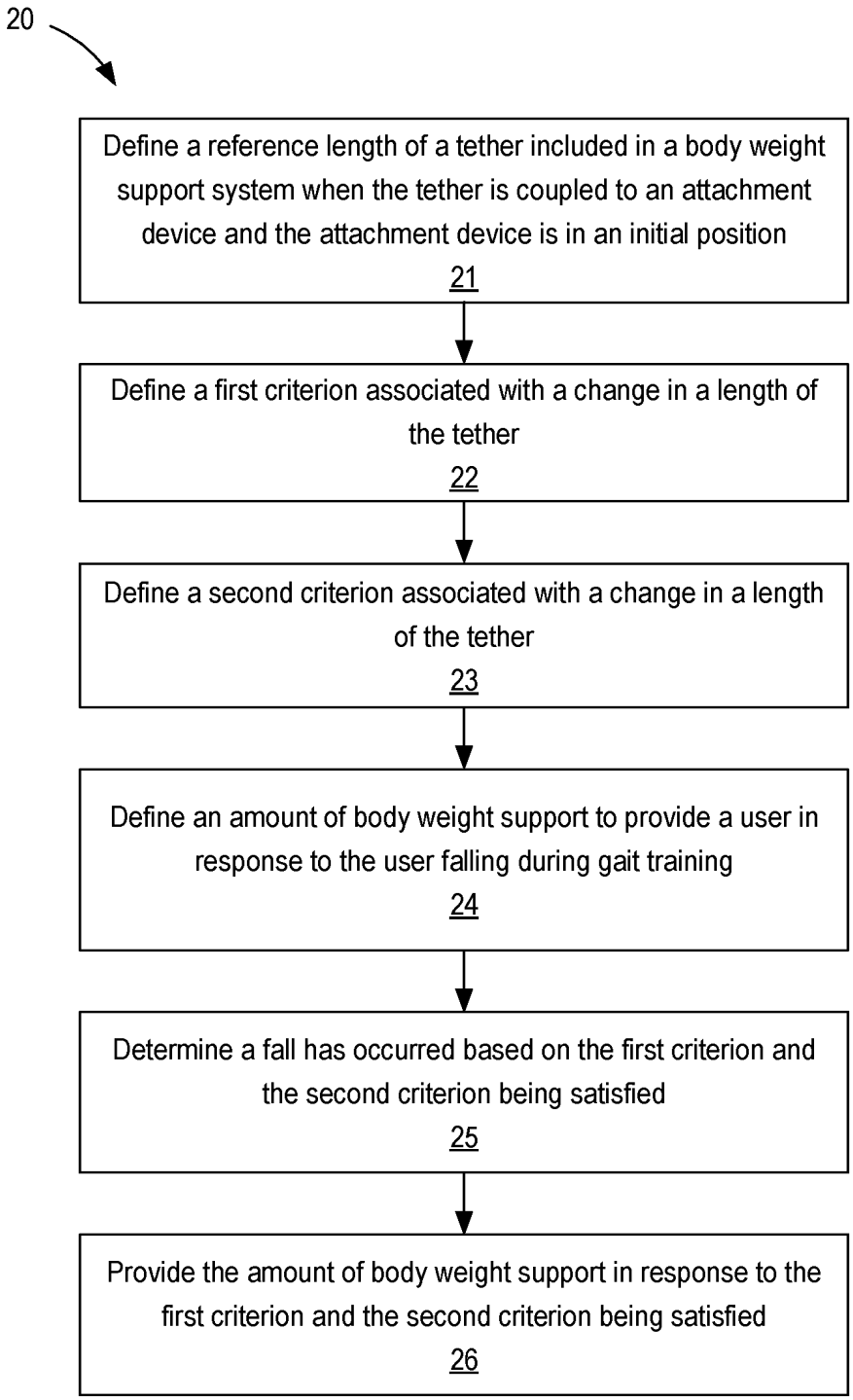

20
Define a reference length of a tether included in a body weight support system when the tether is coupled to an attachment device and the attachment device is in an initial position
21
Define a first criterion associated with a change in a length of the tether
22
Define a second criterion associated with a change in a length of the tether
23
Define an amount of body weight support to provide a user in response to the user falling during gait training
24
Determine a fall has occurred based on the first criterion and the second criterion being satisfied
25
Provide the amount of body weight support in response to the first criterion and the second criterion being satisfied
26

FIG. 78

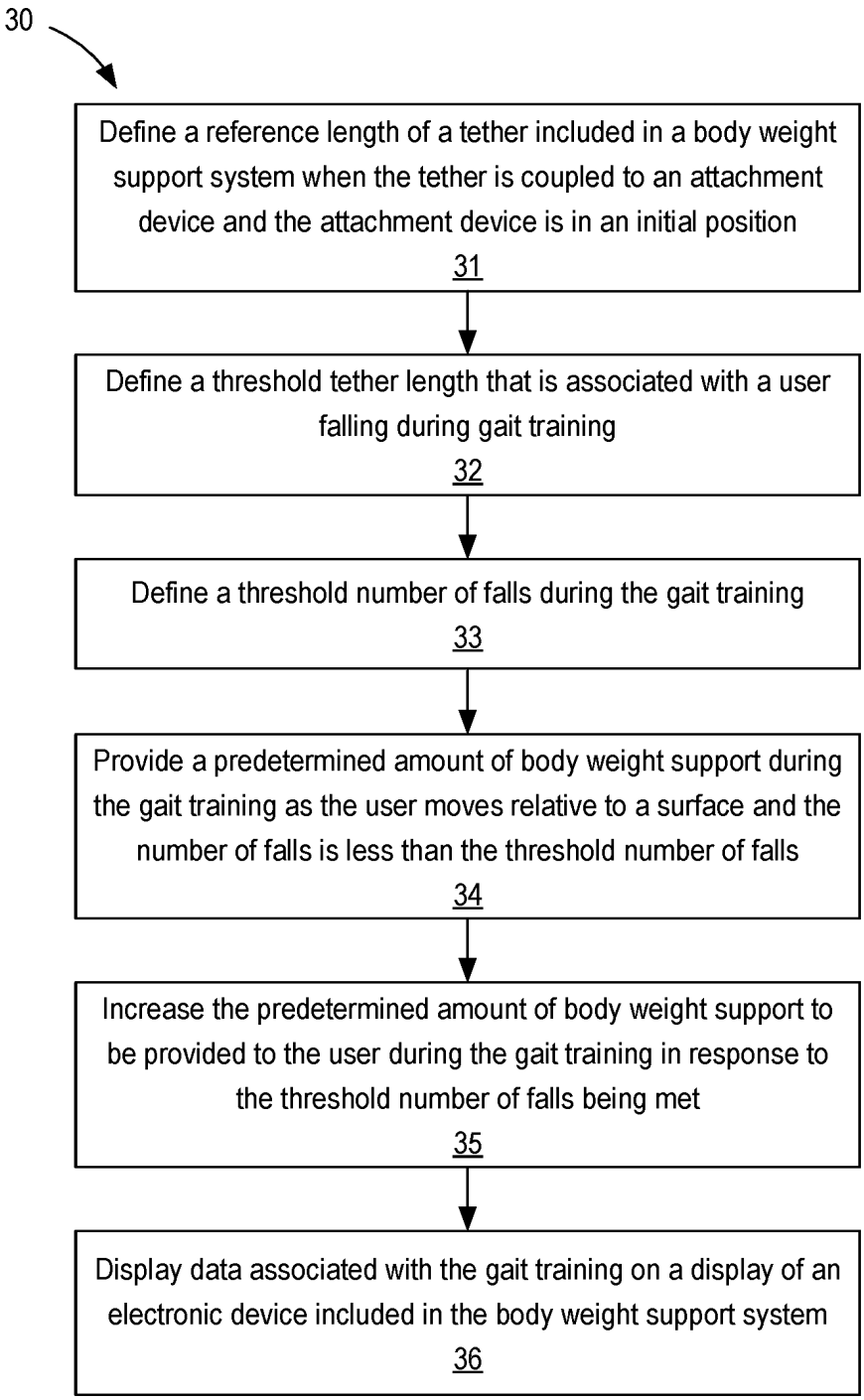

30
Define a reference length of a tether included in a body weight support system when the tether is coupled to an attachment device and the attachment device is in an initial position
31
Define a threshold tether length that is associated with a user falling during gait training
32
Define a threshold number of falls during the gait training
33
Provide a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls
34
Increase the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met
35
Display data associated with the gait training on a display of an electronic device included in the body weight support system
36

FIG. 79

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM
First Named Inventor/Applicant Name:	Keith McBride
Filer:	Michael D. Winternitz
Attorney Docket Number:	BION-051/12US 307799-2333

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
UTILITY APPL SIZE FEE PER 50 SHEETS >100	1081	1	400	400
Claims:				
Miscellaneous-Filing:				
LATE FILING FEE FOR OATH OR DECLARATION	1051	1	160	160

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2280**

Electronic Acknowledgement Receipt

EFS ID:	31789202
Application Number:	15896731
International Application Number:	
Confirmation Number:	4706
Title of Invention:	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM
First Named Inventor/Applicant Name:	Keith McBride
Customer Number:	58249
Filer:	Michael D. Winternitz/Rebecca Phelan
Filer Authorized By:	Michael D. Winternitz
Attorney Docket Number:	BION-051/12US 307799-2333
Receipt Date:	14-FEB-2018
Filing Date:	
Time Stamp:	16:14:36
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$2280
RAM confirmation Number	021518INTEFSW00002909501283
Deposit Account	501283
Authorized User	Rebecca Phelan

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	BION-051-12US-ADS.pdf	1822997 5b576a9dee4e5c96b1591b63688f72d68d59b4c8	no	9
Warnings:					
Information:					
2		BION-051-12US-Specification.pdf	563832 06c441d0216f314d58525ea5cba2d2cde942819c	yes	110

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Specification	1	105
	Claims	106	109
	Abstract	110	110

Warnings:					
Information:					
3	Drawings-only black and white line drawings	BION-051-12US-Figures.pdf	9581952 88ae48fa4ccfebfded9194319ae289d864727a32	no	69
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	38423 0d78499c2c736ff49791204b727e09a0835ed7f7	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	12007204		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

CD Submission Review Results

Internal Worksheet Only - Do Not Scan

Application Number	15896731	Receipt Date	Feb 14, 2018

X	New Application		Response To Notice	Date Of Response

[ ] Jumbo – Large tables are included on the CD

[X] **There are no problems with the CDs in the submission.**

Items checked below are to be selected in the PALM Pre-Exam CD problem list.

Omitted Items

	Files on compact disc are unreadable:
	Disc(s) of either set not readable:
	Disc(s) do not contain file names listed:
	Amended CD missing unamended files
	Missing compact discs

Missing Parts

	Disc(s) do not contain file names listed
	Discs contains files that are non-ASCII files:
	Only one copy of the CD, no duplicate:
	Wrong media type, e.g., CD-RW:
	The transmittal letter and specification do not list information:
	Both disc(s) contain unreadable files:
	One disc(s) contain unreadable files:
	Compact disc(s) contain viruses, but are still readable:
	EFS/Paper Submission:
	Table does not maintain data in proper alignment:
	Not proper subject matter for CD's:

Informality

	No statement in transmittal letter that CD's are the same:
	No incorporation by reference statement for the CD's:
	CD's not labeled "Copy 1" and "Copy 2":
	Deficient CD packaging:
	Deficient Labeling on CD's:
	The transmittal letter does not list information:
	The specification does not list information:
	Table less than 51 pages submitted on CD:

File Directory Attachment

	Copy of file directory listing is attached and should be mailed to applicant
	Copy of file directory listing is not attached
	Copy of file directory listing is not attached because it is over one page long

Additional Comments

Internal Worksheet Only - Do Not Scan

DocCode – SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 15896731 Document Date: 02/14/2018

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via eDAN using the Supplemental Content tab, or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

Form Revision Date: August 26, 2013

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/896,731

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						400
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	2120

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/896,731	02/14/2018	3764	2280	BION-051/12US 307799-2333	20	3

CONFIRMATION NO. 4706

58249
COOLEY LLP
ATTN: Patent Group
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

FILING RECEIPT

OC000000097929680

Date Mailed: 03/12/2018

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Keith MCBRIDE, Ventura, CA;
Arkady GLUKHOVSKY, Valencia, CA;
Augustine SMITH, Santa Clarita, CA;

Applicant(s)

Bioness Inc., Valencia, CA

Assignment For Published Patent Application

Bioness Inc., Valencia, CA

Power of Attorney: None

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/458,648 02/14/2017

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Aretech LLC - Exhibit 1004, Page 00199

If Required, Foreign Filing License Granted: 03/08/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/896,731**

Projected Publication Date: 08/16/2018

Non-Publication Request: No

Early Publication Request: No

Title

METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

Preliminary Class

482

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

Aretech LLC - Exhibit 1004, Page 00200

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333

CONFIRMATION NO. 4706

58249
COOLEY LLP
ATTN: Patent Group
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

INFORMAL NOTICE

OC000000097929681

Date Mailed: 03/12/2018

INFORMATIONAL NOTICE TO APPLICANT

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

The item(s) indicated below are also required and should be submitted with any reply to this notice to avoid further processing delays.

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):
  Keith MCBRIDE
  Arkady GLUKHOVSKY
  Augustine SMITH

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/kxaysana/

Aretech LLC - Exhibit 1004, Page 00202

To: zpatdcdocketing@cooley.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 58249

Mar 12, 2018 03:43:16 AM

Dear PAIR Customer:

COOLEY LLP
ATTN: Patent Group
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004
UNITED STATES

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Application	Document	Mailroom Date	Attorney Docket No.
15896731	APP.FILE.REC	03/12/2018	BION-051/12US 307799-2333
	M327	03/12/2018	BION-051/12US 307799-2333

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333

CONFIRMATION NO. 4706

58249
COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

PUBLICATION NOTICE

OC000000101719643

Title:METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

Publication No.US-2018-0229070-A1
Publication Date:08/16/2018

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Aretech LLC - Exhibit 1004, Page 00204

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Aug 24, 2018 04:12:50 AM

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1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004
UNITED STATES

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15896731	NTC.PUB.DATE	08/21/2018	BION-051/12US 307799-2333

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Aug 24, 2018 04:12:50 AM

Dear PAIR Customer:

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004
UNITED STATES

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15896731	NTC.PUB.DATE	08/21/2018	BION-051/12US 307799-2333

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Washington, DC 20004
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Aug 24, 2018 04:12:50 AM

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1299 Pennsylvania Avenue, NW
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Washington, DC 20004
UNITED STATES

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15896731	NTC.PUB.DATE	08/21/2018	BION-051/12US 307799-2333

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Aug 24, 2018 04:12:50 AM

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From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 58249

Aug 24, 2018 04:12:50 AM

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Suite 700
Washington, DC 20004
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333	4706

58249 7590 08/08/2019

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

EXAMINER	
ATKINSON, GARRETT K	

ART UNIT	PAPER NUMBER
3784	

NOTIFICATION DATE	DELIVERY MODE
08/08/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zIPPatentDocketingMailboxUS@cooley.com

Office Action Summary	Application No. 15/896,731	Applicant(s) MCBRIDE et al.	
	Examiner GARRETT K ATKINSON	Art Unit 3784	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 2/14/2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☑ Claim(s) 14-20 is/are allowed.

7) ☑ Claim(s) 1-4 and 6-13 is/are rejected.

8) ☑ Claim(s) 5 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 2/14/2018 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - NOTICE

2. Applicant's PCT application PCT/US18/18166 contains identical claims. The Office concurs in part with the findings of the ISA Written Opinion dated 7/2/2018. The rejection has been attached for reference.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention 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 claimed invention.

4. Claim(s) 8-13 is/are rejected under 35 U.S.C. 102(a)(1) as being anticipated by Vallery et al (US 2015/0320632).

Vallery teaches regarding claim: 8. A method of using a body weight support system to provide body weight support during gait training (as discussed in paragraph [0015] and seen in FIGs 1-7), the body weight support system including tether (assembly of tethers seen in FIG 4) configured to be coupled to an attachment device (harness assembly seen in FIG 7) worn by a user to couple the user to the body weight support system (as seen in the figures), the method comprising: defining a reference length of

the tether when the attachment device is in an initial position (at rest before a user requires assistance); 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 (see [0031]; various sensors for detecting several different criterion associated with length, such as load, acceleration, orientation, and velocity); defining an amount of the body weight support to provide in response to the user falling during the gait training (see [0062]; based on the sensor data); determining a fall has occurred based on the first criterion and the second criterion being satisfied (again, using the sensor data); and providing the amount of body weight support in response to the first criterion and the second criterion being satisfied (as per [0062]).

Vallery teaches regarding claim: 9. The method of claim 8, wherein the first criterion is a rate of change in the length of the tether (acceleration as discussed above).

Vallery teaches regarding claim: 10. The method of claim 8, wherein the second criterion is a duration during which the length of the tether is changed (a component of acceleration/rate of change).

Vallery teaches regarding claim: 11. The method of claim 10, wherein the second criterion is a minimum duration (part of an acceleration threshold used to detect a fall).

Vallery teaches regarding claim: 12. The method of claim 8, 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 bodily 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 (as best understood, this is achieved when the harness is supporting the user during strides that do not result in falls).

Vallery teaches regarding claim: 13. The method of claim 8, further comprising: redefining the reference length of the tether in response to a change in the length of the tether that does not satisfy at least one of the first criterion or the second criterion (as best understood, this happens as the user walks normally without falling - in order to permit motion, the harness and tethers translate and adjust the reference length without providing additional support unless necessary).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1-4 and 6-7 is/are rejected under 35 U.S.C. 103 as being unpatentable over US 2012/0018249 A1 (MEHR) in view of EP 1 296 595 B1 (LIFEWAVES). See attached ISA written opinion.

Allowable Subject Matter

7. Claims 5 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

8. Claims 14-20 are allowable.

9. See attached ISA written opinion for reasons for indicating allowable subject matter.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to GARRETT K ATKINSON whose telephone number is (571)272-8117. The examiner can normally be reached on 0800-1800 M-F.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, LoAn Jimenez can be reached on (571) 272-4966. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/GARRETT K ATKINSON/
Primary Examiner, Art Unit 3784

Notice of References Cited	Application/Control No. 15/896,731	Applicant(s)/Patent Under Reexamination MCBRIDE et al.	
	Examiner GARRETT K ATKINSON	Art Unit 3784	Page 1 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-5314390-A	05-1994	Westing; Stephen	A63B21/00178	482/111
*	B	US-6880487-B2	04-2005	Reinkensmeyer; David J.	A01K15/027	119/421
*	C	US-5830162-A	11-1998	Giovannetti; Giovanni Battista	A61B5/1038	601/23
*	D	US-7381163-B2	06-2008	Gordon; Keith	A63B22/02	482/69
*	E	US-7125388-B1	10-2006	Reinkensmeyer; David J.	A63B69/0064	601/5
*	F	US-4423864-A	01-1984	Wiik; Sven E.	A63B22/0012	434/253
*	G	US-7621850-B2	11-2009	Piaget; Gary	A63B22/0056	482/54
*	H	US-8002674-B2	08-2011	Piaget; Gary	A63B22/0056	482/52
*	I	US-8550962-B2	10-2013	Piaget; Gary	A63B22/0056	482/52
*	J	US-3408067-A	10-1968	ARMSTRONG RAYMOND E	A63B22/02	482/30
*	K	US-4204673-A	05-1980	Speer, Sr.; John	A63B22/0012	198/817
*	L	US-4733858-A	03-1988	Lan; Chuang S.	A63B23/1209	482/113
*	M	US-20170027803-A1	02-2017	AGRAWAL; Sunil K.	A61B5/6828	1/1

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N	EP-1296595-A2	04-2003	EP	REISMAN STANLEY S	A61B5/0002
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 15/896,731	Applicant(s)/Patent Under Reexamination MCBRIDE et al.	
	Examiner GARRETT K ATKINSON	Art Unit 3784	Page 2 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9713439-B1	07-2017	Wu; Ming	A61B5/112	1/1
*	B	US-20060229167-A1	10-2006	Kram; Rodger	A63B21/00181	482/54
*	C	US-7998040-B2	08-2011	Kram; Rodger	A63B21/4015	482/124
*	D	US-20120018249-A1	01-2012	Mehr; Christian	A63B69/0064	182/5
*	E	US-20040143198-A1	07-2004	West, R. Gary	A61F5/0102	601/5
*	F	US-0229167-A	06-1880	Name not available	B60G11/02	267/39
*	G	US-0143198-A	09-1873	Name not available	A41D1/14	2/211
*	H	US-0018249-A	09-1857	Name not available	B41K3/08	101/110
*	I	US-7980856-B2	07-2011	Grabiner; Mark	A63B22/0292	434/258
*	J	US-20150320632-A1	11-2015	VALLERY; Heike	A61H3/008	482/69
*	K	US-9801775-B2	10-2017	Vallery; Heike	A61H3/008	1/1
*	L	US-20180055715-A1	03-2018	VALLERY; Heike	A61H3/008	1/1
*	M	US-20140206503-A1	07-2014	Stockmaster; James G.	A61H3/008	482/4

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
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	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Notice of References Cited	Application/Control No. 15/896,731	Applicant(s)/Patent Under Reexamination MCBRIDE et al.	
	Examiner GARRETT K ATKINSON	Art Unit 3784	Page 3 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9510991-B2	12-2016	Stockmaster; James G.	A61H3/008	1/1
*	B	US-20170135893-A1	05-2017	Stockmaster; James G.	A61H3/008	1/1
*	C	US-20160256346-A1	09-2016	Stockmaster; James G.	A61H3/008	1/1
	D					
	E					
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	J					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
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	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/896,731	MCBRIDE et al.
	Examiner	Art Unit
	GARRETT K ATKINSON	3784

CPC - Searched*		
Symbol	Date	Examiner
A63B21/4001, A63B69/0002, A63B21/00181, A63B24/0087, A63B23/0464, A63B21/068, A63B69/0064, A63B21/4007, A63B2225/50, A63B2225/20, A63B2220/805, A63B2220/54, A63B2220/51, A63B2220/40, A63B2220/30, A63B2220/10, A63B2071/0018, A63B2024/0093, A63B23/0458, A63B22/0235, A63B71/0622, A63B2022/0092, A63B2208/0204, A63B2022/0094	08/05/2019	GA

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
EAST SEARCH	08/05/2019	GA
INVENTOR NAME SEARCH	08/05/2019	GA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/GARRETT K ATKINSON/ Primary Examiner, Art Unit 3784	

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: Erik B. Milch
Cooley LLP
1299 Pennsylvania Ave.
Suite 700
Washington, District of Columbia 20004
United States of America

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	02 JUL 2018
Applicant's or agent's file reference BION05112WO	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US18/18166	14 February 2018 (14.02.2018)	14 February 2017 (14.02.2017)

International Patent Classification (IPC) or both national classification and IPC
IPC - A61H 3/00; A63B 24/00, 69/00 (2018.01)
CPC - A61H 3/008; A63B 24/0087, 69/0064

Applicant BIONESS INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☒ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	13 April 2018 (13.04.2018)	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:

   ☐ paid additional fees.

   ☐ paid additional fees under protest and, where applicable, the protest fee.

   ☐ paid additional fees under protest but the applicable protest fee was not paid.

   ☒ not paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-7 and 14-20 are directed toward a method of using a body weight support system, the method comprising: defining a threshold length of a tether; providing a predetermined amount of body weight support during a gait training as a user moves relative to a surface; and displaying data associated with the gait training on a display of an electronic device included in the body weight support system.
Group II: Claims 8-13 are directed toward a method of using a body weight support system, the method comprising: defining a first criterion; defining a second criterion; determining a fall has occurred based on the first criterion and the second criterion being satisfied; and providing an amount of body weight support in response to the first criterion and the second criterion being satisfied.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons.

The special technical features of Group I include defining a threshold length of a 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; defining a threshold number of falls during the gait training; providing a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls; increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met; and displaying data associated with the gait training on a display of an electronic device included in the body weight support system (which are not present in Group II).
The special features of Group II include 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; 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 (which are not present in Group I).

The common technical features of Groups I and II include 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.
These common technical features are disclosed by US 2006/0229167 A1 (KRAM). Kram discloses a method of using a body weight support system (weight support device 123; figure 2) to provide body weight support during gait training (used to bear weight of patient 122 over treadmill 110 during physical therapy; paragraphs [0018], [0034]), the body weight support system including a tether (cord between pulley 124 and support harness 102 shown in figure 2) configured to be coupled to an attachment device worn by a user (coupled to support harness 102 worn by patient 122 as shown) to couple the user to the body weight support system (coupling patient 122 to weight support device 123 as shown), the method comprising: defining a reference length of the tether when the attachment device is in an initial position (length of cord connecting pulley 124 and harness 102 is defined as shown in figure 2 when harness 102 is in initial position shown).

Since the common technical features are previously disclosed by the Kram reference, the common features are not special and so Groups I and II lack unity.

4. Consequently, this opinion has been established in respect of the following parts of the international application:

   ☐ all parts.

   ☒ the parts relating to claims Nos. 1-7 and 14-20

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-7, 14-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	5, 14-20	YES
	Claims	1-4, 6-7	NO
Industrial applicability (IA)	Claims	1-7, 14-20	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-4 and 6-7 lack an inventive step under PCT Article 33(3) as being obvious over US 2012/0018249 A1 (MEHR) in view of EP 1 296 595 B1 (LIFEWAVES).

As per claim 1, Mehr discloses a method of using a body weight support system (fall protection device; figure 1; paragraph [0063]) to provide body weight support (which catches person 1 in event of falling; paragraph [0068]) during gait training (during bouncing practice which strengthens muscles for users with difficulties walking; paragraphs [0051], [0068]), the body weight support system including a tether (rope 10) configured to be coupled to an attachment device worn by a user (which is clipped to vest in region of shoulders of user 1; paragraph [0067]) to couple the user to the body weight support system (such that user 1 is secured to fall protection device as shown in figure 1), the method comprising: defining a reference length of the tether (length of rope 10 from stop 13 to user 1 when user 1 is not falling or bouncing as shown in figure 1; paragraph [0071]) when the attachment device is in an initial position (when vest at shoulders of user 1 is at height shown in figure 1); defining a threshold length of the tether (length of rope 10 from immediately above weight 12 to user 1 in initial position shown in figure 1); providing a first amount of body weight support during the gait training (holding rope 10 substantially taught via weight 12 during bouncing practice; paragraph [0068]) as the user moves relative to a surface (as user 1 bounces with amplitude from trampoline mat of trampoline 8, i.e. moves relative to ground surface supporting trampoline 8 in figure 1; paragraph [0068]) and a length of the tether is less than the threshold length of the tether (while weight 12 is not in contact with stop 13, i.e. length of rope 10 from stop 13 to user 1 while user 1 is bouncing or falling is shorter than length of rope 10 from user 1 to directly above weight 12, rope 10 is held taught by only weight 12; paragraphs [0068], [0071]); providing a second amount of body weight support during the gait training (catching user 1 in event of fall during bouncing practice, i.e. providing support via tension of rope 10 equivalent to weight of user 1; paragraph [0068]) as the user moves relative to the surface (as user 1 bounces with amplitude from trampoline mat, i.e. moves relative to ground surface supporting trampoline 8 in figure 1; paragraph [0068]) and the length of the tether is greater than the threshold length of the tether (and weight 12 strikes stop 13, i.e. length from stop 13 to user 1 is greater than length from user 1 to directly above weight 12 in initial position shown in figure 1; paragraphs [0068], [0071]). Mehr does not disclose displaying data associated with the gait training on a display of an electronic device included in the body weight support system. Lifewaves discloses displaying data associated with a gait training (user interface 60 provides visual information regarding heart rate or other type of data from individual 10 exercising on exerciser 20 which can be a trampoline; paragraphs [0023], [0024]) on a display of an electronic device (interface 60 may be display monitor; paragraph [0094]). In order to provide data from the user while the user is performing bouncing practice to train and strengthen muscles (MEHR; paragraph [0051]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Mehr's weight support system to include Lifewaves's electronic device display to display data associated with the gait training, since Lifewaves discloses that the display can provide users with information regarding heart rate or any other type of data (LIFEWAVES; paragraph [0024]); furthermore, providing digital displays for training procedures is well known in the art.

As per claim 2, Mehr and Lifewaves, in combination, disclose the method of claim 1. Mehr further discloses wherein the length of the tether (length of rope 10 from stop 13 to user 1 while user 1 is bouncing or falling; figure 1) is increased in response to an increase in force exerted by the user on the tether (event of falling of user 1, i.e. increase in downward pull from user 1 on rope 10, increases tension on rope 10 and increases length of rope 10 from stop 13 to user 1 until weight 12 strikes stop 13; figure 1; paragraphs [0068], [0071]).

As per claim 3, Mehr and Lifewaves, in combination, disclose the method of claim 2. Mehr further discloses wherein the increase in the force exerted by the user on the tether is associated with the user falling (increase of downward pull from user 1 is due to event of user 1 falling; paragraph [0068]) during the gait training (during bouncing practice; paragraph [0068]).

As per claim 4, Mehr and Lifewaves, in combination disclose the method of claim 1. Mehr further discloses wherein the surface (ground surface supporting trampoline 8 in figure 1) relative to which the user moves (user 1 bounces with amplitude from trampoline mat, i.e. moves relative to ground surface; paragraph [0068]) is a stationary surface (is fixed ground surface also supporting fixed equipment as shown in figure 1).

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 1 and 14 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because the claims are indefinite for the following reasons:

Claim 1 refers to "the length of the tether";

Claim 14 refers to "the number of falls".

There is a lack of antecedent basis for these limitations in the claims. For the purpose of this opinion, as best understood, the claims are interpreted to read:

Claim 1: "a length of the tether";

Claim 14: "a number of falls".

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

-***-Continued from Box V: Citations and Explanations-***-

As per claim 6, Mehr and Lifewaves, in combination, disclose the method of claim 1. Mehr does not further disclose wherein the surface relative to which a user moves is a moving surface included in a treadmill. Lifewaves discloses a treadmill (exerciser 20 can be a treadmill machine; paragraph [0023]). In order to provide the user with an alternative method for users with disabilities or difficulties walking to strengthen muscles, it would have been obvious to one of ordinary skill in the art at the time of the invention to replace Mehr's trampoline with Soderlund's treadmill such that the surface relative to which the user moves is a moving surface included in Lifewaves's treadmill, since Lifewaves discloses that a treadmill can be used for an individual to exercise on to asses the individual's physiological condition (LIFEWAVES; paragraph [0023]).

As per claim 7, Mehr and Lifewaves, in combination, disclose the method of claim 6. Mehr does not further disclose wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill. Lifewaves discloses displaying the data associated with the gait training (user interface 60 provides visual information regarding heart rate or other type of data from individual 10 exercising on exerciser 20 which can be a trampoline; paragraphs [0023], [0024]). In order to provide more types of data from the individual, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Lifewave's displaying of data to include data associated with an operating condition of Mehr's body weight support system and an operating condition of Lifewaves's treadmill, since doing so would provide even more information to better asses the physiological condition of the user (LIFEWAVES; paragraph [0024]); furthermore, modifying a display monitor to display operating conditions such as treadmill speed or tether tension would require only routine skill in the art.

Claim 5 meets the criteria set out in PCT Article 33(2)-(3) because the prior art does not teach or fairly suggest a motivation to combine references.

US 2004/0143198 A1 (WEST) discloses wherein a body weight support system (winch frame 53, harness H, collectively; figures 1, 1a, 2) includes a drive assembly (winch frame 53) configured to movably suspend the body weight support system from a support track (which controls harness H and is slidably supported on rail 50; paragraphs [0036], [0046]), the drive assembly configured to move the body weight support system relative to the support track (harness H suspends from winch frame 53 as shown which is slidably supported on rail 50; paragraph [0036]) in response to a user moving relative to a surface (and is capable of moving along rail 50 in response to user shown in figure 1a moving toward treadmill 140 as shown in figures 1, 1a) such that the body weight support system is maintained in a substantially overhead position relative to the user (such that harness H and winch frame 53 remain overhead relative to user as shown in figure 1a).

Nonetheless, it would not have been obvious to one of ordinary skill in the art at the time of the invention to modify Mehr's body weight support system to move along West's support track in response to the user moving since West's and Mehr's body weight support systems are structurally very different and Mehr's entire body weight support system is not capable of movably suspending from West's support track; furthermore, as per claim 1, an electronic device with a display must be included in the body weight support system and West's electronic device is included with supports for the support track; finally, the prior art fails to teach or fairly suggest a body weight support system with an electronic device with a display included in it with the support system configured to be movably suspended from a support track such that is moves relative to the track in response to a user moving relative to a surface.

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
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-***-Continued from Previous Supplemental Box-***-

Claim 14 meets the criteria set out in PCT Article 33(2)-(3) because the prior art does not teach or fairly suggest defining a threshold number of falls during gait training; providing a predetermined amount of body weight support during the gait training as a user moves relative to a surface and a number of falls is less than the threshold number of falls; and increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met.

Mehr discloses a method of using a body weight support system (fall protection device; figure 1; paragraph [0063]) to provide body weight support (which catches person 1 in event of falling; paragraph [0068]) during gait training (during bouncing practice which strengthens muscles for users with difficulties walking; paragraphs [0051], [0068]), the body weight support system including a tether (rope 10) configured to be coupled to an attachment device worn by a user (which is clipped to vest in region of shoulders of user 1; paragraph [0067]) to couple the user to the body weight support system (such that user 1 is secured to fall protection device as shown in figure 1), the method comprising: defining a reference length of the tether (length of rope 10 from stop 13 to user 1 when user 1 is not falling or bouncing as shown in figure 1; paragraph [0071]) when the attachment device is in an initial position (when vest at shoulders of user 1 is at height shown in figure 1); defining a threshold length of the tether (length of rope 10 from immediately above weight 12 to user 1 while user 1 is falling or bouncing), the threshold length of the tether being associated with the user falling during the gait training (associated with user 1 falling or bouncing during bounce practice); providing a predetermined amount of body weight support during the gait training (holding rope 10 substantially taught via weight 12 during bouncing practice; paragraph [0068]) as the user moves relative to a surface (as user 1 bounces with amplitude from trampoline mat, i.e. moves relative to ground surface supporting trampoline 8 in figure 1; paragraph [0068]); and increasing the predetermined amount of body weight support to be provided to the user during the gait training (catching user 1 in event of fall during bouncing practice, i.e. providing increased support via tension of rope 10 equivalent to weight of user 1; paragraph [0068]).

West discloses displaying data associated with gait training on a display of an electronic device (touch screen 46 of control panel displays set-up and historical information for rehabilitation of non-ambulatory patients; figures 1, 1a, 2; paragraphs [0001], [0007], [0035]) included in a body weight support system (within powered gait orthosis as shown in figure 2; claim 1).

Nonetheless, it would not have been obvious to one of ordinary skill in the art at the time of the invention to modify Mehr's and West's body weight support system to define a threshold number of falls and increase the amount of body weight support to be provided in response to the threshold number of falls being met since neither system includes elements which record the number of falls by the user; furthermore, the prior art fails to teach or fairly suggest defining a threshold number of falls during gait training; providing a predetermined amount of body weight support during the gait training as a user moves relative to a surface and a number of falls is less than the threshold number of falls; and increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met.

Claims 15-20 meet the criteria set out in PCT Article 33(2)-(3) for dependency on clam 14.

Claims 1-7 and 14-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

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(54) **SYSTEM FOR ASSESSING AND MODIFYING AN INDIVIDUAL'S PHYSIOLOGICAL CONDITION**

SYSTEM ZUR BEWERTUNG UND VERÄNDERUNG DER PHYSIOLOGISCHEN KONDITION EINES INDIVIDIUMS

SYSTEME PERMETTANT D'EVALUER ET DE MODIFIER LA CONDITION PHYSIOLOGIQUE D'UN INDIVIDU

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Description

Background of the Invention

[0001] This invention relates generally to systems for assessing and modifying an individual's physiological condition. More particularly, this invention relates to systems for assessing and modifying an individual's physiological condition by analyzing heart rate data collected while the individual is exercising according to an exercise regimen.

[0002] The human physiological condition is the result of complex interactions between various underlying phenomena that are internal as well as external to the human body. For example, cardiac activity is an accumulation of complex interactions between various internal phenomena such as muscular, neurological, vascular, pulmonary, endocrinal, chemical, and cellular phenomena. Cardiac activity also responds to external behavioral activity, such as physical activity that causes energy expenditure and recovery, and to naturally occurring environmental phenomena, such as day-night cycles, lunar cycles, and weather seasons.

[0003] A perspective view of human physiology enables one to describe physiological functions in terms of wave phenomena made up of a superposition of other underlying wave phenomena. For example, cardiac activity manifests itself through repetitive pulsations of the heart as a heart wave. The heart wave is a result of a superposition of many underlying waves (i.e., cycles) including behavioral waves (e.g., energy expenditure and recovery cycles in response to physical activity), environmental waves (e.g., day-night cycles), and internal waves (e.g., molecular biological, cellular, and chemical cycles).

[0004] Heart rate variability (i.e., the variation in an individual's heart rate) is another manifestation of the superimposed effects of various endogenous and exogenous phenomena on human physiology. Decreased heart rate variability has been associated with abnormal physiological conditions and increased mortality. Treatments which increase heart rate variability in an individual's serve both therapeutic as well as prophylactic purposes. Dardik U.S. Patent Nos.5,007,430, 5,800,737, 5,163,439, and 5, 752, 521, which are hereby incorporated by reference in their entireties, further elaborate on the wave nature of cardiac activity.

[0005] Current methods for analyzing cardiac activity, however, are inadequate because they do not analyze the cyclical properties of heart waves with a view to unraveling details of their superimposed wave structure. In the absence of quantitative information on the cyclical properties of heart waves, it is difficult to provide a complete or accurate assessment of an individual's physiological condition, and individually tailor exercise regimens. For example, most methods of prescribing exercise regimens are often based on general criteria, such as age, rather than an individual's actual physiological condition.

[0006] It would therefore be desirable to have systems and methods that more completely and quantitatively characterize heart waves.

[0007] It would further be desirable to characterize heart waves in a manner that provides an accurate quantitative metric of an individual's physiological condition.

[0008] It would also be desirable to be able to generate individually tailored exercise regimens for modifying an individual's physiological condition, based on a quantitative metric.

Summary and Objects of the Invention

[0009] It is an object of the present invention to provide systems for a detailed characterization of heart waves that enables a relatively complete assessment of an individual's physiological condition.

[0010] It is a further object of the present invention to provide quantitative metrics of an individual's physiological condition, based on detailed characterization of cyclic properties of heart waves.

[0011] It is also an object of the present invention to provide systems for generating individually tailored exercise regimens that are independent of general criteria, such as age, but are based on more experimentally determined metrics.

[0012] It is a still further object of the present invention to provide systems for generating individually tailored exercise regimens based on these metrics, with a goal of increasing heart rate variability.

[0013] These objects are achieved with the features of the claims.

[0014] These and other objects of the invention are accomplished in accordance with the principles of the present invention by providing systems for assessing an individual's physiological condition by extracting cycle parameters from a recorded time trace of heart rate data collected while an individual is exercising according to an exercise regimen. While exercising, the individual's heart wave includes energy expenditure and recovery cycles in response to cycles of physical activity. The cycle parameters containing relevant information can include discrete parameters and shape specific parameters. Discrete parameters include, for example, maximum, minimum, and resting heart rates, as well as upward, downward, and baseline slopes. The shape specific parameters (discussed below) can be used to characterize the shapes of portions of the time trace that are believed to contain physiologically important information. Based on these parameters, an individual's physiological condition can be quantified (e.g., in a heart wave index or a capacity

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index), which can incorporate some or all of the relevant physiological information contained in a time trace.

[0015] The quantitative figure of merit can be used to gauge the progress of an individual under an exercise regimen and to design individually tailored exercise regimens for modifying the individual's physiological condition. When used, exercise regimens modify the individual's condition by shaping the heart wave with a goal of increasing the individual's heart rate variability. Individualized heart wave shaping can be achieved in accordance with this invention by application of the principles for therapeutic treatment and bio-rhythmic feed back taught by Dardik, U.S. Patent Nos . 5, 800, 737, 5, 752, 521, 5,163,439, and 5,007,430.

[0016] According to one embodiment of the present invention, an exercise regimen having at least one exercise session that contains one or more exercise cycles is used for assessing an individual's physiological condition. The individual's heart rate is monitored during the exercise session, and a time trace of the heart rate is recorded in an electronic file. Then, the time trace is analyzed to determine one or more cycle parameters, such as a peak heart rate, a minimum heart rate; a resting heart rate, and a base line slope. These parameters can then be used to determine a heart wave index indicative of the individual's physiological condition.

[0017] Additional parameters, such as parabolic coefficients, which characterize the shape of one or more portions of the time trace, can also be obtained. These parameters can also be incorporated into the heart wave index or another figure of merit.

[0018] According to another aspect of this invention, the system allows a quantitative determination of an individual's physiological condition or capability which can be used to prescribe an exercise regimen. As an example, an individual is subject to an exercise test to determine an initial physiological capability. During the test the individual's heart rate is monitored and preferably stored in the form of an electronic file. The test typically includes at least one, and preferably several exercise cycles, including a maximum effort cycle in which the individual attempts to exercise to the individual's maximum capability. Cycle parameters are then obtained by analyzing the heart rate data. The cycle parameters (such as those that characterize the maximum effort cycle) can be incorporated into a figure of merit. Then, an individualized exercise regimen can be generated using an algorithm that relates the figure of merit, or the cycle parameters directly, to exercise regimens.

[0019] In accordance with the principles of the present invention, a system for assessing an individual's physiological condition or capability includes at least an electronic monitor, a recorder, and an analyzer. The monitor monitors the individual's heart rate. The recorder records a time trace of the individual heart rate in an electronic file. The analyzer analyzes the electronic file, using one or more routines (i.e., procedures, programs, or algorithms) to, for example, determine at least one cycle parameter, such as a peak heart rate, a maximum heart rate, a minimum heart rate, an upward slope, a downward slope, and a base line slope. The analyzer can derive shape parameters by fitting one or more parabolas or other mathematical models to portions of the time trace, and can determine a figure of merit based on the determined cycle parameters.

[0020] According to another aspect of this invention, electronic networks, such as the Internet, can be used to receive data and provide information to the individual remotely.

Brief Description of the Drawings and the Appendix

[0021] The above and other objects and advantages of the present invention will be apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

FIG. 1 is a schematic block diagram of an illustrative system constructed in accordance with the present invention;
FIG. 2 is an illustrative exercise regimen that can be generated and used in accordance with the present invention;
FIG. 3 is an illustrative time trace of heart rate data collected over an exercise session, in accordance with the present invention;
FIG. 3a is an illustrative time trace of heart rate data collected over an exercise cycle, in accordance with the present invention;
FIG. 4 is an illustrative top portion of a cycle in a time trace including an illustrative theoretical parabola that has been fit thereto in accordance with the present invention;
FIG. 5 shows two illustrative top portions of a time trace, each corresponding to an abnormal physiological condition, including two illustrative theoretical parabolas that have been fit thereto, in accordance with present invention;
FIGS. 6a, 6b and 6c show three illustrative time traces having cumulative rest portions with varying degrees of parabolicity corresponding to good, moderate and poor physiological conditions, respectively;
FIG. 7 is an illustrative look-up table that can be used in accordance with this invention; and
FIG. 8 is an illustrative exercise regimen that has been generated in accordance with the present invention;
FIG. 9 is a flow chart of a process used to extract cycle parameters from a time trace, in accordance with the present invention;

FIG. 10 is a flow chart of a process used to extract shape parameters from top portions of a time trace, in accordance with the present invention;

FIG. 11 is a flow chart of a process used to extract shape parameters from rest portions of a time trace, in accordance with the present invention; and

Appendix A contains actual exercise regimens appropriate for individuals with nominal capacity indices ranging from 120 to 180 units, in accordance with this invention.

Detailed Description of the Invention

[0022] In order that the invention herein described can be fully understood, the following detailed description is set forth.

[0023] FIG. 1 shows illustrative systems for assessing an individual's physiological condition during performance of an exercise regimen. Individual 10 is shown exercising on exerciser 20. Exerciser 20, for example, can be a treadmill machine, a trampoline, a stationary bicycle, or any other suitable exercising apparatus. Exerciser 20, however, is optional because exercise can be done without the aid of an exercise apparatus (e.g., running, jogging, jumping, walking, moving arms and shoulders, or swinging legs). Electronic monitor 30 monitors the heart rate of individual 10.

[0024] Monitor 30 can be any commercially available unit that measures the heart rate and transmits heart rate data to recorder 40 through link 50. Link 50 can be, for example, a magnetic coupling, a wireless transmission system, or any other electronic or electromagnetic network. Monitor 30 can be connected through link 50 to user interface 60. Interface 60 can provide to users visual, auditory, or tactile information regarding the heart rate or any other type of data. Recorder 40 can be, for example, a printer, a chart recorder, or other device (or combination of devices) that can record the time trace in an electronic file 70.

[0025] Monitor 30, recorder 40, link 50, and interface 60 can be obtained commercially as an integrated heart monitoring and recording unit (such as Model Polar M52 or Model Polar NV sold under the trademark POLAR™, by Polar Electro Inc., of Woodbury, New York). Link 80 connects recorder 40 to analyzer 90, and can be local or remote to exerciser 20. According to one embodiment, and as shown in FIG. 1, link 80 can include watch reading interface 81 (such as "Polar Advantage Interface System" Model 900622K sold under the under the trademark POLAR™, also by Polar Electro Inc.), personal computer 82, and Internet link 83. It will be appreciated, however, that link 80 can be any electronic network that couples recorder 40 to analyzer 90 for data communication.

[0026] Analyzer 90 can include one or more electronic computing devices, preferably programmable computing devices (such as Model HP-VEE sold by Hewlett Packard Company, of Palo Alto, California). It will be appreciated that analysis could, in some cases, involve manual computation or review. Analyzer 90 analyzes electronic file 70, which contains at least one time trace of the heart rate, to determine at least one exercise cycle parameter (e.g., a maximum heart rate). Based on that parameter, analyzer 90 can calculate a heart wave index indicative of the individual's physiological condition.

[0027] FIG. 2 shows illustrative exercise regimen 200, which includes exercise session 201. FIG. 3 shows corresponding illustrative time trace 300 of an individual's heart rate, when exercising according to session 201. Exercise session 201 includes five successive exercise cycles 210-214 of increasing difficulty with each of cycles 210-214 associated with generally increasing target heart rates 215-219. It will be appreciated that an exercise session according to this invention could include more or less than five cycles and that the target heart rates need not increase monotonically.

[0028] In each of exercise cycles 210-214, the individual is expected to commence physical activity and continue the activity over first time period 222 in an attempt to raise the heart rate to one of respective target heart rates 215-219. Period 222 can be fixed or variable. Preferably, period 222 is variable but has an upper time limit. When period 222 is variable and has an upper time limit (e.g., variable cycle 214), the individual exercises only until either the target heart rate is reached or the upper time limit is reached. Preferably, the upper time limit is about one minute. However, when period 222 is fixed, the individual exercises for a fixed amount of time even if the individual's heart rate goes over or stays under the target heart rate. Period 222 when fixed is preferably between about 30 seconds and about 90 seconds, and more preferably about one minute (e.g., cycles 210-213).

[0029] One type of variable cycle is a spike cycle. In spike cycle 214 (represented as "S"), an individual exercises as vigorously as possible to reach target heart rate 219 in as short a time as possible. Thus, the actual time period depends on the condition of the individual.

[0030] In each cycle 210-214, after initial period 222, the individual relaxes during time period 223 by gradually diminishing, or preferably, by abruptly ceasing physical activity. Period 223 can also be fixed or variable. Preferably, period 223 is variable and ends when the heart rate substantially stabilizes (i.e., levels off). A heart rate can be considered "stabilized" when the heart rate changes less than a certain amount over a pre-determined period of time. For example, a heart rate can be considered to be stabilized when the heart rate changes less than about 3 beats/min. over an interval, such as a one minute interval.

[0031] Exercise session 201 can include intervening rest periods 224 between successive exercise cycles 210-214. Additional intervening rest period 224 can also be inserted before post-exercise recovery period 225. Rest periods 221,

224, and 225 can have fixed durations or can be determined by the individual's performance by the amount of time required for the heart rate to substantially stabilize.

[0032] A time trace can contain heart rate data collected over any time period ranging, for example, from a few seconds to several days. Thus a time trace can include data collected over a single or multiple exercise cycles, sessions, or regimens. FIG. 3 shows illustrative time trace 300 of an individual's heart rate during exercise session 201. Trace 300 includes pre-exercise portion 310, which represents the heart rate during time period 221. During period 221, the individual can stay still, acclimatize to exerciser 20 and surroundings, and allow the heart rate to stabilize over several minutes before commencing an exercise cycle. Portion 310 is believed to contain information on the individual's resting heart rate and can serve as a reference or base line heart rate from which to assess changes in the individual's physiological condition, for example, due to exercise.

[0033] Each of portions 320 represents a rising heart rate during each of time periods 222 (FIG. 2). It is believed that each of portions 320 contains physiological information on the individual's ability to sustain increasing stress.

[0034] Each of portions 330 represents a portion of an exercise cycle in which the heart rate of the individual falls. The heart rate often exhibits a natural overshoot phenomena at the end of portion 330, typically falling below an initial base line heart rate (prior to cycles 210-214). After overshooting, the heart rate normally recovers to a new base line heart rate. Portion 330 is believed to contain physiological information on the individual's short term ability to recover from stress.

[0035] Each of top portions 325 represents the heart rate as it transitions between periods 222 and 224, which roughly correspond to time trace portions 320 and 330. In each of cycles 210-214, the individual attains a peak (i.e., maximum) heart rate during top portion 325. Peak heart rates have been found to be a significant measure of an individual's physiological condition.

[0036] Each of portions 340 represents the heart rate during stabilizing periods 224 which allow the individual's heart rate to stabilize between cycles 210-214. Portions 340 are believed to contain physiological information on shifts in the resting heart rates to new base line levels in response to exercise cycles 210-214.

[0037] Portion 350 represents the heart rate during post-exercise recovery period 225. Portion 350 is believed to contain physiological information on an individual's ability to recover from the cumulative effects of exercise cycles 210-214, including any shift in base line heart rates.

[0038] An assessment of an individual's physiological condition can be quantified in a figure of merit (e.g., a heart wave index). This figure can incorporate some or all of the relevant physiological information contained in a time trace of the heart rate, including any of the cycle parameters discussed herein. A heart wave index, for example, is a single metric that can be used to summarize an assessment of the physiological condition. The heart wave index can also be regularly determined and used to gauge the progress of an individual under an exercise regimen. Use of one or more quantitative figures of merit enables an accurate determination of causes and effects of changes that occur in an individual's physiological condition based on an exercise routine. As explained more fully below, exercise regimens for an individual can be designed to cause specific changes in an individual's heart wave index.

[0039] Information contained in a time trace can be characterized by cycle parameters (such as peak heart rates, minimum heart rates, upward slopes and downward slopes), that are achieved during one or more exercise cycles in an exercise regimen. Other cycle parameters such as baseline slopes and resting heart rates can be used to characterize pre-exercise, intervening, and post-exercise rest periods.

[0040] Information contained in a time trace can be further characterized by shape specific cycle parameters that describe the shapes of portions of the time trace. These shape parameters can be incorporated into the heart wave index. For example, cycle parameters that describe the parabolicity of a top portion or a rest portion can be used to determine a heart wave index. Moreover, multiple shape parameters can be used in combination. For example, parabolic coefficients can be used in combination of baseline slopes.

[0041] A time trace can be analyzed to determine a maximum heart rate achieved by the individual in the course of an exercise session. According to one embodiment of the present invention this maximum rate serves as the heart wave index that is used to determine the target heart rates in an individually tailored exercise regimen.

[0042] A time trace can be further analyzed to determine other cycle parameters, such as an upward slope S_{up}, a downward slope S_{down}, a peak heart rate R_{peak}, and a minimum heart rate R_{min}. FIG. 3a shows an illustrative cycle 214 of time trace 300. Starting heart rate R_0 is determined by finding the heart rate at time t_0, at or about the start of period 222. Peak heart rate R_{peak} and corresponding time t_5 are determined by finding the highest heart rate datum within top portion 325. Time t_5 is often located at or about the end of period 222 by which time the target heart rate has been reached. Minimum heart rate R_{min} and corresponding time t_6, are determined by finding the lowest heart rate datum in portion 330. Time t_6 is often located at or about the end of period 223 by which time the heart rate has stabilized.

[0043] The upward slope can be calculated as a derivative, for example, using the change in the heart rate from R_0 to R_{peak} over all of portion 320 (corresponding to time period 222), substantially according to:

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$$S_{up} = (Rpeak-R_0) / (t_5-t_0)$$

[0044] The downward slope can also be calculated as a derivative, for example, using the change in the heart rate from R_{peak} to R_{min}, substantially according to:

$$S_{down} = (Rpeak-R_{min}) / (t_6-t_5)$$

[0045] It will be appreciated that other formulations of the upward and downward slope can be used in accordance with the present invention. For example, an upward slope can be calculated by first identifying a segment of portion 320 which is substantially linear. Such a substantially linear portion is shown in FIG. 3a as the segment between heart rates R_1 and R_2, corresponding to times t_1 and t_2, respectively. Upward slope S_{up} can be calculated according to:

$$S_{up} = (R_2-R_1) / (t_2-t_1)$$

[0046] Similarly, downward slope S_{down} can be calculated by identifying a segment of portion 330 which is substantially linear, such as the segment between heart rates R_4 and R_5 corresponding to times t_3 and t_4, respectively. Downward slope S_{down} can be calculated according to:

$$S_{down} = (R_4-R_5) / (t_4-t_3)$$

[0047] A heart wave index can be determined using one or more of these cycle parameters. For example, heart wave index HWI can be defined as a weighted sum of at least two of upward slope S_{up}, downward slope R_{down}, peak heart rate R_{peak}, and minimum heart rate R_{min}, for example, according to:

$$HWI = a\ R_{peak} + b\ S_{up} + c\ S_{down} + d\ R_{min}$$

where a, b, c and d are weight factors that can be positive, zero, or negative numbers.

[0048] For example, a heart wave index can be a straight linear sum of upward slope S_{up}, downward slope S_{down}, and peak heart rate R_{peak}. In this case, weight factors a, b, and c set are equal to 1, and factor d is equal to zero:

$$HWI = R_{peak} + S_{up} + S_{down}$$

[0049] It will be appreciated that any convenient formulation could be used, depending on the nature or properties of the particular quantities being measured.

[0050] A heart wave index could also incorporate one or more other cycle parameters that characterize pre-exercise, intervening and post-exercise rest portions determined from the time trace. For example, resting heart rate R_{rest} can be used to characterize any of rest portions 310, 340, and 350. Resting heart rate R_{rest} can be determined, for example, by averaging the heart rate after it has substantially stabilized. Further, for example, a base line slope S_{base} can be used to characterize any one or any combination of rest portions. (A combination of rest portions can, for example, consist of all of portions 310, 340, and 350). Base line slope S_{base} can be calculated by determining the change in the heart rate during one or more rest portions, in a manner analogous to the determination of upward and downward slopes described above.

[0051] Thus, the heart wave index can be any function of cycle parameters:

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$$HWI = function(cycle\ parameters).$$

A heart wave index can be equal, for example, to the difference in the resting heart rates determined from portions 310 and 350.

[0052] FIG. 9 shows a flow diagram of process 900 of one embodiment used to analyze a time trace contained in an electronic file. Process 900 begins at step 910 by selecting or receiving an electronic file for analysis. Next, in step 920, any file headers attached to the electronic file can be stripped away. In step 930, any header information can be stored in a database. Steps 920 and 930 are optional, but can be useful when the file is received in the form of an e-mail, for example.

[0053] In step 950, the time trace is further analyzed by determining various cycle parameters, such as baseline slope, upward and downward slopes, and/or maxima and minima for each cycle. In addition to determining cycle parameters, a heart wave index can also be calculated in step 950. In step 960, analysis results are optionally stored in a data base.

[0054] Shape parameters can also be derived from the time trace, for example, by fitting one or more top portions 325, or through all of rest portions 310, 340 and 350 with a theoretical parabola,

$$y = Ax^2 + Bx + C.$$

Regression analysis techniques can be used to fit the parabola to obtain coefficients A, B, and C. Any suitable statistical test (e.g., chi-square) can be used to determine the quality of the fit. At least one goodness of fit parameter (e.g., coefficient of correlation R, or coefficient of determination R^2) that characterizes the quality of the fit can also be calculated.

[0055] FIG. 4 illustrates how a parabola can be fit to a top portion, such as top portion 325, to obtain one or more shape parameters. Time trace portion 400 represents a top portion of an exercise cycle. Theoretical parabola 410 represents a best fit generated, for example, by regression analysis. The heart wave index can then be determined using any of the cycle parameters and one or more shape parameters, such as the parabolic coefficients and one or more goodness of fit parameters. The heart wave index can itself be equal to a goodness of fit parameter.

[0056] FIG. 10 shows a flow diagram of process 1000 of one embodiment used to fit a parabola to top portions contained in an electronic file. In step 1001, an electronic file to be analyzed is selected or received. Next, any file headers attached to the electronic file can be stripped. In step 1020, a maximum heart rate for each relevant cycle is determined, which could involve locating the top portion of each cycle. In step 1030, the top portions are fit to theoretical shapes (e.g., parabolas) using, for example, regression analysis. Parabolic coefficients are obtained and at least one goodness of fit parameter is preferably calculated for each fit. In step 1040, analysis results can optionally be stored in a data base.

[0057] Similarly, FIG. 11 shows a flow diagram of process 1100 of one embodiment used to fit a parabola to resting portions in a time trace. In step 1101, an electronic file to be analyzed is selected or received. In step 1110, any file headers attached to the electronic file can be stripped away and optionally stored. In step 1120, a minimum heart rate for each cycle is determined. In step 1130, a recovery baseline is chosen. This can involve determining a portion of the time trace in which the heart rate is stabilized after recovering from a minimum determined in step 1120. In this manner, rest portions 340 corresponding to each cycle can be identified. In step 1140, regression analysis or any other type of comparable analysis routines are used to fit a parabola to each rest portion. For each fit, parabolic coefficients and/or at least one goodness of fit parameters can be obtained. In step 1150, analysis results can be optionally stored in a data base.

[0058] As explained above, the shapes of the top portions and the resting portions are believed to contain information on the physiological condition of the individual. In particular, it has been discovered that abnormal physiological conditions are often associated with non-parabolic shapes. FIG. 5 shows a heart rate trace that includes two illustrative top portions 501 and 502. These portions correspond to abnormal physiological conditions because their shapes deviate strongly from symmetric parabolas 503 and 504, respectively.

[0059] FIGS. 6a, 6b, and 6c show actual measured time traces 601, 602, and 603, of heart rate data from three different individuals. The time traces represent heart rate data collected over exercise sessions consisting of five exercise cycles (i.e., trace 601 and 602) or six exercise cycles (I e., trace 603). Analysis of pre-exercise rest portions of these traces yields baseline heart rates of 86, 58, and 78 beats per minute, respectively.

[0060] Analysis also includes identification of peak heart rates and minimum heart rates for each of the last four exercise cycles in each trace. The peak heart rates are indicated by square symbols in FIGS. 6a, 6b, and 6c. The peak heart rates for the last four cycles in trace 601, in descending order, are 169, 164, 158, and 149 beats per minute. Similarly, for trace 602 the peak heart rates are 169, 165, 168, and 158 beats per minute, and for trace 603 the peak heart rates are 105, 102, 104, and 95 beats per minute.

[0061] Analysis also includes calculating upward and downward slopes for the last exercise cycle in each trace. For traces 601, 602, and 603, upward and downward slope pairs have values of (48, 24), (72, 60) and (24, 24), respectively.

[0062] In each of FIGS. 6a, 6b, and 6c, the pre-exercise rest portion, the intervening rest portions, and the post-exercise rest portion can be combined to form a cumulative rest portion. Analysis of the leading edge of the cumulative rest portions yields baseline slopes that are positive. The magnitude of these slopes is proportional to the rate of increase of base line heart rates during the exercise sessions. The baseline slopes for traces 601, 602, and 603 are 150.9, 60.3, and 9.4,respectively. These baseline slopes are exemplified with lines 607, 608, and 609, respectively. It has been empirically found that the baseline slope correlates positively with an individual's physiological condition. It is believed that higher (i.e., steeper) baseline slopes correspond to better physiological conditions. Thus, measurement of a baseline slope can be used to assess an individual's physiological condition and to monitor an individual's progress.

[0063] Based on these peak and base line heart rates, baseline, upward, and downward slopes, heart wave indices for each individual are calculated, for example, according to:

$$\text{HWI} = (\text{peak heart rate of last cycle}) + \text{baseline slope}$$

[0064] By this analysis of traces 601, 602, and 603, heart wave indices of 320, 229, and 114 are obtained for the three different individuals, respectively. The relatively low heart wave index of 114 obtained from the analysis of trace 603 correlates positively with the poor physiological condition of the third individual, who was clinically found to suffer from congestive heart disease.

[0065] The shape cumulative rest portions of time traces 601, 602, and 603 exhibit different degrees of parabolicity, which are believed to correspond to good, moderate, and poor physiological conditions, respectively. As an alternate or in addition to baseline slopes, the degree of parabolicity can be quantified by fitting a parabola to the cumulative rest portion. Fitted parabolas 604-606 exhibiting varying degrees of parabolicity are shown in FIGS. 6a, 6b, and 6c, respectively.

[0066] Catalogs can be prepared that link measured coefficients and goodness of fit parameters, or other theoretical models (e.g., based on baseline slopes) to one or more specific abnormal physiological conditions. These catalogs can be based upon actual clinical data and/or theoretical data.

[0067] Abnormal physiological conditions then, can be diagnosed by fitting a parabola through one or more portions of the time trace (e.g., a top portion or a resting portion) to obtain parabolic coefficients and/or goodness of fit parameters. Abnormal physiological conditions can then be identified by determining which of the measured parabolic coefficients and/or goodness of fit parameters are like those listed in the catalog. Abnormal physiological conditions which may be amenable to diagnosis in this manner, can include conditions, such as congestive heart disease, leukemia, anorexia, multiple sclerosis, HIV or other immune deficiencies, astrocytoma of the brain, peripheral ischemia and neuropathy, ileitis, chronic hepatitis, and chronic fatigue syndrome.

[0068] The present invention also can be used to modify an exercise regimen. First, a representative heart wave index for an individual exercising under the regimen is obtained. This heart wave index may represent the results of analyzing time traces from one or more exercise sessions. For example, the representative heart wave index may represent the average of heart wave indices from the analysis of two consecutive exercise sessions, or the average of highest three of five exercise sessions.

[0069] The representative heart wave index is then compared to a target heart wave index associated with the exercise regimen. This comparison is used to determine a need to modify the exercise regimen, such as when the comparison indicates that the individual is not benefitting from the exercise regimen. The exercise regimen can be modified to make it more appropriate to the individual's physiological condition, for example, by raising the target heart rates. In one embodiment of the present invention, the target heart rate can be changed in direct proportion to the difference between the target heart wave index and the representative heart wave index. For example, if the representative heart wave index exceeds the target heart wave index by an amount (e.g., by 20 units), then the target heart rates in the previous regimen can be uniformly increased by one half of the difference (i.e., by 10 units) in the modified regimen.

[0070] An individual's initial physiological capability can be determined and used to individually tailor and prescribe an exercise regimen.

[0071] For example, an individual can be subject to an "exercise test" during which the individual's heart rate is monitored. A time trace is recorded, for example, on a chart recorder or any other electronic recording device.

[0072] The exercise test can include a plurality of test cycles that may be designed to be similar to the exercise cycle described above. The first few cycles can be warm-up cycles, followed by a plurality of intermediate cycles, which are then followed by at least one maximum effort cycle.

[0073] The warm-up cycles can or cannot have defined target heart rates. The intermediate cycles preferably have target heart rates. Most preferably, each of the intermediate cycles have a target heart rate that is greater than that of

its immediately preceding cycle. The increase in target heart rates could vary substantially over an exercise session and in some cases decrease. The amount of the increase, however, is generally less than about 15 beats per minute. A maximum effort cycle does not have a fixed target heart rate but requires that the individual exercise up to the individual's maximum physical capability.

[0074] Test cycles can include a stress portion over a fixed time interval of between about 30 seconds and about 90 seconds, followed by a relaxation portion over another time interval. Preferably, the stress portion is over a time interval that is not in excess of about one minute. The relaxation portion need not be fixed and could be determined by the time it takes the individual's heart rate to recover and stabilize.

[0075] The individual's capability can be assessed in terms of a quantitative figure of merit based on cycle parameters obtained by analyzing the exercise cycles' time trace. In one embodiment, maximum heart rate R_{max}, which is achieved by the individual during each of the test cycles, is determined by analyzing the time trace as described above. Then, a capacity index is assigned a value that is a function of one or more maximum heart rates. For example, the capacity index can be assigned a value equal to the average of maximum heart rates achieved during two consecutive maximum effort cycles. Alternatively, a weighted sum could be used.

[0076] The time trace can be further analyzed to determine upward slopes and downward slopes in the manner discussed above. Then, the capacity index can be assigned a value based on one or more of test cycle parameters, such as maximum heart rates, upward slopes, and downward slopes. For example, the capacity index can be assigned a value equal to a straight or weighted sum or product of a maximum heart rate, upward slope, and downward slope of a maximum effort cycle.

[0077] Once a capacity index is determined, an exercise regimen can be generated. A heart wave index can also be used to generate the regimen. For example, a metric, such as the capacity index or heart wave index, can be received. Then, an individualized exercise regimen can be generated using an algorithm that relates the metric to the regimen. One or both of the receiving and generating steps can use a look-up table. FIG. 7 shows illustrative look-up table 700. Look-up table 700 includes a plurality of capacity indices 720a-720m and a plurality of predetermined exercise regimens 710a-710m.that are respectively linked to the capacity indices. Capacity indices 720a-720m range from 115 to 180 in steps of five units but can have any range and any size steps.

[0078] The use of a look-up table can involve rounding the received metric to a nearest multiple of five or ten units, and then prescribing the exercise regimen corresponding to the rounded number. For example, a received index of 142 can be rounded to 140 (index 720d). Then, using look-up table 700, exercise regimen 710d can be selected and prescribed.

[0079] Exercise regimens 710a-710m can be empirically generated. In this case, the regimens preferably account for the wave nature of cardiac activity and apply the principles for therapeutic treatment and bio-rhythmic feed back taught by Dardik, U.S. Patent Nos. 5,800,737, 5,752,521, 5,163,439, and 5,007,430, incorporated by reference herein. Appendix A, for example, contains an actual set of exercise regimens designed for individual's with capacity indices ranging from 115 to 180 units. The exercise regimens of Appendix A can be used, for example, in look-up table 700.

[0080] Each of regimens 710a-710m can include a plurality of exercise sessions to be performed by the individual over a time period. The time period can be any convenient period of time, such as about one lunar month. Each exercise session preferably includes a plurality of exercise cycles. The exercise cycles can include one or more warm-up cycles and one or more critical cycles that have target heart rates based on a metric.

[0081] The features of these exercise regimens can be better understood in conjunction with FIG. 8, which shows illustrative one month exercise regimen 800 starting April 25, 2000. Regimen 800 is designed for individuals with capacity index 810 having a nominal value of about 115 units. Regimen 800 includes eleven exercise sessions 821-831 and rest week 832. Each of sessions 821-831 includes a plurality of exercise cycles, each of which is designated by a target heart rate and can contain a break if desired.

[0082] The time period over which the sessions are performed can begin with an initial rest period (not shown), end with a final rest period (rest week 832), and include intervening rest periods (April 26, April 28-29, May 1, May 3, May 5-6, May 8, May 10, May 12-13, May 15, and May 17) between the exercise sessions. Intervening rest periods are preferably at least about one day long, while final rest period 832 can be between about 4 days and about 10 days. Regimen 800 is to be performed over about four weeks (including final rest week 823).

[0083] The sessions in an exercise regimen can be synchronized with a lunar cycle. In FIG. 8, for example, regimen 800 is scheduled to start on April 25, 2000 about three weeks prior to a full moon. The exercise sessions can also be synchronized with a circadian rhythm of the individual. For example, in FIG. 8 sessions 821-824, which are to be performed during the first week of the regimen, are scheduled between 6 a.m. and 9 a.m. This time period corresponds to a period of low circadian activity. Sessions 825-827, which are to be performed during the second week of the regimen, are scheduled to be performed between 9 a.m. and 12 p.m. This time period corresponds to a period of moderate circadian activity. Sessions 828-831, which are to be performed in the third week are scheduled to be performed between 3 p.m. and 6 p.m. This period corresponds to a period of high circadian activity.

[0084] The regimens used in the present invention can have a plurality of critical cycles that have sequentially increasing

target heart rates. As used herein, a critical cycle is a cycle that has an associated target heart rate (i.e., is not a warm-up cycle without a defined target heart rate). For example, in session 821 the target heart rates increase sequentially for the first four cycles from 94 beats per minute to 114 beats per minute, and again increase sequentially for the last three cycles from 108 beats per minute to 118 beats per minute. It will be appreciated that the first set of four cycles has a lower initial target heart rate than the second set of three cycles. Also, the initial target heart rate of the second set can be lower than the final target heart rate of the first set. Preferably, the target heart rates for critical cycles within an exercise session increase substantially superlinearly from one cycle to the next.

[0085] Critical cycles can have target heart rates that range up to about 20 beats above the metric being used. For example, sessions 830 and 831 have critical cycles with target heart rates of 130 beats per minute, which is 15 beats per minute higher than the nominal capacity index (i.e., 115).

[0086] Substantially all exercise sessions include a maximum cycle that has a target heart rate that is greater than that for its previous cycle. Preferably, the target heart rates for the maximum cycles increase substantially linearly from one session to the next. For example, in sessions 821-831, the highest target heart rate in each session sequentially increases in small increments from 118 beats per minute to 130 beats per minute (with the exception of a small decrease for session 823). Also, a regimen can include exercise cycles that alternate with rest periods.

[0087] One or more sessions in a regimen can include one or more spike cycles, during which the individual is expected to attempt to reach the target heart rate as rapidly as possible. In FIG. 8, for example, spike cycles are designated by the symbol "S" which is located next to the target heart rates.

[0088] The regimen can be divided into an earlier part and a later part, with the later part having more spike cycles than the early part. For example, in FIG. 8, sessions 821-825 are scheduled to be performed in the first week or so and include no spike cycles, while sessions 827-831 are scheduled to be performed in the second and third weeks and include several spike cycles.

[0089] Regimens provided by this invention can be accompanied by an instruction guide that includes instructions on how to perform the regimen. For example, an instruction could be included that directs the individual to abruptly stop exercising and to rest during a subsequent rest period. An instruction could also be included to exercise as vigorously as possible during a spike cycle.

[0090] The aforementioned methods can be implemented on systems that include an analyzer that preferably is programmable with routines that are capable of processing data contained in a time trace.

[0091] For example, the analyzer can include one or more routines for deriving one or more cycle parameters (such as a maximum heart rate, an upward slope, a downward slope, a peak heart rate, a resting heart rate, and a base line slope) from a time trace. The analyzer can also include routines that use regression analysis for fitting a parabola through a portion of the time trace, and routines for diagnosing abnormal physiological conditions by comparing measured parameters with those in a catalog that are linked with a physiological condition.

[0092] The analyzer can also include routines that compare a measured heart wave index to a target heart wave index and then modify an exercise regimen in response to the comparison.

[0093] In an yet another embodiment the analyzer can include a routine to receive a metric such as a heart wave index or a capacity index, a routine to generate an exercise regimen using an algorithm that relates the metric to the regimen, and a routine to provide the individual with the exercise regimen. The algorithm that relates the metric to the exercise regimen can use, for example, a previously prepared look-up table.

[0094] As used herein, electronic networks could include a local area network, a wireless network, a wired network, a wide area network, the Internet, and any combination thereof. An electronic network can provide links to user interfaces used for sending or receiving data. The interfaces can be any one or more of commercially available interface devices such as a web page, a web browser, a plug-in, a display monitor, a computer terminal, a modem, an audio device, a tactile device (e.g., vibrating surface, etc.), or any combination thereof.

[0095] In accordance with the present invention, software (i.e., instructions) for controlling the aforementioned systems can be provided on computer-readable media. It will be appreciated that each of the steps (described above in accordance with this invention), and any combination of these steps, can be implemented by computer program instructions. These computer program instructions can be loaded onto a computer or other programmable apparatus to produce a machine, such that the instructions which execute on the computer or other programmable apparatus create means for implementing the functions specified in the flowchart block or blocks. These computer program instructions can also be stored in a computer-readable memory that can direct a computer or other programmable apparatus to function in a particular manner, such that the instructions stored in the computer-readable memory produce an article of manufacture including instruction means which implement the function specified in the flowchart block or blocks. The computer program instructions can also be loaded onto a computer or other programmable apparatus to cause a series of operational steps to be performed on the computer or other programmable apparatus to produce a computer implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions specified in the flowchart block or blocks.

[0096] It will be understood that the foregoing is only illustrative of the principles of the invention, and that various

modifications can be made by those skilled in the art without departing from the scope and spirit of the invention.

Appendix A

[0097]

REGIMEN beginning Apr 25

CAPACITY INDEX: 115'S

6- 9AM Tue Apr 25	6- 9AM Thu Apr 27	6- 9AM Sun Apr 30	6-9AM Tue May 2
94	98	100	102
103	109	107	109
111	114	112	116
114	5 min. break	115	117
10 min. break	111	119	122
108	117		
115	120		
118			
9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
104	108	111	
114	116	118 (S)	
118 (S)	122 (S)	124 (S)	
122			
3-6 PM Thu May 11	3-6 PM Sun May 14	3-6 PM Tue May 16	3-6 PM Thu May 18
106	110	113	115
115	118 (S)	118 (S)	121 (S)
119	121 (S)	121 (S)	130 (S)
123 (S)	124 (S)	122 (S)	
120 (S)		130 (S)	
124			

CAPACITY INDEX: 120'S

6-9AM Tue Apr 25	6-9AM Thu Apr 27	6-9AM Sun Apr 30	6-9AM Tue May 2
96	100	102	104
102	112	110	112
114	117	116	120
118	5 min. break	119	121
10 min. break	114	123	126
111	121		
119	124		
122			
9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
106	110	113	

(continued)

9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
118	120	122 (S)	
123 (S)	127 (S)	129 (S)	
127			
3-6 PM	3-6 PM	3-6 PM	3-6 PM
Thu May 11	Sun May 14	Tue May 16	Thu May 18
108	112	115	117
119	122 (S)	121 (S)	125 (S)
123	126 (S)	125 (S)	135 (S)
128 (S)	129 (S)	127 (S)	
125 (S)		135 (S)	
129			
CAPACITY INDEX: 125'S			
6-9AM	6-9AM	6-9AM	6-9AM
Tue Apr 25	Thu Apr 27	Sun Apr 30	Tue May 2
98	102	104	106
105	115	114	115
118	121	120	124
122	5 min. break	124	125
10 min. break	118	128	131
114	125		
123	129		
127			
9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
118	112	115	
121	123	126 (S)	
127 (S)	132 (S)	134 (S)	
132			
3-6 PM	3-6 PM	3-6 PM	3-6 PM
Thu May 11	Sun May 14	Tue May 16	Thu May 18
110	114	117	119
122	125 (S)	124 (S)	129 (S)
127	130 (S)(BD)	129 (S)	140 (S)
133 (S)	134 (S)	131 (S)	
129 (S)		140 (S)	
134			
CAPACITY INDEX: 130'S			
6-9AM	6-9AM	6-9AM	6-9AM
Tue Apr 25	Thu Apr 27	Sun Apr 30	Tue May 2
100	104	106	108
107	118	117	118

(continued)

CAPACITY INDEX: 130'S

6-9AM Tue Apr 25	6-9AM Thu Apr 27	6-9AM Sun Apr 30	6-9AM Tue May 2
121	124	124	128
126	5 min. break	128	129
10 min. break	121	132	135
117	129		
127	133		
131			
9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
110	114	117	
125	127	130 (S)	
132 (S)	137 (S)	139 (S)	
137			
3-6 PM	3-6 PM	3-6 PM	3-6 PM
Thu May 11	Sun May 14	Tue May 16	Thu May 18
112	116	119	121
126	129 (S)	127 (S)	133 (S)
131	135 (S)	133 (S)	145 (S)
138 (S)	139 (S)	136 (S)	
134 (S)		145 (S)	
139			

CAPACITY INDEX: 135'S

6-9AM Tue Apr 25	6-9AM Thu Apr 27	6-9AM Sun Apr 30	6-9AM Tue May 2
102	106	108	110
110	121	121	121
125	128	128	132
130	5 min brk	133	133
10 min brk	125	137	140
120	133	131	138
136			
9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
112	116	119	
128	130	134(S)	
136(S)	142 (S)	144(S)	
142			
3-6 PM	3-6 PM	3-6 PM	3-6 PM
Thu May 11	Sun May 14	Tue May 16	Thu May 18
114	118	121	123
114	118 (S)	121 (S)	123(S)

(continued)

3-6 PM Thu May 11	3-6 PM Sun May 14	3-6 PM Tue May 16	3-6 PM Thu May 18
135	139 (S)	137(S)	150 (S)
143(S)	144 (S)	140 (S)	
138(S)	150 (S)		
144			

CAPACITY INDEX: 140'S

6-9AM Tue Apr 25	6-9AM Thu Apr 27	6-9AM Sun Apr 30	6-9AM Tue May 2
104	108	110	112
112	124	123	124
128	132	132	136
134	5 min. break	136	137
10 min. break	128	141	144
124	137		
135	142		
140			
9-12 AM Thu May 4	9-12 AM Sun May 7	9-12 AM Tue May 9	
114	118	121	
132	134	138 (S)	
141 (S)	147 (S)	149 (S)	
147			
3-6 PM Thu May 11	3-6 PM Sun May 14	3-6 PM Tue May 16	3-6 PM Thu May 18
116	120	123	125
133	136 (S)	133 (S)	141 (S)
139	144 (S)	141 (S)	155 (S)
148 (S)	149 (S)	145 (S)	
141 (S)		155 (S)	
149			

CAPACITY INDEX: 145'S

6-9AM Tue Apr 25	6-9AM Thu Apr 27	6-9AM Sun Apr 30	6-9AM Tue May 2
106	110	112	114
115	128	127	128
132	137	137	141
139	5 min. break	141	142
10 min. break	132	146	149
128	142		
139	147		
145			

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(continued)

9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
116	120	123	
135	138	142 (S)	
145 (S)	152 (S)	154 (S)	
152			
3-6 PM	3-6 PM	3-6 PM	3-6 PM
Thu May 11	Sun May 14	Tue May 16	Thu May 18
118	122	125	127
137	140 (S)	136 (S)	145 (S)
143	148 (S)	145 (S)	160 (S)
153 (S)	154 (S)	149 (S)	
145 (S)		160 (S)	
154			

CAPACITY INDEX: 150'S

6-9AM	6-9AM	6-9AM	6-9AM
Tue Apr 25	Thu Apr 27	Sun Apr 30	Tue May 2
108	112	114	116
117	130	129	130
135	140	140	144
142	5 min. break	144	145
10 min. break	135	150	153
131	145		
143	151		
149			
9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
118	122	125	
139	141	146 (S)	
150 (S)	157 (S)	159 (S)	
157			
3-6 PM	3-6 PM	3-6 PM	3-6 PM
Thu May 11	Sun May 14	Tue May 16	Thu May 18
120	124	127	129
140	143 (S)	139 (S)	149 (S)
147	153 (S)	149 (S)	165 (S)
158 (S)	159 (S)	154 (S)	
150 (S)		165 (S)	
159			

CAPACITY INDEX: 160'S

6-9AM	6-9AM	6-9AM	6-9AM
Tue Apr 25	Thu Apr 27	Sun Apr 30	Tue May 2
112	116	118	120

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(continued)

CAPACITY INDEX: 160'S

6-9AM Tue Apr 25	6-9AM Thu Apr 27	6-9AM Sun Apr 30	6-9AM Tue May 2
122	136	135	136
142	148	148	152
150	5 min. break	152	153
10 min. break	142	159	162
138	153		
151	160		
158.			
9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
122	126	129	
146	148	154 (S)	
159 (S)	167 (S)	169 (S)	
167			
3-6 PM	3-6 PM	3-6 PM	3-6 PM
Thu May 11	Sun May 14	Tue May 16	Thu May 18
124	128	131	133
147	150 (S)	145 (S)	157 (S)
155	162 (S)	157 (S)	175 (S)
168 (S)	169 (S)	163 (S)	
159 (S)		175 (S)	
169			

CAPACITY INDEX: 170'S

6-9AM Tue Apr 25	6-9AM Thu Apr 27	6-9AM Sun Apr 30	6-9AM Tue May 2
116	120	122	124
125	142	141	142
149	156	156	160
158	5 min break	160	161
10 min break	149	168	171
145	161		
159	169		
167			
9-12 AM	9-12 AM	9-12 AM	
Thu May 4	Sun May 7	Tue May 9	
126	130	133	
153	155	162 (S)	
168 (S)	177 (S)	179 (S)	
177			
3-6 PM	3-6 PM	3-6 PM	3-6 PM
Thu May 11	Sun May 14	Tue May 16	Thu May 18
128	132	135	137
154	157 (S)	151 (S)	165 (S)
163	171 (S)	165 (S)	185 (S)
178 (S)	179 (S)	172 (S)	
168 (S)		185 (S)	
179			

(continued)

CAPACITY INDEX: 175'S

6-9AM Tue Apr 25	6- 9AM Thu Apr 27	6-9AM Sun Apr 30	6- 9AM Tue May 2
118	122	124	126
130	145	145	145
153	160	160	164
162	5 min. break	165	165
10 min. break	153	173	176
148	165		
163	174		
172			
9-12 AM Thu May 4	9-12 AM Sun May 7	9-12 AM Tue May 9	
128	132	135	
156	158	166 (S)	
172 (S)	182 (S)	184 (S)	
182			
3-6 PM Thu May 11	3-6 PM Sun May 14	3-6 PM Tue May 16	3-6 PM Thu May 18
130	134	137	139
157	160 (S)	154 (S)	169 (S)
167	175 (S)	169 (S)	190 (S)
183 (S)	184 (S)	176 (S)	
172 (S)		190 (S)	
184			

CAPACITY INDEX: 180'S

6-9AM Tue Apr 25	6-9AM Thu Apr 27	6-9AM Sun Apr 30	6-9AM Tue May 2
120	124	126	128
132	148	147	148
156	164	164	168
166	5 min break	168	169
10 min break	156	177	180
152	169		
167	178		
176			
9-12 AM Thu May 4	9-12 AM Sun May 7	9-12 AM Tue May 9	
130	134	137	
160	162	170 (S)	
177 (S)	187 (S)	189 (S)	
187			
3-6 PM Thu May 11	3-6 PM Sun May 14	3-6 PM Tue May 16	3-6 PM Thu May 18
132	136	139	141
161	164 (S)	157 (S)	173 (S)
171	180 (S)	173 (S)	195 (S)
188 (S)	189 (S)	181 (S)	
177 (S)		195 (S)	
189			

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Claims

1. A system for assessing an individual's physiological condition during said individual's performance of an exercise regimen, wherein said regimen comprises at least one exercise session and 5 wherein said session comprises at least one exercise cycle, said system comprising:

   an electronic monitor that monitors a heart rate of said individual during at least one of said sessions;
   a recorder for recording a time trace of said heart rate to an electronic file; and
   an analyzer for analyzing said electronic file, wherein said analyzer determines at least one cycle parameter and assigns a value to a heart wave index indicative of said condition based on said parameter, and wherein said analyzer is adapted to statistically fit a parabola through at least a portion of said time trace to create a fit, said fit being **characterized by** at least one goodness of fit parameter.

2. The system of claim 1 wherein said recorder, for said at least one exercise cycle, is adapted to record at least one portion selected from a group consisting of a rising portion, a top portion into which said rising portion transitions, and a falling portion into which said top portion transitions, a pre-exercise rest portion, an intervening rest portion corresponding to a period from an end of said at least one exercise cycle to a beginning of a next exercise cycle, and a post-exercise rest portion.

3. The system of claim 1 or 2 wherein said analyzer is adapted to determine at least one parameter selected from a group consisting of a maximum heart rate, an upward slope within said rising portion, a downward slope within said falling portion, a minimum heart rate within said falling portion, a peak heart rate within said top portion, a resting heart rate, and a base line slope.

4. The system of claim 1, 2 or 3 wherein said analyzer is adapted to statistically fit said parabola through at least said portion of said time trace to create said fit using regression analysis, and wherein said analyzer assigns said value to said heart wave index based on said at least one goodness of fit parameter.

5. The system of claim 4 wherein said analyzer further comprises routines for diagnosing abnormal physiological conditions by comparing said set of goodness of fit parameters with a catalog, said catalog relating said goodness of fit parameters to said physiological conditions.

6. The system of any one of claims 1 to 5 wherein said analyzer is adapted to assign to said heart wave index a value based on at least one parameter selected a group consisting of an upward slope, a downward slope, a minimum heart rate, a peak heart rate, a resting heart rate, a base line slope, and a set of goodness of fit parameters.

7. The system of any one of claims 1 to 6 further adapted to a use for modifying an exercise regimen for said individual, said regimen having a target heart wave index and comprising at least one exercise session that comprises at least one exercise cycle having a target heart rate, wherein said analyzer compares said heart wave index to said target heart wave index and changes said target heart rate and said target heart wave index in response to said comparison.

8. The system of any one of claims 1 to 7 further adapted to a use for determining a capacity index, wherein said individual undergoes an exercise test, said test comprising a plurality of test cycles, wherein said plurality of test cycles comprises a maximum effort cycle during which said individual exercises to said individual's maximum physical capability, and wherein said electronic monitor monitors a heart rate of said individual during said test and said analyzer

   (1) determines at least one cycle parameter; and
   (2) assigns to said capacity index a value based on said at least one of said cycle parameter.

9. The system of claim 8 wherein said at least one cycle parameter is selected from the group consisting of a first peak heart rate corresponding to a maximum heart rate monitored during said maximum effort cycle, a second peak heart rate corresponding to a maximum heart rate monitored during another of said plurality of test cycles that is not said maximum effort cycle, an upward slope of said heart rate monitored during a part of a stress portion of at least one of said plurality of test cycles, determines a downward slope of said heart rate monitored during a part of a relaxation portion of the at least one of said plurality of test cycles.

10. The system of claim 8 or 9 wherein said at least one cycle parameter is selected from a group consisting of a peak

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heart rate, an upward slope, and a downward slope.

11. The system of claim 8, 9 or 10 further adapted to a use for prescribing an exercise regimen for an individual, wherein said analyzer is programmed to: (1) receive a metric indicative of said individual's physiological condition and (2) generate said exercise regimen using an algorithm that relates said heart wave index to said regimen; and wherein said system further comprises:

    an output device that provides said individual with said exercise regimen.

12. The system of claim 11 wherein said algorithm uses a look-up table.

13. The system of any one of claims 1 to 12 wherein said analyzer is adapted to generate an exercise regimen that comprises a plurality of exercise sessions comprising:

    at least one warm up cycle; and
    at least one critical cycle that has a target heart rate based on said heart wave index.

14. The system of any one of claims 1 to 3 wherein said analyzer is adapted to synchronize said regimen with at least one cyclic phenomena selected from a group consisting of a lunar cycle and a circadian rhythm of said-individual.

15. The system of any one of claims 1 to 14 wherein said analyzer is adapted to generate an instruction set that provides directions to said individual on how to exercise.

16. The system of any one of claims 1 to 15 further comprising a communication link between said recorder and said analyzer, wherein said link comprises an electronic network selected from a group consisting of a local area network, a wireless network, a wired network, a wide area network, an Internet connection, and any combination thereof.

17. The system of claim 16 further comprising a user interface selected from a group consisting of an Internet web page, a display monitor, a computer terminal, an audio device, a tactile device, or any combination thereof.

Patentansprüche

1. System zur Bewertung der physiologischen Kondition einer Person während der Durchführung eines Trainingsprogramms durch die Person, wobei das Programm mindestens eine Trainingssitzung aufweist und wobei die Sitzung mindestens einen Trainingszyklus aufweist, wobei das System aufweist:

    ein elektronisches Überwachungsgerät, das eine Herzfrequenz der Person während mindestens einer der Sitzungen überwacht;
    ein Aufzeichnungsgerät zum Aufzeichnen eines zeitlichen Verlaufs der Herzfrequenz in einer elektronischen Datei; und
    ein Analysengerät zum Analysieren der elektronischen Datei, wobei das Analysengerät mindestens einen Zyklusparameter bestimmt und einen Wert einem Herzwellenindex als Anzeige der Kondition auf der Grundlage des Parameters zuweist und wobei das Analysengerät geeignet ist, eine Parabel über mindestens einen Abschnitt des zeitlichen Verlaufs statistisch anzupassen, um eine Anpassung zu erzeugen, wobei die Anpassung durch mindestens einen Anpassungsgüteparameter **gekennzeichnet** ist.

2. System nach Anspruch 1, wobei für den mindestens einen Trainingszyklus das Aufzeichnungsgerät geeignet ist, mindestens einen Abschnitt aufzuzeichnen, der aus einer Gruppe ausgewählt ist, die aus einem steigenden Abschnitt, einem oberen Abschnitt, in den der steigende Abschnitt übergeht, und einem fallenden Abschnitt, in den der obere Abschnitt übergeht, einem Ruheabschnitt vor dem Training, einem Zwischenruheabschnitt in Entsprechung zu einer Periode von einem Ende des mindestens einen Trainingszyklus bis zu einem Beginn eines nächsten Trainingszyklus und einem Ruheabschnitt nach dem Training besteht.

3. System nach Anspruch 1 oder 2, wobei das Analysengerät geeignet ist, mindestens einen Parameter zu bestimmen, der aus einer Gruppe ausgewählt ist, die aus einer maximalen Herzfrequenz, einer Steigung im steigenden Abschnitt, einem Gefälle im fallenden Abschnitt, einer minimalen Herzfrequenz im fallenden Abschnitt, einer Spitzenherzfrequenz im oberen Abschnitt, einer Ruheherzfrequenz und einer Grundliniensteilheit besteht.

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4. System nach Anspruch 1, 2 oder 3, wobei das Analysengerät geeignet ist, die Parabel über mindestens den Abschnitt des zeitlichen Verlaufs statistisch anzupassen, um die Anpassung mit Hilfe von Regressionsanalyse zu erzeugen, und wobei das Analysengerät den Wert dem Herzwellenindex auf der Grundlage des mindestens einen Anpassungsgüteparameters zuweist.

5. System nach Anspruch **4**, wobei das Analysengerät ferner Routinen zum Diagnostizieren anomaler physiologischer Konditionen durch Vergleichen des Satzes von Anpassungsgüteparametern mit einem Katalog aufweist, wobei der Katalog die Anpassungsgüteparameter mit den physiologischen Konditionen in Beziehung setzt.

6. System nach einem der Ansprüche **1** bis 5, wobei das Analysengerät geeignet ist, dem Herzwellenindex einen Wert auf der Grundlage mindestens eines Parameters zuzuweisen, der aus einer Gruppe ausgewählt ist, die aus einer Steigung, einem Gefälle, einer minimalen Herzfrequenz, einer Spitzenherzfrequenz, einer Ruheherzfrequenz, einer Grundliniensteilheit und einem Satz von Anpassungsgüteparametern besteht.

7. System nach einem der Ansprüche 1 bis 6, ferner geeignet für eine Verwendung zum Modifizieren eines Trainingsprogramms für die Person, wobei das Programm einen Soll-Herzwellenindex hat und mindestens eine Trainingssitzung aufweist, die mindestens einen Trainingszyklus mit einer Soll-Herzfrequenz aufweist, wobei das Analysengerät den Herzwellenindex mit dem Soll-Herzwellenindex vergleicht und die Soll-Herzfrequenz sowie den Soll-Herzwellenindex als Reaktion auf den Vergleich ändert.

8. System nach einem der Ansprüche 1 bis **7**, ferner geeignet für eine Verwendung zum Bestimmen eines Kapazitätsindex, wobei die Person einen Trainingstest durchführt, wobei der Test mehrere Testzyklen aufweist, wobei die mehreren Testzyklen einen maximalen Belastungszyklus aufweisen, in dessen Verlauf die Person bis zum maximalen körperlichen Vermögen der Person trainiert, und wobei das elektronische Überwachungsgerät eine Herzfrequenz der Person während des Tests überwacht und das Analysengerät (1) mindestens einen Zyklusparameter bestimmt; und (2) dem Kapazitätsindex einen Wert auf der Grundlage des mindestens einen Zyklusparameters zuweist.

9. System nach Anspruch 8, wobei der mindestens eine Zyklusparameter aus der Gruppe ausgewählt ist, die aus folgendem besteht: einer ersten Spitzenherzfrequenz in Entsprechung zu einer während des maximalen Belastungszyklus überwachten maximalen Herzfrequenz, einer zweiten Spitzenherzfrequenz in Entsprechung zu einer während eines weiteren der mehreren Testzyklen, der nicht der maximale Belastungszyklus ist, überwachten maximalen Herzfrequenz, wobei eine Steigung der Herzfrequenz, die während eines Teils eines Beanspruchungsabschnitts mindestens eines der mehreren Testzyklen überwacht wird, ein Gefälle der Herzfrequenz bestimmt, die während eines Teils eines Entspannungsabschnitts des mindestens einen der mehreren Testzyklen überwacht wird.

10. System nach Anspruch 8 oder 9, wobei der mindestens eine Zyklusparameter aus einer Gruppe ausgewählt ist, die aus einer Spitzenherzfrequenz, einer Steigung und einem Gefälle besteht.

11. System nach Anspruch 8, 9 oder 10, ferner geeignet für eine Verwendung zum Verordnen eines Trainingsprogramms für eine Person, wobei das Analysengerät so programmiert ist, daß es (1) ein Maß als Anzeige der physiologischen Kondition der Person empfängt und (2) das Trainingsprogramm mit Hilfe eines Algorithmus erstellt, der den Herzwellenindex mit dem Programm in Beziehung setzt; und wobei das System ferner aufweist:

    eine Ausgabevorrichtung, die das Trainingsprogramm für die Person bereitstellt.

12. System nach Anspruch 11, wobei der Algorithmus eine Nachschlagetabelle verwendet.

13. System nach einem der Ansprüche 1 bis 12, wobei das Analysengerät geeignet ist, ein Trainingsprogramm zu erstellen, das mehrere Trainingssitzungen mit folgendem aufweist:

    mindestens einem Aufwärmzyklus; und
    mindestens einem kritischen Zyklus, der eine Soll-Herzfrequenz auf der Grundlage des Herzwellenindex hat.

14. System nach einem der Ansprüche 1 bis 13, wobei das Analysengerät geeignet ist, das Programm mit mindestens einer zyklischen Erscheinung zu synchronisieren, die aus einer Gruppe ausgewählt ist, die aus einem Mondzyklus und einem Tag-Nacht-Rhythmus der Person besteht.

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15. System nach einem der Ansprüche 1 bis 14, wobei das Analysengerät geeignet ist, einen Befehlssatz zu erstellen, der Anweisungen für die Person bereitstellt, wie zu trainieren ist.

16. System nach einem der Ansprüche 1 bis 15, ferner mit einer Kommunikationsverbindung zwischen dem Aufzeichnungsgerät und dem Analysengerät, wobei die Verbindung ein elektronisches Netzwerk aufweist, das aus einer Gruppe ausgewählt ist, die aus einem lokalen Netzwerk, einem drahtlosen Netzwerk, einem drahtgebundenen Netzwerk, einem Weitbereichsnetzwerk, einer Internetverbindung und jeder Kombination daraus besteht.

17. System nach Anspruch 16, ferner mit einer Benutzerschnittstelle, die aus einer Gruppe ausgewählt ist, die aus einer Internetwebseite, einem Anzeigemonitor, einem Computerterminal, einer akustischen Vorrichtung, einer taktilen Vorrichtung oder jeder Kombination daraus besteht.

Revendications

1. Système pour évaluer une condition physiologique individuelle pendant ladite performance individuelle d'un régime d'exercices, dans lequel ledit régime comporte au moins une session d'exercices et dans lequel ladite session comporte au moins un cycle d'exercices, ledit système comportant :

   un moniteur électronique qui surveille un rythme cardiaque dudit individu pendant au moins une desdites sessions ;
   un enregistreur pour enregistrer une trace de temps dudit rythme cardiaque dans un fichier électronique ; et
   un analyseur pour analyser ledit fichier électronique, dans lequel ledit analyseur détermine au moins un paramètre de cycle et attribue une valeur à un indice d'onde cardiaque indicatif de ladite condition sur la base dudit paramètre, et dans lequel ledit analyseur est adapté pour statistiquement ajuster une parabole à travers au moins une partie de ladite trace de temps pour créer un ajustement, ledit ajustement étant **caractérisé par** au moins une qualité de paramètre d'accès.

2. Système selon la revendication 1, dans lequel ledit enregistreur, pour ledit au moins un cycle d'exercices, est adapté pour enregistrer au moins une partie sélectionnée dans un groupe constitué d'une partie ascendante, d'une partie supérieure dans laquelle ladite partie ascendante effectue une transition, et d'une partie descendante dans laquelle ladite partie supérieure effectue une transition, d'une partie de repos de préexercice, d'une partie de repos d'intervention correspondant à une période à partir d'une fin dudit au moins un cycle d'exercices jusqu'à un début d'un prochain cycle d'exercices, et d'une partie de repos de post-exercice.

3. Système selon la revendication 1 ou 2, dans lequel ledit analyseur est adapté pour déterminer au moins un paramètre sélectionné dans un groupe constitué d'un rythme cardiaque maximum, d'une pente vers le haut dans ladite partie ascendante, d'une pente vers le bas dans ladite partie descendante, d'un rythme cardiaque minimum dans ladite partie descendante, d'un rythme cardiaque maximum dans ladite partie supérieure, d'un rythme cardiaque au repos, et d'une pente de ligne de base.

4. Système selon la revendication 1, 2 ou 3, dans lequel ledit analyseur est adapté pour ajuster statistiquement ladite parabole à travers au moins ladite partie de trace de temps pour créer ledit ajustement en utilisant une analyse de régression, et dans lequel ledit analyseur attribue ladite valeur audit indice d'onde cardiaque sur la base de ladite au moins une qualité de paramètre d'ajustement.

5. Système selon la revendication 4, dans lequel ledit analyseur comporte en outre des routines pour diagnostiquer des conditions physiologiques anormales en comparant ledit ensemble de qualités des paramètres d'accès à un catalogue, ledit catalogue mettant en rapport ladite qualité de paramètres d'ajustement avec lesdites conditions physiologiques.

6. Système selon l'une quelconque des revendications 1 à 5, dans lequel ledit analyseur est adapté pour attribuer audit indice d'onde cardiaque une valeur basée sur au moins un paramètre sélectionné dans un groupe constitué d'une pente vers le haut, d'une pente vers le bas, d'un rythme cardiaque minimum, d'un rythme cardiaque maximum, d'un rythme cardiaque au repos, d'une pente de ligne de base, et d'un ensemble de qualités de paramètres d'ajustement.

7. Système selon l'une quelconque des revendications 1 à 6, adapté en outre pour une utilisation pour modifier un

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régime d'exercices pour ledit individu, ledit régime ayant un indice d'onde cardiaque cible, et comportant au moins une session d'exercices qui comporte au moins un cycle d'exercices ayant un rythme cardiaque cible, dans lequel ledit analyseur compare l'indice d'onde cardiaque audit indice d'onde cardiaque cible, et change ledit rythme cardiaque cible et ledit indice d'onde cardiaque cible en réponse à ladite comparaison.

8. Système selon l'une quelconque des revendications 1 à 7, adapté en outre pour une utilisation pour déterminer un indice de capacité, dans lequel ledit individu subit un test d'exercice, ledit test comportant une pluralité de cycles de test, dans lequel ladite pluralité de cycles de test comporte un cycle d'effort maximum pendant lequel ledit individu pratique un exercice à ladite capacité physique maximum individuelle, et dans lequel ledit moniteur électronique surveille un rythme cardiaque dudit individu pendant ledit test, et ledit analyseur (1) détermine au moins un paramètre de cycle ; et (2) attribue audit indice de capacité une valeur basée sur ledit au moins un desdits paramètres de cycle.

9. Système selon la revendication 8, dans lequel ledit au moins un paramètre de cycle est sélectionné dans le groupe constitué d'un premier rythme cardiaque maximum correspondant à un rythme cardiaque maximum surveillé pendant ledit cycle d'effort maximum, un second rythme cardiaque maximum correspondant à un rythme cardiaque maximum surveillé pendant un autre de ladite pluralité de cycles de test autre qui n'est pas ledit cycle d'effort maximum, une pente vers le haut dudit rythme cardiaque surveillé pendant une partie d'une partie d'effort d'au moins un de ladite pluralité de cycles de test, détermine une pente vers le bas dudit rythme cardiaque surveillé pendant une partie d'une partie de relaxation du au moins un de ladite pluralité de cycles de test.

10. Système selon la revendication 8 ou 9, dans lequel ledit au moins un paramètre de cycle est sélectionné dans un groupe constitué d'un rythme cardiaque maximum, d'une pente vers le haut, et d'une pente vers le bas.

11. Système selon la revendication 8, 9 ou 10, adapté en outre pour une utilisation pour prescrire un régime d'exercices pour un individu, dans lequel ledit analyseur est programmé pour: (1) recevoir une mesure indiquant ladite condition physiologique individuelle, et (2) générer ledit régime d'exercices en utilisant un algorithme qui relie ledit indice d'onde cardiaque audit régime ; et dans lequel ledit système comporte en outre :

un dispositif de sortie qui dote ledit individu dudit régime d'exercices.

12. Système selon la revendication 11, dans lequel ledit algorithme utilise un tableau à consulter.

13. Système selon l'une quelconque des revendications 1 à 12, dans lequel ledit analyseur est adapté pour générer un régime d'exercices qui comporte une pluralité de sessions d'exercices comportant :

au moins un cycle d'échauffement ; et
au moins un cycle critique qui a un rythme cardiaque cible basé sur ledit indice d'onde cardiaque.

14. Système selon l'une quelconque des revendications 1 à 13, dans lequel ledit analyseur est adapté pour synchroniser ledit régime avec au moins un phénomène cyclique sélectionné dans un groupe constitué d'un cycle lunaire et d'un rythme circadien dudit individu.

15. Système selon l'une quelconque des revendications 1 à 14, dans lequel ledit analyseur est adapté pour générer un ensemble d'instructions qui fournissent des directions audit individu sur la façon de faire de l'exercice.

16. Système selon l'une quelconque des revendications 1 à 15, comportant en outre une liaison de communication entre ledit enregistreur et ledit analyseur, dans lequel ladite liaison comporte un réseau électronique sélectionné dans un groupe constitué d'un réseau local, d'un réseau sans fil, d'un réseau câblé, d'un réseau étendu, d'une connexion Internet, et d'une quelconque combinaison de ceux-ci.

17. Système selon la revendication 16, comportant en outre une interface utilisateur sélectionnée dans un groupe constitué d'une page Web d'Internet, d'un écran de visualisation, d'un terminal d'ordinateur, d'un dispositif audio, d'un dispositif tactile, ou d'une quelconque combinaison de ceux-ci.

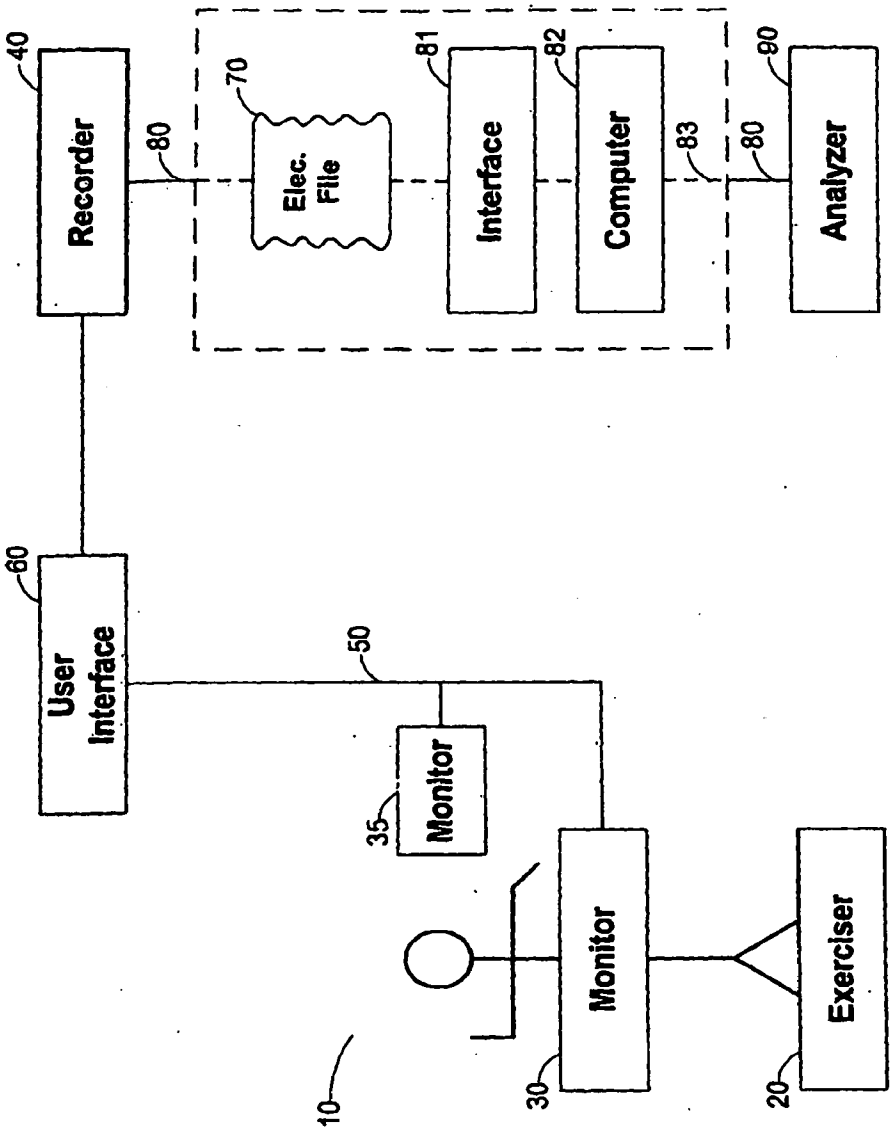

40
Recorder
80
70
Elec. File
81
Interface
82
Computer
83
80
90
Analyzer
60
User Interface
50
35
Monitor
Monitor
30
Exerciser
20
10

FIG. 1

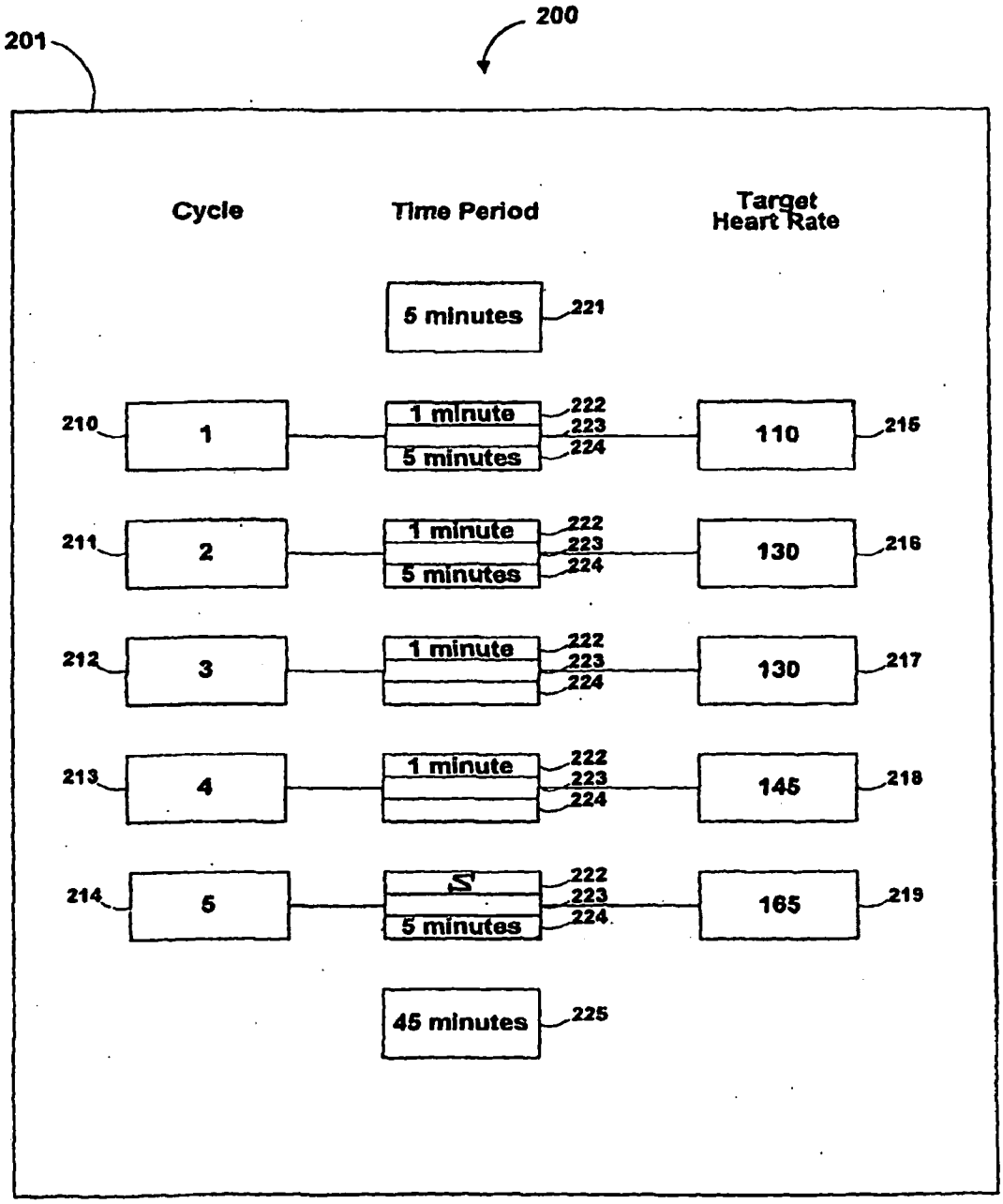
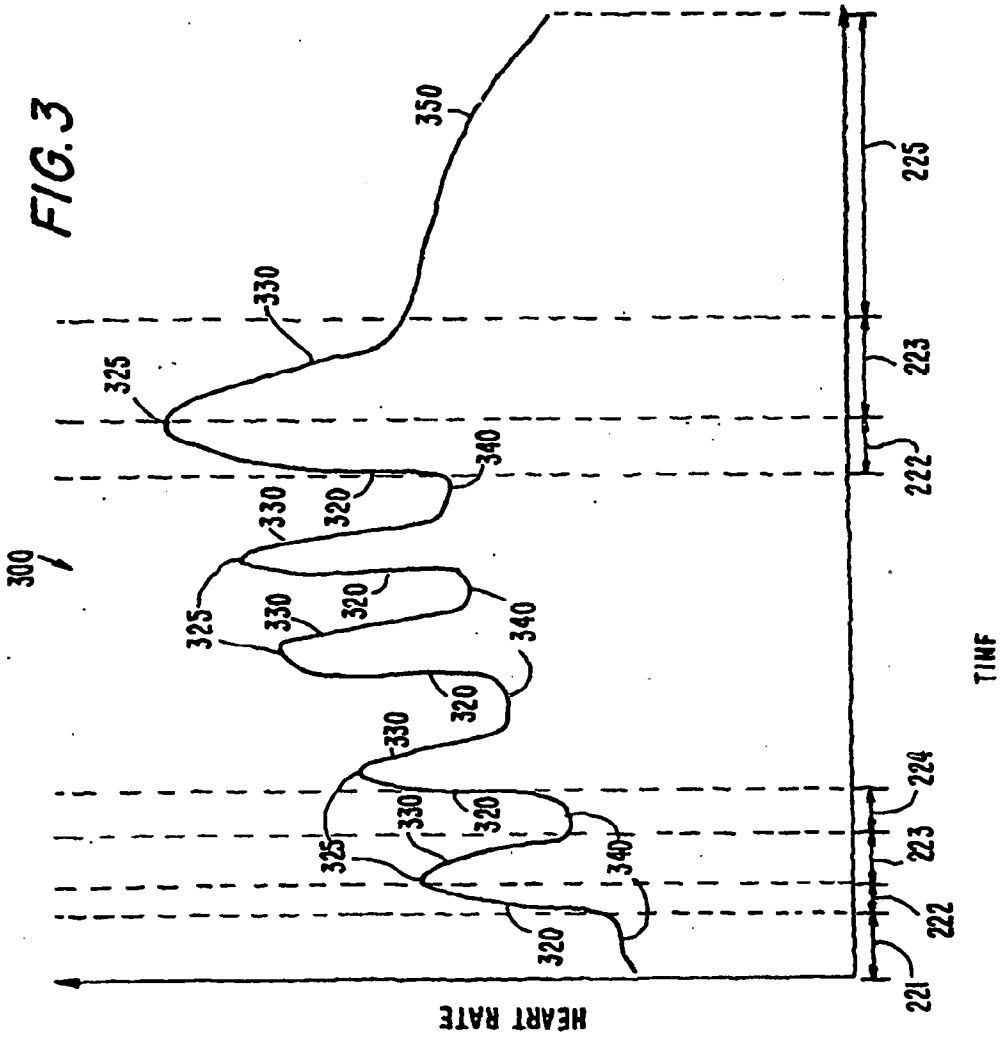

200
201
Cycle
Time Period
Target Heart Rate
5 minutes
221
210
1
1 minute
5 minutes
222
223
224
110
215
211
2
1 minute
5 minutes
222
223
224
130
216
212
3
1 minute
222
223
224
130
217
213
4
1 minute
222
223
224
145
218
214
5
1 minute
5 minutes
222
223
224
165
219
45 minutes
225

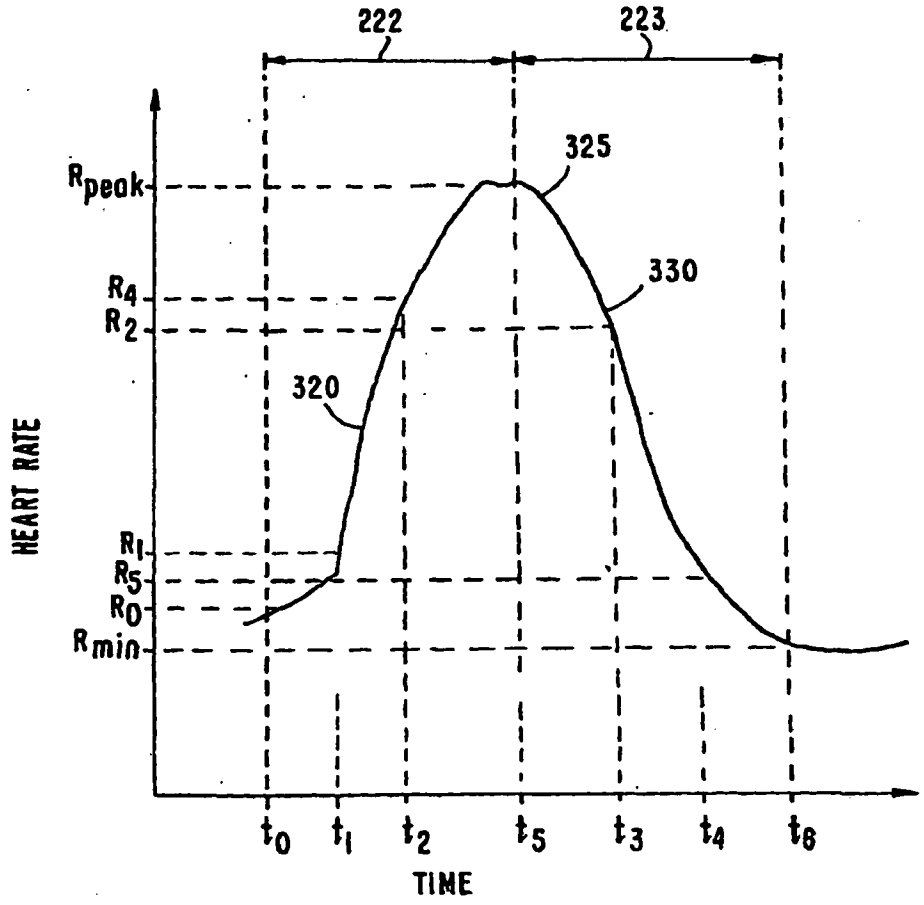
FIG. 2

FIG. 3



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FIG. 3a



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FIG.5

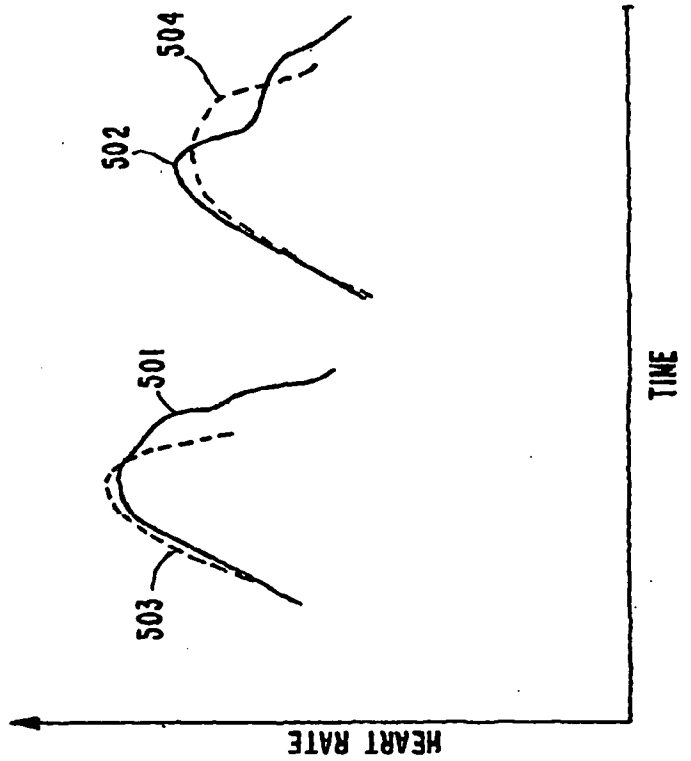
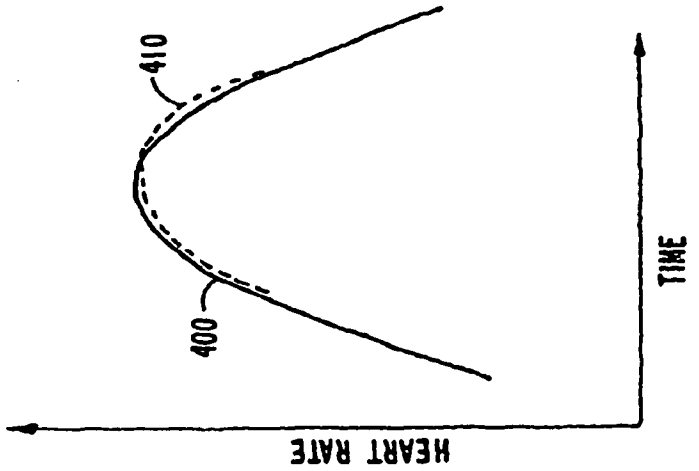


FIG.4



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FIG. 6a

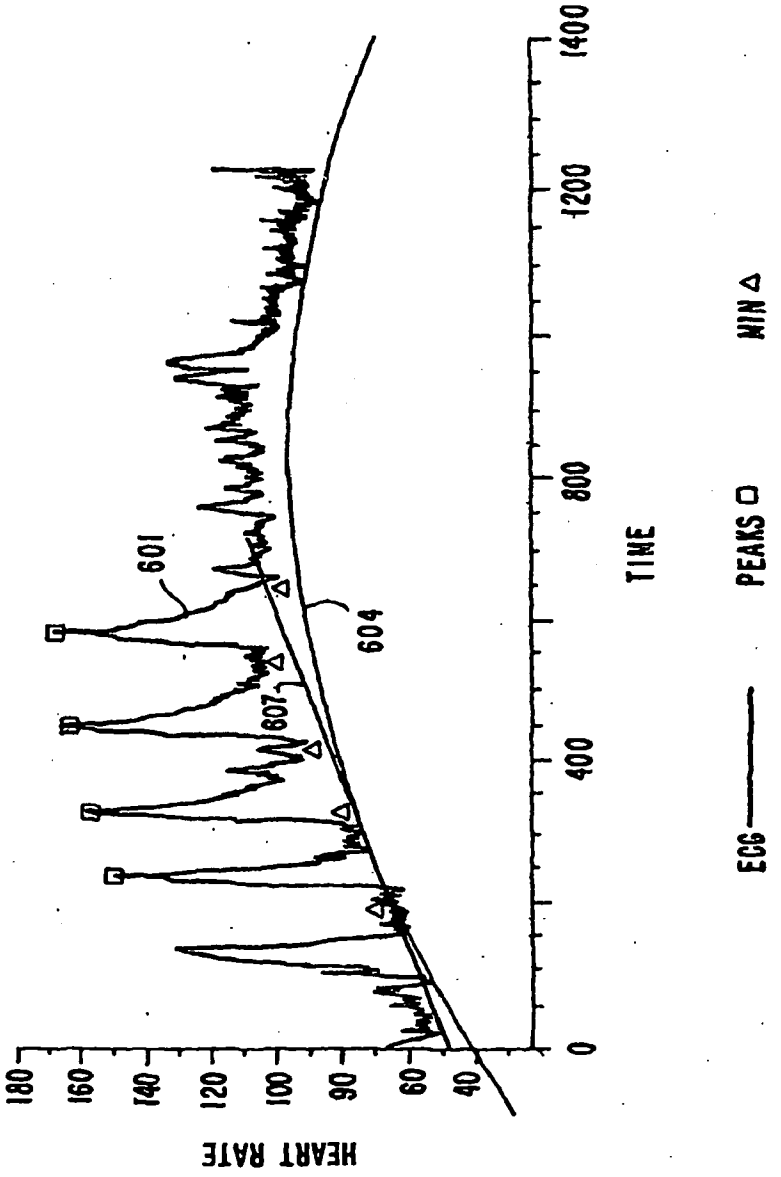

HEART RATE
180
160
140
120
100
90
60
40
0
400
800
1200
1400
TIME
ECG
PEAKS
MIN
601
604
607

FIG. 6b

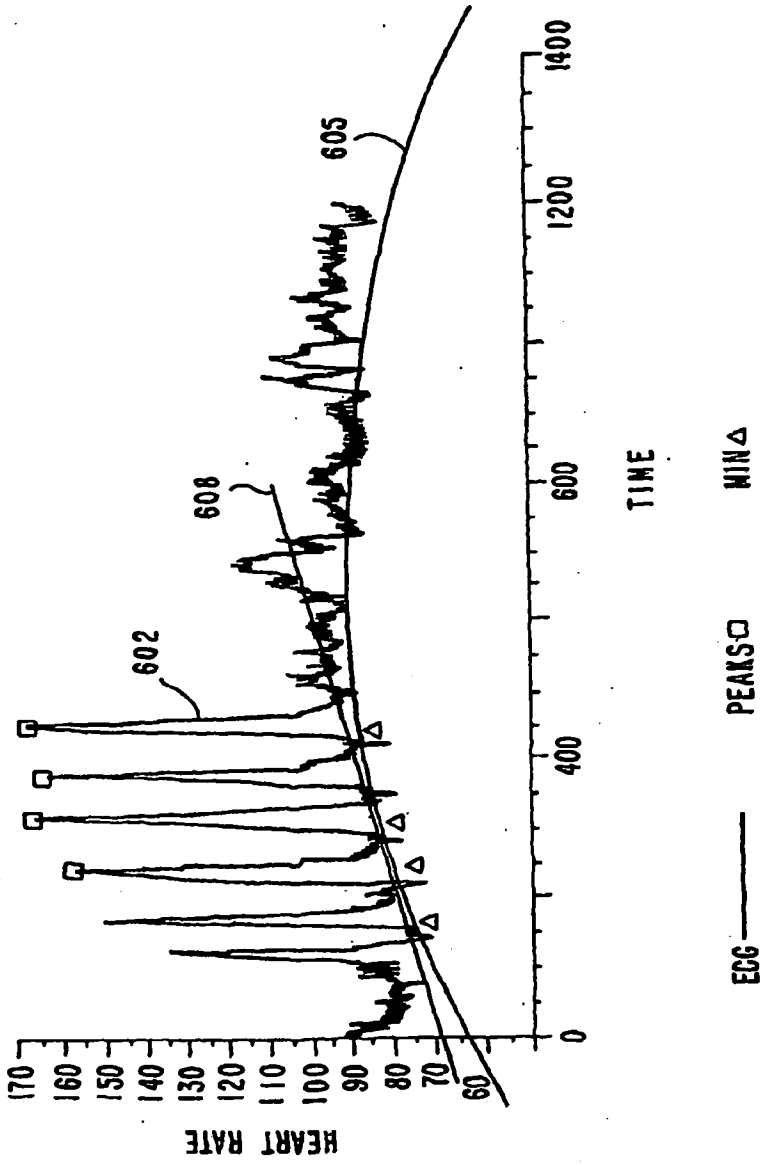
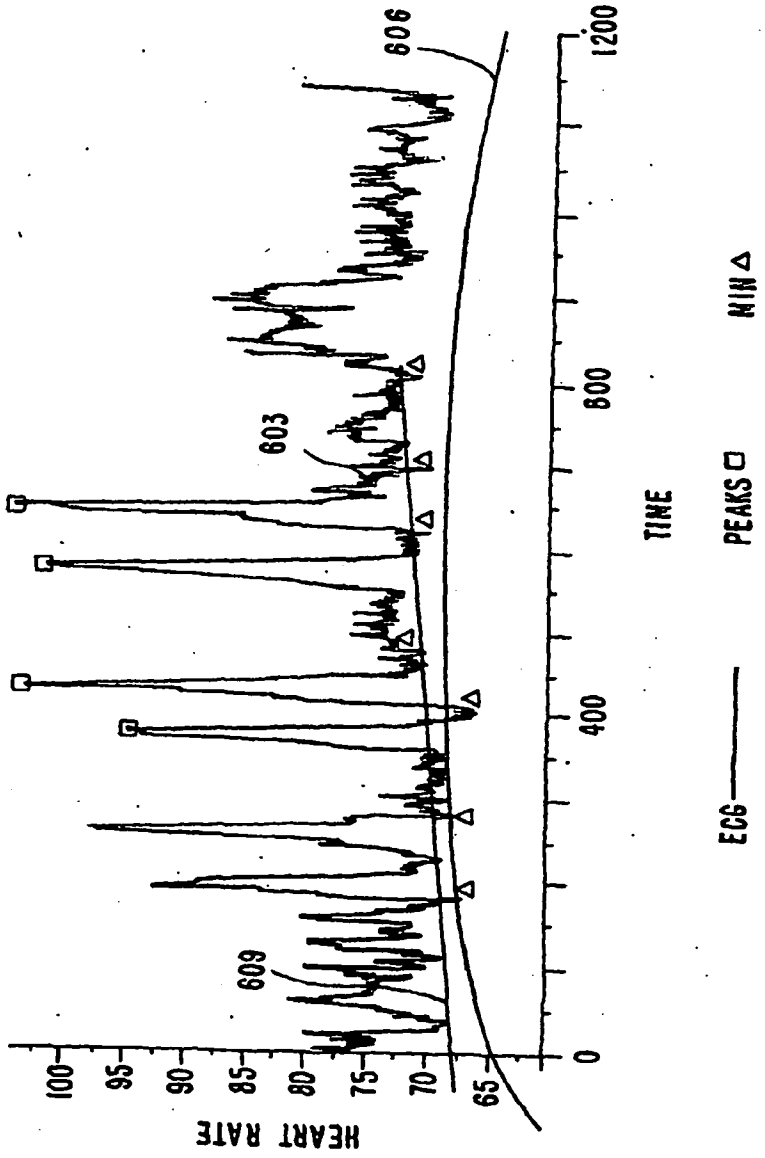

605
608
602
HEART RATE
170
160
150
140
130
120
110
100
90
80
70
60
0
400
600
1200
1400
TIME
ECG
PEAKS□
MIN△

FIG. 6c


606
603
609
HEART RATE
100
95
90
85
80
75
70
65
0
400
800
1200
TIME
PEAKS □
MIN △
ECG

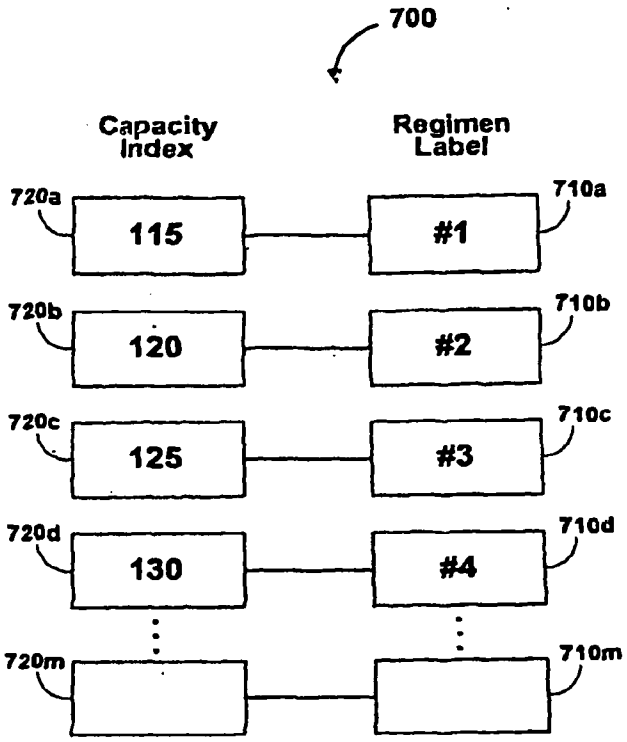


FIG. 7

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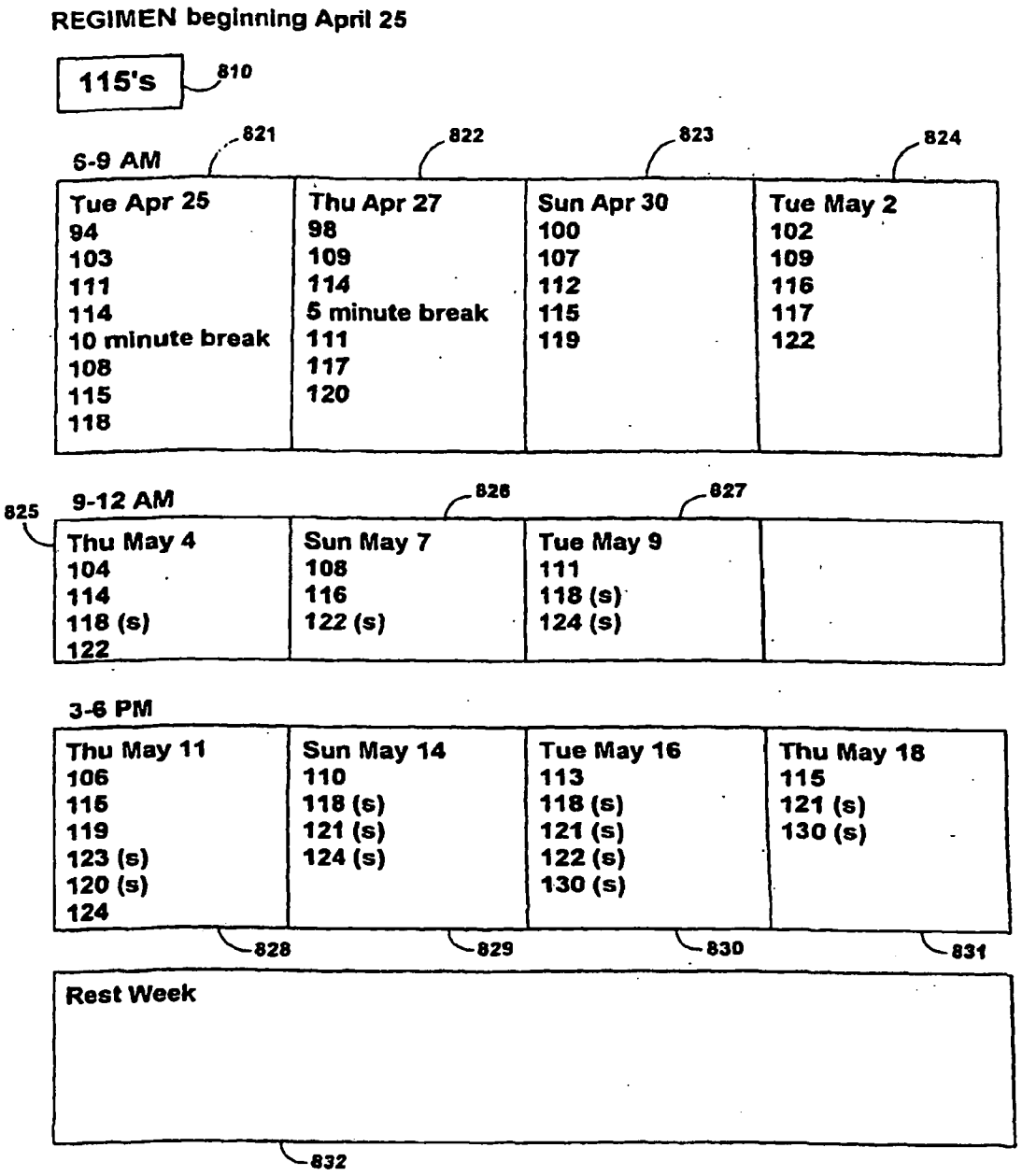

REGIMEN beginning April 25
115's
810
6-9 AM
821
822
823
824
Tue Apr 25
94
103
111
114
10 minute break
108
115
118
Thu Apr 27
98
109
114
5 minute break
111
117
120
Sun Apr 30
100
107
112
115
119
Tue May 2
102
109
116
117
122
825
9-12 AM
826
827
Thu May 4
104
114
118 (s)
122
Sun May 7
108
116
122 (s)
Tue May 9
111
118 (s)
124 (s)
3-6 PM
Thu May 11
106
115
119
123 (s)
120 (s)
124
Sun May 14
110
118 (s)
121 (s)
124 (s)
Tue May 16
113
118 (s)
121 (s)
122 (s)
130 (s)
Thu May 18
115
121 (s)
130 (s)
828
829
830
831
Rest Week
832

FIG. 8

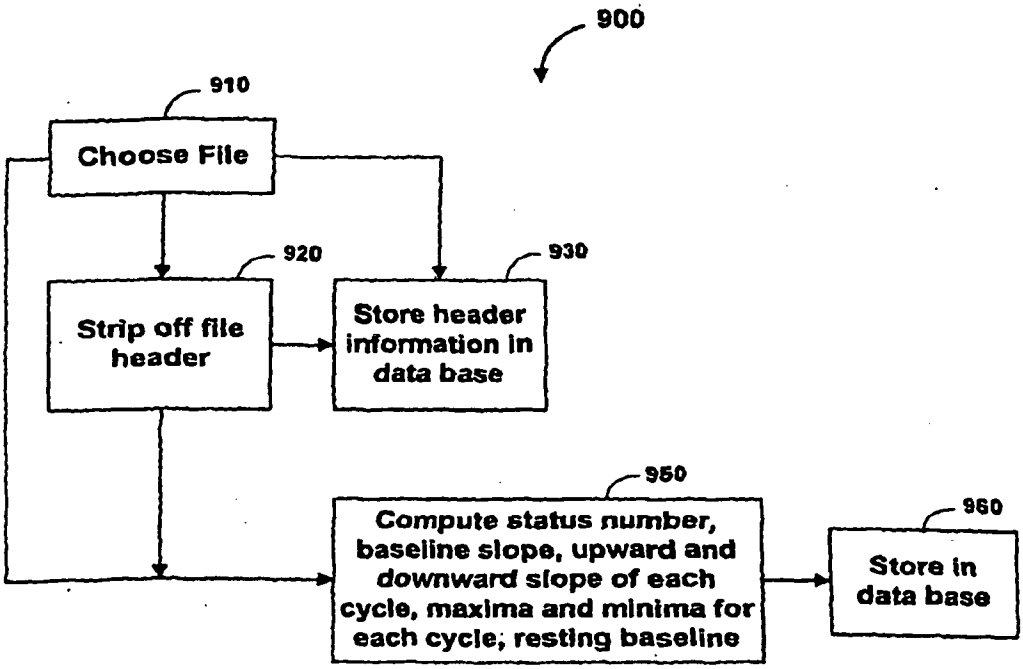


FIG. 9

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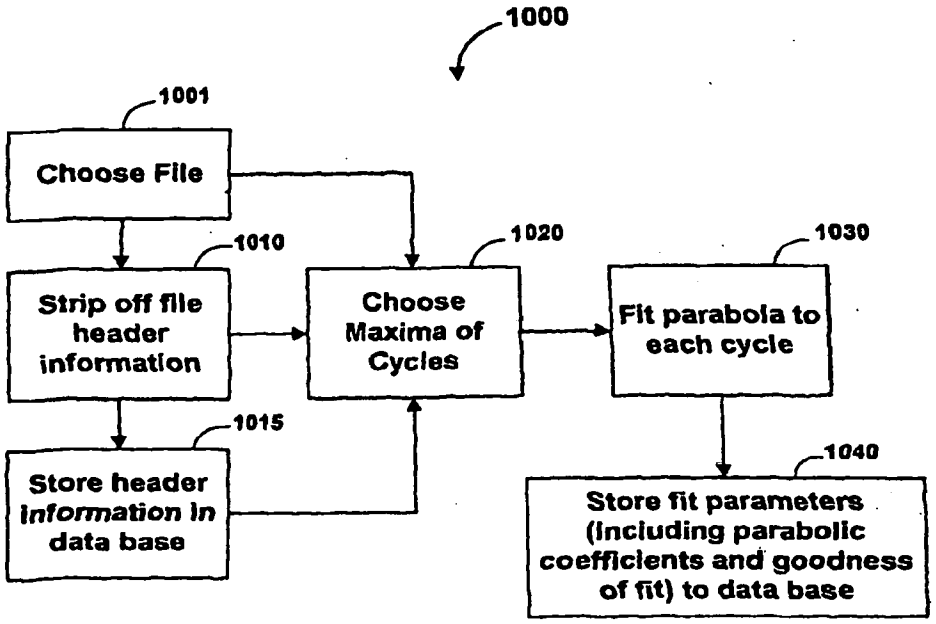

1000
1001
Choose File
1010
Strip off file header information
1015
Store header information in data base
1020
Choose Maxima of Cycles
1030
Fit parabola to each cycle
1040
Store fit parameters (including parabolic coefficients and goodness of fit) to data base

FIG. 10

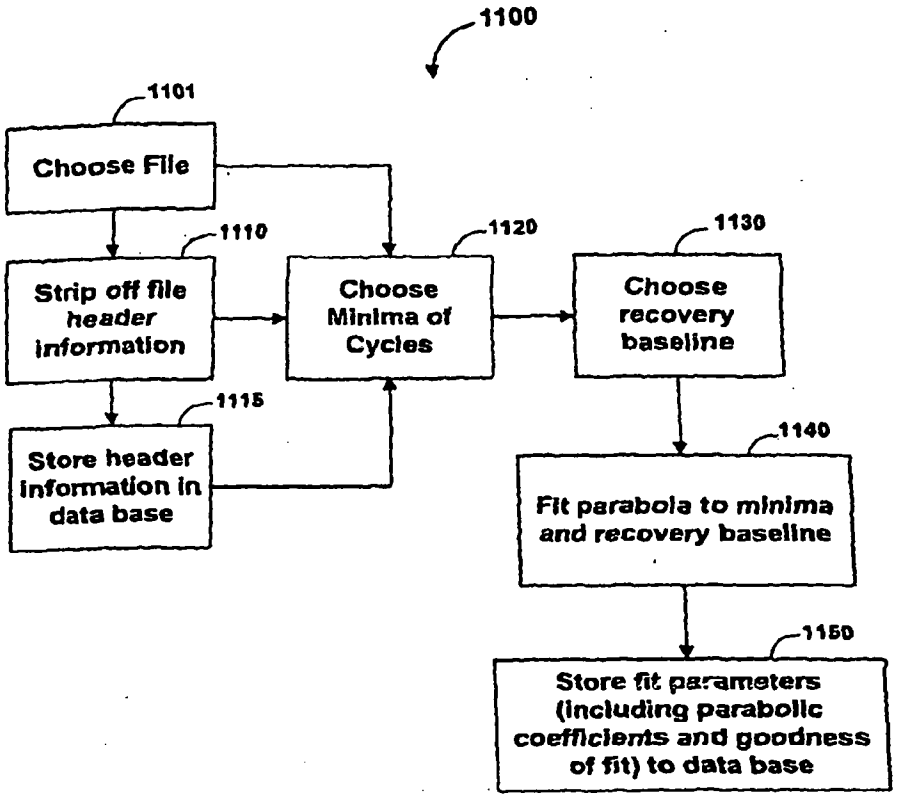


FIG. 11

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5007430 A **[0004] [0079]**
- US 5800737 A **[0004] [0079]**
- US 5163439 A **[0004] [0079]**
- US 5752521 A **[0004] [0079]**

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	161	(("ARIZONA") near3 ("BOARD") near3 ("OF") near3 ("REGENTS") near3 ("ON") near3 ("BEHALF") near3 ("OF") near3 ("ARIZONA") near3 ("STATE") near3 ("UNIVERSITY")).AANM.	USPAT	AND	ON	2019/08/05 09:50
L2	11	(("ARTEMIADIS") near3 ("Panagiotis")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
L3	2	(("BARKAN") near3 ("Andrew")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
L4	4	("20060052728" | "5302162" | "8246354" | "8262590").PN.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L5	4261	(482/51-54).CCLS.	US-PGPUB; USPAT	OR	OFF	2019/08/05 09:50
L6	8209	(A63B22/0292 or A63B22/02$ or A63B69/0064 or A63B22/0235 or A63B24/0087 or A63B21/00181 or A63B22/0221 or A61B5/6892 or A61B5/1036 or A63B2220/52 or A63B2024/0093 or A63B2220/18).cpc.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L7	10959	L5 or L6	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L8	210	L7 and counterweight	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L9	132	L8 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L10	7	L9 and (belt with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L11	0	L9 and (tread with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L12	83	L7 and counterweight and treadmill	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L13	60	L12 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L14	333	L7 and treadmill and (belt near2 (two or split or dual))	US-PGPUB;	AND	ON	2019/08/05 09:50

			USPAT			
L15	162	("0964898" | "1082940" | "20010016542" | "20030064862" | "20040192514" | "20040214693" | "20050209059" | "20050209060" | "20050209061" | "20050233864" | "20060223680" | "20090176626" | "20090264260" | "20100062904" | "20100093500" | "2017128" | "2117957" | "2512904" | "3408067" | "3580340" | "3637206" | "3642279" | "3650529" | "3711090" | "3792860" | "3814420" | "3826491" | "4066257" | "4126326" | "4204673" | "4274625" | "4334676" | "4342452" | "4344616" | "4374587" | "4406451" | "4423864" | "4555108" | "4659074" | "4659077" | "4733858" | "4747612" | "4830362" | "4838543" | "4842268" | "5039088" | "5048821" | "5054770" | "5110117" | "5135447" | "5139255" | "5149084" | "5199934" | "5207621" | "5226866" | "5263910" | "5267923" | "5282776" | "5299993" | "5320588" | "5336142" | "5336146" | "5338273" | "5370592" | "5385520" | "5411279" | "5431612" | "5441467" | "5460586" | "5490818" | "5492517" | "5512025" | "5518470" | "5538489" | "5575740" | "5607376" | "5626539" | "5643144" | "5645512" | "5669856" | "5679101" | "5690582" | "5762587" | "5803871" | "5803874" | "5803880" | "5816372" | "5833584" | "5871421" | "5879271" | "5882281" | "5897459" | "5897460" | "5897461" | "5913384" | "5919115" | "5951449" | "5967944" | "5993358" | "6033344" | "6042519" | "6045490" | "6152859" | "6179754" | "6217487" | "6264042" | "6283896" | "6409633" | "6461279" | "6554749" | "6645124" | "6761667" | "6811517" | "6811519" | "6824502" | "6849034" | "6893383" | "6923746" | "7097593" | "7163493").PN. OR ("7166062" | "7179204" | "7306546" | "7377882" | "7517303" | "7553260" | "7621850" | "7645214" | "7704191" | "7811209" | "7819779" | "D521577").PN. OR ("8002674").URPN.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
L31	161	(("ARIZONA") near3 ("BOARD") near3 ("OF") near3 ("REGENTS") near3 ("ON") near3 ("BEHALF") near3 ("OF") near3 ("ARIZONA") near3 ("STATE") near3 ("UNIVERSITY")).AANM.	USPAT	AND	ON	2019/08/05 09:50
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L33	2	(("BARKAN") near3 ("Andrew")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
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		| "8262590").PN.	PGPUB; USPAT			09:50
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L36	8209	(A63B22/0292 or A63B22/02$ or A63B69/0064 or A63B22/0235 or A63B24/0087 or A63B21/00181 or A63B22/0221 or A61B5/6892 or A61B5/1036 or A63B2220/52 or A63B2024/0093 or A63B2220/18).cpc.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L37	10959	L35 or L36	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L38	210	L37 and counterweight	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L39	132	L38 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L40	7	L39 and (belt with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L41	0	L39 and (tread with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L42	83	L37 and counterweight and treadmill	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L43	60	L42 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L44	333	L37 and treadmill and (belt near2 (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L45	162	("0964898" | "1082940" | "20010016542" | "20030064862" | "20040192514" | "20040214693" | "20050209059" | "20050209060" | "20050209061" | "20050233864" | "20060223680" | "20090176626" | "20090264260" | "20100062904" | "20100093500" | "2017128" | "2117957" | "2512904" | "3408067" | "3580340" | "3637206" | "3642279" | "3650529" | "3711090" | "3792860" | "3814420" | "3826491" | "4066257" | "4126326" | "4204673" | "4274625" | "4334676" | "4342452" | "4344616" | "4374587" | "4406451" | "4423864" | "4555108" | "4659074" | "4659077" | "4733858" | "4747612" | "4830362" | "4838543" | "4842268" | "5039088" | "5048821" | "5054770" | "5110117" | "5135447" | "5139255" | "5149084" | "5199934" | "5207621" | "5226866" | "5263910" | "5267923" | "5282776" | "5299993" | "5320588" | "5336142" | "5336146" | "5338273" | "5370592" | "5385520" | "5411279" | "5431612" | "5441467" | "5460586" |	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50

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L47	6	(("DIAO") near3 ("Xiumin")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
L48	440	(("PURDUE") near3 ("RESEARCH") near3 ("FOUNDATION")).AANM.	USPAT	AND	ON	2019/08/05 09:50
L49	20551	L35 or L36 or L46	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L50	1	L49 and (harness same motion same force same sensor same acceler$6 same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L51	1	L49 and (harness same motion same force same sensor same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L52	7	L49 and (harness same force same sensor same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L53	208	L49 and harness and ((tension or force) same sensor) and cable and actuat$4	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L54	61	L49 and harness and ((tension or force) same sensor) and (cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L55	45	L54 and (motion same sens$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L56	36	L54 and (motion with sens$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L57	60	L49 and harness and ((tension or force) with sens$4) and (cable same actuat$4)	US-PGPUB;	AND	ON	2019/08/05 09:50

			USPAT			
L58	37	L57 and (motion with sens$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L59	33	L58 and acceler$	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L60	28	L59 and signal	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L61	10	L58 and (acceler$ with chang$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L77	287	((("MCBRIDE") near3 ("Keith")) OR (("GLUKHOVSKY") near3 ("Arkady")) OR (("SMITH") near3 ("Augustine"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/08/05 09:50
L78	20	((("BIONESS") near3 ("INC"))).AS,AANM.	USPAT	OR	ON	2019/08/05 09:50
L79	14	2006/0229167	US-PGPUB; USPAT	OR	ON	2019/08/05 10:11
L80	14	2006/0229167	US-PGPUB; USPAT	OR	ON	2019/08/05 10:11
L81	0	(2006/0229167).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/08/05 10:11
L82	2	"20060229167"	US-PGPUB; USPAT	OR	ON	2019/08/05 10:12
L83	16	(US-20170027803-$ or US-20060229167-$).did. or (US-5314390-$ or US-6880487-$ or US-5830162-$ or US-7381163-$ or US-7125388-$ or US-4423864-$ or US-7621850-$ or US-8002674-$ or US-8550962-$ or US-4204673-$ or US-4733858-$ or US-9713439-$ or US-7998040-$).did. or (US-3408067-$).did.	US-PGPUB; USPAT; USOCR	OR	ON	2019/08/05 10:12
L84	6	(US-0018249-$ | US-0143198-$ | US-0229167-$ | US-20040143198-$ | US-20060229167-$ | US-20120018249-$).DID.	US-PGPUB; USPAT	OR	ON	2019/08/05 10:13
L85	21	(US-20170027803-$ or US-20060229167-$ or US-20120018249-$ or US-20040143198-$).did. or (US-5314390-$ or US-6880487-$ or US-5830162-$ or US-7381163-$ or US-7125388-$ or US-4423864-$ or US-7621850-$ or US-8002674-$ or US-8550962-$ or US-4204673-$ or US-4733858-$ or US-9713439-$ or US-7998040-$ or US-0229167-$ or US-0143198-$ or US-0018249-$).did. or (US-3408067-$).did.	US-PGPUB; USPAT; USOCR	OR	ON	2019/08/05 10:13
L86	8	85 and (trip$4 or fall$4)	US-PGPUB;	OR	ON	2019/08/05 10:13

			USPAT			
L87	1	85 and (trip$4 or fall$4) with sensor	US-PGPUB; USPAT	OR	ON	2019/08/05 10:16
L88	434	("0131163" | "0407724" | "1050400" | "1192832" | "2117957" | "2227526" | "2399915" | "2765786" | "2969768" | "3047291" | "3118315" | "3195889" | "3222061" | "3323366" | "3364736" | "3408067" | "3465592" | "3485213" | "3529474" | "3602502" | "3709197" | "3711089" | "3750479" | "3778052" | "3784194" | "3814417" | "3826491" | "3892404" | "3894437" | "3941377" | "3961751" | "3970302" | "4023795" | "4074903" | "4087088" | "4122840" | "4249725" | "4383684" | "4416293" | "4496147" | "4550908" | "4681316" | "4691694" | "4709918" | "4733858" | "4813667" | "4878384" | "4900013" | "4907797" | "4911430" | "4928708" | "4958830" | "4973044" | "5050590" | "5080109" | "5088504" | "5186695" | "5192305" | "5273502" | "5311880" | "5388591" | "5623944").PN. OR ("143198" | "18249" | "2004/0143198" | "229167" | "3408067" | "4204673" | "4423864" | "4733858" | "5314390" | "5830162").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2019/08/05 10:19
L89	7	88 and (trip$4 or fall$4) with sensor	US-PGPUB; USPAT	OR	ON	2019/08/05 10:22
L90	19078	(A63B21/4001 or A63B69/0002 or A63B21/00181 or A63B24/0087 or A63B23/0464 or A63B21/068 or A63B69/0064 or A63B21/4007 or A63B2225/50 or A63B2225/20 or A63B2220/805 or A63B2220/54 or A63B2220/51 or A63B2220/40 or A63B2220/30 or A63B2220/10 or A63B2071/0018 or A63B2024/0093 or A63B23/0458 or A63B22/0235 or A63B71/0622 or A63B2022/0092 or A63B2208/0204 or A63B2022/0094).cpc.	US-PGPUB; USPAT	OR	ON	2019/08/05 10:24
L91	1934	(A63B$ or A61H$).cpc. and (trip$4 or fall) with (catch$4 or prevent$4)	US-PGPUB; USPAT	OR	ON	2019/08/05 10:25
L92	1	91 and (rope or cord or tether or strap) with (length) with (adjust$4) with sensor	US-PGPUB; USPAT	OR	ON	2019/08/05 10:27
L93	23	91 and ((rope or cord or tether or strap) with (adjust$4)) same sens$4	US-PGPUB; USPAT	OR	ON	2019/08/05 10:29
L94	11	93 and acceler$4	US-PGPUB; USPAT	OR	ON	2019/08/05 10:34
L95	22	93 and accelerat$4	US-PGPUB; USPAT	OR	ON	2019/08/05 10:34
S1	27	(("ARIZONA") near3 ("BOARD") near3	USPAT	AND	ON	2017/04/13

		("OF") near3 ("REGENTS") near3 ("ON") near3 ("BEHALF") near3 ("OF") near3 ("ARIZONA") near3 ("STATE") near3 ("UNIVERSITY")).AANM.				15:24
S2	4	(("ARTEMIADIS") near3 ("Panagiotis")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2017/04/13 15:24
S3	1	(("BARKAN") near3 ("Andrew")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2017/04/13 15:24
S4	4	("20060052728" | "5302162" | "8246354" | "8262590").PN.	US-PGPUB; USPAT	AND	ON	2017/04/13 15:25
S5	4265	(482/51-54).CCLS.	US-PGPUB; USPAT	OR	OFF	2017/04/13 15:27
S6	5888	(A63B22/0292 or A63B22/02$ or A63B69/0064 or A63B22/0235 or A63B24/0087 or A63B21/00181 or A63B22/0221 or A61B5/6892 or A61B5/1036 or A63B2220/52 or A63B2024/0093 or A63B2220/18).cpc.	US-PGPUB; USPAT	AND	ON	2017/04/13 15:28
S7	8655	S5 or S6	US-PGPUB; USPAT	AND	ON	2017/04/13 15:28
S8	161	S7 and counterweight	US-PGPUB; USPAT	AND	ON	2017/04/13 15:28
S9	102	S8 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2017/04/13 15:29
S10	5	S9 and (belt with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2017/04/13 15:29
S11	0	S9 and (tread with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2017/04/13 15:31
S12	55	S7 and counterweight and treadmill	US-PGPUB; USPAT	AND	ON	2017/04/13 15:31
S13	38	S12 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2017/04/13 15:31
S14	268	S7 and treadmill and (belt near2 (two or split or dual))	US-PGPUB; USPAT	AND	ON	2017/04/13 15:34
S15	152	("0964898" | "1082940" | "20010016542" | "20030064862" | "20040192514" | "20040214693" | "20050209059" | "20050209060" | "20050209061" | "20050233864" | "20060223680" | "20090176626" | "20090264260" | "20100062904" | "20100093500" | "2017128" | "2117957" | "2512904" | "3408067" | "3580340" | "3637206" | "3642279" | "3650529" | "3711090" | "3792860" | "3814420" | "3826491" |	US-PGPUB; USPAT; USOCR	AND	ON	2017/04/14 22:19

		"4066257" | "4126326" | "4204673" | "4274625" | "4334676" | "4342452" | "4344616" | "4374587" | "4406451" | "4423864" | "4555108" | "4659074" | "4659077" | "4733858" | "4747612" | "4830362" | "4838543" | "4842268" | "5039088" | "5048821" | "5054770" | "5110117" | "5135447" | "5139255" | "5149084" | "5199934" | "5207621" | "5226866" | "5263910" | "5267923" | "5282776" | "5299993" | "5320588" | "5336142" | "5336146" | "5338273" | "5370592" | "5385520" | "5411279" | "5431612" | "5441467" | "5460586" | "5490818" | "5492517" | "5512025" | "5518470" | "5538489" | "5575740" | "5607376" | "5626539" | "5643144" | "5645512" | "5669856" | "5679101" | "5690582" | "5762587" | "5803871" | "5803874" | "5803880" | "5816372" | "5833584" | "5871421" | "5879271" | "5882281" | "5897459" | "5897460" | "5897461" | "5913384" | "5919115" | "5951449" | "5967944" | "5993358" | "6033344" | "6042519" | "6045490" | "6152859" | "6179754" | "6217487" | "6264042" | "6283896" | "6409633" | "6461279" | "6554749" | "6645124" | "6761667" | "6811517" | "6811519" | "6824502" | "6849034" | "6893383" | "6923746" | "7097593" | "7163493").PN. OR ("7166062" | "7179204" | "7306546" | "7377882" | "7517303" | "7553260" | "7621850" | "7645214" | "7704191" | "7811209" | "7819779" | "D521577").PN. OR ("8002674").URPN.				
S31	64	(("ARIZONA") near3 ("BOARD") near3 ("OF") near3 ("REGENTS") near3 ("ON") near3 ("BEHALF") near3 ("OF") near3 ("ARIZONA") near3 ("STATE") near3 ("UNIVERSITY")).AANM.	USPAT	AND	ON	2018/04/02 09:03
S32	8	(("ARTEMIADIS") near3 ("Panagiotis")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2018/04/02 09:03
S33	2	(("BARKAN") near3 ("Andrew")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2018/04/02 09:03
S34	4	("20060052728" | "5302162" | "8246354" | "8262590").PN.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S35	4266	(482/51-54).CCLS.	US-PGPUB; USPAT	OR	OFF	2018/04/02 09:03
S36	6818	(A63B22/0292 or A63B22/02$ or A63B69/0064 or A63B22/0235 or A63B24/0087 or A63B21/00181 or A63B22/0221 or A61B5/6892 or A61B5/1036 or A63B2220/52 or A63B2024/0093 or A63B2220/18).cpc.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S37	9574	S35 or S36	US-	AND	ON	2018/04/02

			PGPUB; USPAT			09:03
S38	180	S37 and counterweight	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S39	113	S38 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S40	7	S39 and (belt with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S41	0	S39 and (tread with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S42	66	S37 and counterweight and treadmill	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S43	46	S42 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S44	289	S37 and treadmill and (belt near2 (two or split or dual))	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S45	154	("0964898" | "1082940" | "20010016542" | "20030064862" | "20040192514" | "20040214693" | "20050209059" | "20050209060" | "20050209061" | "20050233864" | "20060223680" | "20090176626" | "20090264260" | "20100062904" | "20100093500" | "2017128" | "2117957" | "2512904" | "3408067" | "3580340" | "3637206" | "3642279" | "3650529" | "3711090" | "3792860" | "3814420" | "3826491" | "4066257" | "4126326" | "4204673" | "4274625" | "4334676" | "4342452" | "4344616" | "4374587" | "4406451" | "4423864" | "4555108" | "4659074" | "4659077" | "4733858" | "4747612" | "4830362" | "4838543" | "4842268" | "5039088" | "5048821" | "5054770" | "5110117" | "5135447" | "5139255" | "5149084" | "5199934" | "5207621" | "5226866" | "5263910" | "5267923" | "5282776" | "5299993" | "5320588" | "5336142" | "5336146" | "5338273" | "5370592" | "5385520" | "5411279" | "5431612" | "5441467" | "5460586" | "5490818" | "5492517" | "5512025" | "5518470" | "5538489" | "5575740" | "5607376" | "5626539" | "5643144" | "5645512" | "5669856" | "5679101" | "5690582" | "5762587" | "5803871" | "5803874" | "5803880" | "5816372" | "5833584" | "5871421" | "5879271" | "5882281" | "5897459" | "5897460" | "5897461" | "5913384" | "5919115" | "5951449" | "5967944" | "5993358" | "6033344" | "6042519" | "6045490" | "6152859" | "6179754" | "6217487" | "6264042" | "6283896" | "6409633" |	US-PGPUB; USPAT; USOCR	AND	ON	2018/04/02 09:03

		"6461279" | "6554749" | "6645124" | "6761667" | "6811517" | "6811519" | "6824502" | "6849034" | "6893383" | "6923746" | "7097593" | "7163493").PN. OR ("7166062" | "7179204" | "7306546" | "7377882" | "7517303" | "7553260" | "7621850" | "7645214" | "7704191" | "7811209" | "7819779" | "D521577").PN. OR ("8002674").URPN.				
S46	12052	(A61H3/008 or A63B71/0622 or A63B21/4009 or A63B22/02 or A63B23/0405 or A63B21/154 or A63B24/0087 or A61H2201/1619 or A63B2220/51 or A63B2220/803 or A63B2220/40 or A61H2205/10).cpc.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:06
S47	4	(("DIAO") near3 ("Xiumin")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2018/04/02 09:07
S48	257	(("PURDUE") near3 ("RESEARCH") near3 ("FOUNDATION")).AANM.	USPAT	AND	ON	2018/04/02 09:07
S49	17607	S35 or S36 or S46	US-PGPUB; USPAT	AND	ON	2018/04/02 09:11
S50	0	S49 and (harness same motion same force same sensor same acceler$6 same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:23
S51	0	S49 and (harness same motion same force same sensor same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:23
S52	2	S49 and (harness same force same sensor same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:23
S53	151	S49 and harness and ((tension or force) same sensor) and cable and actuat$4	US-PGPUB; USPAT	AND	ON	2018/04/02 09:25
S54	45	S49 and harness and ((tension or force) same sensor) and (cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:25
S55	34	S54 and (motion same sens$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:25
S56	26	S54 and (motion with sens$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:25
S57	44	S49 and harness and ((tension or force) with sens$4) and (cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:26
S58	25	S57 and (motion with sens$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:26
S59	21	S58 and acceler$	US-PGPUB; USPAT	AND	ON	2018/04/02 09:26
S60	20	S59 and signal	US-PGPUB; USPAT	AND	ON	2018/04/02 09:28
S61	9	S58 and (acceler$ with chang$4)	US-	AND	ON	2018/04/02

			PGPUB; USPAT			09:58

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L16	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L17	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L18	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L19	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L20	0	(treadmill with belt with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L21	0	(treadmill with belt with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L22	0	(treadmill with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L23	0	(treadmill with (tension or stiffness) with track with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L24	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L25	4	(treadmill with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L26	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L27	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L28	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L29	2	(treadmill with belt with (split or two or dual) with (tension or stiffness) with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L30	4	(treadmill with belt with (split or two or dual) with (tension or stiffness)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L62	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever with counterweight with	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50

		(harness or body) with (column or post)).clm.				
L63	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L64	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L65	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L66	0	(treadmill with belt with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L67	0	(treadmill with belt with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L68	0	(treadmill with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L69	0	(treadmill with (tension or stiffness) with track with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L70	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L71	4	(treadmill with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L72	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L73	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L74	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L75	2	(treadmill with belt with (split or two or dual) with (tension or stiffness) with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
L76	4	(treadmill with belt with (split or two or dual) with (tension or stiffness)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S16	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S17	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S18	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04

S19	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S20	0	(treadmill with belt with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S21	0	(treadmill with belt with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S22	0	(treadmill with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S23	0	(treadmill with (tension or stiffness) with track with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S24	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S25	2	(treadmill with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:04
S26	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:05
S27	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:05
S28	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with lever).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:05
S29	1	(treadmill with belt with (split or two or dual) with (tension or stiffness) with lever).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:06
S30	2	(treadmill with belt with (split or two or dual) with (tension or stiffness)).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:06
S62	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S63	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S64	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S65	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S66	0	(treadmill with belt with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S67	0	(treadmill with belt with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03

S68	0	(treadmill with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S69	0	(treadmill with (tension or stiffness) with track with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S70	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S71	3	(treadmill with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S72	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S73	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S74	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with lever).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S75	2	(treadmill with belt with (split or two or dual) with (tension or stiffness) with lever).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S76	4	(treadmill with belt with (split or two or dual) with (tension or stiffness)).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03

8/ 5/ 2019 11:19:33 AM
C:\ Users\ gatkinson\ Documents\ EAST\ Workspaces\ 15896731.wsp

Bibliographic Data

Application No: 15/896,731

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /GARRETT K ATKINSON/ Examiner's Signature | Initials

Title: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
02/14/2018	482	3784	BION-051/12US 307799-2333
RULE			

APPLICANTS

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Augustine SMITH Santa Clarita, CA, UNITED STATES

CONTINUING DATA

This application has PRO of 62458648 02/14/2017

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

03/08/2018

STATE OR COUNTRY

UNITED STATES

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Application	Document	Mailroom Date	Attorney Docket No.
15896731	CTNF	08/08/2019	BION-051/12US 307799-2333
	892	08/08/2019	BION-051/12US 307799-2333
	OA.APPENDIX	08/08/2019	BION-051/12US 307799-2333

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Docket No.: BION-051/12US 307799-2333
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor:	Keith MCBRIDE	Confirmation No.:	4706
Application No.:	15/896,731	Group Art Unit:	3784
Filed:	February 14, 2018	Examiner:	Garrett K. ATKINSON

For: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

Via EFS or
MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT/RESPONSE TO OFFICE ACTION

In response to the non-final Office Action dated August 8, 2019, to which the deadline for responding extends to December 8, 2019 with the accompanying payment for a one-month extension of time, the Applicant submits the following Amendments and/or Remarks, and respectfully requests reconsideration of the application in view thereof.

Any extensions of time necessary to prevent abandonment of this application are hereby petitioned for under 37 C.F.R. §1.136(a), and any additional fees required (including fees for net addition of claims) are hereby authorized to be charged to our Deposit Account No. 50-1283.

Amendments to the Claims are reflected in the listing of the claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.

AMENDMENTS

In the Claims:

Set forth below in ascending order, with status identifiers, is a complete listing of all claims currently under examination. Changes to any amended claims are indicated by [[double brackets]],~~strikethrough~~ and /or underlining. This listing also reflects any cancellation and/or addition of claims. No new matter is added by these amendments.

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.

2. (Original) 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.

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3. (Original) 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. (Original) The method of claim 1, wherein the surface relative to which the user moves is a stationary surface.

5. (Canceled)

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

7. (Original) The method of claim 6, wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill.

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

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

9. (Original) The method of claim 8, wherein the first criterion is a rate of change in the length of the tether.

10. (Original) The method of claim 8, wherein the second criterion is a duration during which the length of the tether is changed.

11. (Original) The method of claim 10, wherein the second criterion is a minimum duration.

12. (Original) The method of claim 8, 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 bodily 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.

13. (Original) The method of claim 8, further comprising:

redefining the reference length of the tether in response to a change in the length of the tether that does not satisfy at least one of the first criterion or the second criterion.

14. (Original) A method of using a body weight support system to provide body weight support during gait training, the body weight support system including 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;

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defining a threshold length of the tether, the threshold length of the tether being associated with the user falling during the gait training;

defining a threshold number of falls during the gait training;

providing a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls;

increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met; and

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

15. (Original) The method of claim 14, wherein the surface relative to which the user moves is a stationary surface.

16. (Original) The method of claim 15, wherein the body weight support system includes a drive assembly configured to movably 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.

17. (Original) The method of claim 14, wherein the surface relative to which the user moves is a moving surface included in a treadmill.

18. (Original) The method of claim 17, wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill.

19. (Original) The method of claim 14, wherein providing the predetermined amount of body weight support during the gait training as the user moves relative to the surface is in response to a length of the tether exceeding the threshold length of the tether.

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20. (Original) The method of claim 14, wherein the reference length of the tether is a first reference length of the tether, the method further comprising:

defining a second reference length of the tether in response to the threshold number of falls being met, the second reference length of the tether being shorter than the first reference length of the tether.

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REMARKS

The above-noted amendments are supported by the application as originally filed and do not introduce any new matter. The amendments are made without prejudice to the prosecution of any canceled or amended subject matter in one or more continuing application(s). Upon entry of these amendments, claims 1-4 and 6-20 are pending in the present application. Claim 5 was canceled without prejudice to or disclaimer of the subject matter contained therein. Support for the claim amendments can be found throughout the application as originally filed. No new matter is added.

Allowable Subject Matter

The Applicant appreciates the Examiner's indication that claims 14-20 are allowable and that claim 5 would be allowable if rewritten in independent form.

Claim Rejections

Claims 8-13 stand rejected under 35 U.S.C. § 102 as allegedly being unpatentable over U.S. Patent Publication No. 2015/0320632 to Vallery et al. ("*Vallery*").

Claims 1-4, 6, and 7 stand rejected under 35 U.S.C. § 103 as allegedly being unpatentable over U.S. Patent Publication No. 2012/0018249 to Mehr ("*Mehr*") in view of European Patent No. 1296595 to Lifewaves ("*Lifewaves*"). The rejections are overcome for at least the reasons stated below.

Independent Claim 1 and its Dependent Claims are Patentable

Without acquiescing to the rejection, independent claim 1 has been amended to advance prosecution. Specifically, independent claim 1 has been amended to include the allowable subject matter of now-canceled dependent claim 5 and recites, in part, "the body weight support system includ[es] 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 drive assembly [is]

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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 [a] surface."

For at least the reason that independent claim 1 has been amended to include allowable subject matter, the Applicant submits that amended independent claim 1 is patentable over the cited art. Based at least in part on their dependence upon allowable independent claim 1, dependent claims 2-4, 6, and 7 are also allowable.

Independent Claim 8 and its Dependent Claims are Patentable

Without acquiescing to the rejection, independent claim 8 has been amended to advance prosecution. Specifically, independent claim 8 has been amended to recite, in part, "maintaining the body weight support system in a substantially overhead position relative to the user as the user moves relative to a surface."

Vallery fails to disclose or suggest maintaining a body weight support system in a substantially overhead position relative to a user, as recited in amended independent claim 8. Accordingly, the Applicant submits that amended independent claim 8 is allowable over the cited art. Based at least in part on their dependence upon allowable independent claim 8, dependent claims 9-13 are also allowable.

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Conclusion

In view of the foregoing, Applicant respectfully submits that no further impediments exist to the allowance of this application and, therefore, requests an indication of allowability. However, the Examiner is requested to call the undersigned if any questions or comments arise.

The Director is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 50-1283 **referencing Docket No.** BION-051/12US 307799-2333**.**

Dated: December 6, 2019

Respectfully submitted,
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213501294 v1

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Electronic Patent Application Fee Transmittal

Application Number:	15896731
Filing Date:	14-Feb-2018
Title of Invention:	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM
First Named Inventor/Applicant Name:	Keith MCBRIDE
Filer:	Michael D. Winternitz/Rebecca Phelan
Attorney Docket Number:	BION-051/12US 307799-2333

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	1251	1	200	200
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	240	240
		Total in USD ($)		**440**

Electronic Acknowledgement Receipt

EFS ID:	37953839
Application Number:	15896731
International Application Number:	
Confirmation Number:	4706
Title of Invention:	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM
First Named Inventor/Applicant Name:	Keith MCBRIDE
Customer Number:	58249
Filer:	Michael D. Winternitz/Rebecca Phelan
Filer Authorized By:	Michael D. Winternitz
Attorney Docket Number:	BION-051/12US 307799-2333
Receipt Date:	06-DEC-2019
Filing Date:	14-FEB-2018
Time Stamp:	14:40:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

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Payment Type	DA
Payment was successfully received in RAM	$440
RAM confirmation Number	E2019B6E40527189
Deposit Account	501283
Authorized User	Rebecca Phelan

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Foreign Reference	CH669780_with_English_Translation.PDF	274218 6644d1c5f6cf3f6130b82cf0be8ac75274db0c24	no	7
Warnings:					
Information:					
2	Foreign Reference	CN104308861B_with_English_Translation.pdf	2605495 315e7429c12e8768549c6f2d331f2a00995df694	no	23
Warnings:					
Information:					
3	Foreign Reference	DE102008015879A1_with_English_Abstract.pdf	3818962 213dbab879ef35d4c923fbccb5c4cd1322d5cdb2	no	29
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4	Foreign Reference	EP0088061A2.PDF	475294 a189bcf6cea1f96c52403798d1462487b9afa263	no	14
Warnings:					
Information:					
5	Foreign Reference	EP2402279A1.pdf	714431 a539d427128395bbc6a0bbcc7636fa41bbcc9fa7	no	24
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10	Foreign Reference	WO2009104096A2.pdf	784254 bc0773731f08081adfe4af368ca4c8f90dcf7746	no	26
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13	Non Patent Literature	US-Office_Action_US13745830_June_15_2015.pdf	313123 d30de0184a3a60aceb5309781de8cc9442bcceff	no	9
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14	Non Patent Literature	US-Office_Action_US13745830_Dec_17_2015.pdf	323893 1dabdd1e81852f1c1661e8c96902cfeb1701749f	no	9
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15	Non Patent Literature	US-Office_Action_US13745830_June_2_2016.pdf	386248 bbb30202b664c8687f484858322f62c535d63a40	no	11
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16	Non Patent Literature	US-Office_Action_US14226021_Sep_14_2016.pdf	463121 8d66891f20dc9d356ff284e47de9616b795efca5	no	13
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17	Non Patent Literature	US-Office_Action_US14226021_Feb_22_2017.pdf	397705 026272615c508387e213ce57ed7ac54da033b752	no	11
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18	Non Patent Literature	US-Office_Action_US14613140_Aug_28_2017.pdf	889645 52d6974ff75bd4ac6fc45b5bf4257d2f3ffbd987	no	25
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19	Non Patent Literature	US-Office_Action_US14613140_March_26_2018.pdf	1043883 919ebb767718a82c07843dfcc9fac7215479a0e6	no	28
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20	Non Patent Literature	US-Office_Action_US14613140_Oct_30_2018.pdf	930256 e4847424a1ea98e5443d354c95cc7affbbd8f766	no	28
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21	Non Patent Literature	US-Office_Action_US15783755_2018-05-07_BION051-10US.pdf	566719 82649f884f47d08f3087baacc4c258fcb12701ef	no	14
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22	Non Patent Literature	US-Office_Action_US15349390_2019-01-17.pdf	722112 d606cd33599bcb00ee41112355e54287390cb620	no	15
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23	Non Patent Literature	EP-Extended_ESR_EP14740676_2016-08-18.pdf	225103 e2f92a5ec4fc3566281cb7fb291d8cea058cffb1	no	6
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24	Non Patent Literature	EPExamReport_14740676_2019-06-14.pdf	165397 8b2bf37e3667108f2625678c49237c6fe0b290b4	no	5
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25	Non Patent Literature	EP-EESR_EP16747097_July_27_2018.pdf	6671925 1ad247c8e19f94cbaec5029db69d978fe35400fd	no	8
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26	Non Patent Literature	EPSearchReport_16865093_2019-04-02.PDF	161098 bbfde44cc71e27d6f4602e26d66d25041d2f0a26	no	6
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27	Non Patent Literature	JP_Office_Action_JP2015-553851_English_Translation_July_4_2016.PDF	126962 4aba8bcb400fe3d2c97dcf33cabfc123f763d726	no	9
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28	Non Patent Literature	JP-Office_Action_JP2017052240_Jan_15_2018.pdf	143465 a6636ccb56acb1924be0a522bd8d0d4eb9d1dc17	no	9
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30	Non Patent Literature	JP-Office_Action_JP2017-534701_Oct_16_2019_with_English_Translation.pdf	276534 e288cf3bf95f6ba1f83db07fb66af2b0600359b0	no	16
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31	Non Patent Literature	ISR_WO_PCTUS2014012064_2014-05-09.pdf	293153 8b760c91d09eb4083ca971bd48281b84f68c0a9b	no	6
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33	Non Patent Literature	ISR_WO_PCTUS2016061552_2017-01-31.pdf	7535058 3626fd7edf8325609f336c8172f542552cd352b4	no	10
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36	Non Patent Literature	VALLERY_Multidirectional.pdf	1024899 a018389848ee2df75f770f30ffba4e857cd469dd	no	7
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37	Non Patent Literature	VAHLE_Enclosed_Conductor_System_KBH_2014.pdf	6396401 309a3a7534a467294b28ecad2c85bf44eff95cd1	no	28
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38		BION-051-12US-IDS.pdf	320604 85a3f2d045e8c778fba9dad3927f296be9e74591	yes	9

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	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	6
	Applicant Arguments/Remarks Made in an Amendment	7	9

Warnings:

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Notice

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DESCRIPTION CH669780

DESCRIPTION

<RTI> Previously Eirrichtungen </ RTI> were installed almost exclusively in hospitals and nursing homes for the transport of sick and disabled. The under discussion means consist of a conveyor rail on which a motorized trolley runs with hoist and a corresponding power supply line. The power supply is either via a second, separate parallel track or on a mounted on casters cable, these rollers also run on a separate or the same rail.

While the first option with a corresponding pantograph in manufacturing complex and the assembly is costly, the second option is less costly in the assembly, but aesthetically totally unsatisfactory. Further, in loops dangling cords in many cases is a hindrance, so that the user, the device hardly can use without the help of the nursing staff. It is therefore an object of the present invention to provide a transport rail with power line for a device for transporting the sick and disabled, which is inexpensive to manufacture and easy to assemble.

This object is achieved by a transport rail according to the preamble of claim 1 with the characterizing features of claim 1.

The drawing shows an embodiment of the subject invention is illustrated and explained in detail in

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the following description.

It shows: Fig. 1 shows a section transverse to the running direction by the conveying rail with power line, and Figure 2 shows a power supply base for the inventive transport rail. Fig. 3 shows a partial section through the power line in the transport rail.

In the inventive rail transport a commercial box section 1 was used. It consists of a base 2 and two parallel, perpendicular to the base surface 2 extending side walls 3rd The fourth wall of the box section 1 is the same size of two, formed the center downwardly facing part of walls 4, which can be a slit-shaped, extending in the longitudinal direction of the profile opening 5 free. The Grundfläche2 may be provided with from the inside outward tapered through holes 6 for mounting on a ceiling D at regular intervals already.

At the two side walls 3, a respective electrically conductive tape 7, for example made of copper or a silver alloy is mounted. This is done with a double-sided adhesive tape 8, which is made of insulating carrier material. The width of the electrically conductive tape 7 is less than the width of the insulating tape eighth This measure increases the operational reliability of the transport rail and is particularly useful when a relatively thin layered adhesive tape is used. Normally, however, use a tape with relatively voluminous carrier material. Since the electrically conductive band 7 of cost and processing reasons thin layer <RTI> must be, however, </ RTI> there is a risk that dieStromabnehmer of rolling in the rail trolley be smeared by the side even above, coated adhesive tape with adhesive.

[3]

This danger can be prevented, by providing the tape on the side of the conductive tape with an adhesive strip which is of equal width or narrower than the copper tape 7, so that the adhesive surface is completely covered by the electrically conductive band. A second solution can consist in that one, with an insulating material 9 covers the lateral strips of the adhesive tape strip 8 which project beyond the copper strip 7 (Fig. 3), The tapes not commercially available with pre-applied copper tape to the applicant specifically manufactured and supplied in rolls. Thus, the conductor track 7 with <RTI> derrückseitigen </ RTI> adhesive layer does not come into contact, the back is covered with a tear-off foil. The entire device <RTI> nichtTeildieserErfin - </ RTI> is training is, briefly described here to illustrate the inventive conveyor rail. In hollow section 1 a trolley with two successive pairs of rollers 10 runs.

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The rollers run on the inclined partition walls 4 that achieves a situation stabilizing, centering effect. The rollers 10 are not driven. On the trolley a senkrechtnach down and through the slit-like opening 5 projecting carrier 11 is mounted. On this support 11 the actual device 12, which is merely indicated by dashed lines depends. In this apparatus 12, the drive motors for the travel movement and the upward and downward movement of the lifting train and its control are housed. The drive for the traveling movement is carried out via a friction roller, which presses from the outside onto the rail first

The supply of the unit 12 takes place via the electrically conductive strips 7th For this purpose, on the trolley two outwardly curved spring pressing plate 13, which act as current collectors, is provided. For safety low voltage working with direct current at 36 volts. This made bright also, instead of working with two bonded copper strips 8 with only one, while the track itself is the neutral.

To feed is advantageously a particular, end face attachable to the rail base 20 as shown in Fig. 2, is used. The base 20 is preferably made of an insulating hard plastic. The base 20 has a plug-in the rail 1, the smaller part 21 and a, forming the stop on the rail larger portion 22nd In smaller base part 21, a blind hole 23 is provided with an internal thread, into which a hex bolt 24 plugged. By means of this screw 24, a clamping plate 25 is pressed against the rail, which is used for fixing of the pedestal 20 in the rail first

About an insertable into the socket connector 25 is guided the energy in the socket. The pedestal 20 is penetrated by Bohrungen27 which are drawn into the cable. The cables are each connected to a curved Federplättchen28, by means of screws and cable lugs 29th The spring plate 28 press the corresponding conductor tracks. 7

In addition to the simple and inexpensive construction of the transport rail is immediately evident that also bends the rail for curves can be done easily. An adaptation of the electrical conductor is no longer required. This simplifies and reduces the overall installation.

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CH 669 780 A5

(19) SCHWEIZERISCHE EIDGENOSSENSCHAFT
BUNDESAMT FÜR GEISTIGES EIGENTUM

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H 02 G 11/00
B 66 C 7/02

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Schweizerisch-liechtensteinischer Patentschutzvertrag vom 22. Dezember 1978

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(73) Inhaber:
Benno Nussbaumer, Basel

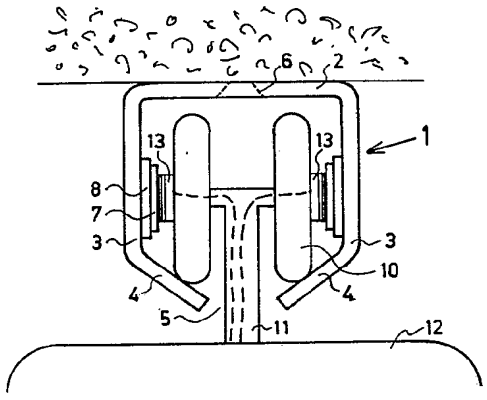
(72) Erfinder:
Nussbaumer, Benno, Basel

(74) Vertreter:
Patentanwaltsbüro Feldmann AG,
Opfikon-Glattbrugg

(54) Transportschiene mit Stromleitung insbesondere für den Kranken- beziehungsweise Behindertentransport.

(57) Die Schiene (1) ist aus einem Hohlprofil mit einer Grundfläche (2) und zwei parallelen, senkrecht zur Grundfläche verlaufenden Seitenwänden (3) gefertigt. Die vierte Wand ist aus zwei gleichgrossen, zur Mitte nach unten weisenden Teilwänden (4) gebildet, die eine spaltförmige, in Längsrichtung des Profils verlaufende Öffnung (5) freilassen. An den beiden Seitenwänden (3) ist je ein elektrisch leitendes Band (7), mittels beidseitig wirkendem Klebeband (8) in der Schiene (1) appliziert.

Die Schiene wird vorwiegend für die Führung und Speisung vom Transportgeräten (12), die am Träger (11) hängen und mittels einer Laufkatze mit Rollen (10) in der Schiene (1) fahren, verwendet. Die Energiezuleitung erfolgt über den Stromabnehmer (13) der Laufkatze.



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PATENTANSPRÜCHE

1. Transportierschiene mit Stromleitung, in der eine elektrische Laufkatze rollt, bestehend aus einem metallischen Kasten-Hohlprofil mit in Längsrichtung verlaufender, zentrischer, in der Montagelage nach unten weisender Öffnung, insbesondere für den Kranken-Behindertentransport, dadurch gekennzeichnet, dass an mindestens einer der beiden senkrechten Seitenwände (3), ein elektrisch leitendes Band (7) mittels eines doppelseitigen, isolierenden Klebebandes (8) angebracht ist, wobei das Klebeband (8) breiter als das elektrisch leitende Band (7) ist, welches auf dem Klebeband mittig angeordnet ist.

2. Transportschiene nach Anspruch 1, dadurch gekennzeichnet, dass nur ein elektrisch leitendes Band (7) appliziert ist und die gegenüberliegende Wand (3) der Schiene (1) als Erdungsleitung dient.

3. Transportschiene nach Anspruch 1, dadurch gekennzeichnet, dass beide gegenüberliegenden Seitenwände (3) je mit einem elektrisch leitenden Band (7) appliziert sind.

4. Transportschiene nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, dass am Ende der Schiene (1) ein Stromzuführungssockel (20) mit zu den Aussenseiten gewölbten, stromführenden Federplättchen (28) eingeschoben ist.

5. Transportschiene nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, dass die seitlich des elektrisch leitenden Bandes (7) hervorschauenden Klebebandstreifen mit isolierenden Materialstreifen (9) abgedeckt sind.

6. Transportschiene nach einem der Ansprüche 1 bis 3 oder 5, dadurch gekennzeichnet, dass das elektrisch leitende Band (7) aus Kupfer ist.

7. Transportschiene nach einem der Ansprüche 1 bis 3 oder 6, dadurch gekennzeichnet, dass das doppelseitige Klebeband (8) auf der dem elektrisch leitenden Band (7) zugekehrten Seite maximal so breit mit Klebstoff versehen ist, wie das elektrisch leitende Band (7) breit ist.

BESCHREIBUNG

Bisher waren Einrichtungen zum Transport von Kranken und Behinderten fast ausschliesslich in Spitälern und Pflegeheimen installiert. Die zur Diskussion stehenden Einrichtungen bestehen aus einer Transportschiene, auf der eine elektromotorische Laufkatze mit Hebezug läuft und einer entsprechenden Stromzuleitung. Die Stromzuleitung erfolgt entweder über eine zweite, separate parallele Schiene oder über ein auf Rollen gelagertes Kabel, wobei diese Rollen ebenfalls auf einer separaten oder derselben Schiene laufen.

Während die erste Variante mit entsprechendem Stromabnehmer in der Herstellung aufwendig und der Montage kostspielig ist, ist die zweite Variante in der Montage etwas weniger kostspielig, jedoch ästhetisch völlig unbefriedigend. Ferner ist das in Schlaufen herab hängende Kabel in vielen Fällen hinderlich, so dass der Benützer die Einrichtung auch kaum ohne Hilfe des Pflegepersonals verwenden kann. Es ist daher die Aufgabe der vorliegenden Erfindung, eine Transportschiene mit Stromleitung für eine Einrichtung zum Transport von Kranken und Behinderten zu schaffen, welche preiswert in der Herstellung und einfach in der Montage ist.

Diese Aufgabe löst eine Transportschiene gemäss Oberbegriff des Patentanspruches 1 mit den kennzeichnenden Merkmalen des Anspruches 1.

In der Zeichnung ist ein Ausführungsbeispiel des Erfindungsgegenstandes dargestellt und anhand der nachfolgenden Beschreibung detailliert erläutert.

Es zeigt:

Fig. 1 einen Schnitt quer zur Laufrichtung durch die Transportschiene mit Stromleitung, und

Fig. 2 einen Stromeinspeisungssockel für die erfindungsgemässe Transportschiene;

Fig. 3 zeigt einen Teilschnitt durch die Stromleitung in der Transportschiene.

Bei der erfindungsgemässen Transportschiene wurde ein handelsübliches Kastenprofil 1 verwendet. Es besteht aus einer Grundfläche 2 und zwei parallelen, senkrecht zur Grundfläche 2 verlaufenden Seitenwänden 3. Die vierte Wand des Kastenprofils 1 ist aus zwei gleichgrossen, zur Mitte nach unten weisenden Teilwänden 4 gebildet, die eine spaltförmige, in Längsrichtung des Profils verlaufende Öffnung 5 frei lassen. Die Grundfläche 2 kann in regelmässigen Abständen bereits mit von innen nach aussen konisch zulaufenden Durchgangslöchern 6 zur Befestigung an einer Decke D versehen sein.

An den beiden Seitenwänden 3 ist je ein elektrisch leitendes Band 7, beispielsweise aus Kupfer oder einer Silberlegierung, angebracht. Dies geschieht mit einem doppelseitigen Klebeband 8, welches aus isolierendem Trägermaterial gefertigt ist. Die Breite des elektrisch leitenden Bandes 7 ist geringer als die Breite des isolierenden Klebebandes 8. Diese Massnahme erhöht die Betriebssicherheit der Transportschiene und ist besonders sinnvoll, wenn ein relativ dünnschichtiges Klebeband verwendet wird. Normalerweise wird man jedoch ein Klebeband mit relativ voluminösem Trägermaterial verwenden. Da das elektrisch leitende Band 7 aus Kosten- und Verarbeitungsgründen dünnschichtig sein muss, besteht jedoch die Gefahr, dass die Stromabnehmer der in der Schiene rollenden Laufkatze durch den seitlich noch vorstehenden, beschichteten Klebstreifen mit Klebstoff verschmiert werden.

Dieser Gefahr kann man vorbeugen, indem man das Klebeband auf der Seite des leitenden Bandes mit einem Klebstoffstreifen versieht, der gleich breit oder schmäler als das Kupferband 7 ist, so dass die Klebefläche vom elektrisch leitenden Band vollständig abgedeckt ist. Eine zweite Lösung kann darin bestehen, dass man die seitlichen Streifen des Klebebandes 8, die über das Kupferband 7 hinausragen, mit einem isolierenden Materialstreifen 9 abdeckt (Fig. 3). Die im Handel nicht erhältlichen Klebebänder mit bereits appliziertem Kupferband werden für die Anmelderin speziell gefertigt und in Rollen angeliefert. Damit die Leiterbahn 7 mit der rückseitigen Klebeschicht nicht in Berührung kommt, ist die Rückseite mit einer abreissbaren Folie abgedeckt. Die gesamte Einrichtung, die nicht Teil dieser Erfindung ist, sei hier zur Erläuterung der erfindungsgemässen Transportschiene noch kurz beschrieben. Im Hohlprofil 1 läuft eine Laufkatze mit zwei hintereinanderliegenden Rollenpaaren 10. Die Rollen laufen auf den schrägen Teilwänden 4, das eine lagestabilisierende, zentrierende Wirkung erzielt. Die Rollen 10 sind nicht angetrieben. An der Laufkatze ist ein senkrecht nach unten und durch die schlitzförmige Öffnung 5 ragender Träger 11 angebracht. An diesem Träger 11 hängt das eigentliche Gerät 12, welches lediglich strichliniert angedeutet ist. In diesem Gerät 12 sind die Antriebsmotoren für die Fahrbewegung und für die Auf- und Abbewegung des Hebezuges sowie deren Steuerung untergebracht. Der Antrieb für die Fahrbewegung erfolgt über eine Reibrolle, welche von aussen auf die Schiene 1 drückt.

Die Speisung des Gerätes 12 erfolgt über die elektrisch leitenden Bänder 7. Hierzu sind an der Laufkatze zwei gewölbt nach aussen drückende Federplättchen 13, die als Stromabnehmer wirken, vorgesehen. Aus Sicherheitsgründen wird bei 36 Volt Niederspannung mit Gleichstrom gearbeitet. Dies ermöglicht es auch, statt mit zwei aufgeklebten Kupferbändern 8 mit nur einem zu arbeiten, während die Schiene selber den Nulleiter darstellt.

Zur Einspeisung wird vorteilhafterweise ein besonderer, stirnseitig auf die Schiene aufsteckbarer Sockel 20, wie in Fig. 2

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dargestellt, verwendet. Der Sockel 20 wird vorzugsweise aus einem isolierenden Hartkunststoff hergestellt. Der Sockel 20 hat einen in die Schiene 1 einsteckbaren, kleineren Teil 21 und einen, den Anschlag an die Schiene bildenden grösseren Teil 22. Im kleineren Sockelteil 21 ist ein Sackloch 23 mit Innengewinde vorgesehen, in dem eine Sechskantschraube 24 steckt. Mittels dieser Schraube 24 wird eine Klemmplatte 25 an die Schiene gepresst, die zur Fixierung des Sockels 20 in der Schiene 1 dient. Über einen in den Sockel einführbaren Stecker 25 wird die Energie in den Sockel geführt. Der Sockel 20 wird von Bohrungen 27 durchsetzt, welche in die Kabel eingezogen sind. Die Kabel sind je mit einem gewölbten Federplättchen 28, mittels Schrauben und Kabelschuhen 29 verbunden. Die Federplättchen 28 drücken auf die entsprechenden Leiterbahnen 7.

Neben dem einfachen und preiswerten Aufbau der Transportschiene ist sofort ersichtlich, dass auch Biegungen der Schiene für Kurven problemlos erfolgen können. Eine Anpassung der elektrischen Leiter ist nicht mehr erforderlich. Dies vereinfacht und verbilligt die gesamte Montage.

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FIG. 1

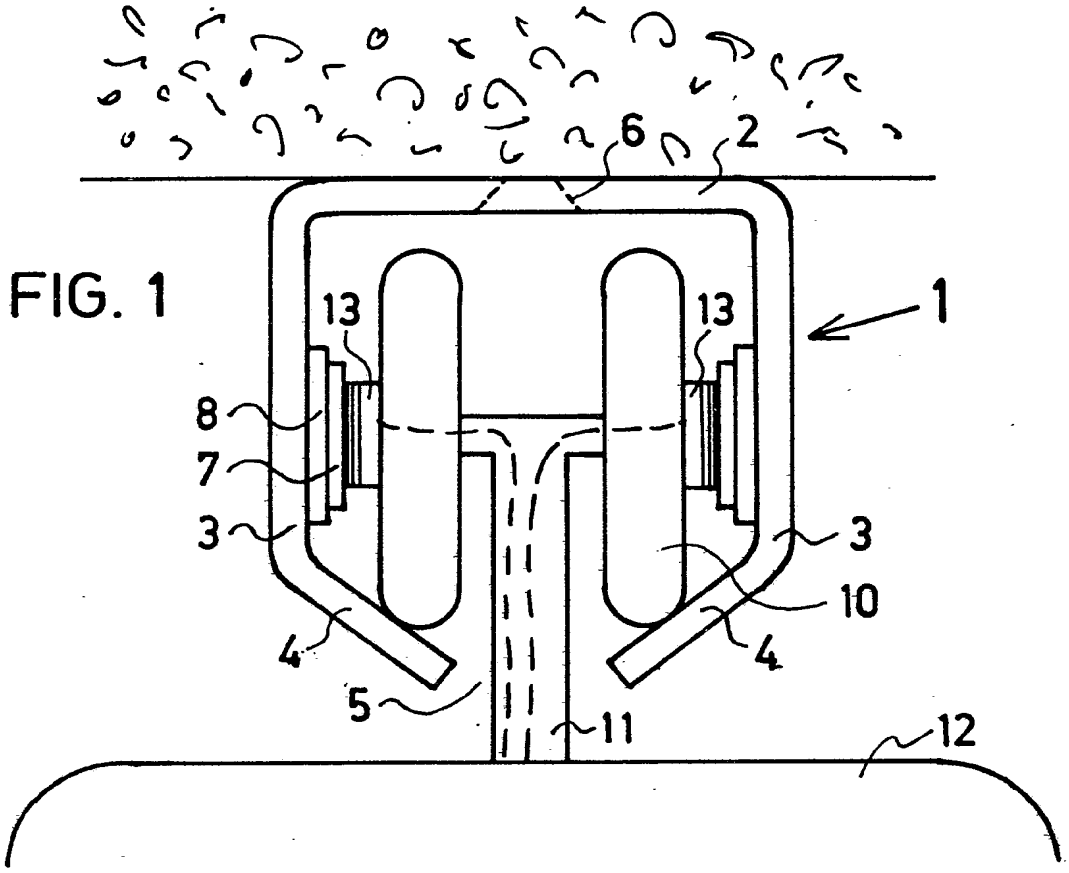


FIG. 2

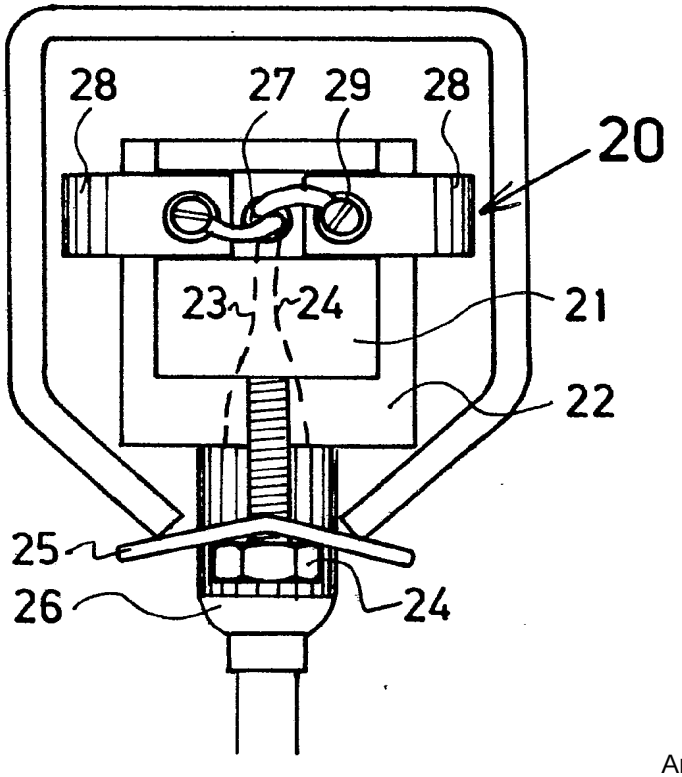
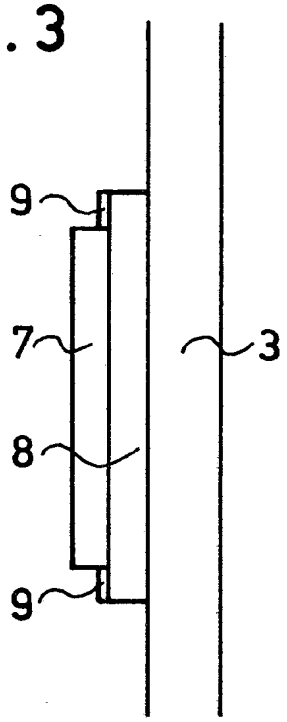


FIG. 3



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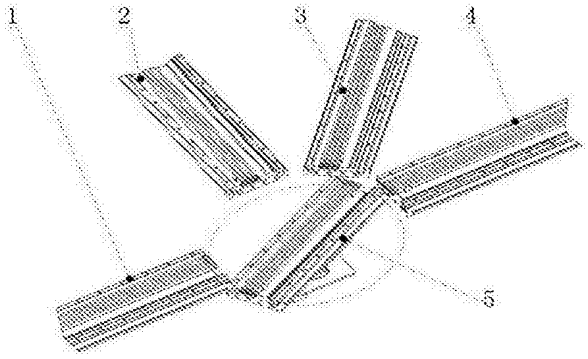
权利要求书2页 说明书5页 附图3页

(54)发明名称

一种轨道式机器人行走路径变换装置及其实现方法

(57)摘要

本发明公开了一种轨道式机器人行走路径变换装置及其实现方法,包括:方向转换平台以及若干条方向不同的路径轨道;所述方向转换平台能够与任意路径轨道对接;方向转换平台包括平台基体、平台伸缩机构、平台旋转机构和平台安装板;所述平台基体与平台伸缩机构连接,平台伸缩机构与平台旋转机构连接,所述平台旋转机构固定在平台安装板上。本发明有益效果:机器人行走路径变换装置实现了多通道并存、多方向选择,一套机器人主体就可完成多个方向场合的工作,提高了工作覆盖率。路径方向变化适应性强,可适应各种角度要求,克服了弯轨转弯角度单一、路径单一的缺点,达到了路径设计随意性。



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1.一种轨道式机器人行走路径变换装置，其特征是，包括：方向转换平台以及若干条方向不同的路径轨道；所述方向转换平台能够与任意路径轨道对接；

所述方向转换平台包括平台基体、平台伸缩机构、平台旋转机构和平台安装板；所述平台基体与平台伸缩机构连接，平台伸缩机构与平台旋转机构连接，所述平台旋转机构固定在平台安装板上；

每一条所述路径轨道包括轨道基体，在所述轨道基体上分别连接有滑触线、导轨、轨道定位板和齿条；所述导轨平行布置在轨道基体的两侧，所述滑触线沿与导轨平行的方向固定在轨道基体上，所述齿条固定在其中一侧导轨上。

2.如权利要求1所述的一种轨道式机器人行走路径变换装置，其特征是，所述平台基体包括：平台底板、定位凸板、平台齿条、平台滑触线和平台导轨；

所述平台底板的两端分别设有定位凸板，定位凸板上设有凸台，所述定位凸板与平台底板通过紧固件连接，在所述平台底板的两侧分别平行布置平台导轨，所述平台滑触线通过滑触线支撑架沿与平台导轨平行方向固定在平台底板上，平台滑触线两端分别设有滑触线对接头，用于与路径轨道中的滑触线进行对接；所述平台齿条，沿与平台导轨平行方向设置在其中一侧导轨的内侧。

3.如权利要求1所述的一种轨道式机器人行走路径变换装置，其特征是，所述平台旋转机构包括电机、减速器以及驱动机构；

所述电机与减速器连接后固定在平台安装板上，所述电机与驱动机构连接；所述驱动机构用于驱动方向转换平台的转动。

4.如权利要求3所述的一种轨道式机器人行走路径变换装置，其特征是，所述驱动机构包括：大齿轮、转筒和小齿轮；所述电机与小齿轮连接，小齿轮与大齿轮进行外啮合，所述转筒固定在平台安装板上，所述转筒的外圆设有安装槽，大齿轮固定在所述安装槽内。

5.如权利要求4所述的一种轨道式机器人行走路径变换装置，其特征是，所述平台伸缩机构包括：伸缩驱动机构、导向杆、伸缩杆和导向联接座；

所述伸缩驱动机构设在转筒内部，所述伸缩杆与导向杆一端与平台安装板上的滑动套配合，另一端与导向联接座连接，所述导向联接座与平台基体底部联接。

6.如权利要求2所述的一种轨道式机器人行走路径变换装置，其特征是，每一条所述路径轨道的轨道基体两侧分别平行布置导轨，所述导轨与轨道基体通过紧固件联接；所述滑触线通过滑触线支撑架沿与导轨平行的方向装配在轨道基体上，所述滑触线对接头，一端设为直线形状，与滑触线采用平滑无缝对接，另一端设为圆弧喇叭口形状，与方向转换平台的平台滑触线采用有缝对接。

7.如权利要求1所述的一种轨道式机器人行走路径变换装置，其特征是，所述轨道定位板设置在轨道基体的与方向转换平台接触的一端，所述轨道定位板上设有凹槽，所述凹槽与平台基体上的定位凸板配合，用于实现方向转换平台与路径轨道的对接。

8.如权利要求7所述的一种轨道式机器人行走路径变换装置，其特征是，所述凹槽包括弧形引导部分和直线定位部分，弧形引导部分设于凹槽外端部、直线定位部分设于凹槽底部，两部分相切；所述弧形引导部分用于弥补加工及装配尺寸误差，定位凸板沿弧形引导部分滑动到位后，与直线定位部分形成配合，完成定位。

9.一种如权利要求1所述的轨道式机器人行走路径变换装置的实现方法，其特征是，包

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括：

机器人在方向转换平台上需要进行路径转换时，平台伸缩机构带动平台基体下降，平台基体上的定位凸板与轨道定位板脱离接合，下降动作停止；

平台旋转机构开始动作，电机及减速器输出扭矩，带动小齿轮旋转，小齿轮驱使大齿轮带动转筒转动，进而带动方向转换平台转动，到达预定方向后，转动运动停止；

平台伸缩机构带动平台基体上升，平台基体上的定位凸板与相应方向上的轨道定位板接合到位，上升动作停止。

10.如权利要求9所述的一种轨道式机器人行走路径变换装置的实现方法，其特征是，所述方向转换平台与相应方向的路径轨道对接完成后，方向转换平台上的两组平台导轨与路径轨道上的两组导轨无缝结合，方向转换平台上的平台滑触线与路径轨道上的滑触线通过滑触线对接头有缝接合。

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一种轨道式机器人行走路径变换装置及其实现方法

技术领域

[0001] 本发明属于特种机器人领域，特别涉及一种机器人轨道应用，通过变换轨道的方向，以更改机器人行走路径的装置。

背景技术

[0002] 在设备巡回检测、物料转运应用中，轨道式机器人以其续航能力强、维护方便的优势得以逐渐应用。为加大机器人运行地理范围，提高对对设备检测、物料投运地点的覆盖率，需要将机器人轨道延伸至多处角落，这涉及到轨道路径的拐弯、分叉，有的路径拐弯角度太大、分叉太多，普通弯轨设计已经无法解决，这对轨道式机器人的行走带来了很多的技术难题。因此研究一种可变换机器人行走路径的装置，能极大推动轨道机器人在设备巡回检测、物料转运应用的发展。

[0003] 经对现有技术的文献检索发现，申请号为201310040511.1名称为“带拐弯装置的轨道机器人”的专利以及申请号为201110091368.X名称为“一种轨道式自主移动机器人”的专利，均提出了一种轨道式机器人的应用，但是其对机器人运行轨道的研究，只局限于单条轨道的运行，对与轨道的拐弯、分叉未能进行具体、深入的研究和探索，更未能提供一种实施方案用于应对行走路径多方向、多分叉的问题，无法拓展轨道机器人的应用。

[0004] 由此可见，现在应用技术中仍没有一种装置来满足轨道路径多方向、多分叉的需要，轨道机器人的应用仍存在较大的技术缺陷，此种现状已经严重制约着轨道机器人的实际应用和推广。

发明内容

[0005] 本发明的目的在于解决上述问题，提供一种可更改轨道机器人行走路径的装置。该装置能够在轨道机器人行走路径出现岔口时，轨道路径由一条变换为三条或多条，当机器人行至并刹车停留在方向转换平台上时，方向转换平台进行下降、旋转、上升的动作，完成行走路径的改变。

[0006] 为了实现上述目的，本发明采用如下技术方案：

[0007] 一种轨道式机器人行走路径变换装置，包括：方向转换平台以及若干条方向不同的路径轨道；所述方向转换平台能够与任意路径轨道对接；

[0008] 所述方向转换平台包括平台基体、平台伸缩机构、平台旋转机构和平台安装板；所述平台基体与平台伸缩机构连接，平台伸缩机构与平台旋转机构连接，所述平台旋转机构固定在平台安装板上；

[0009] 所述每一条路径轨道包括轨道基体，在所述轨道基体上分别连接有滑触线、导轨、轨道定位板和齿条；所述导轨平行布置在轨道基体的两侧，所述滑触线沿与导轨平行的方向固定在轨道基体上，所述齿条固定在其中一侧导轨上。

[0010] 所述平台基体包括：平台底板、定位凸板、平台齿条、平台滑触线和平台导轨；

[0011] 所述平台底板的两端分别设有定位凸板，定位凸板上设有凸台，所述定位凸板与

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平台底板通过紧固件连接，在所述平台底板的两侧分别平行布置平台导轨，所述平台滑触线通过滑触线支撑架沿与平台导轨平行方向固定在平台底板上，滑触线两端分别设有滑触线对接头，用于与路径轨道中的滑触线进行对接；所述平台齿条，沿与平台导轨平行方向设置在其中一侧导轨的内侧。

[0012] 所述平台旋转机构包括电机、减速器以及驱动机构；

[0013] 所述电机与减速器连接后固定在平台安装板上，所述电机与驱动机构连接；所述驱动机构用于驱动方向转换平台的转动。

[0014] 所述驱动机构包括：大齿轮、转筒和小齿轮；所述电机与小齿轮连接，小齿轮与大齿轮进行外啮合，所述转筒固定在平台安装板上，所述转筒的外圆设有安装槽，大齿轮固定在所述安装槽内。

[0015] 所述平台伸缩机构包括：伸缩驱动机构、导向杆、伸缩杆和导向联接座；

[0016] 所述伸缩驱动机构设在转筒内部，所述伸缩杆与导向杆一端与平台安装板上的滑动套配合，另一端与导向联接座连接，所述导向联接座与平台底板连接。

[0017] 所述每一条路径轨道的轨道基体两侧分别平行布置导轨，所述导轨与轨道基体通过紧固件联接；所述滑触线通过滑触线支撑架沿与轨道平行的方向装配在轨道基体上，所述滑触线对接头，一端设为直线形状，与滑触线采用平滑无缝对接，另一端设为圆弧喇叭口形状，与方向转换平台的平台滑触线采用有缝对接。

[0018] 所述轨道定位板设置在轨道基体的与方向转换平台接触的一端，所述轨道定位板上设有凹槽，所述凹槽与平台基体上的定位凸板配合，用于实现方向转换平台与路径轨道的对接。

[0019] 所述凹槽包括弧形引导部分和直线定位部分，弧形引导部分设于凹槽外端部、直线部分设于凹槽底部，两部分相切；所述弧形引导部分用于弥补加工及装配尺寸误差，定位凸板沿弧形引导部分滑动到位后，与直线部分形成配合，完成定位。

[0020] 一种轨道式机器人行走路径变换装置的实现方法，包括：

[0021] 机器人在方向转换平台上需要进行路径转换时，平台伸缩机构带动平台基体下降，平台基体上的定位凸板与轨道定位板脱离接合，下降动作停止；

[0022] 平台旋转机构开始动作，电机及减速器输出扭矩，带动小齿轮旋转，小齿轮驱使大齿轮带动转筒转动，进而带动方向转换平台转动，到达预定方向后，转动运动停止；

[0023] 平台伸缩机构带动平台基体上升，平台基体上的定位凸板与相应方向上的轨道定位板接合到位，上升动作停止。

[0024] 所述方向转换平台与相应方向的路径轨道对接完成后，方向转换平台上的两组平台导轨与路径轨道上的两组导轨无缝结合，方向转换平台上的平台滑触线与路径轨道上的滑触线通过滑触线接头有缝接合。

[0025] 本发明的有益效果是：

[0026] 1、机器人行走路径变换装置实现了多通道并存、多方向选择，一套机器人主体就可完成多个方向场合的工作，提高了工作覆盖率。

[0027] 2、路径方向变化适应性强，可适应各种角度要求，克服了弯轨转弯角度单一、路径单一的缺点，达到了路径设计随意性。

[0028] 3、方向转换机构结构简单、轨道对接方便，克服了其它转弯设备造价高、施工精度

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要求，有利于普及化。

[0029] 4、使用场合的拓展性较大，路径轨道及方向转换平台的结构适应性强，可在单一室内运行，也可多室之间的联通运行。轨道及方向转换平台的设计，通用性强，使用成本低，有利于维护及推广。

附图说明

[0030] 图1为本发明总体结构示意图；

[0031] 图2为本发明实施例方向转换平台与路径轨道完成对接示意图；

[0032] 图3为本发明路径轨道结构示意图；

[0033] 图4为本发明方向转换平台结构示意图；

[0034] 图5为本发明平台基体结构示意图。

[0035] 其中，1.第一路径轨道，2.第二路径轨道，3.第三路径轨道，4.第四路径轨道，5.方向转换平台，6.轨道基体，7.滑触线，8.滑触线对接头，9.导轨，10.滑触线支撑架，11.轨道定位板，12.齿条，13.定位凸板，14.平台齿条，15.平台滑触线，16.平台导轨，17.平台导轨，18.平台安装板，19.电机及减速器，20.转筒，21.大齿轮，22.小齿轮，23.伸缩驱动机构，24.导向杆，25.导向联接座。

具体实施方式：

[0036] 下面结合附图与实施例对本发明做进一步说明：

[0037] 本发明实施例主要由方向转换平台、第一路径轨道、第二路径轨道、第三路径轨道、第四路径轨道或更多路径轨道组成，具体结构如图1和图2所示。路径轨道的长度及与建筑体的安装方式根据现场实际情况确定。

[0038] 第一路径轨道1架设在建筑体支架上，根据现场要求，存在多个岔口以适应不同的行进方向，本案例采用三个岔口，可选择三个行进方向，分别是第二路径轨道2、第三路径轨道3、第四路径轨道4，中间布置方向转换平台5。

[0039] 如图3所示，第一路径轨道包括轨道基体6、滑触线7、滑触线对接头8、导轨9、滑触线支撑架10、轨道定位板11、齿条12。

[0040] 轨道基体6通过预留装配孔，搭建在建筑体上，并设有安装孔位，用于滑触线7、导轨9、轨道定位板11及齿条12与建筑体的联接，轨道基体的设计类型可采用通用型材、特制板材。

[0041] 滑触线7通过滑触线支撑架10装配在轨道基体6上，滑触线对接头8的直线部分与滑触线7对接无缝后，通过紧固件装配在轨道基体6上；滑触线7类型可选用无接缝式、管式等，通用性强、维护性好。滑触线对接头8，一端设为直线形状，与滑触线7采用平滑无缝对接，一端设为圆弧喇叭口形状，与方向转换平台的平台滑触线15采用有缝对接，降低现场调试难度并方便集电器滑触头顺畅通过。滑触线支撑架10，用于滑触线7与轨道基体6之间的联接，设有装配孔及调整孔位，方便调整滑触线7的高度及直线度。

[0042] 导轨9利用紧固件装配在轨道基体6上，两件导轨平行布置在轨道基体6两侧，导轨9的滑轨面类型可采用圆弧或三角形设计，选用范围较宽；

[0043] 齿条12通过紧固件与其中一侧导轨9的内侧面装配，与导轨9形成整体，方便调整；

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齿条12的设计类型可采用直齿或斜齿，齿条12的材质按相应国标要求。

[0044] 轨道定位板11，一端与轨道基体联接，另一端的定位凹槽用于定位。在工作工程中与方向转换平台5的定位凸板13配合，定位凹槽设有弧形引导部分和直线定位部分，降低安装精度要求并能确保定位准确。

[0045] 第二路径轨道2、第三路径轨道3、第四路径轨道4，结构及包含零部件与第一路径轨道1相同，根据现场需要选用，为适应多路径的存在，可增加至第五路径轨道或更多轨道。

[0046] 如图4和图5所示，方向转换平台5包括平台安装板17、平台基体18、平台旋转机构和平台伸缩机构。所述平台基体18上安装定位凸板13、平台齿条14、平台滑触线15和平台导轨16。

[0047] 平台安装板17，设有与台旋转机构及平台伸缩机构装配孔、与建筑体的联接孔。

[0048] 平台基体18上设有安装孔位，用于与方向转换平台各零件的联接，平台基体18的设计类型与第一路径轨道中的轨道基体相同。

[0049] 定位凸板13装配在平台基体18两端，定位凸板13上设有凸台，用于与轨道定位板11的凹槽配合，实现平台旋转机构5的平台导轨16与路径轨道的导轨9的对接；定位凸板13与平台基体18通过紧固件连接。

[0050] 平台导轨16平行布置在平台基体18的两侧，采用紧固件联接；类型与第一路径轨道中的“导轨”相同。

[0051] 平台齿条14与其中一侧导轨装配在一起，设计类型与第一路径轨道中的“齿条”相同。

[0052] 平台滑触线15装配在平台基体18上；布置方式与第一路径轨道1上的滑触线7相同。

[0053] 其中平台旋转机构5包括电机及减速器19、转筒20、大齿轮21、小齿轮22；电机及减速器19和转筒20都装配在平台安装板17上，转筒20的外圆设有安装槽与大齿轮21配合，小齿轮22与电机及减速器19的输出轴采用键连接，大齿轮21与小齿轮22进行外啮合。

[0054] 电机及减速器19，本实施例采用交流伺服电机和行星减速器；转筒20的外圆设有安装槽与大齿轮配合，底部设有装配孔与平台安装板17联接，顶部及内部孔位与平台伸缩机构联接。平台安装板17底部可与建筑体支架联接。大齿轮21和小齿轮22采用国标设计，方便维护及更换；

[0055] 平台伸缩机构包括伸缩驱动机构23、导向杆24、导向联接座25。伸缩驱动机构23主体装配在转筒20内部，可采用电动或启动方式；伸缩杆与导向杆24一端与平台安装板17上的滑动套配合，另一端与导向联接座25联接，导向联接座25与平台基体18底部联接；平台伸缩机构进行上升、下降动作，完成方向转换平台与路径轨道的定位配合。

[0056] 导向杆24，设为三杆或多杆圆周均匀分布，杆部机座设有油槽，采用免维护滑动设计。导向联接座25，设有联接导向杆24、平台基体18的装配孔，一端联接导向杆24，另一端联接平台基体18。

[0057] 机器人主体在第一路径轨道1上行进，根据现场需要，前方道路径由一条变成了为3条，即第二路径轨道2、第三路径轨道3、第四路径轨道4，若按照预先要求，先选择第二路径轨道2，以下步骤将介绍如何行进。

[0058] 机器人行至在方向转换平台5，根据预先设定执行刹车并停留在平台上，方向转换

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平台5随即启动路径转换动作。伸缩机构23和导向杆24下降，拖动平台基体18下降，定位凸板13与轨道定位板11脱离接合，下降动作停止；平台旋转机构开始动作，电机及减速器19输出扭矩，小齿轮22驱使大齿轮21带动转筒20转动，转换平台5承载机器人本体转动，方向运动停止；伸缩机构23和导向杆24上升，推动平台基体18上升，定位凸板13与轨道定位板11接合到位，上升动作停止，此时平台导轨16与导轨9接合完毕，两组导轨为无缝接合，平台滑触线15与滑触线7也完成接合，两组滑触线接合为有缝接合，由于设有滑触线对接头8，集电器触头在滑动中既保证动作流畅也保证触头与滑线导体的及时联通。

[0059] 此时，方向转换平台5完成方向转换动作，图1为方向转换平台转动过程示意图；图2为方向转换平台与第二路径轨道2完成对接示意图。

[0060] 上述虽然结合附图对本发明的具体实施方式进行了描述，但并非对本发明保护范围的限制，所属领域技术人员应该明白，在本发明的技术方案的基础上，本领域技术人员不需要付出创造性劳动即可做出的各种修改或变形仍在本发明的保护范围以内。

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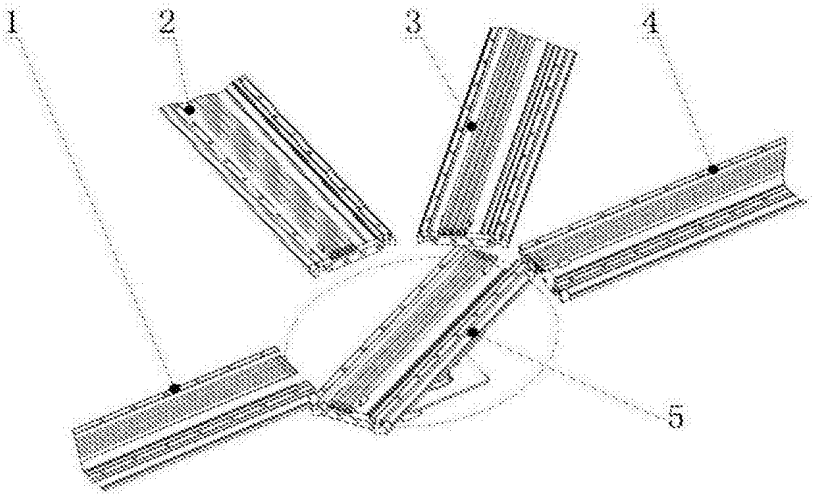


图1

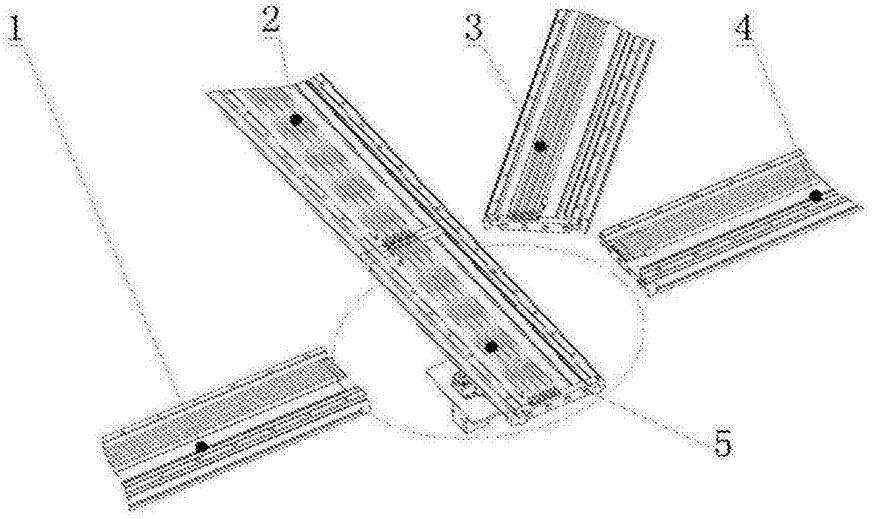


图2

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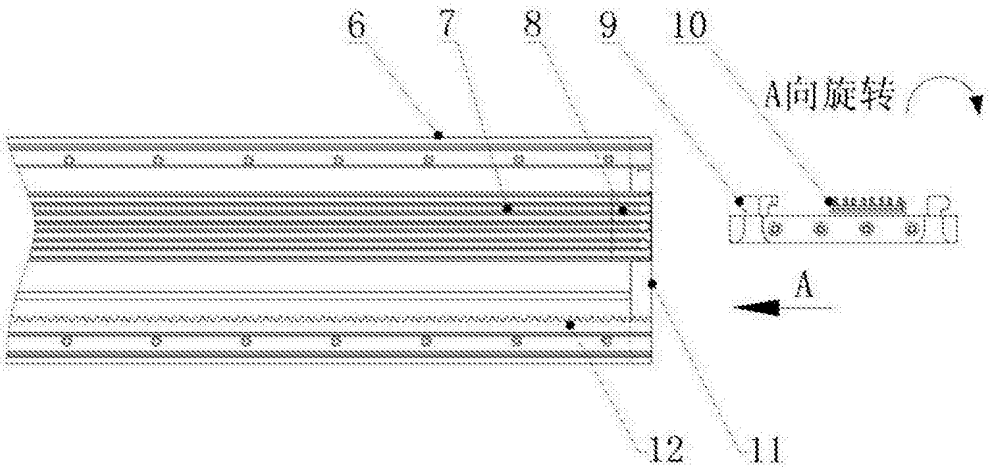


图3

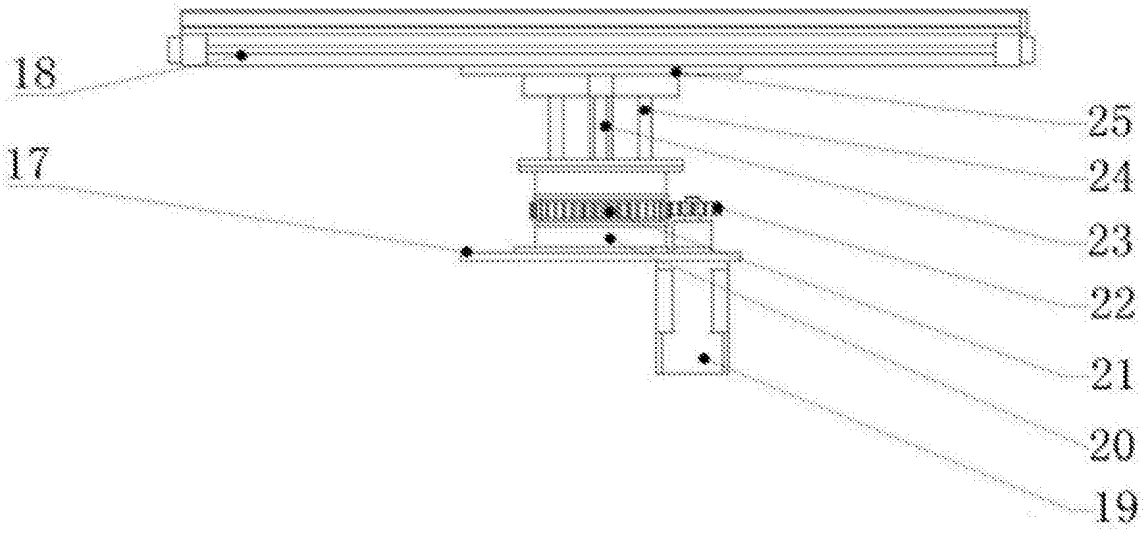


图4

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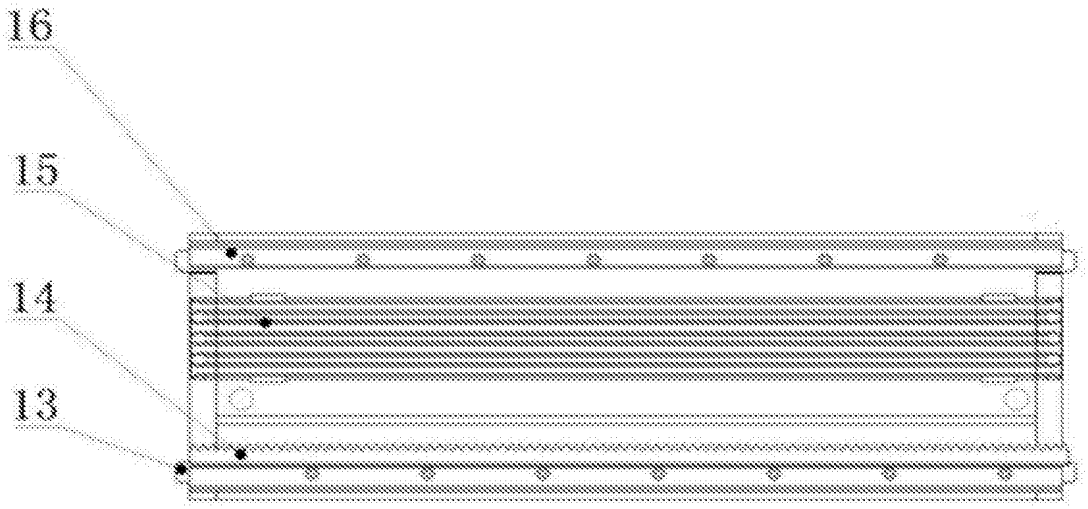


图5

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Patents

One kind of track robot walking path conversion device and implementation method

Abstract

translated from Chinese

The present invention discloses an orbital robot walking path conversion device and implementation method, comprising: direction switching platform and several pieces of different paths track direction; the direction conversion platform to track any path and docking; direction switching platform comprises a platform base platform telescopic mechanism, platform and platform mounting plate rotating mechanism; the base platform with a telescopic mechanism internet connection, internet platform telescopic mechanism and a rotating mechanism connected to the internet platform rotation mechanism fixed to the mounting plate. The beneficial effects of the present invention: a robot traveling path transforming means exist to achieve a multi-channel, multi-select direction, a robot body of work can be completed in multiple directions occasions, improve work coverage. Change the path direction adaptable, can adapt to the requirements of various angles, to overcome the curved track single turn angle, the shortcomings of a single path, the path to achieve the design random.

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CN Grant

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Application number: CN 201410562379

Other languages: Chinese

Other versions: CN104308861A (Application)

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Description

translated from Chinese

One kind of track robot walking path conversion device and implementation method

TECHNICAL FIELD

Claims (10)

translated from Chinese

A robot rail traveling path transforming means, characterized in that, comprising: direction switching platform and several pieces of different paths the track direction; and the direction

of the robot apparatus.

Background technique

[0002] In the device polling, material transfer applications, with its strong track robot life, easy maintenance advantages to be gradually applied. To increase the geographic scope of operation of the robot, improve coverage ratio detection equipment, materials put into operation in place, the robot needs to be extended to many corners of the track, which involves turning orbital path, bifurcation, some path turning angle is too large, diverging too much, ordinary curved track design has been unable to resolve, which is walking track robot brought a lot of technical problems. So Study of a convertible robot walking path means can greatly promote the track robot device polling, development of material handling applications.

[0003] literature search of prior art found, Application No. 201310040511.1 entitled "corner unit with track robot" Patent Application No. 201110091368.X name and as "an orbital autonomous mobile robot" patent, We have put forward the application of a rail-mounted robot, but the robot research on orbit, being confined to a single track running, and turning on the track, bifurcated failed to carry out specific, in-depth study and exploration, more failed provide an embodiment of a multi-directional response walking paths, multi-pronged question, can not expand the application of track robots.

[0004] Thus, the application of technology now still no more than a device to meet the direction of the track path, need more bifurcated track robot applications there is a big technical defects, this status quo has seriously restricted the robot track practical application and promotion.

SUMMARY

[0005] The object of the present invention is to solve the above problems and provide a track to change the travel route of the robot apparatus. When the device is able to track the robot walking paths fork appears, by the orbital path is converted into a three or more, when the robot and the brake lines to stay on the platform in the direction of the conversion, the direction changing platform and platform mounting plate rotating mechanism; the base platform with a telescopic mechanism internet connection, internet platform telescopic mechanism and a rotating mechanism connected to the internet platform rotation mechanism fixed to the mounting plate; each of said path track fixed direction on both sides of the rail tracks arranged in parallel in the substrate, the trolley line along the rail parallel; includes a rail base on the rail base are connected to the trolley line, rails, track positioning plate and the rack on the track base, the rack is fixed on one side of the rail.

2. An orbital robot according to claim 1 traveling path transforming means, wherein, said base platform comprising: a platform floor, the positioning projection plate, rack platform, the platform and platform rail trolley line; the both ends of the platform floor plate positioning projections are provided, the board has positioning projections boss, the positioning projection plate and the bottom plate by fasteners internet connection, arranged parallel to the rail platform on each side of the platform floor, the said platform trolley line trolley line along the support frame in a direction parallel with the platform rails fixed to the floor by sliding on the platform, the platform ends are provided with trolley line trolley line to the connector for the track and path of the trolley line for docking ; the rack platform, and the platform along a direction parallel to the rail which is disposed inside the side rail.

3. An orbital robot according to claim 1 traveling path converting means, wherein said platform comprises a rotating mechanism motor, reducer and a drive mechanism; rear mounting plate secured to the platform with the motor reducer is connected on the motor and drive mechanism is connected; the drive mechanism for driving the direction of rotation of the platform conversion.

[0006] To achieve the above object, the present invention adopts the following technical scheme:

[0007] - the robot walks kind of rail-path conversion device, comprising: direction switching platform and several pieces of different paths the track direction; and the direction conversion platform Docking at an arbitrary path;

[0008] The direction switching platform comprises a platform base platform telescopic mechanism, platform and platform mounting plate rotating mechanism; the base platform with a telescopic mechanism internet connection, internet platform telescopic mechanism and a rotating mechanism connected to the rotation mechanism fixed to the platform platform mounting plate;

[0009] The track each path includes a rail base on the rail base are connected to the trolley line, rails, track positioning plate and the rack; both sides of the rail tracks arranged in parallel at the base of the slide contact with the rail line along a direction parallel to the substrate is fixed on the track, the rack is fixed on one side of the rail.

[0010] The base platform include: platform floor, the positioning projection panels, rack platform, the platform and platform rail trolley line;

[0011] both ends of the platform floor plate positioning projections are provided, the board has positioning projections boss, the positioning projection plate and the bottom plate by fasteners internet connection, parallel to each side of the platform floor rail arrangement platform, the platform trolley line trolley line through the support frame along a direction parallel to the rail platform fixed to the platform floor, respectively, with both ends of the trolley line trolley line to the connector for the track slippery path touch line for docking; the platform rack along a direction parallel to the rail platform disposed inside one side of the rail.

[0012] The platform rotation mechanism comprising a motor, a speed reducer and a drive mechanism;

[0013] Once motor reducer connected to the fixed platform in the mounting plate, a drive mechanism

gear, and the pinion gear drum; said motor is connected with the pinion gear, the pinion and the large externally meshed gears, said drum mounting plate secured to the platform, with the outer circumference of said drum mounting groove, the large gear is fixed to the mounting slot.

5. An orbital robot according to claim 4 traveling path converting means, wherein said platform telescopic mechanism comprising: a telescopic drive mechanism, the guide rod, the guide rod and telescopic connection seat; the telescopic drive mechanism is provided in the drum interior, the telescopic rod guide bar with one end of the sliding platform and the mounting plate and the other end connected to the connection seat and the guide, the guide is coupled with the seat bottom substrate internet connection.

6. An orbital robot according to claim 2 traveling path transforming means, wherein, a track on both sides of the base of each path are arranged in parallel rail track, the rail track and coupled by a fastener substrate ; the trolley line trolley line through the guide rail support bracket assembly in the direction parallel to the substrate on the track, on the trolley line connector at one end to a linear shape, and the trolley line using smooth and seamless docking, the other end platform trolley line to arc bell shape, with the direction changing platform using butt joints.

7. An orbital robot according to claim 1 traveling path converting means, characterized in that the rail track positioning plate disposed at the base of the platform in contact with one end of the direction change, the positioning plate is provided with a concave track grooves, the grooves and the positioning projection on the substrate platform plate fit for realizing the docking

[0014] The drive mechanism comprises: a large gear, and the pinion gear drum; said motor is connected with the pinion gear, the pinion meshing with the large gear be outside, the platform is fixed to the drum mounting plate, said drum the outer circle has a mounting groove, the large gear is fixed to the mounting slot.

[0015] The platform telescopic mechanism comprising: a telescopic drive mechanism, guide rod, telescopic rod and the guide coupling seat;

[0016] The telescopic drive mechanism is provided in the interior of the drum, said guide bar telescopic rod with one end of the sliding platform and the mounting plate and the other end connected to the connection seat and the guide, the guide is coupled with the seat platform backplane connector.

[0017] The substrate on both sides of the track every path are arranged in parallel rail track, the rail and the rail base by a fastener coupling; the trolley line through the direction parallel to the rail support bracket along the trolley line in assembly the track base, the trolley line on the connector at one end to a linear shape, and the trolley line with smooth seamless, and the other end to an arc bell shape, and direction changing platform trolley line platform using slit docking.

[0018] The track rail positioning plate disposed in the substrate and in contact with one end of the direction switching platform, the positioning of the track plate is provided with a groove, the groove and the plate positioning projection on the substrate with the internet, for realizing the direction conversion docking platform and the path of the track.

[0019] The guide groove includes an arcuate portion and a straight portion positioned, the arcuate guide portion is provided at the outer end portion of the groove, the linear portion located in the groove bottom, two tangent portion; said arcuate guide portion for after machining and assembly make up the size of the error, the positioning projection plate along an arcuate guide portion sliding into place, and a straight portion is formed with the completion of positioning.

[0020] A robot walking path track implementation conversion device, comprising:

8. An orbital robot according to claim 7 traveling path converting means, wherein said recess includes an arcuate portion and a linear positioning guide portion, the arcuate portion of the guide groove provided in the outer end portion, a straight line positioning portion provided on the bottom of the groove, tangent of two parts; the arc-shaped guide portion size to make up for machining and assembly error, for the positioning projection plate along an arcuate guide portion after sliding into place, and linear positioning portion is formed with the completion of positioning.

A robot rail as claimed in claim 1, wherein the method implemented traveling path conversion device, which is characterized by comprising: the robot in the direction changing path switching platform when required, the platform base platform telescopic mechanism drives down the base platform positioning projections plate on the track positioning plate is disengaged, the lowering operation is stopped; platform rotating mechanism starts to operate, the output torque of the motor and reducer, driven by rotation of the pinion, pinion driven large gear turns the drum rotates, thereby bringing the rotation direction switching platform after reaching a predetermined direction, rotational motion stops; platform telescopic mechanism drives the base platform rises, the positioning projection on the base plate and the platform track positioning plate corresponding direction of engagement in place, action stopped rising.

10. An orbital robot of claim 9, wherein the method implemented traveling path conversion device, characterized in that, after the direction change path direction corresponding internet Docking at completion, two direction changing guide internet platform seamless integration with the two rail tracks on the path, the direction

decreased, the positioning projection on the base plate of the table positioning plate out of engagement with the track, the lowering operation is stopped;

[0022] platform rotating mechanism starts its operation, the motor and reducer output torque to drive rotation of the pinion, pinion driven large gear turns after the drum rotates, thereby bringing the rotation direction switching platform to reach predetermined direction, rotational motion stops;

[0023] platform telescopic mechanism drives the base platform rises, the positioning projection on the base plate and the platform track positioning plate corresponding direction of engagement in place, action stopped rising.

[0024] direction after the conversion platform and the corresponding direction of track path to complete the docking, the direction switching seamlessly combine two guide rails and two platform tracks the path on the platform on the direction changing platform trolley line on the platform with the path trolley line on the track trolley line through the joint seam bonding.

[0025] the beneficial effects of the present invention are:

[0026] 1 robot walking path transforming means exist to achieve a multi-channel, multi-select direction, a robot body of work can be completed in multiple directions occasions, improve work coverage.

[0027] 2, change the direction of the path adaptability, can adapt to the requirements of various angles, to overcome the curved track single turn angle, the shortcomings of a single path, the path to achieve the design random.

[0028] 3, direction changing mechanism is simple in structure, easy docking track, overcame other turn high equipment cost, construction precision conducive popular.

[0029] 4, using the occasion of the expansion of large orbital path and direction of strong adaptability to convert the platform structure can be run in a single chamber, can also run multiple Unicom chamber.

BRIEF DESCRIPTION

[0030] FIG. 1 is a schematic view of the overall structure of the invention;

[0031] FIG. 2 embodiment of the present invention, the direction changing path orbit docking platform and schematic completed;

[0032] FIG. 3 is a schematic view of the invention path track structure;

[0033] FIG. 4 is a schematic view of the structure of platform shifting direction invention;

[0034] FIG. 5 of the present invention the base platform structure diagram.

[0035] wherein a first track path, 2. The second path track 3. The third orbit path, 4. fourth orbit path, 5. direction switching platform, 6 Track substrate 7. Trolley line, 8. The trolley line the joint, 9. rails, 10 trolley line support bracket 11. The positioning plate track 12. rack 13 positioning convex plate 14. rack platform, 15 platform trolley line, 16. The platform rails 17. platform rails 18. platform mounting plate 19 and the motor reducer 20. drum, 21 large gear 22 pinion 23 telescopic drive mechanism 24. The guide bar 25 The guide coupling seat.

detailed description

:

[0036] The following drawings in conjunction with the embodiment of the present invention will be further explained:

[0037] The embodiments of the present invention is mainly composed of the direction switching platform, the first track path, the second path track, the third track path, or the fourth path orbital path more tracks, the specific structure shown in Figures 1 and 2. Installation path length of the track and with the body of the building is determined according to the actual situation.

[0038] The first track I set up in the path of construction scaffolding, according to site

the second track path 2, the third path rail 3, the fourth orbit path 4, the intermediate platform 5 is arranged to convert the direction.

[0039], the first path includes a track 6, track trolley line matrix 7, trolley line in Figure 3 the joint 8, 9 rail, trolley line support frame 10, the track positioning plate 11, the rack 12.

[0040] orbit base 6 by reserving mounting holes, built in the architectural body, and has mounting holes for the trolley line 7, the guide 9, the coupling track positioning plate 11 and the rack 12 and body building, track design type substrate may be generic profiles, a special sheet.

After the [0041] 7 trolley line trolley line through the support frame 10 mounted on the track base 6, the trolley line straight portion of the connector 8 and 7 butt seamless trolley line through the fastener assembly 6 on the rail base ; trolley line 7 types can be used without joints, pipe, etc., versatility, good maintainability. Trolley line connector 8 for an end to a linear shape, and the trolley line 7 with smooth seamless, end to arc bell shape, and direction changing platform trolley line platform 15 using butt joints, reduce field debugging difficult and easy collector slip smoothly through the contacts. Trolley line support frame 10, the coupling between the trolley line 6 and 7 for the orbital base with mounting holes and holes to adjust, easy to adjust the height of the trolley line and straightness 7.

[0042] guide 9 using fasteners mounted on the track base 6, two guide rails arranged in parallel on both sides of the substrate 6, the type of guide rail surface can arc or 9 triangular design, the choice of a wide range;

[0043] with the rack 12 by a fastener assembly wherein the inner surface of the side rails 9, 9 formed integrally with the guide rail, easy to adjust; design type rack 12 can be straight or helical teeth, according to the material of the rack 12 corresponding national standard.

[0044] track positioning plate 11, one end of the base body is coupled with the track, the other end of the

arcuate portion and a linear positioning guide portion and lower mounting accuracy requirements and to ensure accurate positioning.

[0045] The second path track 2, a third path rail 3, 4 fourth orbit path, the structure and components of the first path contains the same track l, according to the site need to use, in order to adapt to the presence of multipath, the first increase to five or more rail track path.

[0046] Figures 4 and 5, the direction conversion plate mounting platform 5 includes a platform 17, the platform substrate 18, the table rotating mechanism and a telescopic mechanism internet. Installation of the platform 18 is positioned on the base plate 13 is convex, rack platform 14, platform 15 and platform trolley line guide 16.

[0047] platform mounting plate 17 is provided with a rotary mechanism and platforms telescopic mechanism mounting holes, and building body coupling hole.

[0048] provided the platform base 18 mounting holes, coupled with the direction changing platform for all parts of the platform design type substrate 18 and the first track in the path of the track the same substrate.

[0049] positioning projection plate 13 mounted on the base platform 18 at both ends, the positioning projection plate 13 is provided with projections, with recesses for track positioning plate 11 together to achieve platform rotation mechanism of the platform 5 and Route 16 rail track docking rail 9; positioning projection 18 is connected by a fastener plate 13 and the base platform.

[0050] platform rails 16 are arranged in parallel on both sides of the base platform 18, using fastener connection; type in the first track in the path "guide" the same.

[0051] wherein one side of the platform 14 and the rack rails are assembled together, the type and design of the first track path "rack" the same.

[0053] wherein rotation of the platform 5 includes a motor and reduction gear mechanism 19, the drum 20, the large gear 21, the pinion 22; motor and gear unit 19 and the drum 20 are mounted on platforms mounting plate 17, 20 of the outer drum round with a mounting groove 21 with the large gear, a pinion gear and the output shaft 22 of the motor reducer 19 is keyed connection, the large gear 21 and the pinion 22 engaging outside.

[0054] Motor and reducer 19, the present embodiment adopts AC servo motor and planetary gear; cylindrical drum 20 is provided with a mounting groove with the large gear, with a bottom hole assembly 17 is coupled with the platform mounting plate, and top internal holes and platforms telescopic mechanism is coupled. Platform bottom mounting plate 17 may be coupled to the bracket body and architecture. The large gear 21 and the pinion gear 22 with the national standard design, easy maintenance and replacement;

[0055] The telescopic drive mechanism includes a telescopic platform mechanism 23, the guide rod 24, the guide holder 25 is coupled. Telescopic drive mechanism body 23 is fitted inside the drum 20, may be electrically or start mode; extendable rod sleeve slidably fit with the guide rod 17 on the end of the 24-platform mounting plate, the other end of the connection seat 25 coupled with the guide, guide the coupling seat 25 and 18 at the bottom of the base platform connected; platform telescopic bodies rising and falling action, completed direction switching platform and locate the path with the track.

[0056] the guide rod 24, is set to three or more circumferentially uniform rod, the rod base portion with a sump, maintenance-free slide design. Guide seat 25 is coupled with the coupling guide rod 24, the base platform mounting hole 18, the guide rod 24 is coupled at one end and the other end coupled to the base platform 18.

[0057] In the robot body on the first track path I travel, according to the site needs, from the front of a road into a path of three, the second track path 2, a third path rail 3, 4 fourth orbit path, if in accordance with the

[0058] line to the robot in the direction of the conversion stage 5, the implementation of the brake according to pre-set and stay on the platform, the platform 5 will launch direction changing path conversion action. Down 23 telescopic mechanism and a guide rod 24, 18 is lowered drag platform base, positioning projection plate 13 is engaged with the positioning plate 11 from the track, the lowering operation is stopped; platform rotating mechanism starts its operation, the motor output torque and speed reducer 19, a pinion 22 driven the large gear 21 to drive the drum 20 is rotated, the conversion platform 5 carrying robot body rotates, the direction of motion stops; telescoping mechanism 23 and the guide rod 24 to rise, pushing the platform base 18 rises, the positioning projection plate 13 and the track positioning plate 11 is engaged in place, rising action stop, then 16 and the guide rail platform engaging finished 9, two guide seamless engagement platform trolley line trolley line 15 and 7 also completed engagement, the two groups joined for the trolley line seam bonding, since with a slide touch line of contact 8, the collector contacts the slide in both to ensure the smooth operation of China Unicom also ensure timely contact with the slide wire conductor.

[0059] In this case, the direction changing operation of the direction changing platform 5 is completed, FIG. 1 is a schematic view during the rotation direction switching platform; Figure 2 is the second path direction changing track platform 2 a schematic view of the docking is completed.

[0060] said although the drawings of specific embodiments of the invention have been described, but not limit the scope of the present invention, one of ordinary skill in the art should be understood on the basis of technical solution of the present invention, the skilled in the art without pay all kinds of creative work to make modifications and variations still within the scope of the present invention.

Patent Citations (4)

Patents

			圳）有限公司	Mobile platform using same
CN102736623A *	2011-04-12	2012-10-17	中国科学院沈阳自动化研究所	Track self-directed moving robot
CN103878760A *	2012-12-24	2014-06-25	李木	Single-track robot capable of positioning via magnetic field and control method of multi-track robot
CN204136067U *	2014-10-21	2015-02-04	山东鲁能智能技术有限公司	Rail type robot walking path switching device

* Cited by examiner, † Cited by third party

Also Published As

Publication number	Publication date	Type
CN104308861A	2015-01-28	Application

Similar Documents

Publication	Publication Date	Title
CN101712445A	2010-05-26	Fork hydraulic lifting platform
CN102631172A	2012-08-15	Lifting telescopic corridor cleaning robot
CN102975184A	2013-03-20	Double-shaft rotating table for adjusting satellite postures
CN202580477U	2012-12-05	Spiral pipe robot
CN201130012Y	2008-10-08	Sandwich plate flatness measuring device
CN102950503A	2013-03-06	Gantry-type high-precision automatic loading and unloading manipulator
CN2612503Y	2004-04-21	Welding positioner with three degree of freedom
CN202280240U	2012-06-20	Construction robot for wall surface of building
CN101920370A	2010-12-22	Three-shaft steel tube intersecting line cutting machine
CN202291969U	2012-07-04	Rotating fixture
CN201525731U	2010-07-14	Shear-fork type hydraulic lifting platform with improved structure

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CN2702969Y	2005-06-01	Overhead electric moving machine
CN101818847A	2010-09-01	Combined telescopic support device for extra-large LED display wall
CN201792123U	2011-04-13	Triaxial steel pipe intersecting line cutting machine
CN203265199U	2013-11-06	Ejecting rod type automatic area changing and positioning device for full-automatic cleaning equipment of tube nest type heater
CN203609365U	2014-05-28	Suction robot
CN201211536Y	2009-03-25	Digital control three-dimensional hydraulic pipe bender
CN201005624Y	2008-01-16	Rail-climbing equipment capable of climbing slope
CN203141009U	2013-08-21	Vertical type connecting-rod-type intersecting line cutting head
CN203452683U	2014-02-26	Catwalk machine and catwalk device
CN204108508U	2015-01-21	Pure mechanism wire feeding gantry type H-shaped steel welding device
CN204525474U	2015-08-05	Two-way parallel orbit robot of biax
CN203528629U	2014-04-09	Similar wheel type wall crawling obstacle crossing robot

Legal Events

Date	Code	Title	Description
2015-01-28	C06	Publication	
2015-02-25	C10	Entry into substantive examination	
2016-06-08	C14	Grant of patent or utility model	

Espacenet

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Overhead mono rail-rail multipurpose profile for compatible operation of e.g. friction drive, in e.g. tunnel construction, has compatible rail module connected with radial connector for friction drive in polygon oppressive manner

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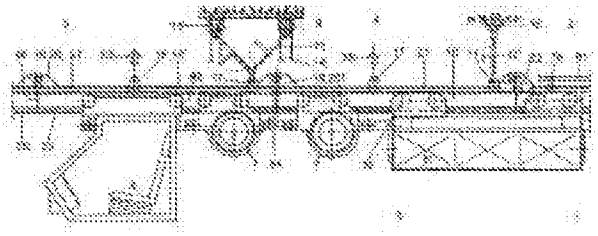
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- cooperative: E01B25/24

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Abstract of DE102008015879 (A1)



The profile has a roll and bending resistant flange formed with an under welded toothed rod rack or a flat section. Horizontal or vertical movement of a shear connection (19) takes place with a hinge, without profile displacement. The flange reinforces a roller running path for receiving larger loads at an edge section. A compatible rail module (10) is connected with a radial connector for a toothed wheel drive (7) or a friction drive in a polygon oppressive manner for spatial movements in an axis with a case hinge, and is compatibly driven for friction and wheel drive systems.

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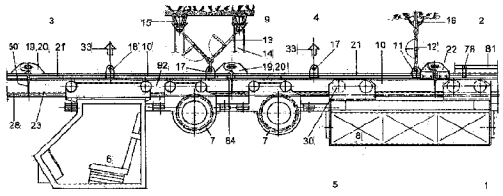
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Die folgenden Angaben sind den vom Anmelder eingereichten Unterlagen entnommen

(54) Bezeichnung: **EHB-Schienen-Kombiprofile mit gelenkgeführten Scherenverbindungen, für den kompatiblen Betrieb von Zahnrad- und / oder Reibradbahnen, mit verschiebbaren Aufhängesystemen am Anker- oder Unterstützungsausbau**

(57) Zusammenfassung: Ein EHB-Schienenmodul für den kompatiblen Betrieb mit Diesel-, Elektro- oder elektrohydraulischen Antrieben und einer Zahnstange unter dem Laufbahnflansch, bestehend aus einem handelsüblichen Walzprofil mit aufgeschweißtem Zusatzprofil, einer gelenkgeführten Scherenverbindung mit einem Kugelschalen-, Kugelscheiben-, Winkel- oder Bewegungsgelenk und einem integrierten, gelenkentlastenden Aufhängesystem mit selbstsicherndem, unverlierbar angeordnetem Schiebeanker oder nachträglich montierbaren, selbstsichernden Klemmankern, die zwischen den Scherenverbindungen, ohne Schrägzug zur Aufhängung an Gebirgsankern oder Bogenprofilen, an jeder Stelle des Zusatzprofils angeordnet werden können.
Die Zahnstange für den Zahnradantrieb der Zuglaufkatzen, wird unter dem Laufbahnflansch schienenfähig, zur rollen- und biegesteifen Kantenverstärkung verschweißt, die auch den Drehpunkt der Scherenverbindung mit einem Freiwinkel zur Verhinderung des Polygonaufbaus aufnimmt.
Mit den großen Laufrädern wird die spezifische Last und der Rollwiderstand auf der Laufschiene verringert.
Schiebe- oder Klemmanker werden mit den vorgesehenen Sicherungsmitteln, unter Last zur selbstsichernden Aufhängung am Oberflansch der EHB-Kombiprofile eingesetzt, ohne die EHB-Rollenlaufwerke zu behindern und zur freien Montage von Stromschienen für elektrohydraulische Zahn- und/oder Reibradantriebe oder Rollenträger, für Zugseile eingesetzt.
Bei Betrieb einer kompatiblen EHB-Zahn- und/oder Reibradanlage mit ...



Beschreibung

[0001] Die Erfindung– betrifft ein EHB-Schienensystem für den kompatiblen Betrieb mit einem Diesel- oder Elektrohydraulischen, sowie Elektro- oder Batterie-EHB-Zahn- und/oder Reibradantrieb am Profilsteg und mit einer angeordneten Zahnstange unter dem Laufbahnflansch, bestehend aus einem handelsüblichen IPN oder Sonderprofil nach DIN 20653 für eine breite Rollenauflage mit einem aufgeschweißten Zusatzprofil auf dem Oberflansch, einer gelenkgeführten Scherenverbindung mit einem Kugelschalen-, Kugelscheiben-, Winkel- oder Bewegungsgelenk und einem integrierten, gelenkentlastenden Aufhängesystem mit einem selbstsichernden, unverlierbar angeordneten Schiebeanker oder nachträglich montierbaren, selbstsichernden Klemmankern, die zwischen den Scherenverbindungen, ohne auslösenden Schrägzug zur Aufhängung an Gebirgsankern oder Unterstützungsausbau, für EHB-Schienen, roll- und biegesteif für Zahn- und/oder Reibradantrieben ausgerüstet und so verbessert wird, dass an jeder Stelle auf dem Oberflansch am Zusatzprofil des Schienenmoduls, eine Aufhängung ohne aufgeschweißte Laschen usw. nachgerüstet und betriebsgerecht angeordnet werden kann.

[0002] Bei Betrieb einer kompatiblen EHB-Zahnrad- und/oder Reibradanlage mit Elektrohydraulischem- oder Elektroantrieb, werden außer der Aufhängung auch die Stromschienenhalter, mit selbstsichernden Klemmankern an dem aufgeschweißten Zusatzprofil auf dem Oberflansch der EHB-Schienen, an jeder Stelle betriebsgerecht verspannt.

[0003] Die Spannschrauben in den Scherenverbindungen, dämpfen mit einer Spannscheibe, die Pendelbewegungen der Schienenmodule während des Betriebes.

[0004] Mit der verspannten, balligen Verlagerung der Scherenlaschen mit den neuartigen Gelenken und den dazu begrenzten Bewegungsräumen der Zahnstangenkralle in der Zahnstangentasche, wird der Aufbau einer Polygonbewegung im Schienenstrang schon im Ansatz unterdrückt.

[0005] Zur vibrationsfreien Versteifung der Gelenke und zur Ausrichtung in die Stunde wird in den Profilkanälen des Zusatzprofils, mit Spannschrauben und Tellerfedern bei Brems- und Anfahrmanöver, die Möglichkeit einer weiteren Polygonentwicklung im Schienenstrang verhindert.

[0006] Die für den Antrieb der Zuglaufkatze erforderliche Zahnstange, wird unter dem Laufbahnflansch in Modullängen verschweißt und dient auch in der vorgeschlagenen Ausführung gleichzeitig zur schienenfähigen, roll- und biegesteifen Verstärkung der EHB-Laufbahn, für alle Reib- oder/und Zahnrad angetriebene EHB-Zuglaufkatzen mit den Zugeinheiten in dem Schienensystem.

[0007] Der Drehpunkt der Scherenverbindung im Kombiprofil, wird bei Zahn- oder Reibradantrieben von der stabilen Zahnstangenverbindung mit dem zweiteiligen, mit Laschen verstärktem Taschengelenk aufgenommen.

[0008] Mit den großen Laufrädern wird die spezifische Last auf der Laufschiene ideal übertragen und die Wirtschaftlichkeit des kompatiblen EHB-Zahnrad- und/oder Reibradsystems, ohne dass eine Überbelastung durch den Rollwiderstand auftreten kann, wesentlich verbessert.

[0009] Beide Antriebseinheiten Zahn- oder Reibrad, können mit diesem Kombiprofil, wechselweise und als Kombibetrieb, in beiden Systemen überrollend befahren werden.

[0010] Alle Pendelbewegungen werden schon durch das bessere Massenverhältnis des Schienenstranges zum EHB-Zug und durch die versteifende Scherenverspannung mit Tellerfedern in allen Ebenen, schon in der Entstehung, unterdrückt.

[0011] Entscheidend für den wirtschaftlichen Betrieb einer EHB-Zahnrad- und/oder Reibradanlage ist jedoch auch die sichere Aufhängung, mit vorgespannten Ankertraversen und dem Freispiel-Mischankersystem und/oder am Unterstützungsausbau, mit Querlasttaschen verstärkte Profiltraversen.

Stand der Technik:

[0012] Alle bekannten EHB-Schienenprofile haben mit der Schienenverbindung, bei einer horizontalen und vertikalen Auswinkelung ohne ein Kugelgelenk den Nachteil, dass durch die Aufhängung im, oder außerhalb des Gelenkes mit Zusatzbohrungen, ein schädlicher Versatz der Profile in den Schienenverbindungen, durch das Verschwenken der Scherenlaschen um die äußeren Anschlagkanten entsteht, der sich verschleißfördernd auf Reib- und Laufräder auswirkt.

[0013] Ober- und Untergurt des Schienenprofils werden damit derart in der Achse verschoben, dass mit den ausgewinkelten Kanten der Profilschnitte der EHB-Schiene in der ungenau gearbeiteten Schienenverbindung, der Verschleiß der Lauf- und Reibantriebsräder exorbitant erhöht wird.

[0014] Diese Schienenmodule, wurden bisher in den Gelenken mit Schäkeln, Ketten oder auch zum Ausgleich in die Stunde, mit Spannschlössern in Bogenstrecken an Aufhängeklauen verspannt, oder in

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Ankerstrecken mit aufgeschraubten Ösen an den Gebirgsankern aufgehangen und müssen dadurch alle Kräfte der Aufhängung und alle Gelenkbewegungen an der schwächsten Stelle eines Schienenmoduls, also in der Schienenverbindung aufnehmen.

[0015] Da jedoch oftmals die Aufhängepunkte am Bogenausbau, keinem Teilungsmodul der EHB-Schienen entsprechen, entstehen dadurch in den Aufhängungen Schrägzugbelastungen, die nur mit aufwendigen technischen Mitteln ausgeglichen werden können.

[0016] Erforderliche nachrüstbare Zwischenaufhängungen innerhalb eines Schienenmoduls bei Schwerlastbetrieb, sind bisher nur mit zusätzlich aufgeschweißten Laschen möglich, die bereits vor der Montage einer EHB Anlage angebracht werden und in der Anordnung dem Widerstandsmoment des Schienenprofils entsprechen müssen.

[0017] Daraus ergeben sich bei den heute im Einsatz befindlichen Schienensystemen, dass bereits bei der Fertigung an dem Oberflansch der Schienenprofile zusätzliche Laschen, zur Aufhängung der EHB-Module zu verschweißen sind.

[0018] Diese am Schienenmodul fixierten Kurzlaschen mit Bohrungen nehmen bei Bedarf das zusätzliche Kettengeschirr oder ein Spannschloss für ein EHB-Modul auf und erlauben dann nur an der vorgesehenen Stelle, eine Verspannung der Schienenaufhängung für eine höhere Transportlast.

[0019] Ein willkürlicher Angriffspunkt mit Klemmankern, für eine zusätzliche Aufhängung, der die bisherige EHB-Schiene am Oberflansch umgreift, ist ohne Behinderung der eng bemessenen EHB-Laufwerke, mit den vorhandenen Konstruktionen nicht möglich.

[0020] Diese Probleme ergeben sich auch mit der Schienenaufhängung am Unterstützungsausbau, wenn die Modulmaße der EHB-Schienen nicht mit dem Abstand der Baue übereinstimmen.

[0021] Mit den dann erforderlichen Diagonalaufhängungen, auch beim Einsatz von Verteilerschwingen, entstehen ungünstige Querkräfte an jedem EHB-Aufhängepunkt mit der Verspannung, die den dynamischen Belastungen, ausgelöst durch die Pendelbewegungen der EHB-Züge und durch nicht in die Stunde verlegte Schienenmodule, oft nicht gewachsen sind und zu eklatanten Betriebsstörungen in den Schienenverbindungen führen.

[0022] Hinzu kommen, durch die Verlagerung des Drehpunktes der Schienenverbindung unterhalb des Laufbahnflansches des EHB-Schienenprofils, das Schäden entstehen, die mit dem bisherigen Schrägschnitt der Schienenprofile, einen Abbauhammereffekt durch das Anschlagen der kleinen Rollen verursachen und je nach Schienenbelastung, zur schnellen Zerstörung der EHB-Reibradantriebe und der Schienenverbindung mit einer exorbitanten Spaltbildung zwischen den Schienenmodulen führt.

[0023] Auch steht das Beharrungsvermögen der EHB-Schienenanlagen durch die Unterdimensionierung der Schienensysteme, in einem Missverhältnis zu dem Bewegungsvolumen unbeladener oder auch beladener EHB-Züge.

[0024] Ebenso sind für Reib- oder Zahnradantriebe unterschiedliche Schienenmodule erforderlich und daher ist für die bisherige Ausführungen der beiden Antriebssysteme keine Kompatibilität mit den Schienensystemen zu erreichen.

[0025] Kurvenelemente aus den bisher bekannten EHB-Profilen nach DIN 20653, besitzen den weiteren Nachteil, dass diese nur mit zusätzlichen aufgeschweißten Laschen oder unterstützenden, aufwendigen Hilfskonstruktionen und Sonderverbindungen, als zusammenhängendes Bogensegment eingesetzt werden können.

[0026] Schon die unterschiedlich anfallenden Toleranzen, in den verschiedenen Losen der Walzprofile mit angerollten Stegen zur Unterstützung der Laufbahnkanten, weisen für die Laufbahnkante so große Radien auf, dass damit die Laufbahnfläche durch einseitig abgelaufene Rollen exorbitant verkleinert wird und sich damit der Verschleiß der EHB-Rollen mit diesen Profilen stark erhöht.

[0027] Diese Profile, mit den schmalen unterdimensionierten Laufbahnen, lassen eine genaue austauschbare Fertigung der Schienenmodule nicht zu und die Stand- und Lebensdauer einer bisherigen EHB Schienenverbindung wird, mit den bisher verwendeten unterdimensionierten Laufrollen, trotz der geringen EHB-Geschwindigkeit, stark herabgesetzt.

[0028] Vortriebsmaschinen, die in den Strecken- oder Tunnelquerschnitten im Bereich der zweiten Ebene mit EHB-Schienen nach DIN 20653 eingesetzt werden, erhalten bisher zwischen den Schienverbindungen am Oberflansch, ein durchgehend, aufwendig aus Flachquerschnitten geschweißtes T-Profil mit Verstärkungsrippen.

[0029] Eine kontinuierliche Verschiebung der Systeme an den Anschlagpunkten der Maschinenaufhängung ist damit nicht möglich. Das Fehlen einer untergriffigen Abrutschleiste an den Schweißprofilen für die Haken der Aufhängung, vermindert weiter die geforderte Betriebssicherheit.

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Aufgabenstellung:

[0030] Das durch eine Mechanisierung im Berg- und Tunnelbau zwangsläufig bedingte hohe Aufkommen von Transportvolumen ist nur durch eine ausgeprägte, übergreifende Logistik, aller heute im Einsatz befindlichen Betriebsmittel zu bewältigen:

a.) Mit der Anpassung der Systeme an alle Anforderungen durch die im Betrieb umzuschlagenden Mengen und Gewichte aller Güter zur Versorgung des Betriebes.

b.) Die Bewältigung hoher Lasten bis zu den Gewichten von mehr als 20 t durch die Schiebe- und Klemmanker, die bei Bedarf jederzeit nachgerüstet werden können, ohne den Betrieb zu behindern.

c.) Erreichbarkeit aller Betriebspunkte unter den unterschiedlichsten geologischen und betrieblichen Bedingungen wie Feuchtigkeit.

d.) Bewältigung aller Neigungen bis über 40 gon, mit einem anpassungsfähigen Aufhänge- und einem variablen Antriebssystem für alle Betriebsbedingungen.

[0031] Einschienenhängebahnen haben heute Vorort eine zentrale Bedeutung in der Förderung und zur Materialversorgung in Vortriebs- und Gewinnungsbetrieben.

[0032] Es liegt also nahe und wird zur Aufgabe dieser Erfindung, dass zum sicheren und kostengünstigen Transport von Material und Gewinnung in Neigungen ab 15 bis über 40 gon, die von den Reibradantrieben nicht mehr sicher beherrscht werden, die Aus-gestaltung der Reibrad- und Zahnradsysteme so zu kombinieren, dass ein übergreifendes Antriebssystem den Material- und Förderfluss, mit beiden Schienensystemen gewährleistet wird:

a.) Eine extreme Steigfähigkeit durch formschlüssigen Zahnradantrieb,

b.) eine sichere Bedienung beim Rangieren und Positionieren von schweren Lasten in extremen Neigungen,

c.) eine sichere Krafteinleitung durch Unabhängigkeit vom Reibbeiwert der Schiene beim Fahren und Bremsen, z. B. in feuchten Betriebspunkten,

d.) ein reduzierter Schienenverschleiß bei häufigem Bremsen durch formschlüssige Bremswirkung über die Zahnstange und

e.) eine Verstärkung der Laufbahnkanten mit der untergeschweißten Zahnstange, für maximale dynamische und statische Kräfte, die in der Förderung für alle Betriebsbelastungen auftreten können.

f.) Die Dimensionierung der Scherenlaschen wird damit auf die reine Haltefunktion in der Schienenverbindung zurückgeführt.

[0033] Mit der hier vorgestellten Erfindung eines EHB-Schienenprofilsystems mit der gelenkgeführten neuartigen Scherenverbindung, im Zusammenwirken mit Spannelementen in den Kanälen des Zusatzprofils, zur Unterdrückung von schädlichen Pendel- und Polygonbewegungen im Schienenstrang mit dem kompatiblen EHB-Kombiprofil für Reib- und/oder Zahnradantriebe aus einem handelsüblichen IPN oder Walzprofil nach DIN 20653, mit einer Aufhängung zur Entlastung der Scherengelenke durch selbstsichernde Schiebe- oder Klemmanker, die das gewalzte Zusatzprofil mit den Sicherungsleisten an jeder Stelle zwischen den Sche-renverbindungen abrutschsicher untergreifen, wird mit einer genauen, toleranzge-bundenen Fertigung der Scherenlaschen eine Entwicklung vorgestellt, mit der alle betrieblichen Anforderungen für einen EHB-Schwerlastbetrieb wirtschaftlich beherrscht und der bisher betriebsbedingte Verschleiß im EHB-Schienensystem, mit den engeren Toleranzen in der gelenkgeführten Scherenverbindung, weitgehend verhindert.

[0034] Mit einer Verstärkung der Laufbahnkanten durch die trapezförmig ausgebildeten Zahnstangenmodule, für die EHB-Zahnrad-Antriebseinheiten, wird eine verschleißfeste, biege- und rollensteife Laufbahn, eine unfallsichere Montage und die mit Freispiel-Mischankern erfolgte Aufhängung von EHB-Anlagen, mit vorspannbaren Ankertraversen oder Aufhängeklauen mit Querlasttaschen, im Berg- und Tunnelbau, für alle Betriebsbelastungen erreicht.

[0035] Mit der schmalen Bauform der Zahnradantriebe, die ohne Schlupf mit dem rollengeführten elektro-dieselhydraulischen oder Elektro-Antriebssystem arbeitet, werden durch die Verbindung von mehreren Antrieben in der Modulbauweise, alle erforderlichen Zugkräfte, auch die für extreme Betriebsverhältnisse z. B. in Feuchtbetrieben bei Schwerlasttransporten, aufgebracht.

[0036] Eine reibungslose und unfallfreie wirtschaftliche Unterhaltung einer EHB-Zahn- oder Reibradanlage, ist nur mit einer sicheren Verankerung, durch das Hohlstab-Mischankersystem, beschrieben unter DE 10 2007 014 905.2 möglich, mit dem alle auftretenden statischen und dynamischen Kräfte einwandfrei aufgenommen und in das Gebirge abgesetzt werden.

[0037] Die dazu erforderlichen Traversen mit einem Ankervorspann-System, oder Aufhängeklauen mit Querlasttaschen, im Zusammenwirken mit einer kettenlosen Aufhängung von EHB-Anlagen, zur Verhinderung von Polygoneinflüssen im EHB-Schienensystem, sind in der Schrift DE 100 56233 A1 eingehend aufgeführt.

[0038] Ebenso werden zur Vermeidung von Unfällen im EHB-Schienensystem, Abspannungen einer EHB-Zahn- oder Reibradanlage nach der Schrift DE DE 100 10 167 A1 vorgeschlagen, mit denen der

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Schienenstrang mit eingeleiteten Zugkräften, gegen eine Polygonbildung betrieblich gesichert wird, um höhere Zuggeschwindigkeiten zu ermöglichen.

[0039] Mit dem Einsatz einer EHB-Anlage, wird mit diesem kompatiblen Kombiprofil für Reib- oder/und Zahnradantriebe, die Kombination von beiden Antriebssystemen an einem Schienenstrang möglich.

[0040] In Abbaubetrieben mit schwierigen Antriebsverhältnissen, wie Nässe und große Steigungen usw., können mit den ohne Schlupf fahrenden Zahnradantrieben, mehrere Betriebe versorgt und damit die Förderung wirtschaftlicher gestaltet werden.

[0041] Die Abförderung von Gewinnungsmaterial und der Zubringerdienst, kann auch im gleichen Schienensystem von EHB-Maschinen mit Reibantrieben umschlagartig übernommen werden, da mit dem größeren Kombiprofil auch breitere Reibräder mit einer geringeren spezifischen Belastung und geringerem Verschleiß zum Einsatz kommen und mit der Verwendung eines handelsüblichen IPN oder EHB-Walzprofils mit den untergeschweißten Zahnstangenmodulen, eine wirtschaftliche Kompatibilität und Austauschbarkeit der Kombiprofile für alle Antriebsarten erreicht wird.

[0042] Schienenverbindungen und EHB-Systeme verschiedener Bauart, sind in den Schriften DE 101 55 996 A1, DE 10 2004 028 567 A1, DE 103 53 208 A1, DE 102 39 355 A1,, DE 297 03 939 U1, DE 196 33 220 A1, DE 35 22 330 A1, DE 35 14 614 A1, DE 33 26 103 A1, DE 29 22 086 A1, DE 28 54 769 A1, DE 93 18 654 U1, DE 91 01 732 U1, P 21 45 300.9-25, DE 30 27 793 A1, DE 30 46 045 A1, DE 195 33 403 C1, DE 195 11 035 A1, DE 195 11 035 A1, DE 296 04 431 U1, DE 196 16 937 C1, DE 196 16 938 C1, ohne einen Hinweis auf ein kompatibles Schienensystem für Reib- und/oder Zahnradantrieb, veröffentlicht.

a.) Das EHB-Schienenmodul mit Zusatzprofil und Zahnstange:

[0043] Mit der Verwendung eines handelsüblichen IPN- oder Walzprofils nach DIN 20653, mit einem aufgeschweißten T-förmigen Zusatzprofil auf dem Oberflansch und mit Zahnstangen Modulen am Unterflansch zur roll- und biegesteifen Verstärkung der kompatiblen Laufbahn für einen Diesel- oder Elektrohydraulischen Zahnund/oder Reibradantrieb, werden mit dem um 250% statisch verbesserten EHB-Kombiprofil, gegenüber den bisher eingesetzten Schienensystemen, bei gleichen Herstellungskosten, wesentlich höhere Lasten aufgenommen und transportiert.

[0044] Die Schienenmodule werden im Laufbahnbereich mit einem Laschen verstärkten Taschengelenk hakenförmig verbunden.

[0045] Das Taschengelenk nimmt alle räumlichen Bewegungen, mit einem radialgeformten Gelenkhaken alle Abspannkräfte im Schienenstrang auf und verhindert mit den dadurch begrenzten Freiräumen den Polygonaufbau.

[0046] Dabei kann Das vorgeschlagene Kombiprofil bei einer Ausführung ohne Zahnstange, dann ersatzweise auch nur mit einem Zusatzflachprofil, zur Erreichung der gleichen statischen Werte, ausgerüstet werden.

[0047] Die großen Rollen erhalten durch die Verstärkung der Laufbahn mit den untergeschweißten Zahnstangen-Modulen die Beibehaltung der Laufflächenbreite und damit eine Vergrößerung der Lastaufnahme.

[0048] Für einen Strebumzug im Bergbau, mit den exorbitanten Gewichten von komplett verschlauchten Ausbaueinheiten, ist mit dem hier vorgestellten Kombiprofil, eine zusätzliche Vorrichtung, zur Verstärkung der normalen EHB-Aufhängungen, an den Schienenmodulen nicht mehr erforderlich.

[0049] Das Kombiprofil kann an jeder Stelle der Schienenmodule, montagefreundlich und behinderungsfrei für die Laufrollen, mit den Schiebe- oder Klemmankern umgreifend nachgerüstet werden, so dass ein schädlicher Diagonalzug zum Aufhängepunkt an den Gebirgsankern oder am Unterstützungsausbau, vermieden wird.

b.) Die EHB-Scherenverbindung mit Kugelschalen-, Kugelscheiben-, Winkel- oder Bewegungsgelenk:

[0050] Mit der mittigen Anordnung eines Kugelschalen-, Kugelscheiben-, Winkel- oder Bewegungsgelenkes zwischen den Scherenlaschen, wird das asymmetrische Auswinkeln der Profile im gesamten Schienenquerschnitt verhindert und eine exakte Parallelität der Schnittkanten des Kombiprofils, in jeder räumlichen Lage in der EHB-Scherenverbindung, erreicht.

[0051] Die bisherige Überdimensionierung der Scherenlaschen wird auf die reine Haltefunktion in der Scherenverbindung zurückgeführt, da alle Abspannkräfte von den Klemm-, oder Schiebeankern übernommen werden.

[0052] Das Scherengelenk wird einmal mit einer ballig angeschmiedeten Anlage der Scherenlasche, mit der mittig zur Achse der Schienenverbindung angeordneten Bohrung und der mit einer Kulissenführung ausgebildeten Gegenlasche mit dem radial und symmetrisch zum Drehpunkt angeordnetem Langloch in der Scherenverbindung, ausgeführt.

[0053] Weiter kann das Kugelscheibengelenk mit ei-

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ner Hohl- und einer ballig ausgeführten Scheibe ausgeführt werden. Dabei wird die Scherenlasche mit dem Langloch durch die Spannschraube in jeder Montageposition beweglich fixiert.

[0054] Ebenso kann eine einfache Bewegungsscheibe mit radialen, konischen oder kurvenförmigen Außenseiten zwischen beiden Scherenlaschen, als Bewegungsbegrenzung für alle Ebenen, den Bewegungsablauf der Schienenmodule sichern.

[0055] Auch eine einfache, zur Bohrung und Langloch Scherenlasche, nach der Anpressflache zwischen den Scherenlaschen bemessene Scheibe, vermindert den maximalen, schädlichen Verkantungsausschlag in der Scherenverbindung.

[0056] Des weiteren werden die Scherenlaschengelenke mit der Spannschraube und einem Federelement so elastisch versteift, dass immer eine automatische Ausrichtung in die Stunde des Schienenstranges, im räumlichen Drehpunkt der Schienenmodule erfolgt.

[0057] Durch die Einwirkung des Federelementes mit der drehgesicherten Spannschraube, werden betrieblich auftretende Pendelbewegungen der Schienenmodule durch diese Gelenkversteifung und auch ein auftretender Polygoneffekt im Schienenstrang, ausgelöst durch eine plötzliche Vollbremsung, weitgehend automatisch unterdrückt.

[0058] Mit den zu dem EHB-Kombiprofil maximal ausgebildeten Laufrädern und durch die Verbindung der Schienenmodule mit dem Drehpunkt im Laufhorizont der EHB-Zahnstange durch ein mit Rippen versteiftes Taschengelenk, wird der bisher in jeder Schienenverbindung durch die, mit den bisher unterdimensionierten Laufrollen verursachten und ausgelösten "Abbauhammereffekt", zum vorzeitigen Verschleiß der Schienenverbindung, einhergehend mit der Zerstörung der Laufrollen, verhindert.

[0059] Ein exorbitanter Verschleiß der Laufbahnen in staubigen Gewinnungsbetrieben, erfordert oftmals den Austausch der Schienenmodule und ermöglicht durch die vorgestellte Konstruktion den wirtschaftlichen Austausch der Scherverbindungen, da diese durch die geringere Belastung, für weitere Einsätze noch verwendbar bleiben.

[0060] Diese austauschbaren Scherenverbindungen, mit einer asymmetrischen Ausbildung der Scherenlaschen, werden aus einem Pressprofil gefertigt und um 180°, durch die asymmetrisch angeordneten Scherenlaschen und einem Kugelschalen-, Kugelscheiben-, Winkel- oder Bewegungsgelenk in der Scherenverbindung mit einer gefederten Spannschraube verbunden.

[0061] Das aufgeschobene, austauschbare Scherenlaschenprofil, umgreift das aufgeschweißte Zusatzprofil und wird mit weiteren Spannschrauben am Zusatzprofil gesichert.

c.) Der EHB-Schiebeanker:

[0062] Ein sich unter Last, mit ausgebildeten Krallen, selbstsichernder einteiliger Schiebeanker, aus einem gezogenen, gepressten oder geschmiedeten Querschnitt ist so ausgebildet, dass er das Zusatzprofil mit den Sicherheitsleisten, ohne Störung der EHB-Laufrollenbereiche umgreift und zwischen den Scherenlaschen des Schienenmoduls am Zusatzprofil montiert wird.

[0063] Der Schiebeanker, ein- oder zweilaschig, wird unverlierbar auf dem Oberflansch eines Kombiprofils vor der Verschweißung der Scherenlaschen mit dem Zusatzprofil aufgeschoben und kann an jeder Stelle zwischen den Scherenverbindungen, als Aufhängung zur Verankerung, ohne Diagonalzug über Spannschlösser und Ketten, an einem Unterstützungsausbau oder an einem Gebirgsanker eingesetzt werden.

[0064] Da das gewalzte, aufgeschweißte Zusatzprofil, keine den Betrieb behindernde Verstärkungsrippen zwischen den Scherenverbindungen benötigt, kann sich eine Aufhängung mit dem Schiebe- oder Klemmanker, dem Abstand der Ausbaubögen oder Gebirgsankern, im Strecken- oder Tunnelvortrieb, diagonalzugfrei anpassen.

d.) Der EHB-Klemmanker:

[0065] Ein zweiteilig, symmetrisch ausgebildeter Klemmanker, zur Befestigung am EHB-Kombiprofil, aus einem gezogenen, gepresstem oder geschmiedetem Querschnitt, ist als Zusatzaufhängung in EHB-Zahn- und/oder Reibrad-Schwerlastbetrieben, oder auch zur freien Montage von Stromschienen oder Rollenträgern für EHB-Zugseile zur einfachen Montage an jedem EHB-Kombimodul geeignet.

[0066] Mit dem zweiteilig symmetrisch ausgebildeten Klemmanker, können Stromschienenträger für EMTS-Anlagen, oder Rollenträger für seilbetriebene EHB-Bahnen, ohne Schweißverbindungen, mit dem Kombiprofil an jeder Stelle am EHB-Schienenmodul, betriebsicher verspannt werden.

[0067] Mit diesen Klemmankern wird der Betrieb und das Verfahren von ortsveränderlichen Maschinen, für den Vortrieb im Berg- und Tunnelbau erleichtert, die in der zweiten Ebene des Streckenquerschnittes aufgehangen und montiert werden, ohne dass eine Behinderung von Rollen- oder Zahntriebläufwerken oder Schreitsystemen erfolgt.

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[0068] Mit den am Zusatzprofil angewalzten Sicherungsleisten, wird eine Verkrallung mit den angedrückten Verrippungen an den Klauen der umgreifenden Klemmanker zur größeren Sicherheit der Aufhängung, der einfallend oder ansteigend eingesetzten EHB-Schienensysteme, erreicht.

[0069] In geraden Streckenabschnitten können daher mit den zur Verfügung stehenden um 250% besseren statischen Werten des Kombiprofils, die Modullängen der EHB-Schienen vergrößert, mit den Klemmankern die Aufhängung den Abständen der Gebirgsanker oder Ausbaubögen angepasst und somit größere Gewichte in Schwerlastbetrieben aufgenommen werden.

[0070] Mit der dadurch erreichten geringeren Anzahl der Scherenverbindungen im Schienenstrang, wird eine größere Wirtschaftlichkeit und Sicherheit der EHB-Zahn- oder Reibradanlage erreicht.

[0071] Alle an diesen Schiebe- oder Klemmankern angreifenden Kräfte, die einmal durch das Gewicht der EHB-Züge und durch die mit der Radreibung erzeugten Zugkräfte der EHB-Zahnrad- und/oder Reibradzuglaufkatzen, sowie durch bedingte Pendelbewegungen der EHB-Zugeinheiten im Schienensystem entstehen, beschrieben unter DE 100 56 233 A1, werden als eine kettenlose Aufhängung, bestehend aus Sicherheitsspannschlössern, Zungentraversen mit Querlasttaschen zur Verhinderung des Polygoneffektes im Schienenstrang aufgenommen und in den Unterstützungsausbau oder den Gebirgsankern abgesetzt.

[0072] Damit stellt sich die vorliegende Erfindung die Aufgabe, neue Gegenstände zum sicheren und wirtschaftlichen Betrieb von kompatiblen EHB-Zahn- und/oder Reibrad Antriebssystemen im Berg- und Tunnelbau vorzustellen, die auf einer erfinderischen Tätigkeit beruhen und gewerblich anwendbar sind.

[0073] Alle genannten Merkmale, auch die den Zeichnungen allein zu entnehmenden, werden allein und in Kombination als erfindungsreich angesehen.

Ausführungsbeispiele.

[0074] Weitere Merkmale und Vorteile der Erfindung ergeben sich aus der Beschreibung und den dazugehörigen Zeichnungen mit den bevorzugten Ausführungsbeispielen, in denen die notwendigen Einzelheiten dargestellt werden. Es zeigen:

[0075] Fig. 1, den Längsschnitt einer Tunnel-Strecke mit Anker- und Unterstützungsausbau mit einem doppelten EHB-Zahnradantriebssystem.

[0076] Fig. 2, den Querschnitt des EHB-Schienen-Kombiprofils mit Laufrollen und der laufbahnverstärkende trapezförmigen Zahnstange.

[0077] Fig. 3, den oberen Querschnitt des EHB-Schienen-Kombiprofils mit einem ein- oder zweilaschigen Schiebeanker.

[0078] Fig. 4, den oberen Querschnitt des EHB-Schienen-Kombiprofils, a.) mit einem symmetrischen, zweiteiligen Klemmanker für eine Spanngabel oder b.) Kettenaufhängung mit Schäkel.

[0079] Fig. 5, den oberen Querschnitt des EHB-Schienen-Kombiprofils mit einem gelenkgeführten Scheren-Kugel- Gelenk.

[0080] Fig. 6, den oberen Querschnitt des EHB-Schienen-Kombiprofils mit einem gelenkgeführten Scheren-Kugel-Scheibengelenk.

[0081] Fig. 7, Vorderansicht-, Draufsicht mit den Ansichten A und B des Zahnstangen-Taschengelenkes.

[0082] Fig. 8, die Seitenansicht einer aufgeschweißten gelenkgeführten Scherenverbindung mit Kugelgelenk und einer elastischen Schienenverspannung, dem EHB-Schienen-Kombiprofil, der Zahnstange mit Taschengelenk und die Aufhängung mit dem Schiebeanker.

[0083] Fig. 9, den oberen Querschnitt des EHB-Schienen-Kombiprofils mit einer austauschbaren, gelenkgeführten Scherenverbindung, Kugel-Scheibengelenk und Spannschrauben.

[0084] Fig. 10, die Seitenansicht und Querschnitt einer elastischen Schienenverspannung mit Federelementen, zur Stabilisierung und Verhinderung des Polygoneffektes im EHB-Schienenstrang.

[0085] Fig. 11, den oberen Querschnitt des EHB-Schienen-Kombiprofils mit einem montierten Klemmanker und Träger für Stromschienen.

[0086] Fig. 12, den Querschnitt des EHB-Schienen-Kombiprofils nach DIN 20653, mit Laufrollen für Zahn- und Reibradantriebe und dem laufbahnverstärkenden Zahnstangenbett.

[0087] Fig. 13, den oberen Querschnitt des EHB-Schienen-Kombiprofils mit einem gelenkgeführten Scheren-Winkelscheibengelenk.

[0088] Fig. 14, den oberen Querschnitt des EHB-Schienen-Kombiprofils mit einem gelenkgeführten Scheren-Bewegungsscheibengelenk.

Beschreibung

[0089] Fig. 1 zeigt den Längsschnitt **1** durch einen

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geankerten **2**, bzw. mit Unterstützungsausbau **3** gesicherten Streckenabschnitt **4**, mit einer EHB-Anlage mit Zahnradantrieb **5**, bestehend aus der Fahrerkabine **6**, mit zahnradgetriebenen EHB-Doppelantrieben **7**, der Elektro-Dieselhydrostation oder Elektrohydrostation **8**.

[0090] Für den sicheren Transport von gewonnenen Mineralien oder Abraum aus Abbau- oder Tunnelvortrieben, ist ein schlupfloser Zahnradantrieb **7** in feuchten und steilen Gewinnungsbetrieben, wegen der besseren Steigfähigkeit und Leistung/Antrieb dieser Ausführung, besonders wirtschaftlich.

[0091] Die Aufhängung **9** eines EHB-Schienenmoduls **10**, an einem Klemmanker **17** mit diagonal angeordneten Sicherheitsspannschlössern **12**, zeigt die kettenlose Aufhängung **13**, am TH-Bogenausbau **14** mit der Zungentraverse **15**.

[0092] Die kettenlose Aufhängung **13** in einer geankerten Strecke **2**, erfolgt mit der vorgespannten Ankertraverse **16** und dem Schiebe- **11** oder Klemmanker **17**.

[0093] Der Klemmanker **17** ist für einen Gabelanschluss ausgebildet und wird je nach Ausführung der Aufhängung **13** mit Sicherheitsspannschlössern **12**, auch zweiteilig, für einen Ösen- oder Laschenanschluss, als Klemmanker **18** ausgelegt.

[0094] Der Schiebeanker **11** wird vor Verschweißung der Scherenlaschen **20** der Scherenverbindung **19** auf das Zusatzprofil **21**, des Schienenmoduls **10** aufgeschoben und ist dadurch unverlierbar mit dem Schienenmodul **10** verbunden.

[0095] In Betrieben mit abrasiven Stäuben, kann bei einem vorzeitigen Verschleiß der Laufbahn **23** in dem Schienenmodule **10**, eine mit Spannschrauben **71** festgelegte und auswechselbare gelenkgeführten Scherenverbindung **22** eingesetzt werden.

[0096] Fig. 2 zeigt den Querschnitt des Kombiprofils **24** eines EHB-Schienenmoduls **10**, mit dem auf dem Oberflansch **26** eines handelsüblichen IPN Profiles **25**, aufgeschweißten Zusatzprofil **21** mit den Sicherheitsleisten **31**.

[0097] Für Zahnradantriebe **2** wird der Unterflansch **27** für die großen Laufrollen **30**, mit dem zur biege- und rollensteifen Verstärkung ausgebildeten und untergeschweißten, Zahnstangenbett **29**, des trapezförmig ausgebildeten Zahnstangenmodules **28**, zur Vergrößerung der Lastaufnahme und Kantenversteifung **97** der Laufbahn **88**, unter Beibehaltung der spezifischen Belastung, mit den für dieses Kombiprofil **24** ausgelegten großen Laufrollen **30**, verstärkt.

[0098] Für Reibungsantriebe kann der Unterflansch **27** für die Laufrollen **30** zur Vergrößerung der Lastaufnahme und Kantenversteifung **97** unter Beibehaltung der spezifischen Belastung mit den für dieses Kombiprofil **24** ausgelegten großen Laufrollen **30**, mit einem Flachprofil **93**, für Reibradantriebe **95** oder für den kompatiblen Betrieb unter Beibehaltung des Zahnstangenbettes **29**, verstärkt werden.

[0099] Mit dieser verschweißten Anordnung der Querschnitte zu **21**, **25**, **29** und **93** erhält das für alle Antriebssysteme kompatible Kombiprofil **24** ein 2,5 fach höheres Widerstandsmoment gegenüber den bisher verwendeten EHB-Profilen.

[0100] Fig. 3 zeigt den Querschnitt eines gewalzten, aufgeschweißten Zusatzprofils **21** mit unteren Sicherungsleisten **31**, verschweißt mit dem Oberflansch **26** des Kombiprofils **24**, in der Darstellung mit einem einteiligen mittellaschigen Schiebeanker **11**, der vor Verschweißung der gelenkgeführten Scherenlaschen **20**, oder vor Montage der auswechsel-baren Scherenlaschen **22**, auf das Zusatzprofil **21** aufgeschoben wird und dadurch unverlierbar, für alle nachträglichen Montagen einer Abspannung zur Verfügung steht.

[0101] Die Mittellasche **34** des als Pressprofil **35** hergestellten Schiebeankers **11** wird von einer Spannschlossgabel **36** oder auch bei einer Aufhängung mit Ketten **37** von einem Schäkel **38**, zur Verankerung mit dem Strecken- **14** oder Ankerausbau **16** aufgenommen.

[0102] Die Sicherungsleisten **31** des Zusatzprofils **21** werden von den Laschen **39** des Schiebeankers **11** oder **32** untergriffen und mit einer Verzahnung **40** ausgebildet, die sich mit den Sicherungsleisten **31** nur bei Belastung, abrutschsicher verkrallen.

[0103] Fig. 4 zeigt den Querschnitt eines gewalzten, aufgeschweißten Zusatzprofils **21** mit unteren Sicherungsleisten **31**, verschweißt mit dem Oberflansch **26** des Kombiprofils **24**, in der hälftigen Darstellung a.) mit einem Klemmanker **17** für eine Gabel- und **18** und in der hälftigen Darstellung b.) für eine Schäkel- oder Laschenaufhängung **18** dargestellt.

[0104] Die symmetrische Ausführungen der Klemmanker **17** und **18** werden mit Imbusschrauben **41** und Sicherheitsmutter **42** verspannt.

[0105] Die Sicherungsleisten **31** des Zusatzprofils **21** werden von den Laschen **39** des Klemmankers **17** oder **18** untergriffen und mit einer Verzahnung **40** ausgebildet, die sich mit den Sicherungsleisten **31**, nur bei Belastung, abrutschsicher verkrallen.

[0106] Fig. 5 zeigt den Querschnitt einer auf dem Zusatzprofil **21** verschweißten gelenkgeführten Scherenverbindung **19**, mit den Scherenlaschen **20**

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und dem Scheren-Kugel-Gelenk **43**.

[0107] Die gelenkgeführten Scherenlasche **44** mit der Bohrung **45** und der Kugelhalbschale **46** nimmt die Hohlkulisse **47** mit der Scherenlasche **48**, mit dem Langloch **49** auf und bei einer horizontalen als auch vertikalen Bewegung in der gelenkgeführten Scherenverbindung **19**, werden die Schnittflächen **50** des EHB-Schienenmoduls **10**, ohne Profilverschiebung um die Achse **51**, geführt.

[0108] Zur besseren Ausrichtung der Schienenmodule **10** in die Stunde, wird mit einer Spannschraube **52**, der drehgesicherten Sicherheitsmutter **53** und mit der Tellerfeder und Unterlegscheibe **54**, eine Versteifung der gelenkgeführten Scherenverbindung **19** mit dem Scheren-Kugelgelenk **43**, erreicht.

[0109] Fig. 6 zeigt den Querschnitt einer auf dem Zusatzprofil **21** verschweißten gelenkgeführten Scherenverbindung **19**, mit den Scherenlaschen **20** und dem Scheren-Kugel-Scheibengelenk **55**.

[0110] Die Kugelscheibe **56** als auch die Hohlscheibe **57**, werden zwischen der gelenkgeführten Scherenlasche **58** mit Bohrung, der Scherenlasche **59** mit Langloch, mit der Spannschraube **52**, der drehgesicherten Sicherungsmutter **53** und der Tellerfeder mit der Unterlegscheibe **54** gesichert und bei einer horizontalen als auch vertikalen Bewegung der Schnittflächen **50** des EHB-Schienenmoduls **10**, ohne Profilverschiebung um die Achse **51** geführt und die Hohlscheibe **57** mit der Kugelscheibe **56** vollflächig verspannt.

[0111] Zur automatischen Ausrichtung der Schienenmodule **10** in die Stunde, wird eine elastische Versteifung der gelenkgeführten Scherenverbindung **19**, mit dem Scheren-Kugel-Scheibengelenk **55**, erreicht.

[0112] Fig. 7 zeigt die Vorderansicht, Draufsicht und die Ansichten A und B des für alle Antriebssysteme kompatiblen Zahnstangen-Taschengelenkes **60**.

[0113] Die Zahnstangentasche **61** mit den Verstärkungsrippen **62**, verschweißt mit dem Unterflansch **27** des Kombiprofils **24**, verstärkt in der Breite **64**, die rollen- und biegesteife EHB-Laufbahn **23** des Kombiprofils **24**.

[0114] Die Zahnstangenkralle **63** greift drehgelenkig mit der balligen Verlagerung **100** in die Zahnstangentasche **61** ein und ist mit den außenliegenden Verstärkungsrippen **66**, mit dem Unterflansch **27** des Kombiprofils **24** verschweißt.

[0115] Mit der radial angeordneten Ausbildung **98** der Zahnstangentasche **61** und der Zahnstangenkralle **63**, werden alle räumlichen Bewegungen funktionsgerecht mit dem Freiraum **99** von dem Zahnstangen-Taschengelenk **60** aufgenommen.

[0116] Das Zahnstangentaschengelenk **60**, als auch die Zahnstangenmodule **67** werden als Schmiedeteile oder als schweißbare Gussteile ausgeführt.

[0117] Fig. 8 zeigt die Verbindung von EHB-Schienenmodulen **10** mit einer verschweißten gelenkgeführten Scherenverbindung **19**, den breit aufliegenden Laufrädern **30** auf der rollen- und biegesteifen Laufbahn **23**, dem Zahnstangentaschengelenk **60**, den Zahnstangenmodulen **67** und die kettenlose EHB-Aufhängung **13** mit einem mittellaschigen Schiebeanker **17**, **11**, für eine Ketten- oder Spannschlossaufhängung.

[0118] Die aufgeschweißte gelenkgeführte Scherenverbindung **19** mit dem Scheren-Kugelgelenk **43** oder Scheibengelenk **55**, wird in vertikalen als auch in horizontalen Bewegungen um die Achse **51**, ohne Versetzungen der Profil-Schnittflächen **50**, geführt.

[0119] Fig. 9 zeigt das System einer lösbaren, gelenkgeführten Scherenverbindung **68**, mit der Möglichkeit, die Schienenmodule in Betrieben mit abrasiven Stäuben ohne Verlust der gelenkgeführten Scherenverbindungen **19**, auszuwechseln.

[0120] Die in einem Pressprofil asymmetrisch, zur Achse **51** angeordneten Scherenlaschen **69**, **70**, werden aus dem gleichen Strang, nach der Ausführung mit einer Bohrung **96** oder Langloch **70** geschnitten.

[0121] Die Scherenlaschen **86** oder **70** werden zur Montage auf die Schienenmodule **10** aufgeschoben und mit den drehgesicherten Spannschrauben **71** mit Innensechskant **72**, mit dem Zusatzprofil **21**, in den Profilkanälen **73** verspannt.

[0122] Zur besseren Ausrichtung der Schienenmodule **10** in die Stunde, wird mit einer Spannschraube **52**, Sicherheitsmutter **54** und der Tellerfeder **54** mit Unterlegscheibe, eine Versteifung der gelenkgeführten Scherenverbindung **19**, mit einem Kugelschalen- **43**, Kugelscheiben- **55**, Winkel- **101** oder Bewegungsgelenk **104** erreicht.

[0123] Fig. 10 zeigt die gelenkgeführte Scherenverbindung **19** mit den Scherenlaschen **20**. In den von dem Zusatzprofil **21** gebildeten Kanälen **73**, mit gegenläufig eingelegten, drehgesicherten Spannschrauben **74** mit Innensechskant **72**, können die Schienenmodule **10** zusätzlich, zur Verhinderung eines Polygonaufbaus im Schienenstrang **92** in der Scherenverbindung **19**, verspannt werden.

[0124] Die eingeschweißten Anschlagnocken **75** erhalten als Schmiedeteile, zur vertikalen und horizontalen Bewegung, konische Bohrungen **76**.

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[0125] Die erforderliche Vorspannung in der gelenkgeführten Scherenverbindung **19** und zur entlastenden Aufnahme von Zugspannungen aus dem Zahnstangen-Taschengelenk **60**, wird mit den angeordneten Tellerfedern **77** der Spannschraube **74** erreicht.

[0126] Fig. 11 zeigt den Querschnitt eines gewalzten, aufgeschweißten Zusatzprofils **21** mit unteren Sicherungsleisten **31**, verschweißt mit dem Oberflansch **26** des Kombiprofils **24**, in der Darstellung mit einem zweiteiligen Klemmanker **78**, Spannschrauben **79**, Stromschienenhalter **80**, für den Elektro-Hydroantrieb der EHB-Zahnradantriebe **7**.

[0127] Der Einsatz dieser EHB-Stromschienensysteme **81**, ist jedoch nur in Sch-Ex freien Betrieben und bei Bedarf, zur nachträglichen Ausrüstung einer EHB-Anlage, möglich. Die Stromschienenhalter **80** können in einer freien Reihenfolge an den EHB-Schienenmodulen **10**, mit dem Klemmanker **78** verspannt werden.

[0128] Fig. 12 zeigt den Querschnitt des EHB-Schienen-Kombiprofils **85** mit dem aufgeschweißten Zusatzprofil **21**, mit den unteren Sicherungsleisten **31**, verschweißt mit dem Oberflansch **86** des symmetrischen Walzprofils **87** nach DIN 20653.

[0129] Die Laufbahn **88** wird zur Vergrößerung der Lastaufnahme und Kantenversteifung **97**, zur Beibehaltung der spezifischen Belastung für die dafür ausgelegten Laufrollen **89**, mit dem untergeschweißten Zahnstangenbett **90** für Zahnradantriebe **7**, oder Bedarfsweise mit einem Flachprofil **93** für Reibradantriebe **95** roll- und biegesteif verstärkt.

[0130] Das Kombiprofil **85** ist In dieser Ausführung in den statischen Werten stärker ausgelegt, als alle bisher eingesetzten EHB-Profile und kann daher mit den im Einsatz befindlichen schweren EHB-Antriebseinheiten, gefahrlos befahren werden.

[0131] Fig. 13, zeigt den Querschnitt einer auf dem Zusatzprofil **21** verschweißten gelenkgeführten Scherenverbindung **19**, mit den Scherenlaschen **20** und dem Scheren-Winkelscheibengelenk **101**.

[0132] Die zwischen den Scherenlaschen **20** eingelegte Winkelscheibe **102**, mit einer für die Spannschraube **52** ausreichend dimensionierten Anpressfläche **103**, wirkt als Begrenzung für die horizontale Bewegung der Schienenmodule.

[0133] Bei einer horizontalen als auch vertikalen Bewegung in der gelenkgeführten Scherenverbindung **19**, mit der Winkelscheibe **102** werden die Schnittflächen **50** des EHB-Schienenmoduls **10**, ohne Profilverschiebung um die Achse **51** geführt.

[0134] Zur besseren Ausrichtung der Schienenmodule **10** in die Stunde, wird mit der Spannschraube **52**, Sicherheitsmutter **54** und der Tellerfeder **54** mit Unterlegscheibe, eine elastische Versteifung der gelenkgeführten Scherenverbindung **19**, mit dem Scheren-Winkelscheibengelenk **101**, erreicht.

[0135] Fig. 14, zeigt den Querschnitt einer auf dem Zusatzprofil **21** verschweißten gelenkgeführten Scherenverbindung **19**, mit den Scherenlaschen **20** und dem Scheren-Bewegungsgelenk **104**.

[0136] Die zwischen den Scherenlaschen **20** eingelegte, radial ausgebildete Bewegungsscheibe **105**, mit einer für die Spannschraube **52** ausreichend dimensionierten Anpressfläche **103**, wirkt als Begrenzung für die horizontale Bewegung der Schienenmodule.

[0137] Bei einer horizontalen als auch vertikalen Bewegung in der gelenkgeführten Scherenverbindung **19**, mit der Winkelscheibe **105** werden die Schnittflächen **50** des EHB-Schienenmoduls **10**, ohne Profilverschiebung um die Achse **51** geführt.

[0138] Zur besseren Ausrichtung der Schienenmodule **10** in die Stunde, wird mit der Spannschraube **52**, Sicherheitsmutter **54** und der Tellerfeder **54** mit Unterlegscheibe, eine elastische Versteifung der gelenkgeführten Scherenverbindung **19**, mit dem Scheren-Bewegungsgelenk **104**, erreicht.

[0139] Ein Scherengelenk mit einer flachen radial geformten Bewegungsscheibe, mit dem Durchmesser der Anpressfläche **103**, zur Verminderung des Verkantungsausschlages mit der Länge der Scherenlaschen, ist zeichnerisch nicht dargestellt

Bezugszeichenliste

1	Längsschnitt einer EHB-Anlage, mit EHB-Kombischienenmodule
2	Streckenabschnitt, geankert, zu **1**
3	Streckenabschnitt, mit Unterstützungsausbau, zu **1**
4	Streckenabschnitt, zu **1**
5	EHB-Anlage mit Zahnstangenantrieb, zu **1**
6	Fahrerkabine, zu **5**
7	Zahnrad-Doppelantrieb, zu **5**
8	Diesel- oder Elektrohydrostation, zu **5**
9	Aufhängung, zu **3**
10	EHB-Schienenmodul, aus INP zu **5**
11	Schiebeanker, mittellaschig, zu **2** und **3**
12	Sicherheitsspannschloss, zu **9**
13	Aufhängung, kettenlos, zu **9**
14	TH-Bogen-Unterstützungsausbau, zu **3**
15	Zungentraverse, zu **14**
16	Ankertraverse, vorgespannt, zu **2**
17	Klemmanker, Gabelaufhängung, zu **2** und **3**
18	Klemmanker, Ösen/Laschenaufhängung, zu **2** und **3**

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19 Gelenkgeführte Scherenverbindung, verschweißt, zu **21**
20 Gelenkgeführte Scherenlaschen, zu **19**
21 Zusatzprofil, zu **10**
22 Gelenkgeführte Scherenverbindung, auswechselbar, zu **10**
23 Laufbahn, zu **24**
24 Kombiprofil, zu **10**
25 IPN 220, zu **24**
26 Oberflansch, zu **24**
27 Unterflansch, zu **24**
28 Zahnstangenmodul, trapezförmig, zu **27**
29 Zahnstangenbett, zu **28**
30 Laufrollen, zu **5**
31 Sicherungsleisten, zu **21**
32 Schiebeanker, zweilaschig, zu **33**
33 Zusatzaufhängung, zu **32**
34 Mittellasche, zu **11**
35 Außenlaschen, zu **32**
36 Spannschlossgabel, zu **34**
37 Kettenaufhängung, zu **32**
38 Kettenschäkel, zu **37**
39 Lasche, untergreifend, zu **21**
40 Verzahnung, zu **39**
41 Spannschraube mit Innensechskant, zu **17** und **18**
42 Sicherheitsmutter, zu **41**
43 Kugelgelenk, zu **19** und **20**
44 Gelenkgeführte Scherenlasche mit Bohrung, zu **43**
45 Bohrung, zu **44**
46 Kugelschale, zu **44**
47 Hohlkulisse, zu **48**
48 Gelenkgeführte Scherenlasche mit Langloch, zu **43**
49 Langloch, zu **48**
50 Profil-Schnittflächen, zu **24**
51 Achse, zu **10**
52 Spannschraube, zu **43**
53 Sicherheitsmutter mit Drehsicherung, zu **43**
54 Tellerfeder mit Unterlegscheibe, zu **43**
55 Kugelscheibengelenk, zu **24**
56 Kugelscheibe, zu **55**
57 Hohlscheibe, zu **55**
58 Gelenkgeführte Scherenlasche mit Bohrung, zu **55**
59 Gelenkgeführte Scherenlasche mit Langloch, zu **55**
60 Zahnstangen-Taschengelenk, zu **24**
61 Zahnstangentasche, zu **24**
62 Verstärkungsrippen, zu **61**
63 Zahnstangenkralle, zu **61**
64 Taschengelenk, Breite, zu **60**
65 Gelenktasche, zu **60**
66 Verstärkungsrippen, zu **63**
67 Zahnstangenmodule, zu **24**
68 Gelenkgeführte Scherenverbindung, lösbar, zu **24**
69 Gelenkgeführte Scherenlasche mit Bohrung, zu **68**
70 Gelenkgeführte Scherenlasche mi+ Langloch, zu **68**
71 Spannschrauben, zu **69** und **70**
72 Innensechskant, zu **71**
73 Spannkanal, zu **21**
74 Spannschrauben, zu **73**
75 Anschlagnocken, zu **73**
76 Bohrung, konisch, zu **75**
77 Tellerfedern, zu **74**
78 Klemmanker, zu **21** und **24**
79 Spannschrauben, zu **78**
80 Stromschienenhalter, zu **78**
81 Stromschienensystem, zu **78**
82 Flansch, Zusatzprofil, zu **21**
83 Zahnprofil, zu **28**
84 Schienenverspannung, zu **10**
85 EHB-Schienen-Kombimodul **140E**
86 Oberflansch, zu **85**
87 Walzprofil, nach DIN 20653
88 Laufbahn, zu **85**
89 Laufrollen, klein, zu **88**
90 Zahnstangenbett, zu **85**
91 Zahntaschen, zu **83**
92 Schienenstrang, zu **1**, **2** und **3**
93 Flachprofil, zu **85**, **87**, **88** und **89**
94 Reibradantrieb, zu **24**, **85**, **87**
95 Schienenmodule, zu **87**
96 Taschengelenk, zu **87**
97 Versteifung im Kantenbereich, zu **24** und **87**
98 Radius, zu **60**
99 Freiwinkel, zu **61** und **63**
100 Gallige Verlagerung, zu **61** und **63**
101 Winkelgelenk, zu **10** und **85**
102 Winkelscheibe, zu **101**
103 Anpressfläche, zu **102** und **105**
104 Bewegungsgelenk, zu **10** und **85**
105 Bewegungsscheibe, radial geformt
106 Radius, zu **104**
107 Bewegungswinkel, zu **101** und **102**

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ZITATE ENTHALTEN IN DER BESCHREIBUNG

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Patentansprüche

1. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil (**10**, **87**), mit einer Scherenverbindung (**19**, **68**), Kugel- (**43**) oder Kugel-Scheibengelenk (**55**), sowie Winkel- (**101**) oder Bewegungsgelenk (**104**), Schiebe- (**11**) und/oder Klemmanker (**17**, **18**) mit Sicherungsmitteln (**40**) zur selbsttätigen Festlegung an den Sicherungsleisten (**31**) des aufgeschweißten Zusatzprofils (**21**), **dadurch gekennzeichnet**, dass horizontale oder vertikale Bewegungen der Scherenverbindung (**19**, **68**) mit den Gelenken (**43**, **55**, **101** und **104**) ohne Profilversatz erfolgen, ein roll- und biegesteifer Flansch (**27**), mit dem untergeschweißten Zahnstangenbett (**29**) oder Flachprofil (**93**) gebildet wird, der die Rollenlaufbahn (**23**, **88**) zur Aufnahme von größeren Lasten im Kantenbereich (**97**) verstärkt und die kompatiblen Schienenmodule (**10**, **95**), für alle räumlichen Bewegungen in der Achse (**51**) mit dem Taschengelenk (**60**, **96**) mit einer radialen Verbindung (**98**) für Zahnrad- (**7**) oder Reibradantriebe (**94**) polygonunterdrückend verbindet und für Reib- (**94**) und Zahnrad- (**7**) Antriebssysteme kompatibel befahrbar macht.

2. Schiebe- oder Klemmanker für EHB-Schienenmodule, nach Anspruch 1, dadurch gekennzeichnet dass die ausgebildeten Sicherungsmittel (**40**) die Sicherungsleiste (**31**) unterfassen.

3. Schiebe- oder Klemmanker für EHB-Schienenmodule, nach einem der Ansprüche 1 und 2 dadurch gekennzeichnet, dass die Sicherungsleisten (**31**) oberhalb oder/und unterhalb des Flansches (**82**) angeordnet sind.

4. Schiebeanker für EHB-Schienenmodule nach einem der Ansprüche 1 bis 3 dadurch gekennzeichnet, dass der Schiebeanker (**11**, **32**) unverlierbar auf dem Oberflansch (**82**) eines Schienenmoduls (**10**), vor Montage der Scherenverbindung (**19**, **68**) zwischen den Scherenlaschen (**19**, **20**, **69**, **70**) angeordnet wird.

5. Schiebe- oder Klemmanker für EHB-Schienenmodule nach einem der Ansprüche 1 bis 4 dadurch gekennzeichnet, dass sich der Schiebe- (**11**, **32**) oder Klemmanker (**17**, **18**) nur unter Last, mit der vorgesehenen Verzahnung (**40**), festlegt.

6. Schiebe- oder Klemmanker für EHB-Schienenmodule nach einem der Ansprüche 1 bis 5 dadurch gekennzeichnet, dass der Schiebeanker (**11**, **32**) mit einem Mittelflansch (**34**) oder zwei Außenflanschen (**35**) ausgebildet ist.

7. Schiebe- oder Klemmanker für EHB-Schienenmodule nach einem der Ansprüche 1 bis 6 dadurch gekennzeichnet, dass der zweiteilige Klemmanker (**17**, **18**) symmetrisch für ein gabelförmiges oder laschenförmiges Aufhängeelement (**33**) ausgebildet ist.

8. Schiebe- oder Klemmanker für EHB-Schienenmodule nach einem der Ansprüche 1 bis 7 dadurch gekennzeichnet, dass die (**11**, **32**) Schiebe- und Klemmanker (**17**, **18**) als Pressprofil oder als Schmiedeteil gefertigt werden.

9. Schiebe- oder Klemmanker für EHB-Schienenmodule nach einem der Ansprüche 1 bis 8 dadurch gekennzeichnet, dass der Klemmanker (**17**, **18**) mit drehgesicherten Spannschrauben (**41**) festgelegt wird.

10. Scherenverbindung mit Kugelschalen- oder Kugelscheibengelenk nach Anspruch 1 dadurch gekennzeichnet, dass in der horizontalen und vertikalen Bewegungslage der Scherenverbindungen (**19**, **68**) die Profilschnittflächen (**50**) sich ohne Versatz, um die Achse (**51**) bewegen.

11. Scherenverbindung mit dem Kugelschalengelenk nach einem der Ansprüche 1 oder 10 dadurch gekennzeichnet, dass die Scherenlaschen (**19**, **20**) mit dem Kugelschalensystem (**46**, **47**) aus einem Stück geschmiedet oder gegossen sind.

12. Scherenverbindung mit dem Kugelscheibengelenk nach Anspruch 11 dadurch gekennzeichnet, dass das Kugelscheibengelenk (**55**) aus zwei Scheiben (**56**, **57**) besteht.

13. Scherenverbindung mit einem Winkel- oder Bewegungsgelenk nach Anspruch 12 dadurch gekennzeichnet, dass das Winkel- (**101**) und Bewegungsgelenk (**104**) aus einteiligen Winkel- (**102**) und Bewegungsscheiben (**105**) gebildet wird.

14. Scherenverbindung nach Anspruch 12 und 13 dadurch gekennzeichnet, dass die Scherenverbindungen (**19**, **68**) mit einer Tellerfeder und Sicherheitsscheibe (**54**) und einer drehgesicherten Spannschraube (**52**) versteift werden.

15. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 1 dadurch gekennzeichnet, dass durch das Zahnstangenbett (**29**) oder dem Flachprofil (**93**), der Flansch (**17**) der EHB-Laufbahn (**23**), roll- und biegesteif, unter Beibehaltung der spezifischen Laufbahn (**23**, **88**) für die Rollen (**30**, **89**) verstärkt und für Reib- und Zahnradantriebe kompatibel ist.

16. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 15 dadurch gekennzeichnet, dass das Zahnstangengelenk (**60**) aus einer Zahnstangentasche (**61**) und Zahnstangenkralle (**63**) besteht, radi-

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al (**98**) und ballig (**100**) mit dem Freiwinkel (**99**) verlagert, für Reib- (**94**) und Zahnradantriebe (**7**) beweglich und kompatibel ausgebildet ist.

17. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach einem der Ansprüche 1, 15 und 16 dadurch gekennzeichnet, dass die Zahnstangentasche (**61**) und die Zahnstangenkralle (**63**) mit Verstärkungsrippen (**62**, **66**) versteift werden.

18. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 17 dadurch gekennzeichnet, dass die Zahnstangenmodule (**67**) im Querschnitt, trapezförmig ausgebildet sind.

19. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 18 dadurch gekennzeichnet, dass das Zahnstangenbett (**29**) breiter ausgebildet ist, als die trapezförmigen Zahnstangenmodule (**67**) und die Zahnprofile (**83**) mit Zahntaschen (**90**) ausgebildet sind.

20. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 19 dadurch gekennzeichnet, dass die Zahnstangenmodule (**67**) aus Stahlguss bestehen oder geschmiedet werden.

21. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 20 dadurch gekennzeichnet, dass die Zahnstangenmodule (**67**) aus Walzmaterial mit Wasser- oder Laserstrahl, im Doppelpaar geschnitten werden.

22. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 21 dadurch gekennzeichnet, dass in den mit dem Zusatzprofil (**21**) gebildeten Kanälen (**73**), Spannschrauben (**74**) mit Anschlagnocken (**75**) untergebracht sind.

23. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 22 dadurch gekennzeichnet, dass die Anschlagnocken (**75**) mit konischen Bohrungen (**76**) ausgebildet werden.

24. EHB-Schienen-Kombiprofil aus einem handelsüblichen Walzprofil mit einem Zahnstangentrieb nach Anspruch 23 dadurch gekennzeichnet, dass die Spannschrauben (**74**) mit den zugeordneten Tellerfedern (**77**) räumliche Bewegungen der Schienenmodule (**10**) dämpfen und damit den Polygonaufbau zwischen den Schienenmodulen (**10**) im EHB-Schienenstrang (**93**) unterdrücken.

25. EHB-Schienen-Kombiprofile nach Anspruch 1 bis 24 dadurch gekennzeichnet, dass EHB-Anlagen aus den Kombimodulen (**10**, **85**), für Zahn- (**7**) und Reibradantriebe (**94**) kompatibel und mit kantenversteiften Laufbahnen (**23**, **88**) ausgebildet sind.

26. EHB-Schienen-Kombiprofile nach Anspruch 1 bis 25 dadurch gekennzeichnet, dass EHB-Anlagen aus den Kombimodulen (**10**, **85**), für Zahn- (**7**) und Reibradantriebe (**94**) kompatibel und mit kantenversteiften Laufbahnen (**23**, **88**) ausgebildet sind und die Profil-Schnittflächen (**50**) abgerundet ausgebildet sind.

Es folgen 14 Blatt Zeichnungen

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Anhängende Zeichnungen

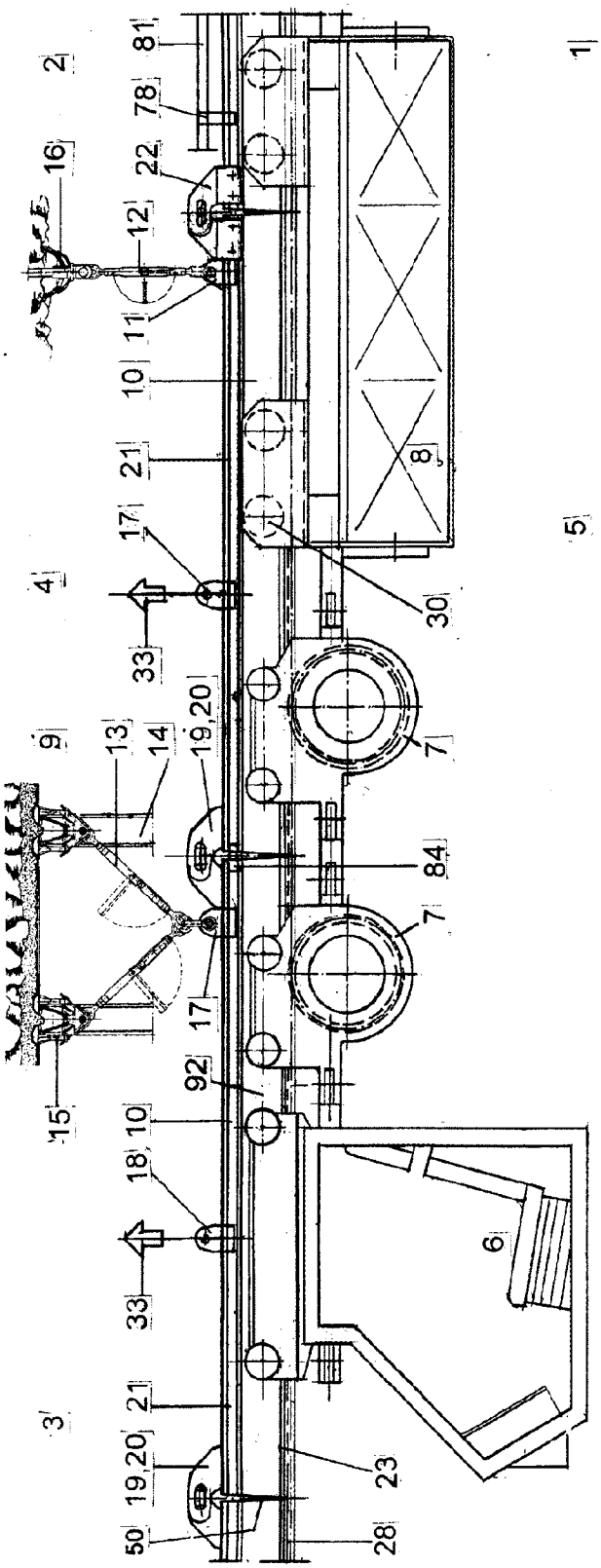


Fig. 1

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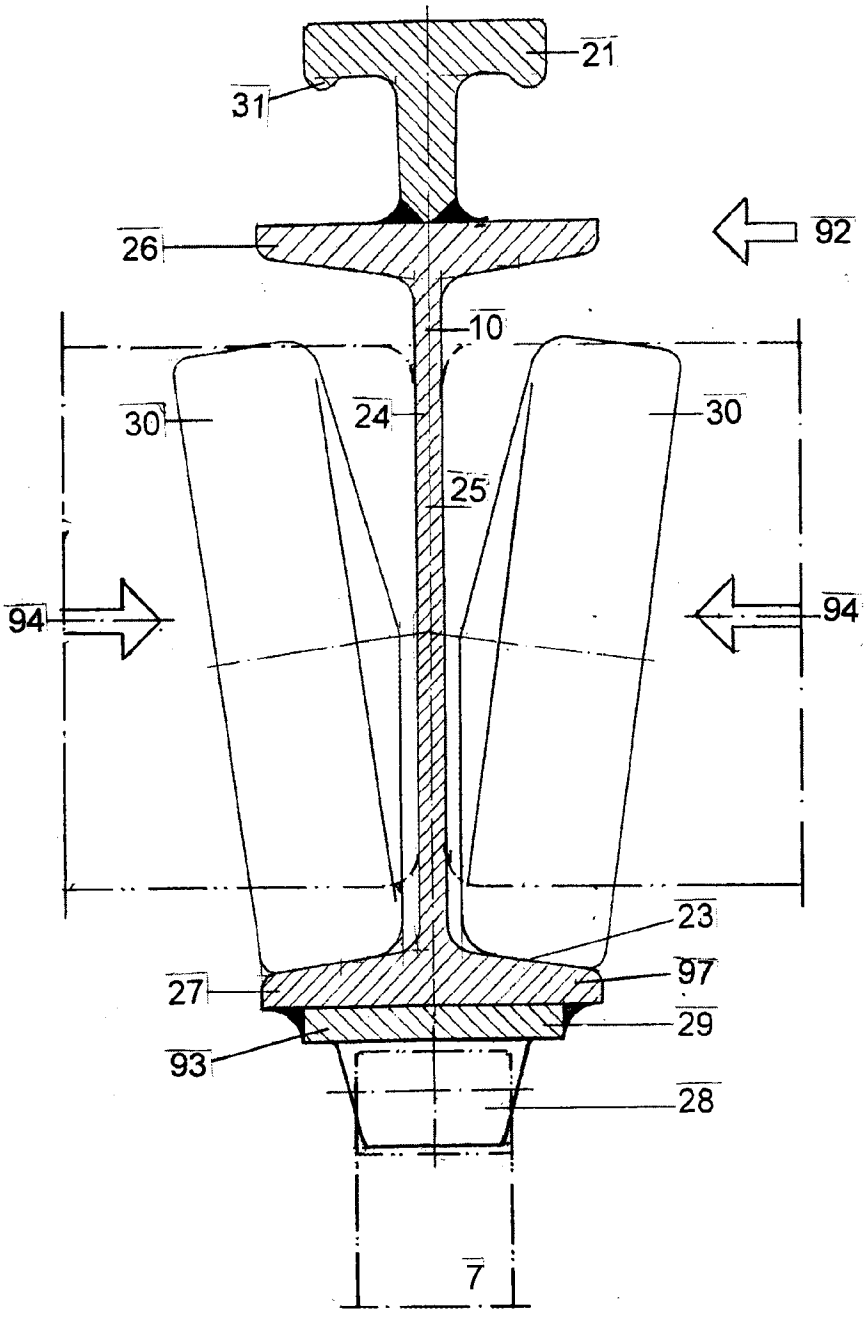


Fig. 2

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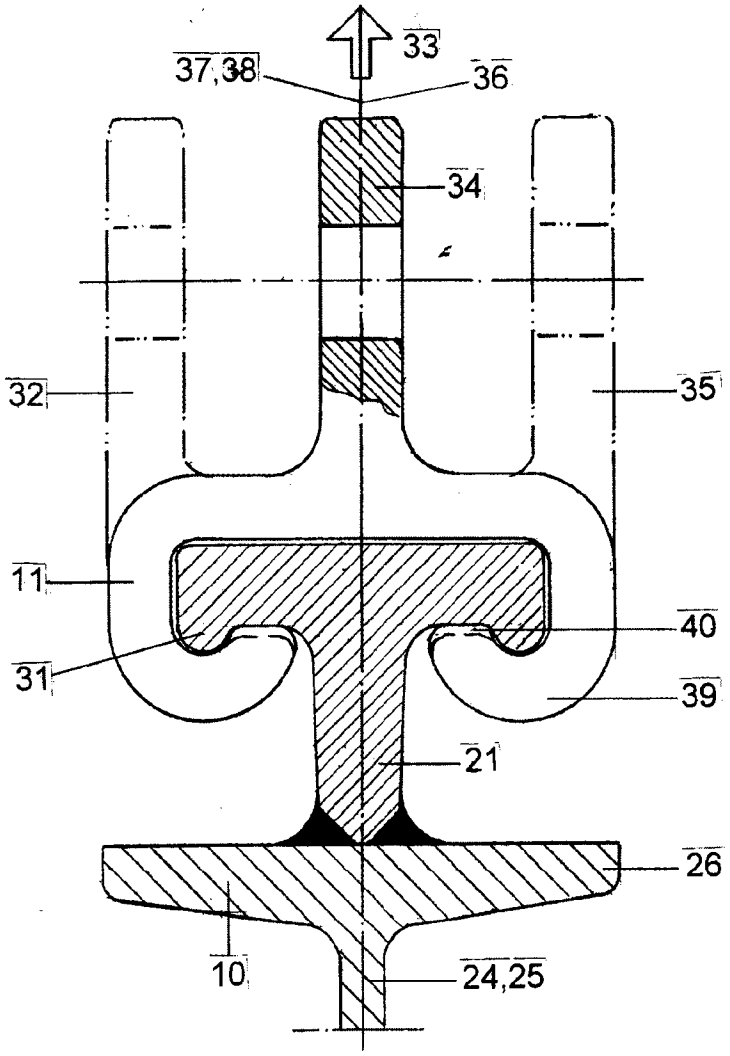


Fig. 3

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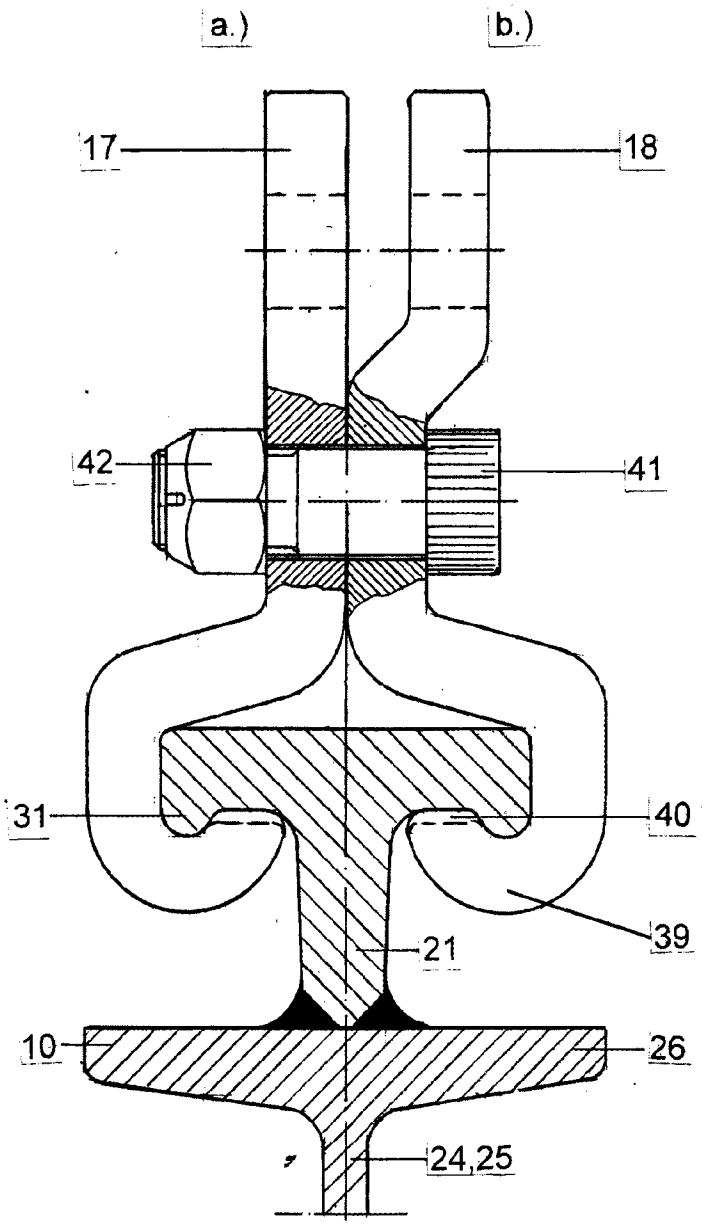


Fig. 4

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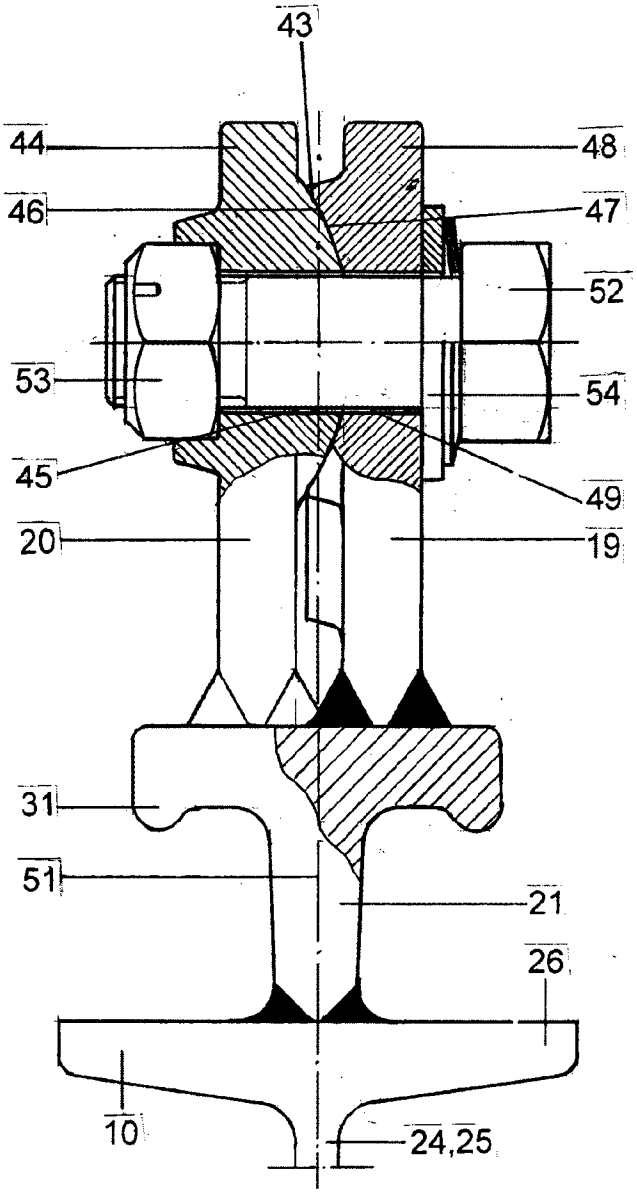


Fig. 5

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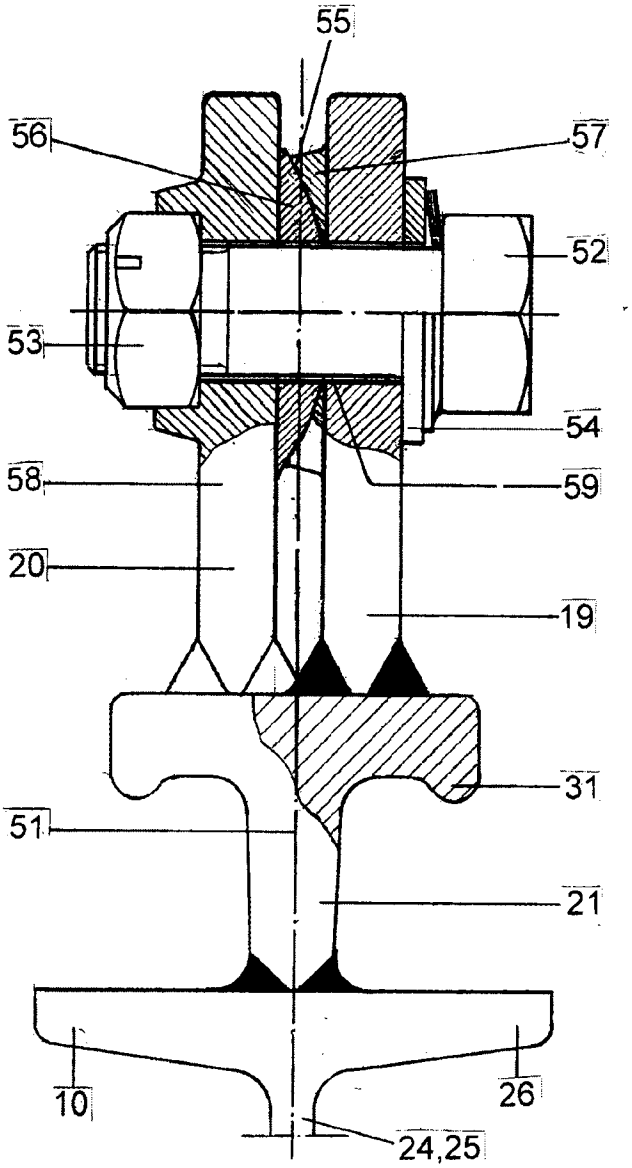


Fig. 6

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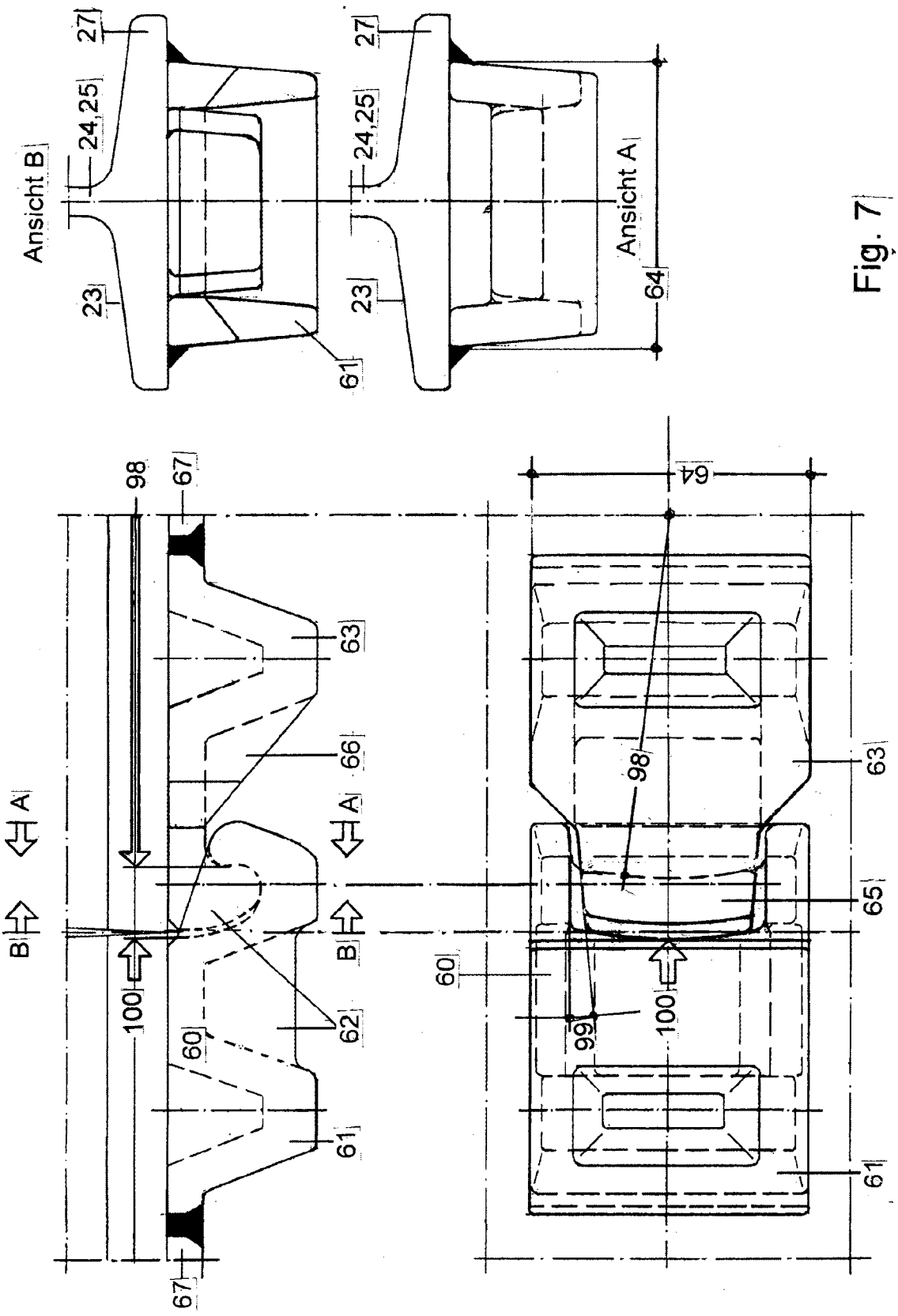


Fig. 7

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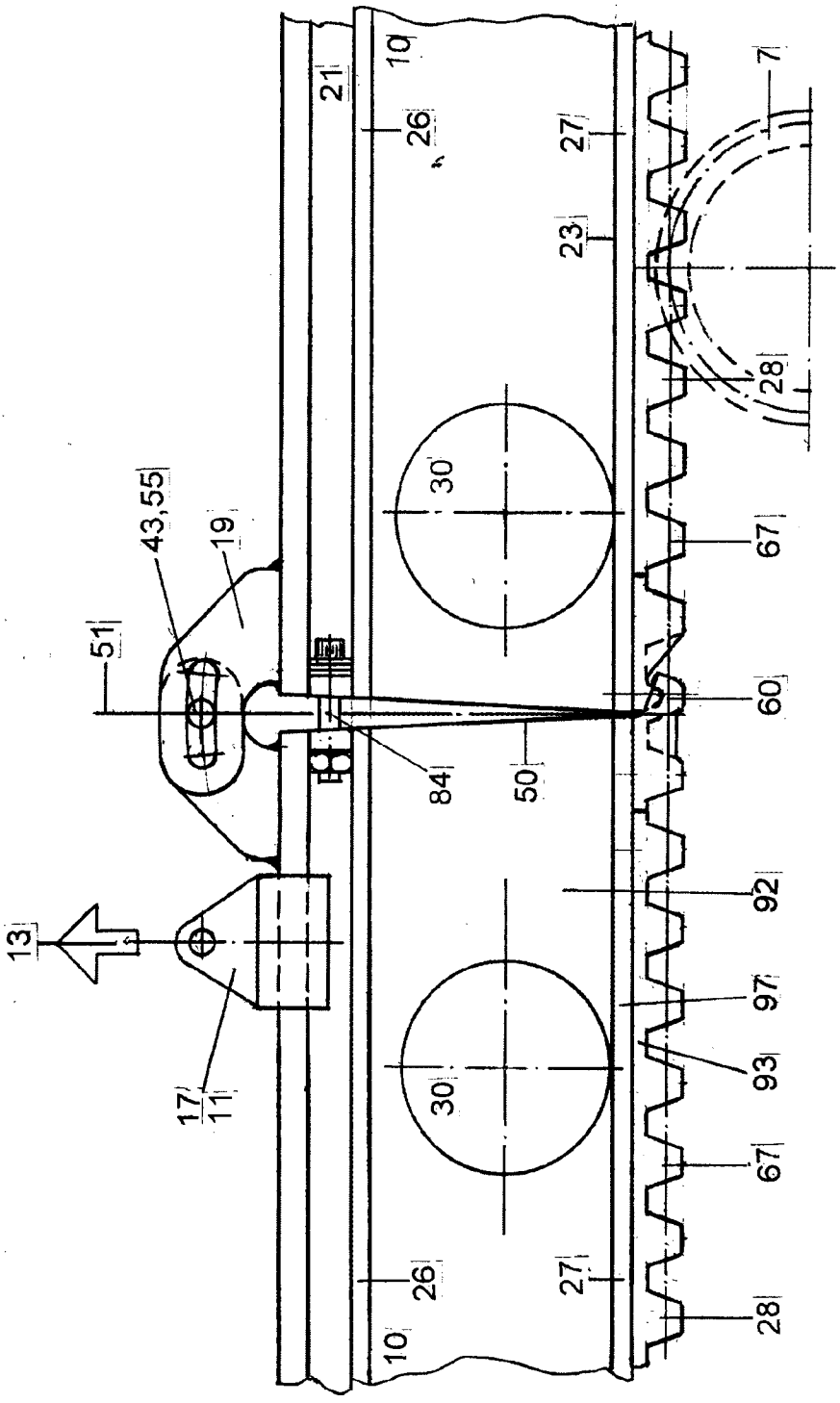


Fig. 8

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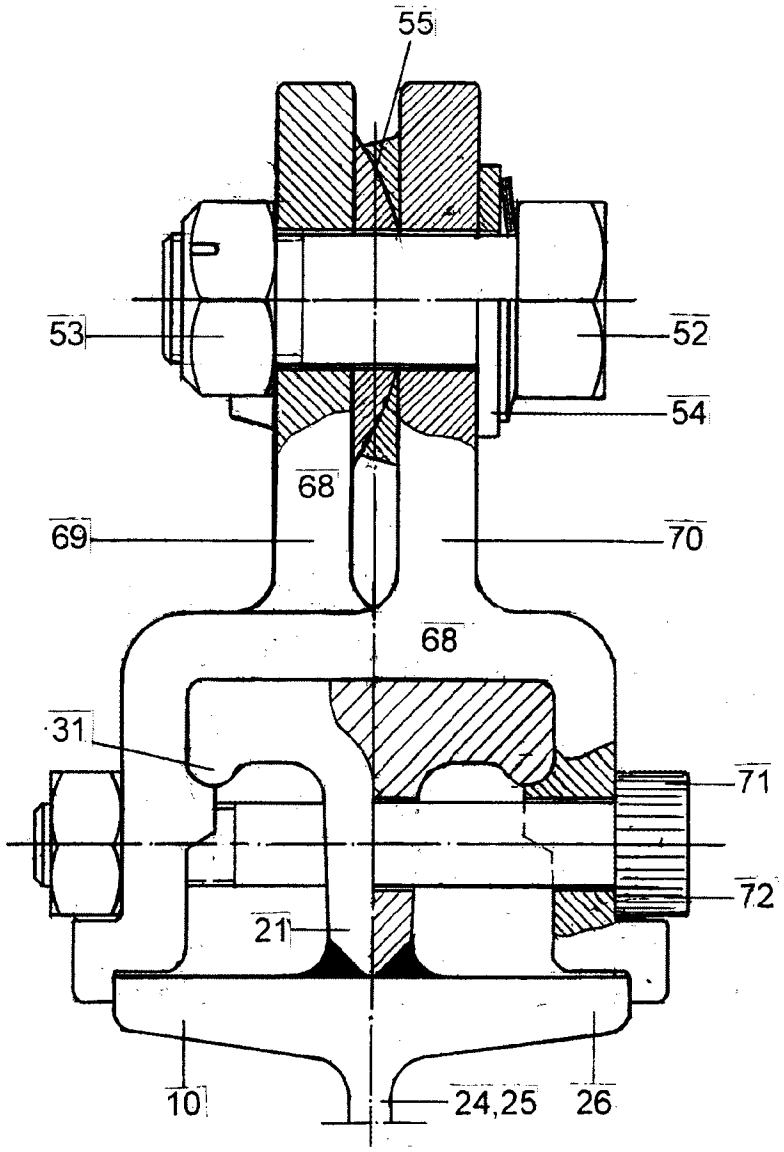


Fig. 9

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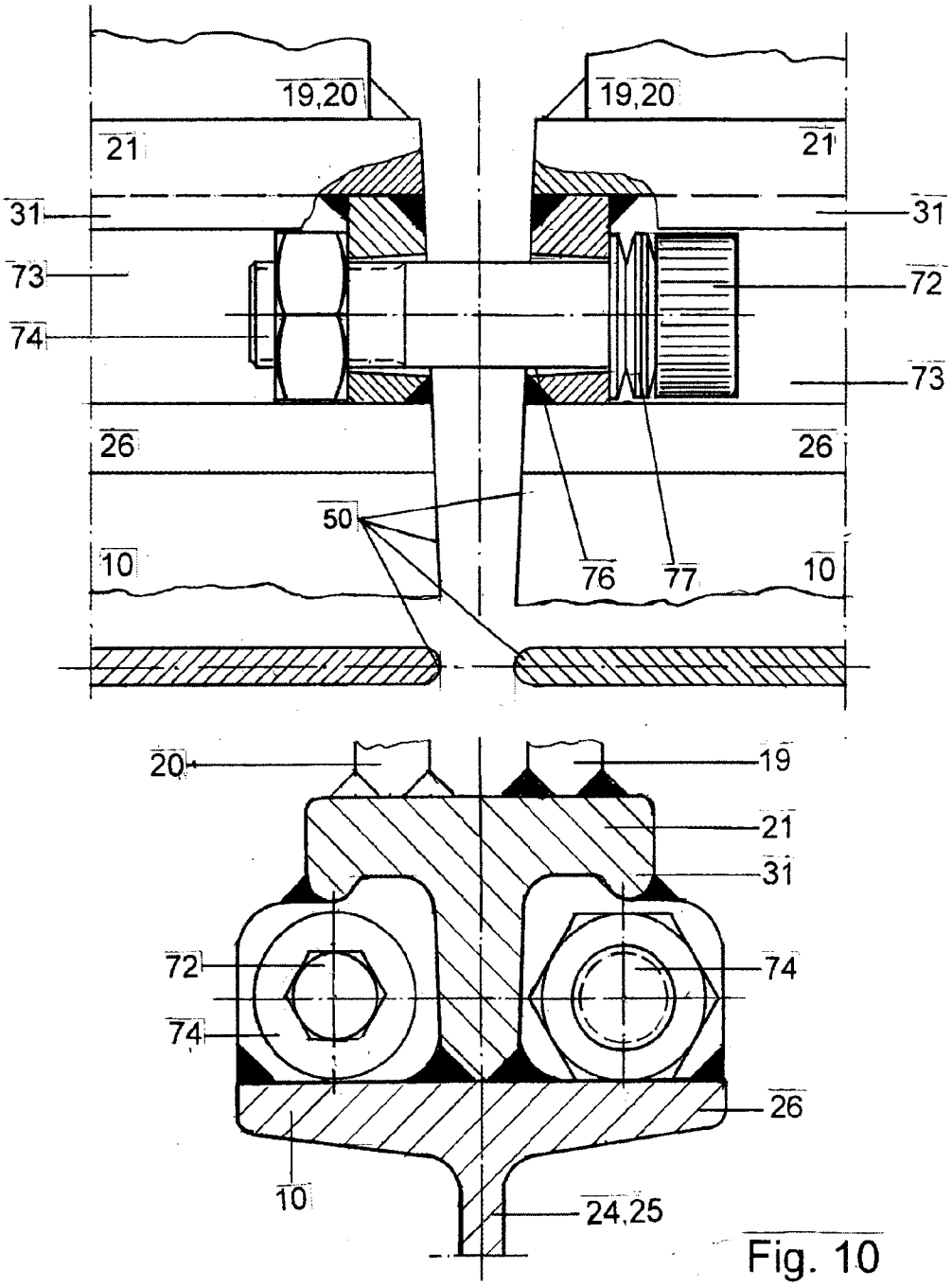


Fig. 10

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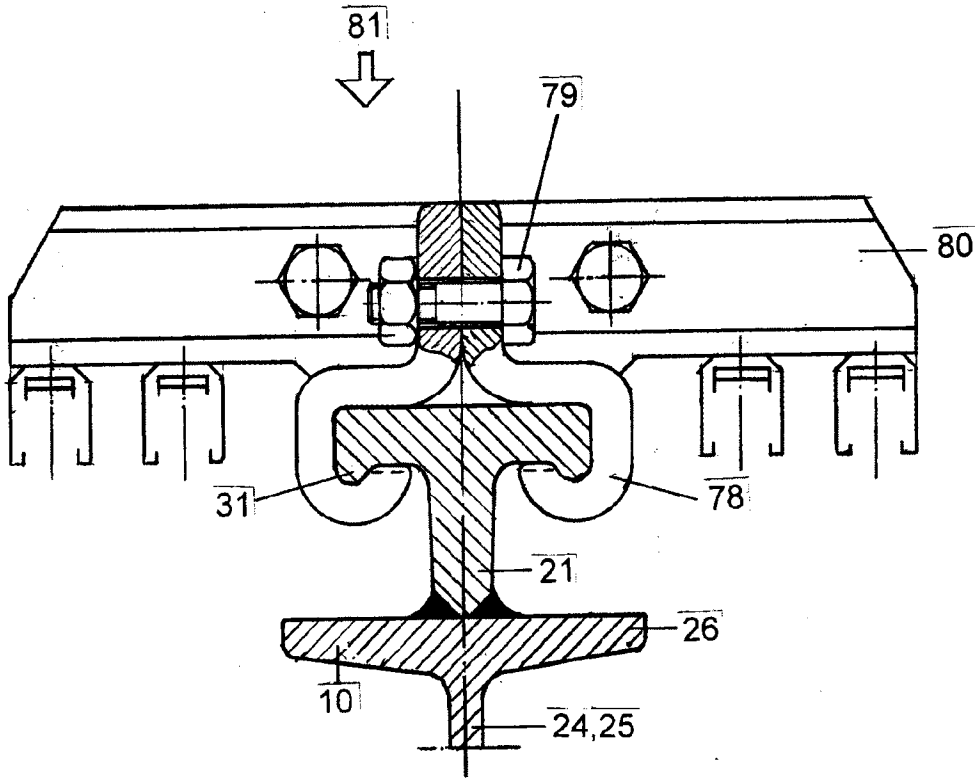


Fig. 11

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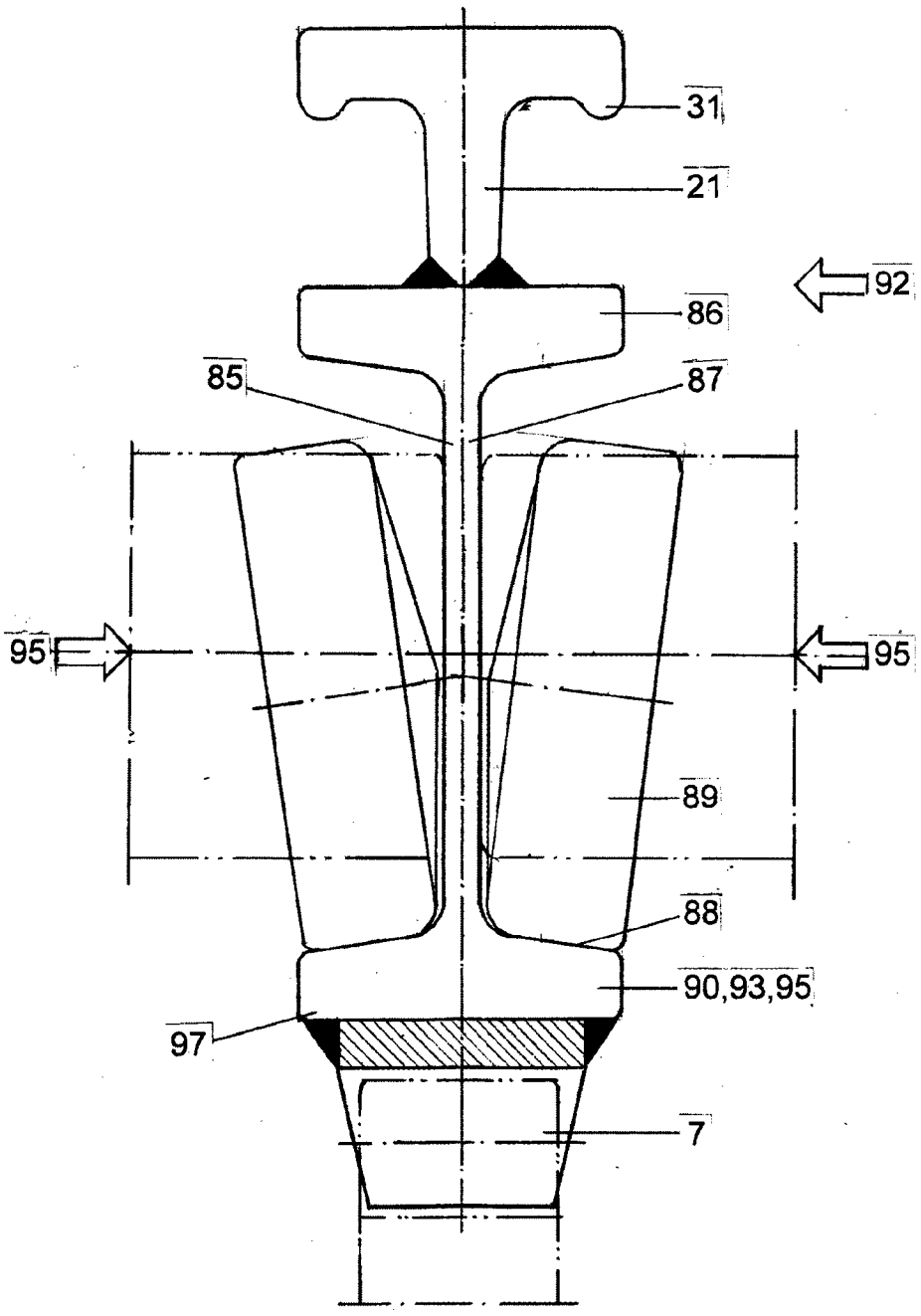


Fig 12

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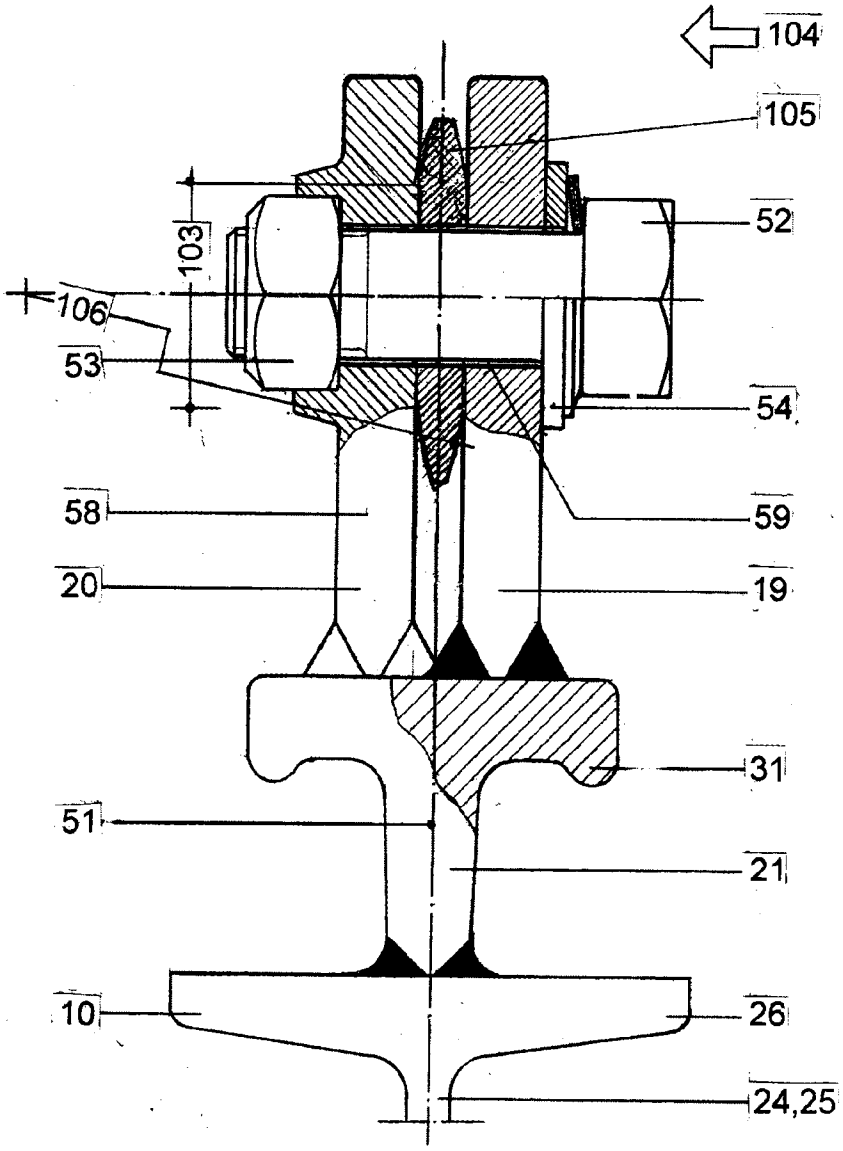


Fig. 13

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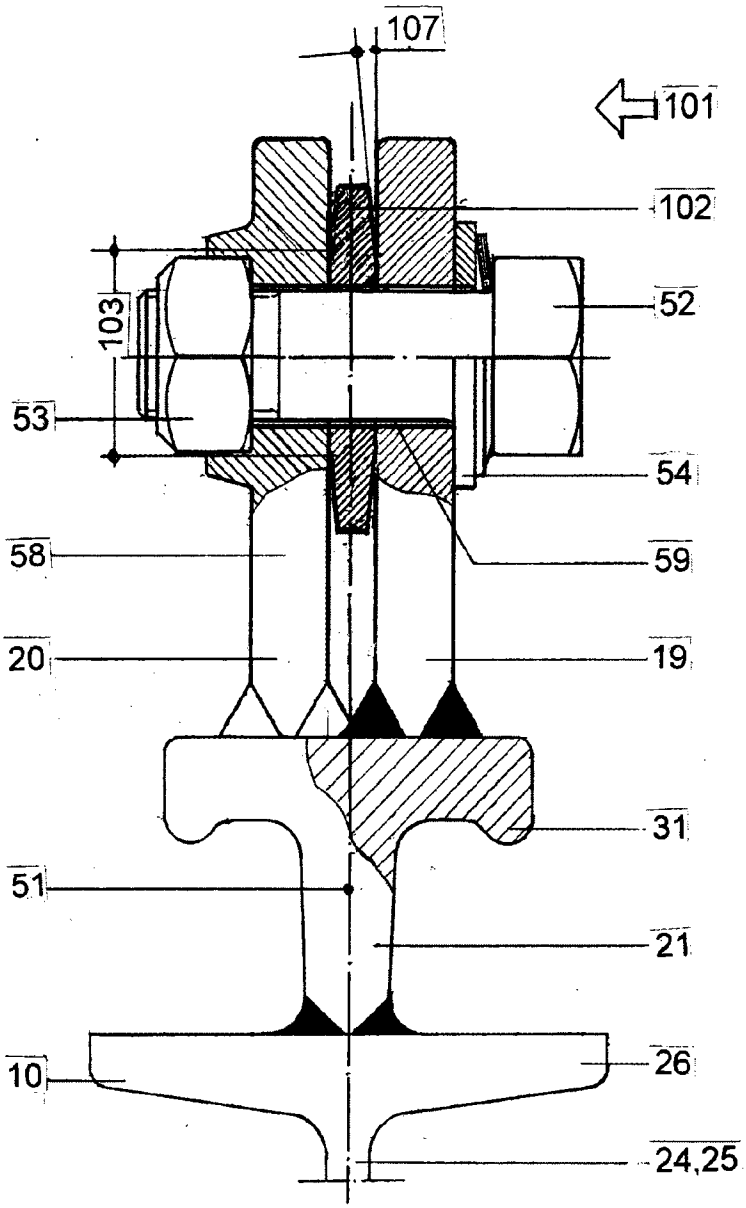


Fig. 14

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(54) Device for conveying goods or persons along a guide-rail.

(57) A device intended for the conveyance of goods utilising a guide-rail (2) as a goods-conveying track, and an organ (4) driven electrically or in some other way and capable of interacting with the goods. The organ (4) exhibits two wheels (8,9) capable of interacting with the opposite sides of the guide-rail (2) in relation to which the point of contact (20') of the weight of the goods is located to the side of the wheels (8,9) and the guide-rail (2). The two wheels (8,9) are connected together so as to be driven in synchronism by a driving motor (14). The distance between the driving surfaces of the driving wheels facing the guide-rail is selected so as to match the shape of the driving surfaces in such a way that the space formed between the driving surfaces matches the profile of the guide-rail (2). One of the wheels is divided into two parts (91,92) and has the parts held together by spring pressure (93).

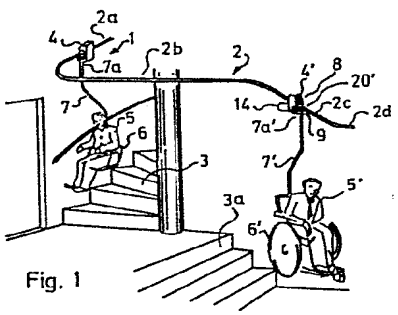


Fig. 1

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TITLE MODIFIED
see front page

"Device intended for the conveyance of goods".

The present invention relates to a device intended for the conveyance of goods and in particular to a device of this kind which utilises a guide-rail as the goods-conveying track together with an organ driven electrically or in some other way and capable of interacting with the goods. This organ exhibits two wheels capable of interacting with opposite sides of the guide-rail in relation to which the point of contact of the weight of the goods is located to the side of the wheels and the guide.

It is clear that the areas of application for a device intended for the conveyance of goods of the nature described above are numerous, although simply by way of an example reference may be made to the different transport requirements within industry, the conveyance of persons, especially the handicapped, up and down stairs, and the conveyance of refuse containers up and down stairs, etc.

Devices intended for the conveyance of goods have previously been disclosed which utilise a guide-rail attached to a ceiling as the goods-conveying track. A device of this kind is used, for example, within the meat processing industry for the transport of carcasses from one processing point to another. In this case the goods are usually conveyed along a horizontal guide-rail.

Other devices intended for the conveyance of goods have also previously been disclosed which utilise a vertically extending guide-rail as the

goods-conveying track. A device of this kind is used, for example, within the bakery industry for raising sacks from one level to a higher level. An example of a device of this kind is described in Swedish Patent Specification 7976.

Also previously disclosed is the method of driving electrically or by some other means organs capable of interacting with the goods in order to facilitate the conveyance of the goods. Also previously disclosed is the method of causing the organ to have two wheels capable of interacting with the opposite sides of the guide-rail whereby the point of contact of the weight of the goods is located to the side of the wheels and the guide-rail. It is usual in this case for the distance between the surfaces of the wheels facing the guide-rail to be considerably greater than the thickness of the guide-rail, which means that the wheels bear against the guide-rail at different heights. Finally, reference may be made to the disclosure in German Patent Specification 90 297 of a device in which two driving wheels bear on either side of a guide-rail, said driving wheels being driven commonly by one and the same driving device.

It is clear that a large number of different technical problems are associated with the conveyance of goods and that in practice these problems have led to the use of special goods-conveying devices for the conveyance of goods along horizontal guide-rails and to the use of other goods-conveying devices for the conveyance of goods along vertical guide-rails. Other types of device have usually been necessary where the conveyance of goods was required to take place along an inclined or somewhat sloping track.

Most of the different transport devices for different applications indicate the existence of an exacting technical problem in designing a single transport device which can be used for many different purposes and within a wide range of different industries.

Accordingly an exacting technical problem is associated with the design of a device intended for the conveyance of goods of such a nature that it will not only be of simple construction, thereby having small external dimensions, but will also be suitable for the conveyance of goods

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along a horizontal guide-rail, and will also be suitable for the conveyance of goods along a vertical guide-rail, and will also permit the goods to be conveyed if the guide-rail is caused to assume any angular value between the angular values for the horizontal and for the vertical position.

An exacting technical problem has been associated for some time with the design of a device for the conveyance of goods in which the installation costs for the device are low and in which the installation does not restrict the available space or only restricts it to a small extent. The available space shall be capable of being used for its intended purpose, irrespective of whether the goods-conveying device is or is not present.

An exacting technical problem is also associated with providing conditions such that the device will be able to move along the guide-rail even if the guide-rail exhibits irregularities.

An exacting technical problem is also encountered in relation to the horizontal conveyance of goods in providing conditions under which tension will exist between the driving wheels, said tension increasing when the goods are conveyed in an inclined or vertical plane.

Finally, an exacting technical problem is associated with providing conditions such that the device will be clamped firmly against the guide-rail in the event of the failure of one or both of the shafts for the driving wheels.

Preferred embodiments of the invention may solve some or all of the above problems.

The present invention relates to a device intended for the conveyance of goods of such a nature that it utilises a guide-rail as the goods-conveying track together with an organ driven electrically or in some other way and capable of interacting with the goods so that the goods can be moved along the guide-rail. The organ exhibits two wheels capable of interacting with the opposite sides of the guide-rail. Also, the point of contact of the weight of the goods shall be located to the side of one of the wheels and the guide-rail.

The two wheels are connected together so as to be driven in synchronism by a single driving motor. The driving surfaces facing the guide-rail also have a shape which matches the profile of the guide-rail.

It has been found to be particularly advantageous for the guide-rail to have at least two surfaces forming an angle, and for the driving surfaces

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to be given a matching angular form.

The present invention also offers the possibility of causing the guide-rail to serve as a steering device intended to change the direction of the organ in relation to the guide. A steering device of this kind or a steering rail or a steering rail profile may also be positioned alongside the guide-rail, preferably running parallel with the guide-rail along its entire length.

In accordance with the present invention the two wheels and the point of contact of the weight of the goods shall, in the case of the horizontal conveyance of goods, be located in or at least essentially in a vertical plane. This means that, when the goods are conveyed along a vertically extending guide-rail, the two wheels and the point of contact of the weight of the goods will lie in or at least essentially in a horizontal plane. As the angle at which the goods are being conveyed gradually changes from horizontal conveyance to vertical conveyance of the goods, the plane of the two wheels and the point of contact will change its angle from being in a vertical plane to being in a horizontal plane.

In the event of an electrically driven organ being specified it is recommended that the current-carrying and voltage-carrying rails are arranged so as to run parallel with or inside the guide-rail.

The present embodiment requires the driving motor and its associated gear box to be arranged to one side of a plate, and the two driving wheels to be located to the other side of the plate and to be connected together via a system of gear wheels.

The distance between the axes of rotation of the driving wheels is essentially the same as the distance between the point of contact of the weight of the goods and the axis of rotation of the closest driving wheel. The point of contact of the weight of the goods is applied via a freely-rotating sleeve arranged around a fixed shaft attached to the plate.

The present invention also incorporates the unique design feature in which one of the driving wheels is split at right-angles to the axis of rotation and in which the two halves of the wheel are forced towards each other by spring pressure. The spring pressure is variable.

The advantages which may be regarded as being associated with a device

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intended for the conveyance of goods in accordance with the present invention are principally the very simple installation work involved in positioning a guide-rail along the track on which it is proposed to convey the goods, and also that the device is designed in such a way that it is able to transport or convey goods both along a horizontal guide-rail and along a vertical guide-rail, and also along a guide-rail which forms an angle somewhere between the angles for a horizontal guide-rail and for a vertical guide-rail.

A preferred embodiment of a device intended for the conveyance of goods in accordance with the present invention is described below in greater detail with reference to the attached drawing, in which:

Figure 1 shows the invention being used in a typical application;

Figure 2 shows a sectional view of an organ belonging to the device interacting with a guide-rail;

Figure 3 shows a side-view of the organ with the guide-rail arranged horizontally;

Figure 4 shows a side-view of the organ with the guide-rail arranged at an inclined angle;

Figure 5 shows a side-view of the organ with the guide-rail arranged vertically; and

Figure 6 shows an alternative embodiment of the device in accordance with Figure 2.

As previously mentioned, the device intended for the conveyance of goods which is significant to the present invention may be used in a range of different applications, although in the following specification

the application of the invention will be illustrated in relation to a goods conveyor track intended to be used for the transport of handicapped persons up and down stairs.

Figure 1 shows a perspective view of a staircase in which the device intended for the conveyance of goods in accordance with the invention is being used. The goods-conveying device 1 is designed to run along a guide-rail 2 , which is positioned above the stairs 3 and the stairs 3a , with a section 2a forming an angle of approximately 30° to the horizontal plane, a section 2b extending essentially horizontally and connected to the section 2a , a section 2c running at something of an inclined angle and also connected to the section 2b , and finally a section 2d running essentially horizontally. The guide-rail 2 is used as the goods-conveying track. It should be pointed out that the guide-rail 2 is attached to the ceiling or to parts of the walls by means of fixing devices which are not shown or described here but which interact with the guide-rail in the manner illustrated in Figure 2.

An organ 4 which is driven electrically or in some other way is fitted, as illustrated in more detail in Figure 2, with wheels interacting with the opposite sides of the guide-rail; the point of contact of the weight of the goods is located to the side of the wheels and the guide-rail.

Figure 1 shows that the goods are suspended from the organ 4 and have their centre of gravity located beneath the guide-rail 2 .

Figure 1 also shows the manner in which the present invention may be applied to a handicapped person 5 sitting in a chair 6 which is attached to the organ 4 via one end 7a of a bar 7 in such a way that it is free to swivel. Similarly, Figure 1 also illustrates a person 5' sitting in a wheelchair 6' which is connected by means of a previously disclosed organ to the bar 7' , of which one end 7a' is attached to the organ 4' in such a way that it is free to swivel.

Figure 2 shows a sectional view through part of an electrically driven organ 4 capable of interacting with the goods and being utilised in the embodiment in accordance with Figure 1.

The power supply to the electrically driven organ 4 may, of course, be provided via an electrical cable, although it may be appropriate to arrange the current-carrying and voltage-carrying rails to run parallel with the guide-rail 2 , whereby the organ 4 will require to be fitted

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with collector shoe gear to interact with the conductor rails. The controls used for moving the organ 4 in one direction or the other or for causing the organ to stop may be in the form of a control panel connected to the organ 4 via a cable, although this is not illustrated here.

The organ 4 is fitted with an upper wheel 8 and with a lower wheel 9 . The upper wheel 8 is attached via a shaft 10 to a plate 11 , whereas the lower wheel 9 interacts with a shaft 12 fitted with a toothed wheel 13 connected to an electric motor 14 . The toothed wheel 13 is attached to the plate 11 .

The two wheels 8 and 9 are connected together so as to be driven in synchronism by the driving motor 14 , which takes place by the wheel 9 interacting with a toothed wheel 15 and by the wheel 8 interacting with a toothed wheel 16 , said toothed wheels being in mesh with each other.

The distances between the driving surfaces 8a,9a of the driving wheels 8,9 facing the guide-rail 2 are specified in such a way, and the shapes of the driving surfaces are specified in such a way that the space formed between the driving surfaces matches the profile of the guide-rail 2.

The typical embodiment described here shows that the guide-rail has been given a rectangular cross-section and more specifically a square cross-section, thereby enabling the driving surfaces to be given an L-shaped cross-section. The driving wheel 8 is, of course, designed to have a fillet 17 and the driving wheel 9 is also designed to have a fillet 18 so that the driving surfaces 8a,9a will make contact with the guide-rail 2 over their entire surface area in the plane shown in Figure 2.

A number of discrete fixing organs 19 are used to hold the guide-rail 2 in its desired attitude.

In the event of the guide-rail profile being specified in accordance with the typical embodiment the organ 4 will match the guide-rail 2 precisely, and the organ will be unable to turn around the guide-rail.

One particular feature of Figure 2 is the fact that, if goods are being conveyed horizontally along a horizontal guide-rail 2 , the two wheels 8 and 9 and the point of contact 20 of the weight of the goods will lie in or essentially in a vertical plane. This means that the weight of the goods will be transferred to and supported exclusively by the wheel 8 and the shaft 10 and that only the pressure existing between the driving surfaces 8a and the upper L-shaped surface of the

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guide-rail 2 will provide the conditions required for moving the goods, provided that the necessary normal force and friction occur at that point.

Figure 2 shows that the driving motor 14 and its associated gear box 13 are arranged to one side of the plate 11 and that the output shaft from the gear box extends through the plate 11 and interacts on the other side of the plate 11 with the driving wheel 9 , said driving wheel being connected to the driving wheel 8 via the system of toothed wheels 15,16 . The plane in which the load of the goods is to be applied should be specified so as to lie beneath the guide-rail 2 in order to eliminate imbalance and torsional stress on the guide-rail 2 .

The distance between the axes of rotation 10' and 12' of the driving wheels is essentially the same as the distance between the point of contact 20' of the weight of the goods and the axis of rotation 12' located closest to the point of contact. The Figure also shows that the point of contact 20' of the weight of the goods shall be applied via a freely-rotating sleeve 21 arranged around a fixed shaft 22 attached to the plate 11 .

Figure 3 shows that, in the case of a guide-rail 2 which extends horizontally, the wheels 8 and 9 and the point of contact 20' of the weight of the load "F" lie in a vertical plane, and that the force which is applied between the driving surface 8a of the wheel 8 and the guide-rail 2 is essentially the same as the weight of the goods.

In the case of transport along a guide-rail forming an angle in relation to horizontal plane in accordance with Figure 4, it is clear that the point of contact 20' of the weight of the goods will change its position and will give rise to a breaking stress between the wheels 8 and 9 , said breaking stress having the effect of increasing the normal pressure on the driving surfaces 8a and 9a against the guide-rail 2 . The larger the angle the greater will be the normal pressure, at the same time as which the normal force will increase in proportion to the increasing weight of the goods. The normal forces and the effect of the weight of the goods achieve their maximum values in the vertically extending guide-rails in accordance with Figure 5.

Figure 6 shows that one of the driving wheels is split into two parts 91 and 92 , said parts being pressed against each other by a set of springs 93 . This is designed in such a way that a small force

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presses the two parts of the wheel 91 and 92 against each other so as to produce a certain small level of normal pressure when the goods are being conveyed horizontally. When goods are being conveyed upwards and at an angle the force between the two parts of the wheel will increase so that they are forced away from each other until the spring assembly is fully compressed, as is the case when goods are being conveyed vertically.

The movement between the parts of the wheel shall be adjusted so as to ensure that the inclination of the shafts in relation to the longitudinal extension of the guide-rail is adequate. Too small an angle will result in an excessively high normal pressure and excessive wear. Too large an angle will result in excessively low normal pressure and inadequate holding force. The latter range of angles is dependent on the coefficient of friction.

Reference may be made to the fact that steel against steel produces a coefficient of friction of 0.1 and that the angular value should not exceed 15°.

A holder 94 is arranged around the wheel 8 , and a similar holder 95 is arranged around the wheel 9 . Any fracture of one or both of the shafts 10,12 will result in the device being held tightly against the guide-rail 2 .

The variable spring tension is best achieved by specifiying that one of the Belleville spring washers 93 shall be softer than the other two.

Figure 6 also shows that the point of contact "A" of the load is located at a certain distance "d" away from the centre-line of the guide-rail 2 and on the opposite side to the driving motor 14 and the gear box 13 for reasons of balance.

The present invention is not, of course, restricted to the embodiment described above by way of an example, but may be modified.

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CLAIMS

1. A device intended for the conveyance of goods utilising a guide-rail as a goods-conveying track, and an organ driven electrically or in some other way and capable of interacting with the goods, said organ exhibiting two wheels capable of interacting with the opposite sides of the guide-rail in relation to which the point of contact of the weight of the goods is located to the side of the wheels and the guide, said two wheels being connected together so as to be driven in synchronism by a driving motor and forced against driving surfaces facing the guide-rail which match the profile of the guide-rail, characterized in that the guide-rail is designed to have at least two surfaces forming an angle, and in that the driving surfaces are formed against a corresponding angular form.

2. A device in accordance with Patent Claim 1, characterized in that, in the case of the horizontal conveyance of goods the two wheels and the point of contact of the weight of the goods are located in or essentially in a vertical plane.

3. A device in accordance with Patent Claim 1, characterized in that, in the case of an electrically driven organ current-carrying and voltage-carrying rails are arranged parallel with or inside the guide-rail.

4. A device in accordance with Patent Claim 1, characterized in that the driving motor and its associated gear box are arranged to one side of a plate, and in that the driving wheels are located on the other side of the plate and are connected together via a system of gear wheels.

5. A device in accordance with Patent Claim 1, characterized in that the distance between the axes of rotation of the driving wheels are essentially the same as the distance between the point of contact of the weight of the goods and the closest axis of rotation.

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6. A device in accordance with Patent Claims 1 and 6, characterized in that the point of contact of the weight of the goods is applied via a freely-rotating sleeve arranged around a fixed shaft attached to the plate.

7. A device in accordance with Patent Claim 1, characterized in that the distance between the driving surfaces and the shape of the driving surfaces are specified in such a way that the wheels will bear against essentially diametrically opposed parts of the guide-rail.

8. A device in accordance with Patent Claim 1, characterized in that one of the driving wheels is split at right-angles to the axis of rotation, and in that the two parts of the wheel are forced towards each other by spring pressure.

9. A device in accordance with Patent Claim 8, characterized in that the spring pressure is variable and provides light spring tension for the initial displacement of the parts of the wheels away from each other.

10. A device in accordance with Patent Claims 8 or 9, characterized in that each of the driving wheels is enclosed by a holder.

11. A device for the conveyance of goods substantially as described herein with reference to and as illustrated in the accompanying drawings.

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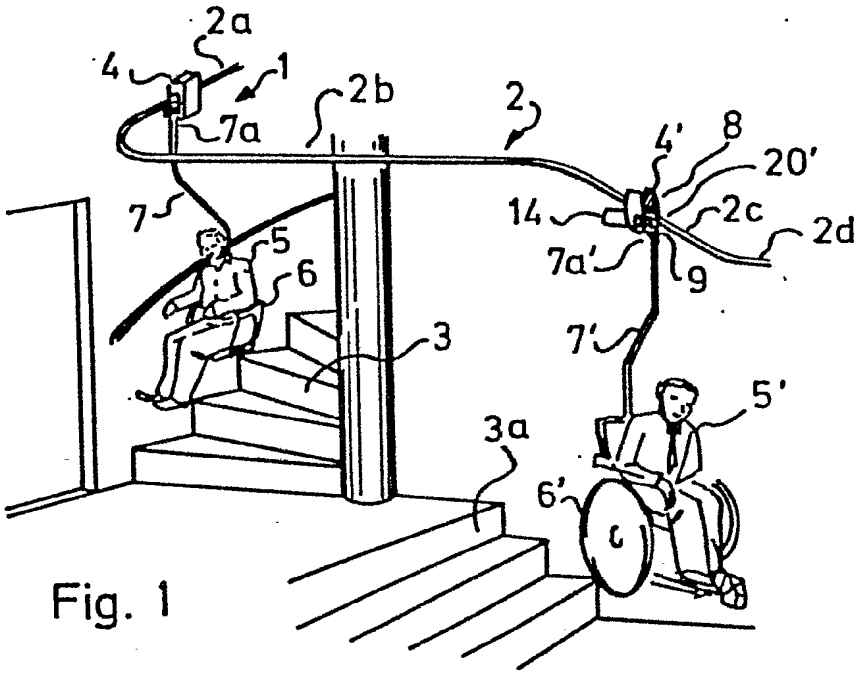


Fig. 1

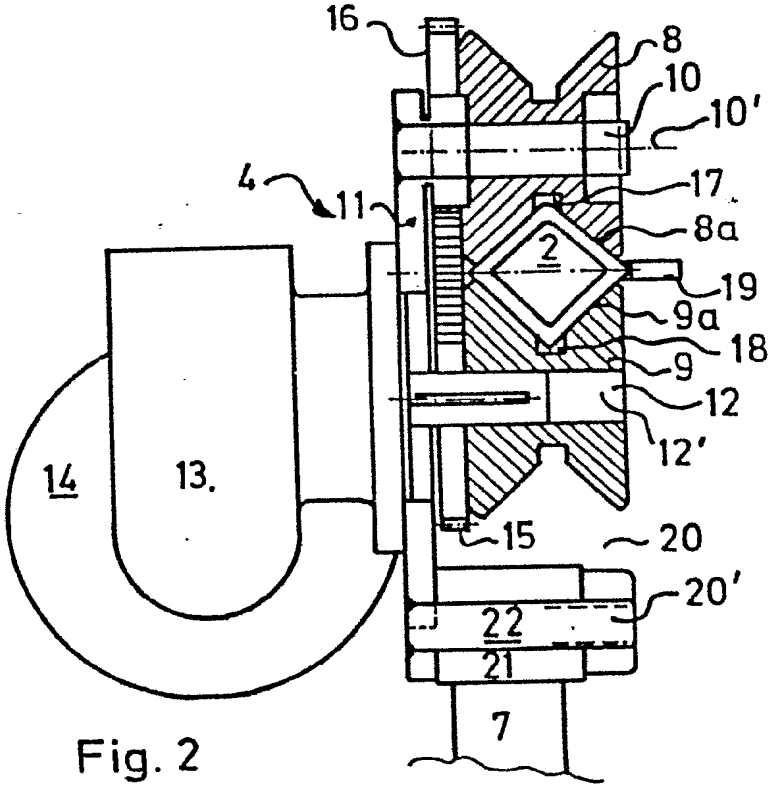


Fig. 2

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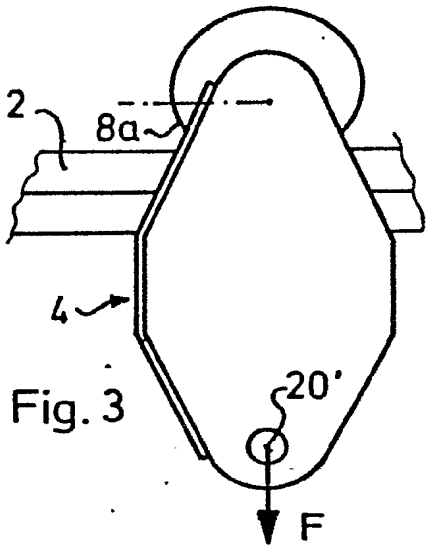


Fig. 3

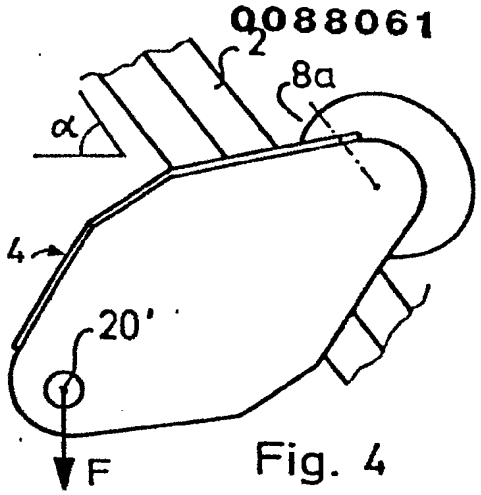


Fig. 4

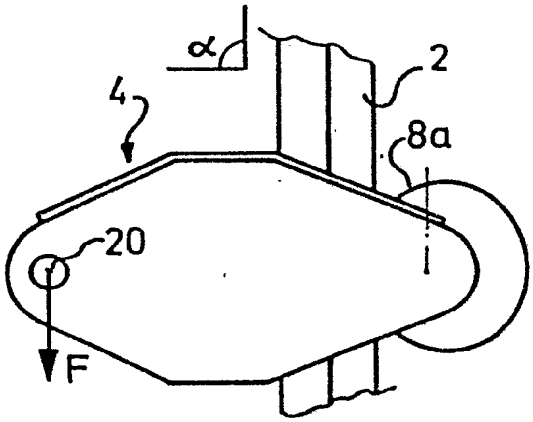


Fig. 5

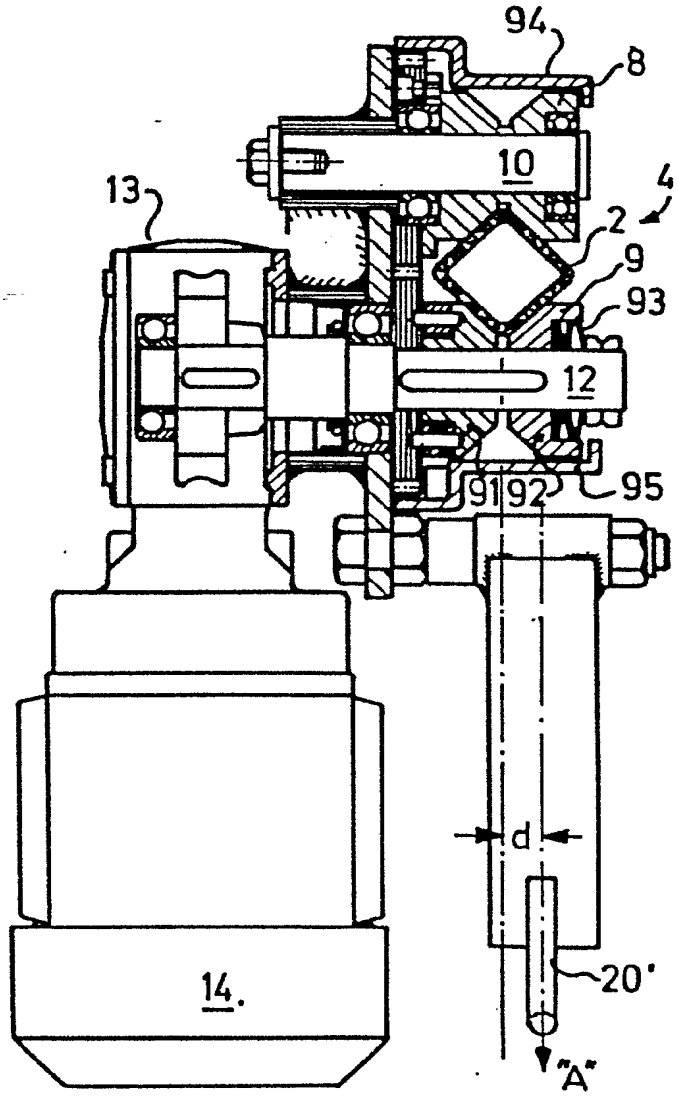


Fig. 6

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(54) Lift systems with continuous in-rail charging

(57) Rail-mounted lift systems is disclosed. The lift system includes a rail having at least one conductor positioned on an upper interior surface of the rail. A carriage is slidably disposed in the rail for relative movement to the rail. The carriage generally includes a carriage body, at least one pair of support wheels rotatably coupled to the carriage body and slidably engaged with the rail, and a conductor truck comprising at least one conductive roller rotatably attached to the conductor truck. The conductor truck may be mounted to the carriage body with a biasing member upwardly biasing the conductive roller into rolling engagement with the at least one conductor. A lift unit is coupled to the carriage body and includes a motor paying out and taking up a lifting strap. The lift unit is electrically coupled to the at least one conductive roller.

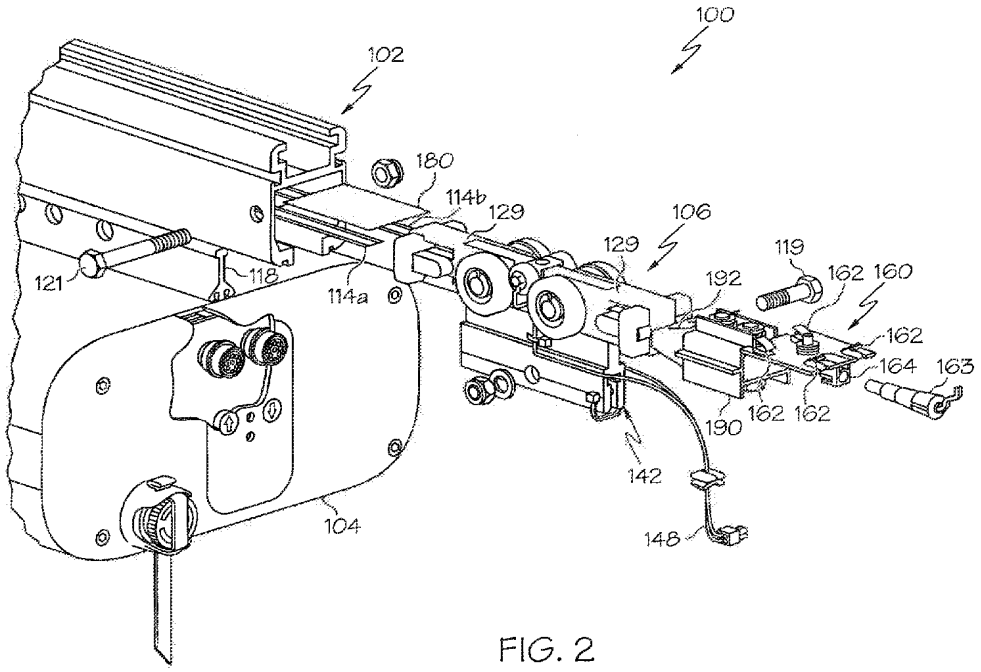


FIG. 2

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Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Patent Application No. 61/361,231 entitled "Continuous In-Rail Charging For Lift Systems" filed July 2, 2010, the entirety of which is herein incorporated by reference.

TECHNICAL FIELD

[0002] The present specification generally relates to rail-mounted lift systems and, more specifically, to rail-mounted lift systems with continuous in-rail charging of the lift unit.

BACKGROUND

[0003] Overhead lifting devices, such as patient lifts used in the health care industry, may generally comprise a lift unit with an actuator, such as an electric motor or similar actuator, coupled to a mechanical lifting arm or cable lift system, such as a lifting strap. The actuator facilitates actuation of the mechanical lifting arm or cable lift system thereby raising and/or lowering a load attached to the lifting arm or cable lift system. The lift unit may be coupled to a rail system with a carriage which facilitates positioning the lift unit with respect to the rail. Positioning the unit along the rail system may be accomplished manually or, in the alternative, with a motor mechanically coupled to the carriage and operable to traverse the carriage and lift unit over the span of the rail system. The actuator and motor may be powered by a battery system positioned in the lift unit. In order to charge the battery system of the lift unit, the lift unit must be periodically coupled to a charging station requiring the lift unit to be moved to specific locations along the rail. Accordingly, during charging, the lift unit may not be used for lifting and transport.

[0004] Accordingly, a need exists for alternative mechanisms for continuously powering and/or charging a lift unit as the lift unit is traversed across a rail.

SUMMARY

[0005] In one embodiment, a rail-mounted lifting system includes a rail comprising at least one conductor positioned in a carriage support channel formed in the rail. A carriage may be slidably disposed in the rail for relative movement to the rail. The carriage may include at least one conductive roller rotatably attached to the carriage and upwardly biased into rolling engagement with the at least one conductor. A lift unit may be coupled to the carriage body and electrically coupled to the at least one conductive roller. The lift unit may include a motor paying out and taking up a lifting strap.

[0006] In another embodiment, a rail-mounted lifting system includes a rail, a carriage and a lift unit. The rail may include at least one conductor positioned on an upper portion of the rail, a first support flange, and a second support flange. A carriage may be slidably disposed in the rail for relative movement to the rail. The carriage may include a carriage body and at least one pair of support wheels rotatably coupled to the carriage body. The at least one pair of support wheels may be slidably engaged with the first support flange and the second support flange. The carriage may also include a conductor truck comprising at least one conductive roller rotatably attached to the conductor truck. The conductor truck may be mounted to the carriage body with a biasing mechanism which upwardly biases the at least one conductive roller into rolling engagement with the at least one conductor. The lift unit may be coupled to the carriage body and includes a motor paying out and taking up a lifting strap, wherein the lift unit is electrically coupled to the at least one conductive roller.

[0007] In yet another embodiment, a kit of parts for retrofitting an overhead rail for continuously charging a lift unit along a length of the rail may include a conductive tape and a carriage packaged together. The carriage generally includes a carriage body, and at least one pair of support wheels rotatably coupled to the carriage body. The carriage may also include at least one conductive roller rotatably attached to the carriage. The conductive roller is upwardly biased into rolling engagement with the conductive tape when the conductive tape and the carriage are installed in the rail.

[0008] These and additional features provided by the embodiments described herein will be more fully understood in view of the following detailed description, in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The embodiments set forth in the drawings are illustrative and exemplary in nature and not intended to limit the subject matter defined by the claims. The following detailed description of the illustrative embodiments can be understood when read in conjunction with the following drawings, where like structure is indicated with like reference numerals and in which:

[0010] FIG. 1 schematically depicts a rail-mounted lift system, according to one or more embodiments described herein;

[0011] FIG. 2 schematically depicts an exploded view of the rail-mounted lift system of FIG. 1;

[0012] FIG. 3A schematically depicts a carriage for use with the rail-mounted lift system of FIG. 1, according to one or more embodiments described herein;

[0013] FIG. 3B schematically depicts a partially exploded view of the carriage of FIG. 3A;

[0014] FIG. 4 schematically depicts a side view of a carriage for use with the rail-mounted lift system of FIG. 1;

[0015] FIG. 5 schematically depicts the electrical interconnectivity of the various components of the rail-mount-

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ed lift system of FIG. 1;

[0016] FIG. 6 schematically depicts a cross section of a rail of the rail-mounted lift system according to one or more embodiments described herein;

[0017] FIG. 7 schematically depicts a cross section of one embodiment of a conductive tape for use with the rail mounted lift system of FIG. 1, according to one or more embodiments described herein;

[0018] FIG. 8 schematically depicts a cross section of a rail-mounted lift system according to one or more embodiments shown and described herein;

[0019] FIG. 9 schematically depicts an applicator tool for applying a conductor to the rail of the rail-mounted lift system;

[0020] FIG. 10 schematically depicts the applicator tool of FIG. 9 being used to install a conductor in the rail of the rail-mounted lift system; and

[0021] FIG. 1 schematically depicts the applicator tool of FIG. 9 being used to install a conductor in the rail of the rail-mounted lift system.

DETAILED DESCRIPTION

[0022] FIG. 1 generally depicts one embodiment of a rail-mounted lift system. The lift system generally comprises a lift unit slidably coupled to a rail with a carriage. The rail includes a conductor which is electrically coupled to a power supply. The carriage includes at least one conductive roller which is upwardly biased from the carriage into rolling engagement with the conductor. The conductive wheel is also electrically coupled to the lift unit thereby electrically coupling the lift unit to the conductor and the power supply and enabling the lift unit to be powered and/or charged along the entire length of the rail as the lift unit is traversed over the rail. The lift system and the various components of the lift system will be described in more detail herein with specific reference to the appended figures.

[0023] Referring now to FIGS. 1, 2 and 5, the rail-mounted lift system 100 generally comprises a lift unit 104 which is slidably coupled to a rail 102 with a carriage 106. The lift unit 104 may be used to support and/or lift a patient with a lifting strap 108 which is coupled to a motor 133 contained within the lift unit 104. The motor 133 facilitates paying-out or taking-up the lifting strap 108 from the lift unit 104 thereby raising and lowering a patient attached to the lift strap. In the embodiments described herein, the lift unit 104 further includes a battery 132 which is housed in the lift unit 104 and electrically coupled to the motor 133 thereby providing power to the motor 133. However, it should be understood that, in other embodiments, the lift unit 104 may be constructed without the battery, such as when the motor is directly coupled to the conductors 114a, 114b located in the rail 102.

[0024] In the embodiment of the lift system 100 shown in FIG. 1, a patient may be attached to the lifting strap 108 with a sling bar 110 or a similar accessory attached to the lifting strap 108. More specifically, the sling bar 110 or a similar accessory may be attached to a harness or sling in which the patient is positioned thereby facilitating the lifting operation. The lift unit 104 may be actuated with hand control 112 which is communicatively coupled to the motor. In the embodiment shown in FIG. 1, the hand control 112 is directly wired to the lift unit 104. However, it should be understood that, in other embodiments, the hand control 112 may be wirelessly coupled to the lift unit 104 to facilitate remote actuation of the lift unit 104.

[0025] Referring now to the exploded view of the lift system 100 schematically depicted in FIG. 2, the lift unit 104 is mechanically coupled to a carriage 106 which facilitates slidably positioning the lift unit 104 along rail 102. In the embodiments of the lift unit 104 described herein, the lift unit 104 includes a connection rail 118 which is mounted to the top surface of the lift unit 104. The connection rail 118 facilitates connecting and securing the lift unit 104 to the carriage 106. In the embodiment of the lift unit 104 shown in FIG. 2, the connection rail 118 has a T-shaped configuration and the carriage 106 has a receiving slot 142 with a complimentary configuration for receiving the connection rail 118. The carriage 106 may be secured to the connection rail 118 with a fastener 119, such as a bolt and nut as depicted in FIG. 2, which extends transversely through openings in the carriage 106 and a corresponding opening in the connection rail 118.

[0026] Referring now to FIGS. 3A and 3B, the carriage 106 generally comprises a carriage body 140 to which a plurality of support wheels 144a, 144b, 144c, and 144d are rotatably attached for supporting the carriage 106 in the rail. The support wheels 144a, 144b, 144c, and 144d facilitate positioning the carriage 106 and lift unit along the length of the rail. In the embodiments described herein, the carriage 106 is depicted with four support wheels. However, it is contemplated that the carriage 106 may be constructed with fewer than 4 support wheels. For example, in some embodiments, the carriage may be constructed with one or two support wheels (i.e., a pair of support wheels). Accordingly, it should be understood that the carriage 106 includes at least one support wheel. The support wheels 144a-d are positioned on axles 120 which extend transversely through the carriage body 140. Each support wheel is secured to the axle 120 with a fastener, such as retaining clips 122, such that the support wheels are rotatable on the axle 120.

[0027] In the embodiment of the carriage 106 depicted in FIGS. 3A and 3B, the support wheels 144a, 144b, 144c, and 144d are passive (i.e., the support wheels are not actively driven with a motor or a similar drive mechanism) and the lift unit is manually traversed along the rail. However, in alternative embodiments (not shown), the support wheels may be actively driven such as when the support wheels are coupled to a motor or a similar mechanism. In such embodiments, the drive mechanism may be communicatively coupled to a hand control (such as hand control 112 shown in FIG. 1) which actuates the drive mechanism and facilitates traversing the lift unit

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along the rail with the drive mechanism.

[0028] In the embodiments described herein, the carriage 106 further comprises at least one conductive roller 156 (two shown in FIGS. 3A and 3B). The conductive rollers 156 electrically couple the battery and/or the motor of the lift unit to a conductor positioned in the rail to which the lift unit is attached, as will be described in more detail herein. The conductive rollers 156 are formed from an electrically conductive material such as copper or a copper alloy, aluminum or an aluminum alloy, steel, or a similar conductive metallic material and/or alloy. Alternatively, the conductive rollers 156 may be formed from an electrically conductive polymer material. In the embodiments described herein, the conductive rollers are formed from an oil-bronze, specifically SNF-12 oil bronze. However, it should be understood that the conductive rollers may be formed from other conductive materials.

[0029] In the embodiments described herein, the conductive rollers 156 are rotatably attached to a conductor truck 146 which, in turn, is mounted to the carriage body 140. Specifically referring to FIG. 3B, the conductor truck 146 is formed from a polymeric material and includes at least one axle 154 to which the conductive rollers are rotatably attached. In the embodiment of the conductor truck 146 shown in FIG. 3B, the axle 154 is integrally formed with the conductor truck 146. However, in other embodiments, the axles 154 may be independent of the conductor truck 146, such as when a separate axle is utilized in conjunction with the conductor truck 146.

[0030] The conductive rollers 156 are positioned on the axles 154 of the conductor truck 146 and a spacer 158 is positioned between the conductive roller 156 and the axle 154 to facilitate rotation of the conductive roller 156 on the axle 154. In the embodiments described herein, the spacer 158 is formed from an electrically conductive material, such as steel. However, it should be understood that the spacer 158 may be formed from other electrically conductive materials, including, without limitation, other electrically conductive metals and alloys and/or electrically conductive polymeric materials. The conductive rollers 156 are secured on their respective axles 154 with a fastener 174 and a washer 172, both of which are electrically conductive. Specifically, the washer 172 is sized such that the washer is in direct contact with the conductive roller 156 and/or the spacer 158 when the conductive roller 156 is secured on the conductor truck 146 with screw 147.

[0031] As noted hereinabove, the conductor truck 146 is attached to the carriage body 140. Specifically, the carriage body 140 comprises a cutout feature 176 formed in an upper portion of the carriage body 140. The conductor truck 146 is positioned in the cutout feature 176 with a biasing member 168, such as a compression spring or another suitable biasing member, positioned between the conductor truck 146 and the carriage body 140. The conductor truck 146 is secured to the carriage body 140 with a fastener 150 which extends through the conductor truck146 and the biasing member 168 and into the carriage body 140. The fastener prevents the lateral movement of the conductor truck 146 with respect to the carriage body. When the conductor truck 146 is installed in the cutout feature 176 and secured with fastener 150 the biasing member 168 bias the conductor truck 146 and the conductive rollers 156 upwards (i.e., in the z-direction in the coordinate axes depicted in FIG. 3B) and away from the carriage body 140. Accordingly, it should be understood that, when the carriage 106 is installed in the rail 102 (FIG. 2), the biasing member 168 biases the conductive rollers 156 into rolling engagement with the conductors 114a, 114b (FIG. 2) positioned on an upper portion of the rail 102.

[0032] Referring to FIGS. 2 and 3A-3B, the carriage 106 further comprises a power lead 148 electrically coupled to the conductive rollers 156. Specifically, the power lead 148 comprises a plurality of electrical conductors (i.e., wires) which are coupled to an interface connector 149 on one end and the conductive rollers 156 on the opposite end. The electrical connection with the conductive rollers 156 is facilitated by eye connectors 178, or similar electrical connectors, which are in electrical contact with the fastener 174 and/or washer 172. Specifically, the fastener 174 is inserted through the eye connector 178 such that the eye connector 178 is positioned between the fastener 174 and the washer 172. The power lead 148 conducts current from the conductive rollers 156 to the lift unit 104, as will be described in more detail herein.

[0033] Referring now to FIGS. 1 and 4, in some embodiments, the carriage 106 may further comprise bumper assemblies 129 positioned on either end of the carriage body 140. The bumper assemblies may be attached to the carriage body 140 and secured in place with the axles 120 which extend transversely through the carriage body 140. The bumper assemblies 129 may include rubber end caps 131 which cushion the carriage 106 when the carriage 106 encounters an end stop 192 located at either end of the rail 102. In the embodiments of the carriage 106 described herein, the bumper assemblies 129 are optional and, as such, it should be understood that the carriage 106 may be constructed without the bumper assemblies.

[0034] Referring to FIGS. 2 and 6, the lift system 100 further comprises a rail 102 in which the carriage 106 is slidably disposed for relative movement to the rail 102. Accordingly, it should be understood that, when the lift unit 104 is mechanically coupled to the carriage 106, the lift unit may be traversed along the rail with the carriage 106. In the embodiment of the rail 102 shown in FIG. 6, the rail 102 is generally formed from a metallic material, such as aluminum, an aluminum alloy, or a similar metallic material, and generally comprises an upper portion 130, a first sidewall 132a integrally formed with the upper portion 130, and a second sidewall 132b integrally formed with the upper portion 130. The upper portion 130, first sidewall 132a and second sidewall 132b are

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oriented such that the upper portion 130, first sidewall 132a and second sidewall 132b form a carriage support channel 135 in which the carriage 106 is slidably disposed. To that end, the first sidewall 132a further comprises a first support flange 134a which extends from the first sidewall 132a into the support channel 135 and the second sidewall 132b further comprises a second support flange 134b which extends from the second sidewall 132b into the support channel 135. In the embodiments described herein, the first support flange 134a and the second support flange 134b are generally opposed to one another and lie in a common horizontal plane (i.e., the x-y plane in the coordinate axes shown in FIG. 6). The first support flange 134a and the second support flange 134b may also be substantially parallel with the upper portion 130 of the rail 102. However, it should be understood that other configurations of the support flanges and the upper portion of the rail are also contemplated. For example, in an alternative embodiment, the support flanges may be upwardly angled with respect to the horizontal plane. Moreover, it should be understood that the structure of the rail 102 depicted in FIGS. 2 and 6 is exemplary and that other rail configurations are contemplated.

[0035] Still referring to FIGS. 2 and 6, the lift system 100 further comprises a pair of conductors 114a, 114b positioned in the support channel 135 on the upper portion 130 of the rail 102. When the carriage 106 is installed in the rail 102, the conductive rollers 156 of the carriage are biased into rolling engagement with the conductors 114a, 114b such that current passing through the conductors 114a, 114b is communicated to the conductive rollers 156 and, in turn, to the power lead 148. The conductors 114a, 114b may be formed from various conductive materials.

[0036] For example, referring now to FIGS. 6 and 7, one embodiment of a conductor 114 for use in the rail 102 of the lift system 100 is schematically depicted in cross section. In this embodiment, the conductor 114 is a flexible conductive tape which generally comprises an insulating layer 253, a primary conductive layer 252, and a protective layer 251. The layers are ordered such that the primary conductive layer 252 is positioned between the insulating layer 253 and the protective layer 251. When the conductor 114 is positioned in the upper portion 130 of the rail 102, as described above, the insulating layer 253 is positioned closest to the upper portion of the rail 102 while the protective layer 251 is furthest from the upper portion of the rail.

[0037] In one embodiment, the insulating layer 253 is formed from an electrically insulating material, such as an insulating polymeric material, which also functions to adhesively bond the conductor 114 to the upper portion of the rail 102. For example, the insulating polymeric material may be polyethylene terephthalate (PET) or a similar polymeric material. The insulating layer 253 may generally have a thickness of less than about 100 um. For example, in one embodiment, the PET has a thickness of about 50 um. The insulating layer 253 prevents current conducted through the primary conductive layer 252 from being conducted to the rail 102 when the conductor is positioned on the upper portion of the rail 102. The insulating layer may be adhesively bonded to the rail with an adhesive material. For example, in one embodiment, the insulating layer 253 is bonded to the upper portion of the rail 102 with a double-sided adhesive tape, such as, for example, 9495 LE adhesive tape manufactured by 3M.

[0038] The primary conductive layer 252 is formed from an electrically conductive material such as copper or a copper alloy. For example, in one embodiment, the electrically conductive tape is formed from E-Cu58 copper alloy. However, it should be understood that the primary conductive layer 252 may be formed from other conductive materials including, without limitation, other elemental metallic materials and/or alloys thereof. The primary conductive layer 252 may generally have a thickness of less than about 100 um. For example, in one embodiment, the primary conductive layer 252 has a thickness of about 50 um. In one embodiment, the primary conductive layer 252 comprises multiple layers of conductive material, such as when the primary conductive layer 252 is constructed of two or more layers of conductive material such as copper or a copper alloy. The primary conductive layer 252 may be bonded to the insulating layer 253 with an adhesive material. For example, in one embodiment, the primary conductive layer 252 is adhesively bonded to an insulating layer 253 with a double-sided adhesive tape such as, for example 55256 double-sided adhesive tape manufactured by 3M.

[0039] The protective layer 251 is formed from a polymeric material. For example, the polymeric material may be a polyester, such as a polyester fabric. Alternatively, the polymeric material may be a polymeric film. In one embodiment, the protective layer is a polyester fabric coated with a conductive material such as, for example, CN-3190 conductive fabric tape manufactured by 3M which is coated on one side with an electrically conductive acrylic adhesive. The protective layer 251 may generally have a thickness of less than about 200 um. For example, in one embodiment, the protective layer has a thickness of less than about 180 um. When the conductor 114 is positioned on the upper portion of the rail 102, the conductor 114 is oriented such that the conductive rollers of the carriage are in rolling engagement with the protective layer 251, thereby enabling current flowing through the primary conductive layer 252 to pass through the protective layer 251 to the conductive rollers. While the protective layer 251 facilitates passing current from the primary conductive layer 252 to the conductive rollers, the protective layer also protects the primary conductive layer 252 from wear and/or corrosion. For example, the protective layer 251 provides a barrier between the primary conductive layer 252 and the outside environment. Moreover, the protective layer 251 mitigates wear and/or other mechanical damage as the conductive rollers of the carriage are rolled along the conductor 114.

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[0040] Referring again to FIG. 2, the lift system 100 further comprises a connector card 160 which couples the conductors 114a, 114b to a power source, such as an electrical outlet. The connector card 160 generally comprises a plurality of spring contacts 162 which engage with the conductors 114a, 114b when the connector card 160 is installed in the rail 102. The connector card 160 further comprises a power port 164 which is electrically coupled to the spring contacts 162. The power port 164 is configured to receive an adapter plug 163, which, in turn, may be coupled to a power source (not shown) for providing current to the connector card 160 and the conductors 114a, 114b.

[0041] In the embodiments described herein, the connector card 160 may be mechanically coupled to an adapter 190 to facilitate positioning the connector card 160 in the support channel of the rail 102. In some embodiments, the adapter 190 may further comprise an end stop 192 which provides cushioning to the adapter 190 and connector card 160 when the adapter is contacted by the carriage 106.

[0042] The construction of the rail-mounted lift system 100 will now be described with specific reference to the exploded view of the lift system 100 shown in FIG. 2 and the cross section of the assembled lift system 100 shown in FIG. 8. The conductors 114a, 114b are adhesively attached to the upper portion 130 of the rail 102 such that the conductors 114a, 114b extend along the length of the rail 102. An insulating pad 180 may be positioned between the conductors 114a, 114b and the upper portion 130 of the rail proximate the end of the rail 102.

[0043] In one embodiment, the conductors 114a, 114b may be installed in the rail 102 utilizing an applicator tool 300, as depicted in FIG. 9. The applicator tool 300 generally comprises an applicator frame assembly 310 and a spindle 302 to which a spool of wound conductor may be attached. The applicator frame assembly 310 generally includes an extension body 313, a support arm assembly 312 and a dolly portion 315. The support arm assembly 312 is mechanically coupled to the extension body 313 and supports the spindle 302 such that the spindle 302 is free to rotate in the support arm assembly 312. The dolly portion 315 is coupled to the extension body 313 with sideplates 314 (one shown in FIG. 9).

[0044] Referring to FIGS. 9-11, the dolly portion 315 of the applicator tool 300 generally includes a contact roller mechanism 330 for impinging the conductor against the rail and a tensioning mechanism 320 for tensioning the conductor as it is paid-out from the spindle 302. The dolly portion 315 further comprises a dolly portion shoe 328 and a normalizing plate 326 which work in conjunction with one another to guide the conductor through the applicator tool 300 and into the tensioning mechanism 320. A lanyard 318 may be attached to the dolly portion 315 to assist in traversing the applicator tool 300 through the rail during application of the conductor to the rail.

[0045] The tensioning mechanism of the dolly portion 315 includes a pair of flange engagement wheels 322a, 322b positioned to engage the support flanges 134a, 134b of the rail 102 and thereby guide the applicator tool 300 in the rail 102. Similarly, the contact roller mechanism 330 contains a pair of contact wheels 332a, 332b positioned to engage the upper portion 130 of the rail 102 and thereby guide the applicator tool 300 in the rail 102 while simultaneously laminating the conductor to the rail 102, as will be described further herein.

[0046] Referring specifically to FIG. 11, the contact roller mechanism 330 includes a contact wheel 332 that is coupled to the applicator frame assembly 310 through a follower mechanism 336. The contact wheel 332 and the follower mechanism 336 are configured to translate inward and outward (i.e., in the +/- z-direction as shown in FIG. 11) relative to the applicator frame assembly 310. To facilitate this translation, the contact roller mechanism 330 includes a biasing member 334 that applies a force to the follower mechanism 336 and the contact wheel 332 in a direction that tends to position the contact wheel 332 and the follower mechanism 336 in a direction away from the applicator frame assembly 310, which, in the embodiment shown in FIG. 11, is the positive z-direction.

[0047] Still referring to FIG. 11, the tensioning mechanism 320 further comprises a plurality of roller elements 340, guide pins 341 and a pair of reversing wheels 324a, 324b (one shown in FIG. 11) through which the conductor laminate 113 may be wound in order to maintain tension on the conductor 114 as the conductor is applied to the rail 102.

[0048] Referring again to FIGS. 9-11, to install the conductor in the rail 102, a length of conductor laminate 113 (i.e., the conductor 114, as described hereinabove, and a backing tape 115 applied to the adhesive layer) is arranged in a spool 304 and placed about the spindle 302 of the applicator tool 300. The conductor laminate 113 is fed from the spool 304 and directed between the extension body 313 and an extension body follower 316 that is coupled to the extension body 313. The conductor laminate 113 is passed between the applicator sideplates 314 and directed to the dolly portion 315, as shown in greater detail in FIG. 11, where the conductor laminate 113 is introduced into the tensioning mechanism 320. Specifically, the conductor laminate 113 first passes over a dolly portion shoe 328, and is wound through the plurality of roller elements 340 and pins 341 that form the tensioning mechanism 320, and directed over the reversing wheel 324. At the reversing wheel 324, the backing material 115 is removed from the conductor 114, thereby exposing the adhesive layer of the conductor 114. With the adhesive layer of the conductor 114 exposed, the conductor 114 may be directed over the reversing wheel 324, over the normalizing plate 326, and beneath a contact wheel 332 of the contact roller mechanism 330. As is depicted in FIG. 11, as the conductor laminate 113 passes through the tensioning mechanism 320, any twisting, for example, due to winding the conductor laminate 113 about the spindle 302, is minimized, such that the conductor laminate 113 will generally lie flat when

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being applied to the rail 102.

[0049] Referring now to FIGS. 10 and 11, once the conductor laminate 113 is loaded into the applicator tool 300, the applicator tool 300 is positioned in the rail 102 such that the flange engagement wheels 322a, 322b engage the support flanges 134a, 134b of the rail 102 and the contact wheels 332a, 332b engage the upper portion 130 of the rail 102. With the applicator tool 300 in this position, the contact wheel 332b impinges the conductor 114 against the upper portion 130 of the rail 102 thereby laminating the conductor 114 to the rail. Thereafter, the applicator tool 300 is translated along a length of the rail 102 by a user. As the applicator tool 300 is translated along the rail 102, additional conductor is paid out from the spindle 302, passes through the applicator tool 300, and below the contact roller mechanism 330 such that the conductor 114 is applied to the length of the rail. As the applicator tool passes through the rail, the biasing member 334 applies pressure through the contact wheel 332 to the conductor 114 as the applicator tool 300 is translated forward along the rail 102. The pressure exerted by the contact wheel 332 secures the conductor 114 to the rail 102 by pressing the adhesive layer of the conductor 114 against the upper portion of the rail 102. A user may grasp the lanyard 318 coupled to the applicator frame assembly 310 to translate the applicator tool 300 along the rail 102. Two conductors 114 (i.e., the first conductor 114a and the second conductor 114b, as depicted in FIGS. 6 and 8) may be applied to the rail by first translating the applicator tool 300 along the rail 102 from a first end to a second end, then rotating the applicator tool 300 within the rail 102 as to translate the applicator tool 300 from the second end to the first end of the rail 102. Thus, the applicator tool 300 can place the first conductor 114a and the second conductor 114b such that they are approximately evenly spaced in a lateral direction across the rail 102.

[0050] Referring again to FIGS. 2 and 8, after the conductors 114a, 114b are installed in the rail, the carriage 106 is installed on the lift unit 104 by inserting the connection rail 118 into the corresponding receiving slot 142 of the carriage 106 and securing the carriage 106 on the connection rail 118 with fastener 119. The lift unit 104 with attached carriage 106 is then suspended from the rail 102 by positioning the carriage 106 in the rail 102 such that the support wheels 144a, 144b are slidably engaged with the first support flange 134a and the second support flange 134b, respectively. With the carriage 106 in this position, the biasing member 168 biases the conductor truck 146 and the conductive roller 156 upwards (i.e., in the z-direction of the coordinate axes shown in FIG. 8) and away from the carriage body 140 such that the conductive rollers are in rolling engagement with and electrically coupled to the conductors 114a, 114b, as depicted in FIG. 8. The power lead 148 is also electrically coupled to the battery and/or motor of the lift unit 104.

[0051] Thereafter, the connector card 160 and adapter 190 are inserted into rail 102 such that the spring contacts 162 positioned on the connector card are engaged with the conductors 114a, 114b. The connector card 160 and adapter 190 are secured in the rail 102 with fastener 121, such as a bolt and nut, and the adapter plug 163 is inserted in the power port 164 thereby providing power to the lift system 100.

[0052] Referring now to FIGS. 1, 2 and 5, the lift unit 104 may be traversed over the rail 102 with the carriage 106. As the lift unit 104 is traversed over the rail 102, current provided to the conductors 114 through connector card 160 is communicated to the conductive rollers 156 which are in rolling engagement with the conductors 114. The current passes from the conductors 114 through the power lead 148 to the lift unit 104 thereby providing power to charge the battery 132 and/or operate the motor 133. For example, in embodiments where the lift unit 104 includes a battery 132, as shown in FIG. 5, the current from the power lead charges the battery and may also power the motor. In these embodiments, the motor 133 may be actuated with either current from the battery 132 or current supplied directly from the power lead 148. Alternatively, in embodiments (not shown) where the lift unit 104 does not include a battery 132, the current supplied to the lift unit 104 with the power lead 148 directly powers the motor 133.

[0053] Moreover, because the conductors 114a, 114b extend along the entire length of the rail 102 and the conductive rollers 156 are in rolling engagement with the conductors 114a, 114b as the lift unit 104 is traversed over the length of the rail 102, it should be understood that power is continuously provided to the lift unit irrespective of the position of the lift unit 104 relative to the rail 102 (i.e., power is provided to the lift unit at every point along the length of the rail).

[0054] In the embodiments described herein and shown in the figures, the lift system 100 is constructed with the carriage 106, conductors 114a, 114b, and connector card 160 to facilitate charging and/or providing power to the lift unit 104 at any point along the length of the rail 102. However, it is also contemplated that certain components of the lift system 100 may be separately provided as a kit of parts which may be used to retro fit lift systems which do not have continuous charging capabilities. For example, in one embodiment, a kit of parts for retrofitting a rail-mounted lift system for continuous charging of a lift unit along a length of a rail may include a conductor and a carriage which are packaged together. In one embodiment, the conductor is a flexible conductive tape as depicted in FIG. 7 and described hereinabove, although it should be understood that other conductors suitable for use in a rail-mounted lift system may be included in the kit of parts. In one embodiment, the carriage may include a carriage body, at least one support wheel rotatably coupled to the carriage body, and a conductor truck, as described hereinabove and depicted in FIGS. 3A and 3B. In this embodiment, the conductor truck includes at least one conductive roller rotatably attached

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to the conductor truck and the conductor truck is mounted to the carriage body with a biasing mechanism for upwardly biasing the at least one conductive roller away from the carriage body, as described above.

[0055] In another embodiment, the kit of parts may further comprise a connector card for electrically coupling the conductor and the carriage to a power source. In this embodiment, the kit of parts may optionally include an adapter for positioning the conductor card in the rail of a lift system and an end stop. The kit of parts may also optionally include a plug adapter and the corresponding power supply for electrically coupling the connector card to line voltage.

[0056] As noted above, the kit of parts may be used to retrofit and convert an existing rail-mounted lift system to a rail-mounted lift system with continuous charging capabilities. The various parts of the kit of parts may be installed in the rail of the existing lift system as described herein above thereby converting the existing lift system to a continuous charging system.

[0057] Based on the foregoing, it should now be understood that the embodiments shown and described herein relate to a rail-mounted lift system for lifting and supporting patients. The lift system includes a lift unit which is supplied with current along the entire length of the rail to which the lift unit is attached. The current supplied to the lift system may be used to either directly power a motor of the lift unit and/or charge a battery of the lift unit at any point along the length of the rail. In this manner, the lift unit can be powered by the line current or, when the line current is discontinued such as during a power failure, the lift unit can be powered by the battery.

[0058] In some embodiments, the rail-mounted lift system includes conductors formed from a flexible conductive tape having a primary conductive layer disposed between an insulating adhesive layer and a protective layer. The insulating adhesive layer facilitates installation of the conductor on a rail without modifying the rail. Moreover, the protective layer encapsulates the primary conductive layer thereby preventing degradation of the primary conductive layer due to exposure to environmental conditions and permitting the conductor to be used in lift systems installed in humid environments (i.e., over therapy pools and the like). Further, the protective layer also mitigates wear on the primary conductive layer as the conductive rollers of the carriage are brought into rolling engagement with the conductor.

[0059] Also described herein is a kit of parts for retrofitting and converting an existing rail-mounted lift system to a rail-mounted lift system in which the lift unit can be continuously charged and/or powered along the entire length of the rail, as described herein.

[0060] It is noted that the terms "substantially" and "about" may be utilized herein to represent the inherent degree of uncertainty that may be attributed to any quantitative comparison, value, measurement, or other representation. These terms are also utilized herein to represent the degree by which a quantitative representation may vary from a stated reference without resulting in a change in the basic function of the subject matter at issue.

[0061] While particular embodiments have been illustrated and described herein, it should be understood that various other changes and modifications may be made without departing from the spirit and scope of the claimed subject matter. Moreover, although various aspects of the claimed subject matter have been described herein, such aspects need not be utilized in combination. It is therefore intended that the appended claims cover all such changes and modifications that are within the scope of the claimed subject matter.

Claims

1. A rail-mounted lift system comprising:

   a rail comprising at least one conductor positioned in a carriage support channel formed in the rail;
   a carriage slidably disposed in the rail for relative movement to the rail, the carriage comprising at least one conductive roller rotatably attached to the carriage, wherein the at least one conductive roller is upwardly biased into rolling engagement with the at least one conductor; and
   a lift unit coupled to the carriage, the lift unit comprising a motor paying out and taking up a lifting strap, wherein the lift unit is electrically coupled to the at least one conductive roller.

2. The rail-mounted lift system of claim 1, wherein the at least one conductive roller is rotatably attached to a conductor truck and the conductor truck is mounted in the carriage with a biasing member upwardly biasing the conductor truck away from the carriage.

3. The rail-mounted lift system of claim 1, wherein the at least one conductor is a conductive tape comprising a primary conductive layer positioned between an insulating layer and a protective layer.

4. The rail-mounted lift system of claim 3, wherein the protective layer is a polyester fabric, the primary conductive layer is a copper alloy, and the insulating layer is PET.

5. The rail-mounted lift system of claim 1, wherein the at least one conductive roller is electrically coupled to at least one of a battery of the lift unit and the motor of the lift unit.

6. A rail-mounted lift system comprising:

   a rail comprising at least one conductor positioned on an upper portion of the rail, a first support flange, and a second support flange;

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a carriage slidably disposed in the rail for relative movement to the rail, the carriage comprising:

a carriage body;
at least one pair of support wheels rotatably coupled to the carriage body, the at least one pair of support wheels slidably engaged with the first support flange and the second support flange;
a conductor truck comprising at least one conductive roller rotatably attached to the conductor truck, wherein the conductor truck is mounted to the carriage body with a biasing member upwardly biasing the at least one conductive roller into rolling engagement with the at least one conductor; and

a lift unit coupled to the carriage body, the lift unit comprising a motor paying out and taking up a lifting strap, wherein the lift unit is electrically coupled to the at least one conductive roller.

7. The rail-mounted lift system of claim 6, wherein the lift unit further comprises a battery electrically coupled to the motor and the at least one conductive roller.

8. The rail-mounted lift system of claim 6, wherein the at least one conductor is a conductive tape comprising a primary conductive layer positioned between an insulating layer and a protective layer and the insulating layer is adhesively bonded to the upper portion of the rail.

9. The rail-mounted lift system of claim 8, wherein the protective layer is a polyester fabric, the primary conductive layer is a copper alloy, and the insulating layer is PET.

10. The rail-mounted lift system of claim 6, wherein the rail comprises a first sidewall integrally formed with the upper portion, and a second sidewall integrally formed with the upper portion and opposed to the first sidewall, the first sidewall, the second sidewall and the upper portion defining a carriage support channel, wherein:

the first support flange extends into the carriage support channel from the first sidewall;
the second support flange extends into the carriage support channel from the second sidewall; and
the at least one conductor is positioned in the carriage support channel and adhesively coupled to the upper portion of the rail.

11. The rail-mounted lift system of claim 6, wherein the carriage comprises a first end bumper attached to a first end of the carriage and a second end bumper attached to a second end of the carriage.

12. The rail-mounted lift system of claim 6, wherein:

the carriage comprises a cutout feature formed in an upper portion of the carriage and the conductor truck is positioned in the cutout feature and secured to the carriage with a fastener, wherein the fastener prevents lateral movement of the conductor truck with respect to the carriage body; and
the biasing member is a compression spring positioned around the fastener between the conductor truck and the carriage such that the biasing member biases the conductor truck upwards, out of the cutout feature.

13. A kit of parts for retrofitting an overhead rail for continuously charging a lift unit along a length of a rail, the kit of parts comprising:

a conductive tape comprising a primary conductive layer positioned between an insulating layer and a protective layer;
a carriage comprising:

a carriage body;
at least one pair of support wheels rotatably coupled to the carriage body;
at least one conductive roller rotatably attached to the carriage, wherein the at least one conductive roller is upwardly biased into rolling engagement with the conductive tape when the conductive tape and the carriage are installed in the rail;

a connector card for electrically coupling the conductive tape to a power source; and
a plug adapter and a power supply for electrically coupling the connector card to line voltage, wherein the conductive tape, the carriage, the connector card, the plug adapter and the power supply are packaged together.

14. The kit of parts of claim 13, wherein the at least one conductive roller is rotatably attached to a conductor truck and the conductor truck is mounted in the carriage body with a biasing member upwardly biasing the conductor truck away from the carriage body.

15. The kit of parts of claim 13, wherein the protective layer is a polyester fabric, the primary conductive layer is a copper alloy, and the insulating layer is PET.

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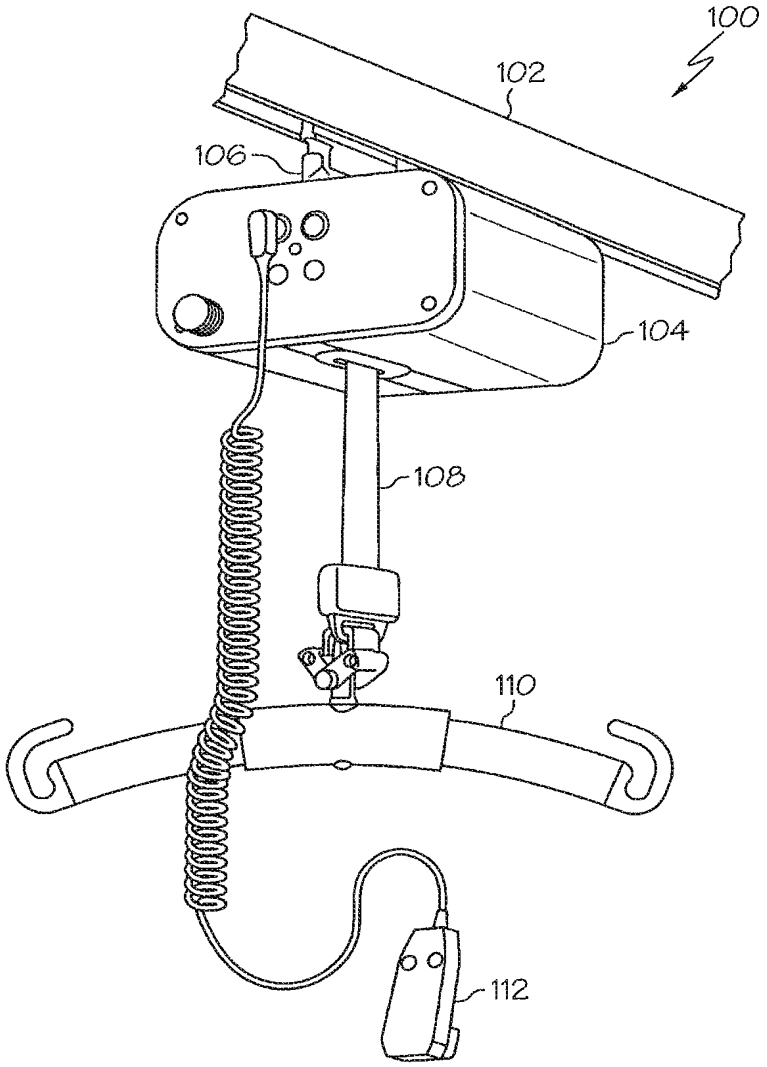


FIG. 1

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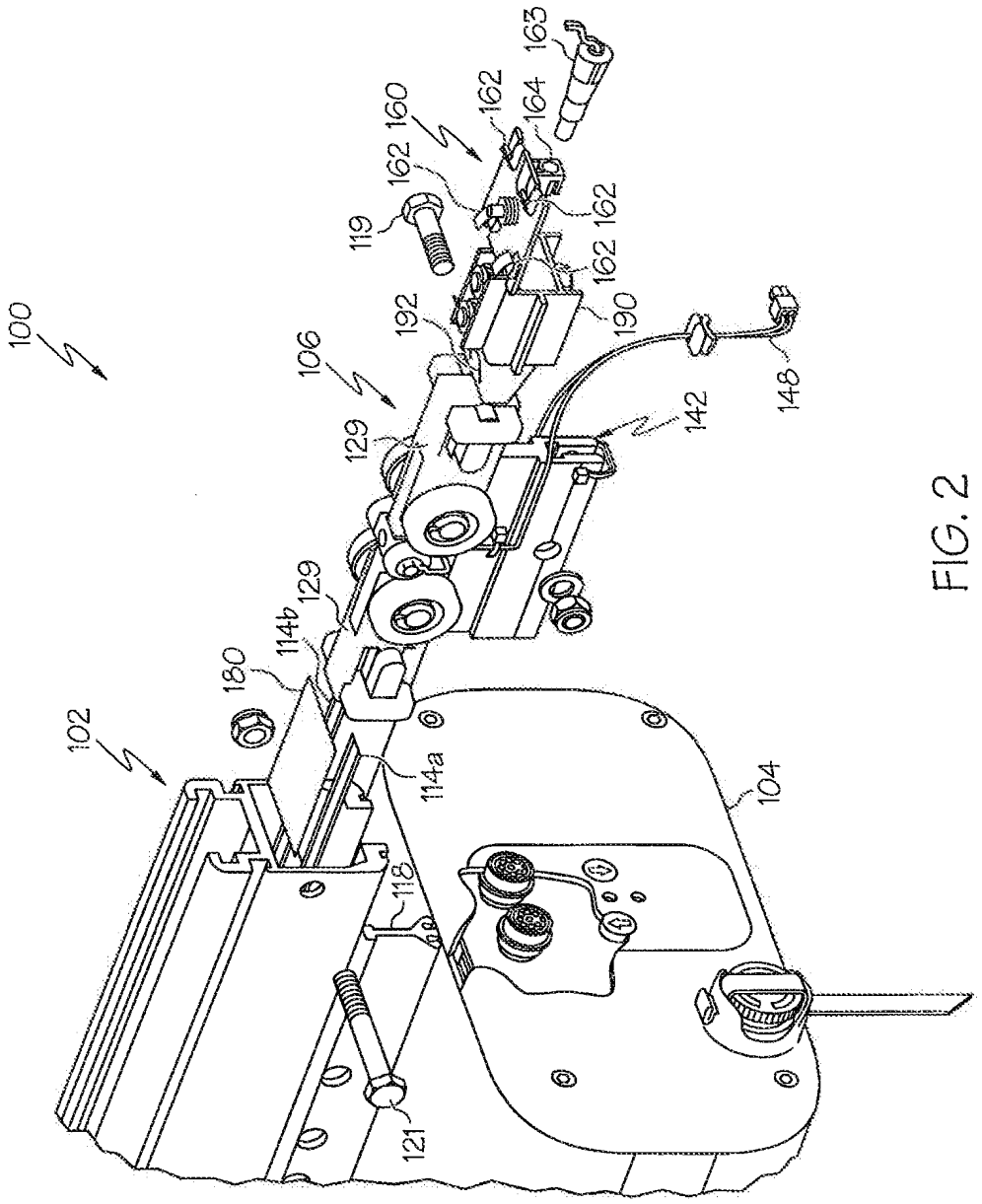


FIG. 2

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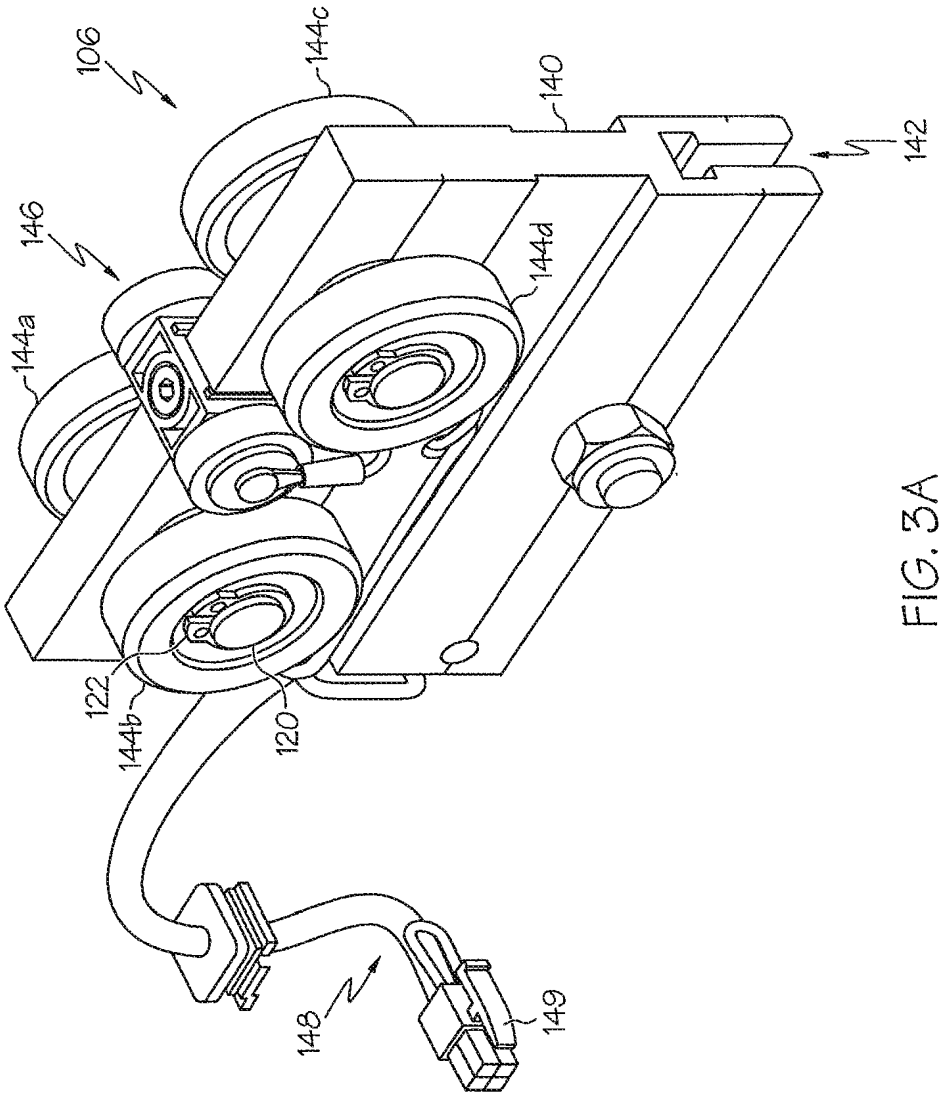


FIG. 3A

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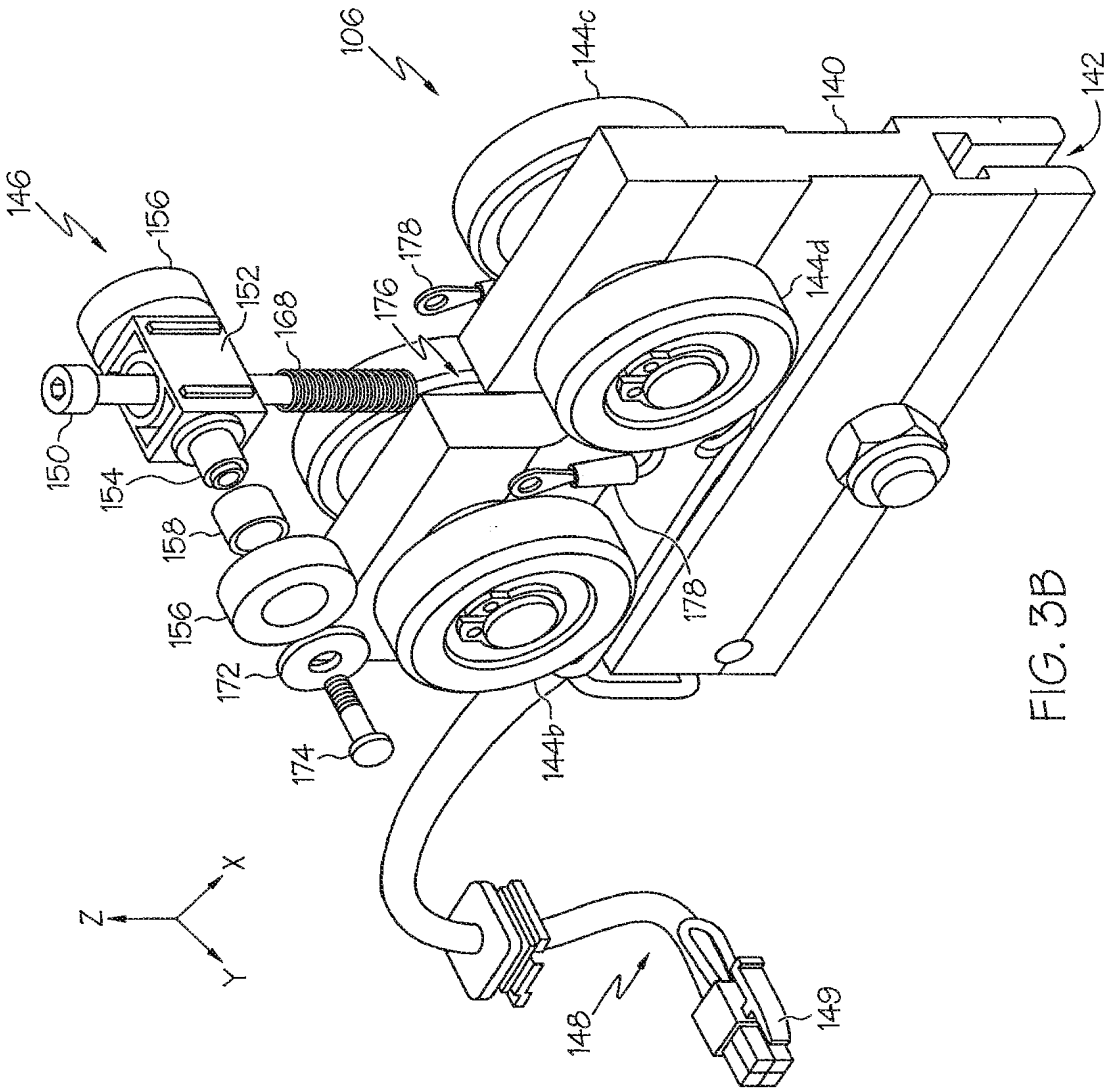


FIG. 3B

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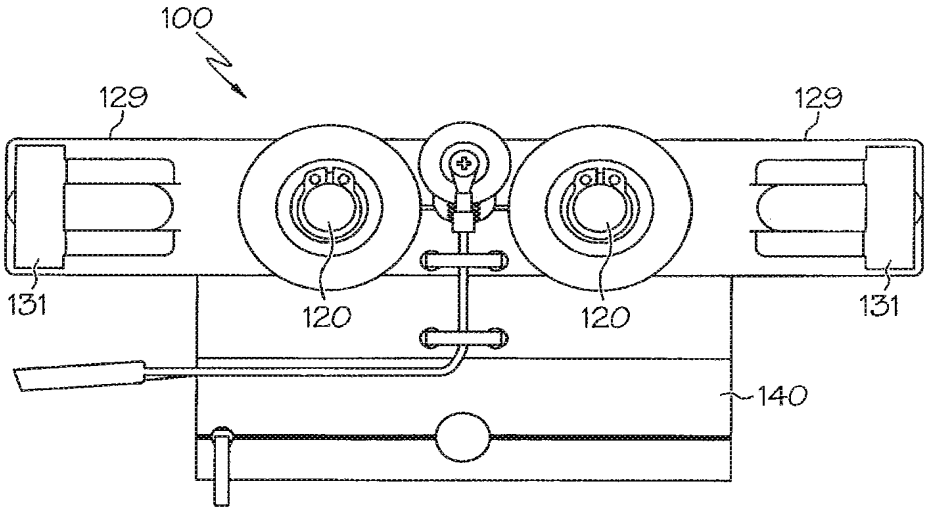


FIG. 4

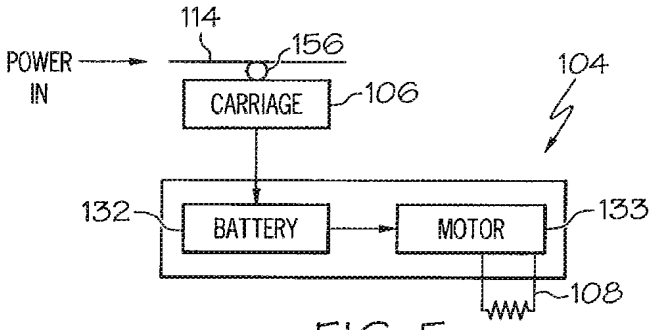


FIG. 5

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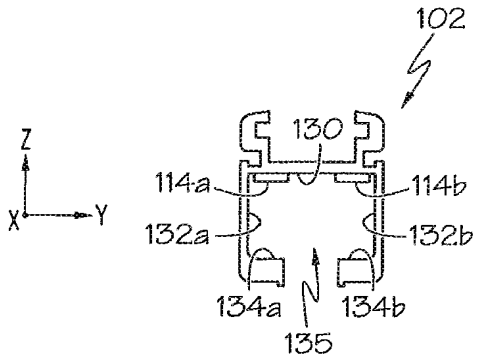


FIG. 6

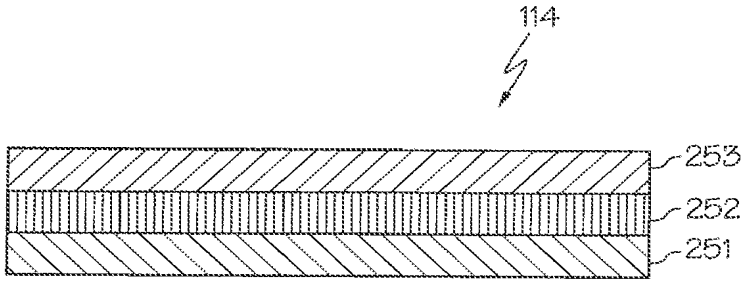


FIG. 7

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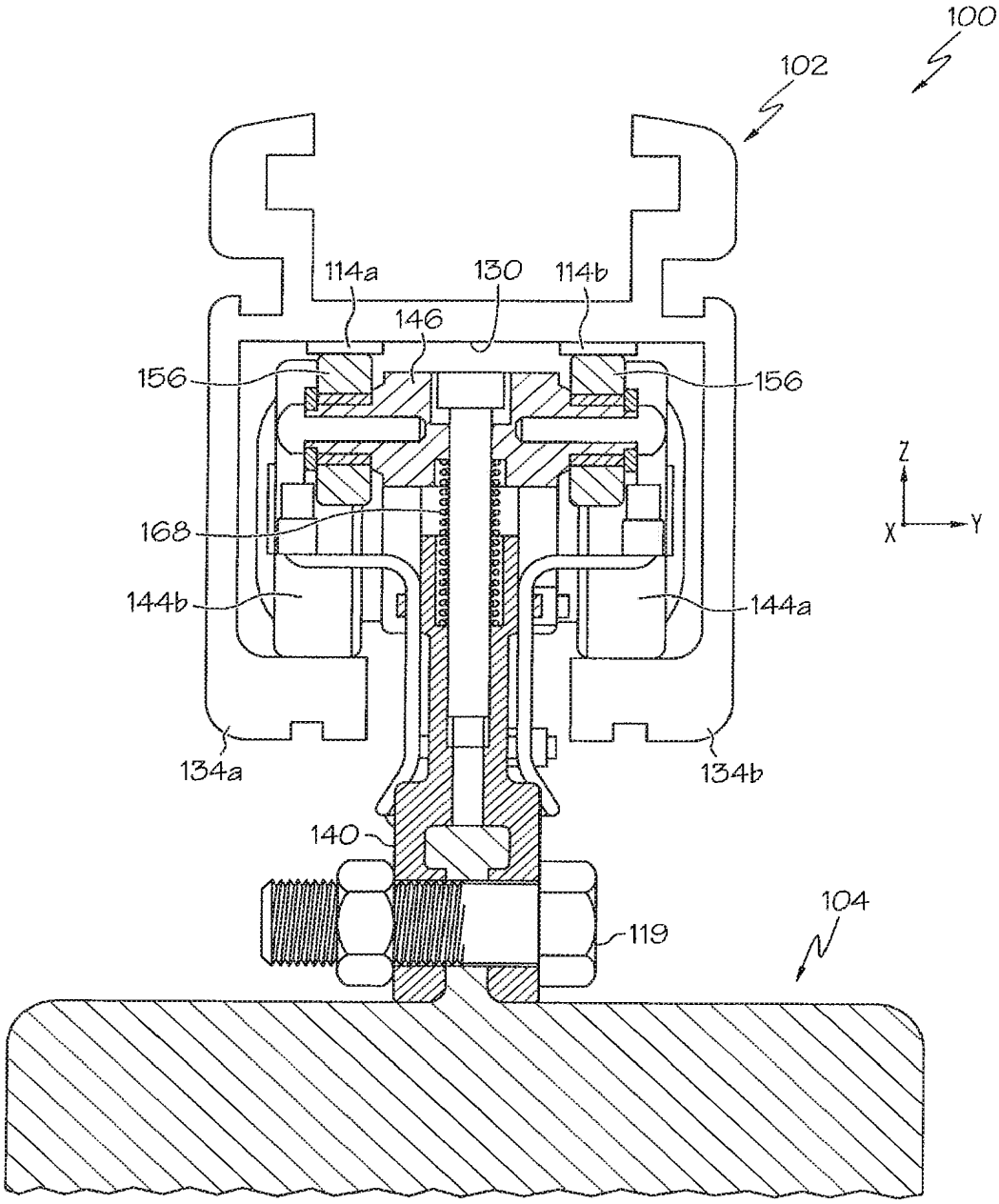


FIG. 8

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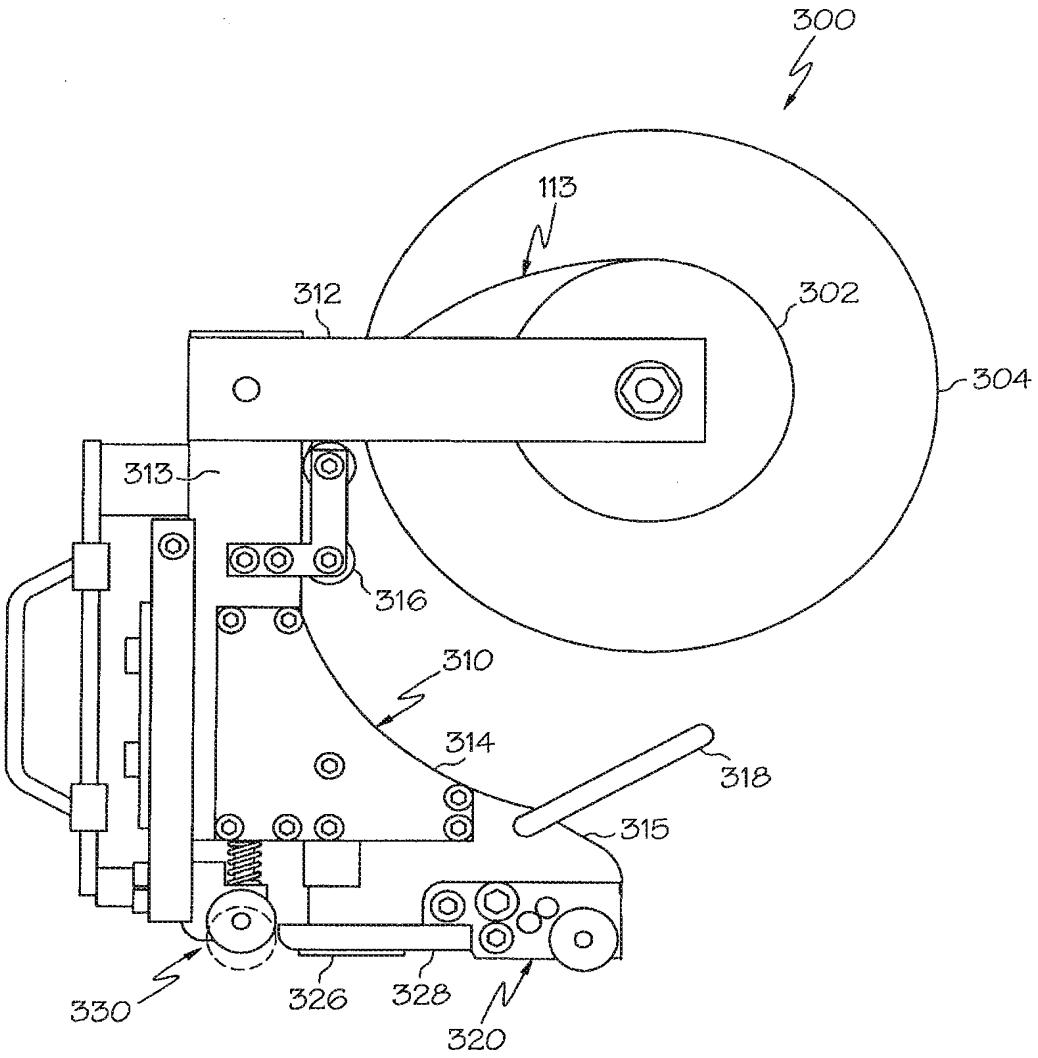


FIG. 9

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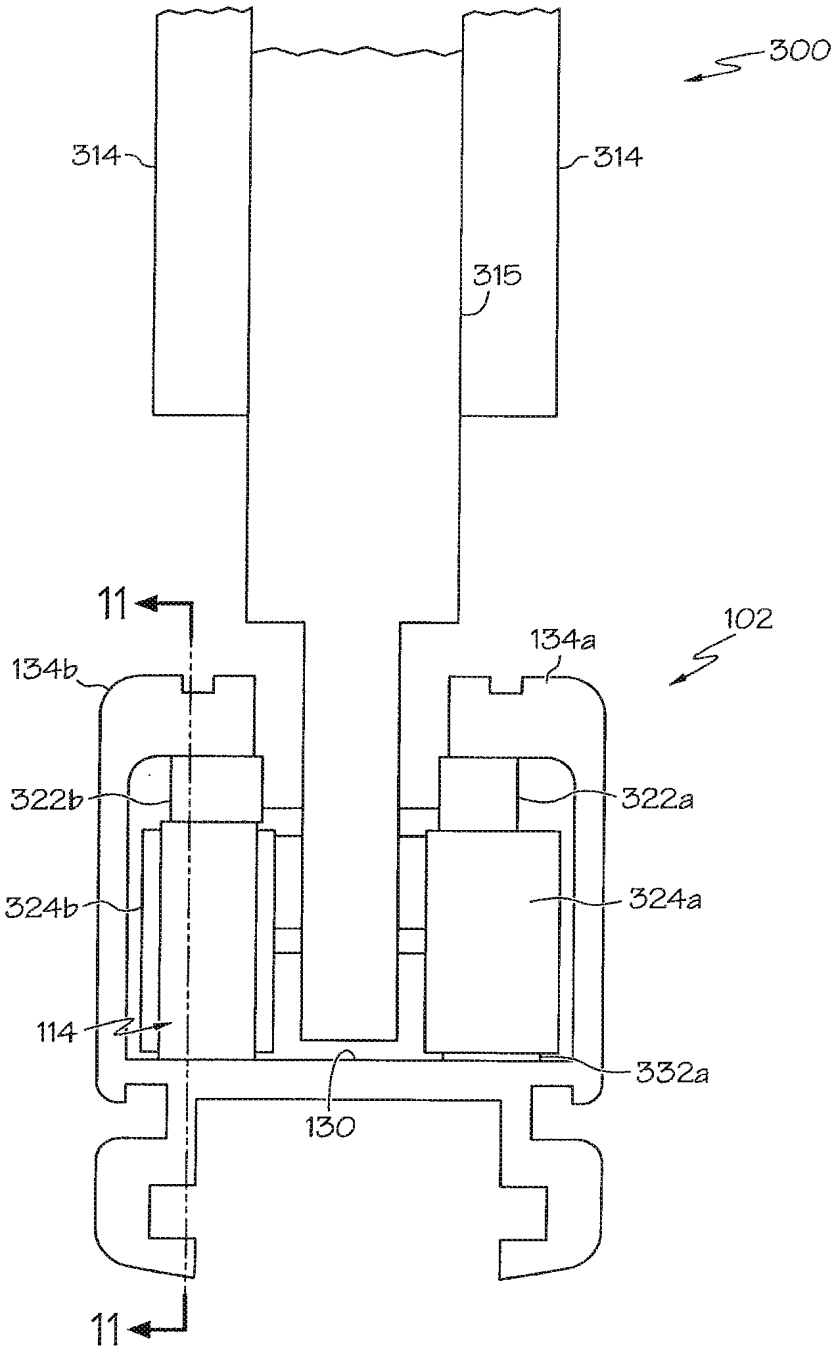


FIG. 10

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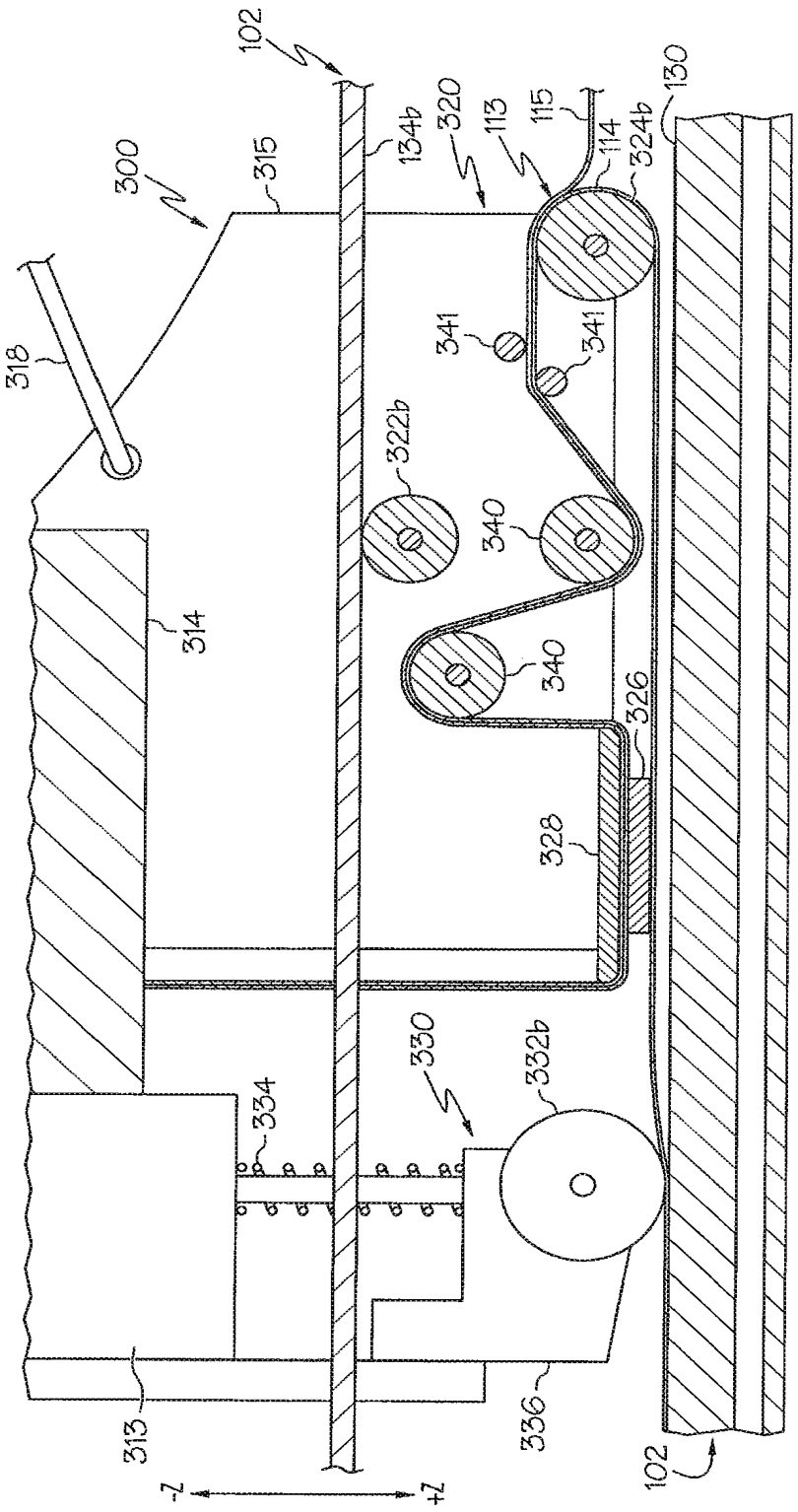


FIG. 11

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PARTIAL EUROPEAN SEARCH REPORT

under Rule 62a and/or 63 of the European Patent Convention. This report shall be considered, for the purposes of subsequent proceedings, as the European search report

Application Number EP 11 17 1726

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	WO 00/27333 A1 (CHEESEBORO ROBERT G [US]) 18 May 2000 (2000-05-18) * page 6, line 20 - page 7, line 11 * * figures 8,9,11 *	1,2,5 3,4	INV. B66C11/00 B66D3/18 A61G7/10 B66C7/02
Y	JP 10 286288 A (DAIFUKU KK) 27 October 1998 (1998-10-27) * abstract * * figures 4,5 *	1	
Y	FR 1 235 844 A (JUNGJUNGER B) 8 July 1960 (1960-07-08) * abstract * * figure 1 *	1	
A	GB 1 323 892 A (STIERLEN WERKE AG) 18 July 1973 (1973-07-18) * figure 7 *	1,2	
A	JP 2001 112823 A (DOUUMANZU KK) 24 April 2001 (2001-04-24) * abstract * * figure 9 *	1,2	
	-/--		

TECHNICAL FIELDS SEARCHED (IPC)

B66C
B66D
A61G

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC so that only a partial search (R.62a, 63) has been carried out.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:

see sheet C

Place of search	Date of completion of the search	Examiner
The Hague	26 October 2011	Serôdio, Renato

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

1

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PARTIAL EUROPEAN SEARCH REPORT

Application Number
EP 11 17 1726

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
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A	DE 40 10 020 A1 (HOYER GMBH [DE]) 2 October 1991 (1991-10-02) * figure 1 *	3,4	
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1

EPO FORM 1503 03.82 (P04C10)

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Europäisches Patentamt
European Patent Office
Office européen des brevets

INCOMPLETE SEARCH
SHEET C

Application Number
EP 11 17 1726

Claim(s) completely searchable:
1-5

Claim(s) not searched:
6-15

Reason for the limitation of the search:

Multiple independent claims in the same category
Claims 1, 6 and 13 have been drafted as separate independent claims. Under Article 84 in combination with Rule 43(2) EPC, an application may contain more than one independent claim in a particular category only if the subject-matter claimed falls within one or more of the exceptional situations set out in paragraph (a), (b) or (c) of Rule 43(2) EPC. This is not the case in the present application, however, since the subject-matter of the mentioned claims does not involve:
a plurality of interrelated products,
different uses of a product or apparatus,
alternative solutions to a particular problem, where it is inappropriate to cover these alternatives by a single claim.

In particular, claims 1 and 6, both defining a rail-mounted lift system, do not contain the same features and as such are independent. Claim 13, relating to a kit of parts for retrofitting an overhead rail, is also independent of any of claims 1 and 6.

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 17 1726

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-10-2011

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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特開2000－237250
（P2000－237250A）
(43)公開日　平成12年９月５日(2000.9.5)

(51)Int.Cl.'	識別記号	ＦＩ	ﾃｰﾏｺｰﾄﾞ(参考)
Ａ６１Ｇ　7/10		Ａ６１Ｇ　7/10	４Ｃ０４０

審査請求　有　　請求項の数２　ＯＬ　（全　５　頁）

(21)出願番号　特願平11－44330

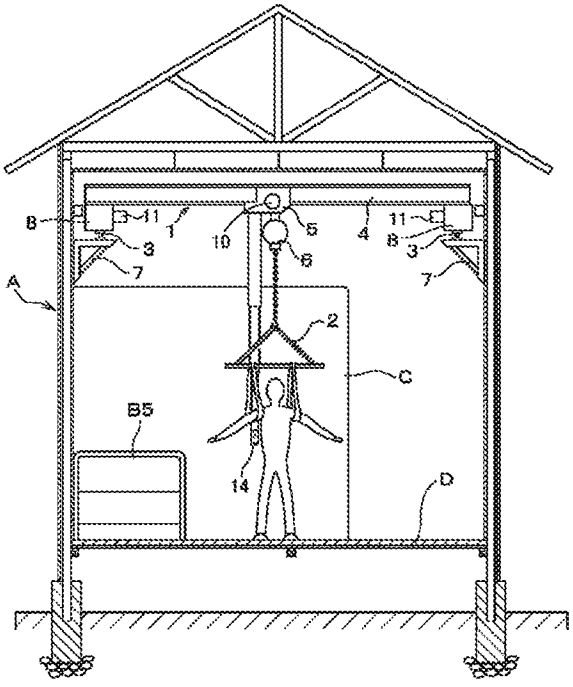
(22)出願日　平成11年２月23日(1999.2.23)

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Ｆターム(参考)　4C040 AA08 EE05 HH01 JJ02 JJ07

(54)【発明の名称】　介護室装置

(57)【要約】
【課題】　患者、介護人に取って操作しやすい介護室装置を提供すること。
【解決手段】　患者の生活に必要な設備を備えた介護室Ａの天井に、一方向に配設した案内レール３と、該案内レール３に沿って自走する、該案内レールと直角方向に長い移動レール４と、該移動レール４に沿って走行するサドル５と、該サドル５に設けた巻上げ機６とからなる自走式天井走行クレーン１を設け、該巻上げ機６に吊した吊具２で患者を吊り、操作盤１４の操作ボタン１４ａ～１４ｆの操作で該吊具２に吊った患者を介護室内で縦横に移動させる。このような介護室装置にあって、操作盤１４をサドル５から下方に突出する棒状体１５の下端部に設けて、操作盤１４をサドル５に固定された安定状態とすることで、該操作盤１４に設けた操作ボタンを片手又は手以外の部分で操作できるようにした。



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【特許請求の範囲】

【請求項１】　患者の生活に必要な設備を備えた介護室の天井に、一方向に配設した案内レールと、該案内レールに沿って自走する、該案内レールと直角方向に長い移動レールと、該移動レールに沿って走行するサドルと、該サドルに設けた巻上げ機とからなる自走式天井走行クレーンを設け、該巻上げ機に患者を吊る吊具を取り付け、該走行クレーンを操作する操作盤に設けた操作ボタンの操作で該吊具を、介護室を縦横に移動自在に且つ高さ位置を調節できるようにした介護室装置において、前記操作盤を、サドルに固設したサドルから下方に突出する棒状体の下端部に設けたことを特徴とする介護室装置。

【請求項２】　前記棒状体は伸縮自在としたことを特徴とする請求項１記載の介護室装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は主として木造住宅を利用する介護室装置に関する。

【０００２】

【従来の技術】本願出願人は、患者の生活に必要な設備を備えた介護室の天井に、一方向に配設した案内レールと、該案内レールに沿って自走する、該案内レールと直角方向に長い移動レールと、該移動レールに沿って走行するサドルと、該サドルに設けた巻上げ機とからなる自走式天井走行クレーンを設け、該巻上げ機に患者を吊る吊具を取り付け、該走行クレーンを操作する操作盤の操作ボタンの操作で、吊具を、介護室を縦横に移動自在に且つ高さ位置を調節できるようにした介護室装置を提案した（特願平１０－２８６４２４号）。

【０００３】

【発明が解決しようとする課題】しかし、歩行が困難であると共に、手の不自由な患者等に取っては、コードに吊り下げられている不安定な操作盤を押さえて操作盤の操作ボタンを操作することは、きわめて難しい。

【０００４】本発明はかかる不具合のない介護室装置を提供することを課題とする。

【０００５】

【課題を解決するための手段】本願の請求項１に記載の発明は、患者の生活に必要な設備を備えた介護室の天井に、一方向に配設した案内レールと、該案内レールに沿って自走する、該案内レールと直角方向に長い移動レールと、該移動レールに沿って走行するサドルと、該サドルに設けた巻上げ機とからなる自走式天井走行クレーンを設け、該巻上げ機に患者を吊る吊具を取り付け、該走行クレーンを操作する操作盤の操作ボタンの操作で該吊具を、介護室を縦横に移動自在に且つ高さ位置を調節できるようにした介護室装置において、前記操作盤をサドルに固設したサドルから下方に突出する棒状体の下端部に設けたことで、該操作盤サドルに固定されて安定した

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状態にあるため、片手、又は手以外の部分で該操作ボタンを操作することができる。

【０００６】

【発明の実施の形態】本発明の実施の形態を図面に付き説明する。図でＡは患者の生活に必要な設備Ｂを備えた本造の介護室を示し、設備Ｂとしては、該介護室Ａの一側に集中させて設けた風呂場Ｂ１、便所Ｂ２、洗濯機を配した洗濯場Ｂ３、洗面台を配した洗面場Ｂ４並びにベットＢ５、箪笥等の収納家具Ｂ６等を備える。

【０００７】１は、患者がこれら設備Ｂを利用する場合に、該設備Ｂを設けた位置まで患者を搬送するために、該介護室Ａの天井面に取り付けた自走式天井走行クレーンを示し、該自走式天井走行クレーン１は、介護室Ａの一方向（Ｘ方向）に配設した案内レール３と、該案内レール３に沿って自走する該案内レール３と直角方向（Ｙ方向）に長い移動レール４と、該移動レール４に沿って走行するサドル５と、該サドル５に設けた巻上げ機６とで構成し、該巻上げ機６に患者を吊る吊具２を吊持させる。なお、各設備Ｂ間には仕切り壁Ｃを設けることが望ましく、該仕切り壁Ｃの上部には、後述する自走式天井走行クレーン１を取り付けるときの邪魔に成らないように、天井面との間に間隔を設ける。

【０００８】案内レール３並びに移動レール４は、アルミ合金等の軽量金属材で構成し、案内レール３は、介護室Ａの一方向の両側に設けた柱Ｄに支持させた支持金具７に支持させて介護室Ａの両側に取付け、移動レール４はその両端に設けたサイドサドル８で案内レール３に載架して、案内レール３に沿って移動できるように設ける。なお、サドル５並びにサイドサドル８はウレタン樹脂等のタイヤ５ａ、８ａを備え、該タイヤ５ａ、８ａで案内レール３並びに移動レール４上に載せ、案内レール３並びに移動レール４に沿って静かに走行させるようにした。

【０００９】サドル５並びにサイドサドル８、８は、集電トロリー９を備え、該集電トロリー９によってサドル５並びにサイドサドル８、８に設けた電動機（１００Ｖ電動機）１０、１１並びにサドル５上の電動機６ｃ等に給電する。これを説明すると、案内レール３と移動レール４に沿わせて設けたリップ付きチャンネル状の鞘体１２を案内レール３と移動レール４側に固定し、該鞘体１２内に設けた設けた給電レール１３に、サドル５並びにサイドサドル８、８に設けた集電子（図示しない）を接触させて給電させるようにした。

【００１０】１４は該自走式天井走行クレーン１を操作する操作盤を示し、該操作盤１４は、吊具２の上動用並びに下動用の操作ボタン１４ａ、１４ｂと、移動レール４を自走させて吊具２をＸ方向に移動させる移動用の操作ボタン１４ｃ、１４ｄと、サドル５を自走させて吊具２をＹ方向に移動させる移動用の操作ボタン１４ｅ、１４ｆとを備え、これら操作ボタン１４ａ乃至１４ｆを適

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宜操作することで、該吊具２を昇降動させて患者を吊ると共に、所望の場所に移動させることができる。

【００１１】操作盤１４は、サドル５に固定してこれから下方に突出させた棒状体１５の下端部に設けた。該棒状体１５は外パイプ１５ａに対し内パイプ１５ｂを僅かに接触抵抗があるように挿入した２重パイプで構成し、その外パイプ１５ａをサドル５に固着し、外パイプ１５ａ内に設けた滑車１５ｃに懸架した紐１５ｄの一端に内パイプ１５ｂを結着すると共に、該紐１５ｄの他端に内パイプ１５ｂと等しい重量の重り１５ｆを取り付けることで、該内パイプ１５ｂの外パイプ１５ａに対する高さを調節して、操作盤１４の位置を患者が使い易い高さ位置に臨ませることができるようにした。しかし、高さの調節はこの手段に限定されるものでない。なお、棒状体１５は、サドル５から側方に突出する腕５ｂに支持させた。なお、操作ボタン１４ａ乃至１４ｆの操作盤１４上の配置は、患者または介護人が操作を誤らないように、例えば図４に示すごとく配置することが望ましく、又、該操作盤１４上に人を呼ぶためのブザー、冷暖房機等の機器の操作ボタン１４ｇ、１４ｈ等を付設すると便利である。なお、巻上げ機６は、電動機６ｃに連動して正逆回転する巻胴（図示しない）に巻かれるチエン６ａと、該チエン６ａの先端に取付けたフック６ｂを備え、該フック６ｂに吊具２を着脱自在に吊持させる。なお、吊具２は、図１に示すように、足が悪いため歩行困難な患者用としては、患者の脇に掛けるベルト２ａ、２ａを備えるものを用い、殆ど動けない患者用としては、患者全体を支える図５に示す舟２ｂを備えるものを用いる。なお、ＸＹ平面のＸＹは、Ｘ軸とＹ軸が直角に交わる平面であれば良く、図示のＸＹ軸の向きに特定されるものでない。

【００１２】次ぎに本装置の使い方を説明する。

【００１３】手は自由に動かせるが足が悪く歩行困難な患者患者がベットＡ５上で、操作盤１４を操作し、吊具２のベルト２ａを、自分の脇に掛けやすい位置まで下げた後、ベルト２ａ、２ａを自分で脇に掛け、次いで、操作盤１４の操作ボタンを操作して、吊具２を所望位置まで上げれば、患者は図１に示すように吊具２に吊られた状態と成る。したがって、次いで操作盤１４の操作ボタンを操作して、吊具２を所望方向に移動させれば、介護人の手を煩わせることなく、患者自身で所望の設備Ｂ位置まで行き必要な用事を済ますことができる。

【００１４】介護人が、操作盤１４を操作し、図５に示す吊具２の舟２ｂを、所定位置まで下げた後、舟２ｂ上に患者を載せ、次いで、操作盤１４を操作して、吊具２を所望位置まで上げれば、患者を吊具２で吊上げることができる。したがって、次いで操作盤１４を操作して、吊具２を所望方向に移動させれば、患者を所定の設備Ｂ位置まで簡単に搬送することができる。なお、手の自由が多少とも利く患者であれば、操作盤１４がサドル５に固定され安定した状態にあるため、単に操作ボタンを簡単に操作することができる。

【００１５】

【発明の効果】本願の請求項１の発明によれば、操作盤がサドルに対し固定され安定した状態にあるため，従来のように操作盤を一方の手で固定して操作ボタンを操作する必要がなく片手、又は身体の適当な部位で簡単に操作ボタンを押し操作することができ、手の不自由な患者等でも簡単に操作することができる。

【００１６】又、片手で操作できるため、介護人が操作する場合、一方の手で患者を支えた状態で操作ボタンを操作することができて、介護人にとっても取扱い易い。

【００１７】本願の請求項２の発明によれば、患者、介護人の使いやすい高さ位置に操作盤を位置させることができる。

【図面の簡単な説明】

【図１】　本発明実施の形態の一例を示す側面図

【図２】　裁断平面図

【図３】　自走式天井走行クレーンの要部を示す拡大図

【図４】　操作盤の拡大図

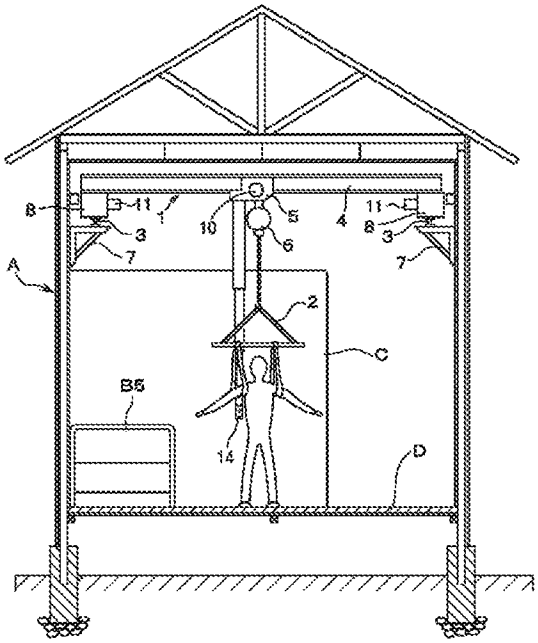
【図５】　吊具の変形例を示す図

【符号の説明】

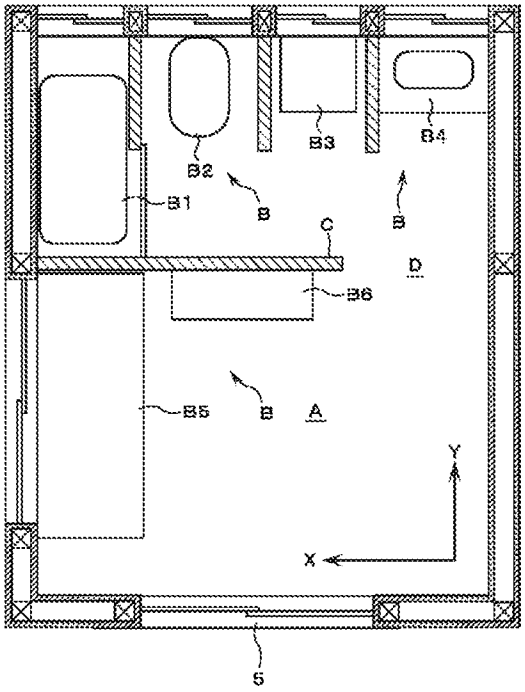
１　自走式天井走行クレーン　　２　吊具
３　案内レール
４　移動レール　　５　サドル
６　巻上げ機
１０　電動機　　１１　電動機
１４　操作盤
Ａ　介護室　　Ｂ　設備

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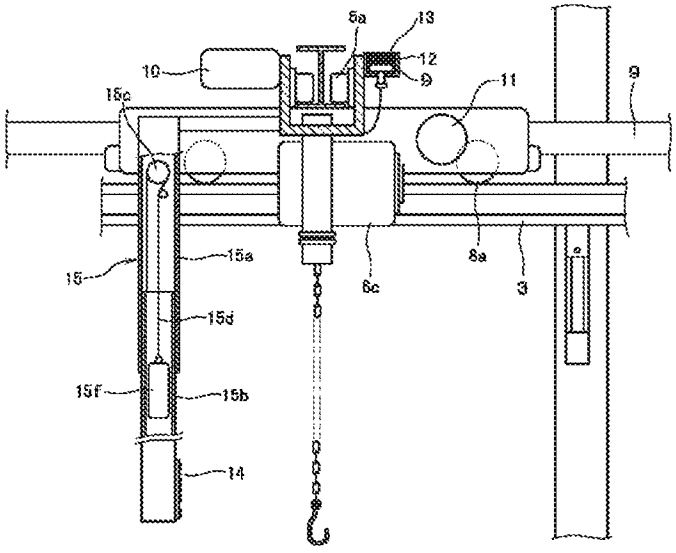
【図1】



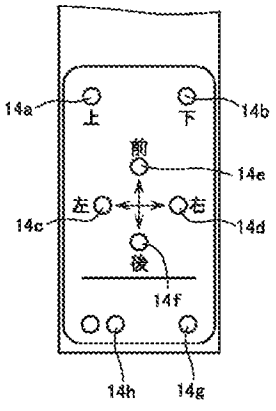
【図3】



【図2】

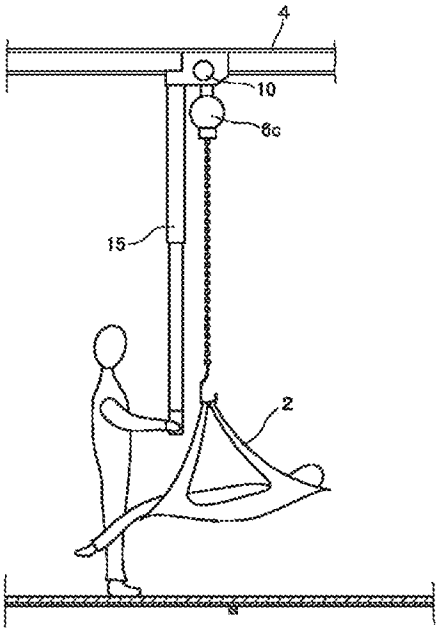


【図4】



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【図５】



JP2000-237250A – Translation from WIPO

CARING ROOM DEVICE

PROBLEM TO BE SOLVED: To provide a caring room device which is easy to operate for a patient and a carer.

SOLUTION: On the ceiling of this caring room A equipped with an equipment required for the daily life of a patient, a self running type ceiling running crane 1 comprising a guide rail 3 which is arranged in one direction, a movable rail 4 which runs along the guide rail 3, and extends in the perpendicular direction to the guide rail, a saddle 5 which runs along the movable rail 4, and a winch 6, is provided, and the patient is hung by a hanging utensil 2 which is hung from the winch 6, and the patient hung by the hanging utensil 2 is moved in the longitudinal and lateral directions in the caring room, by the operation of an operation button on the operation panel 14. In such a caring room device, the operation panel 14 is provided on the lower end section of a bar-shape body which protrudes downward from the saddle 5, and the operation panel 14 is placed under a stable state being fixed to the saddle 5, and thus, the operation button provided on the operation panel 14 is made operable by one hand or by a section other than the hand.

DETAILED DESCRIPTION OF THE INVENTION

[0001] BACKGROUND OF THE INVENTION: 1. Field of the Invention The present invention relates to a care room apparatus mainly utilizing a wooden house.

[0002] 2. DESCRIPTION OF THE RELATED ART: The applicant of the present invention has proposed a guide rail disposed in one direction on a ceiling of a care room provided with equipment necessary for a patient's life and a guide rail which freely runs along the guide rail A self-propelled overhead traveling crane comprising a travel rail that is long in a right angle direction, a saddle that travels along the travel rail, and a hoisting machine that is provided on the saddle, a hoisting device that hangs a patient is attached to the hoist machine, We have proposed a care room apparatus which allows a hanger tool to freely move vertically and horizontally in a care room and adjust its height position by operating an operation button of an operation panel for operating the traveling crane (see Japanese Patent Application No. 10-286424 issue).

[0003] However, in addition to difficulty in walking, for handicapped patients or the like, an unstable operation panel suspended from the cord is pressed and the operation buttons of the operation panel It is extremely difficult to operate.

[0004] It is an object of the present invention to provide a care room apparatus which does not have such a problem.

[0005] SUMMARY OF THE INVENTION: According to a first aspect of the present invention, there is provided a cabinet comprising a guide rail arranged in one direction on a ceiling of a care room having facilities necessary for the life of a patient, and a guide rail provided on the guide rail A self-propelled overhead traveling crane comprising self-propelled self-propelled traveling rails comprising a moving rail that is long in a direction perpendicular to the guide rail, a saddle that travels along the traveling rail, and a hoisting machine provided on the saddle, A hanging device for hanging a patient is attached to a machine, and the hanger is manipulated by operating an operation button of an operation panel for operating the traveling crane so that the care room can be freely moved vertically and horizontally, and the height position can be adjusted , Since the operation panel is provided at the lower end portion of the rod-shaped body projecting downward from the saddle fixed to the saddle, it is fixed to the operation panel saddle and is in a stable state, so that it is possible to hold the operation panel in a position other than one hand or a hand Operate the operation button with It can be.

[0006] DESCRIPTION OF THE PREFERRED EMBODIMENTS: Embodiments of the present invention will be described with reference to the drawings. In the figure, A shows a wooden care room with equipment B necessary for the patient's life, and as equipment B, a bathroom B 1, a toilet B 2, a washing machine B 2, A laundry facility B 3 arranged, a washbasin B 4 having a wash basin, a bed B 5, storage furniture B 6 such as a chest of drawers, and the like.

[0007] 1 shows a self-propelled overhead traveling crane attached to the ceiling surface of the care room A in order to convey a patient to a position where the facility B is provided when a patient uses these facilities B. The self-running overhead traveling crane 1 includes a guide rail 3 arranged in one direction (X direction) of the nursing care room A, a guide rail 3 arranged in a direction (X direction) perpendicular to the guide rail 3 self-propelled along the guide rail 3, a long moving rail 4, a saddle 5 that runs along the moving rail 4, and a hoisting machine 6 provided on the saddle 5, and the hoisting machine 2 hanging the patient is hung on the hoisting machine 6. In addition, it is desirable to provide a partition wall C between each facility B, and an upper portion of the partition wall C is provided with a partition wall C in such a manner that it does not become an obstacle to attach a self-propelled overhead traveling crane 1. Space is provided between them.

[0008] The guide rail 3 and the moving rail 4 are made of a lightweight metal material such as an aluminum alloy and the guide rail 3 is supported by a support metal 7 supported by pillars D provided on both sides in one direction of the care room A and the movable rail 4 is mounted on the guide rail 3 by side saddles 8 provided at both ends thereof so as to be movable along the guide rail 3. I made it so the saddle 5 and the side saddle 8 are provided with tires 5 a, 8 a such as urethane resin, placed on the guide rail 3 and the movable rail 4 by the tires 5 a, 8 a, and quietly run along the guide rail 3 and the moving rail 4.

[0009] The saddle 5 and the side saddles 8, 8 are provided with a current collecting trolley 9 so that electric motors (100 V electric motors) 10, 11 provided on the saddle 5 and the side saddles 8, 8 and the saddle 5 Electric power to the electric motor 6 c and the like. To explain this, the sheath body 12 with a lip provided along the guide rail 3 and the moving rail 4 is fixed to the guide rail 3 and the moving rail 4 side, and the power supply provided in the sheath body 12 A power collector (not shown) provided on the saddle 5 and the side saddles 8, 8 is brought into contact with the rail 13 to supply power.

[0010] Reference numeral 14 denotes an operation panel for operating the self-running overhead traveling crane 1. The operation panel 14 includes operation buttons 14a, 14b for upward movement and downward movement of the suspender 2 and self-propelled movement rails 4. Operation buttons 14c and 14d for moving the hoisting tool 2 in the X direction and operation buttons 14e and 14f for movement for moving the saddle 5 in a self-running manner and moving the hoisting tool 2 in the Y direction. By appropriately operating the operation buttons 14a to 14f, the hanger 2 can be raised and lowered to hang the patient and move it to a desired place.

[0011] The control panel 14 is fixed to the saddle 5 and provided on the lower end portion of a rod-shaped body 15 projecting downward from this. The rod-like body 15 is constituted by a double pipe in which the inner pipe 15 b is inserted into the outer pipe 15 a so as to have a slight contact resistance, and the outer pipe 15 a is fixed to the saddle 5, and a pulley 15c, a weight 15f having the same weight as that of the inner pipe 15b is attached to the other end of the cord 15d so that the height of the inner pipe 15b with respect to the outer pipe 15a So that the position of the operation panel 14 can be brought to a height position where the patient can easily use it. However, the adjustment of the height is not limited to this means. The rod-like body 15 was supported by an arm 5 b projecting sideways from the saddle 5. The arrangement of the operation buttons 14a to 14f on the operation panel 14 is desirably arranged as

shown in FIG. 4, for example, so that the patient or the care giver does not mistakenly operate, and a person is placed on the operation panel 14 It is convenient to attach operation buttons 14 g, 14 h, etc of equipment such as buzzer, air conditioner and the like for calling. It should be noted that the hoisting machine 6 is provided with a chain 6a wound around a hoisting drum (not shown) rotating in forward and reverse interlocking with the electric motor 6c and a hook 6b attached to the tip of the chain 6a, and the hoisting tool 2 Is detachably held. As shown in FIG. 1, for the patient who is difficult to walk because the foot is bad as shown in FIG. 1, one having the belts 2a, 2a to be hung on the side of the patient is used as the suspender 2. For the patient who can hardly move, Which has the boat 2b shown in FIG. 5 which supports the whole is used. Note that the XY of the XY plane may be any plane as long as the X axis and the Y axis intersect at right angles and is not specified as the XY axis direction shown in the drawing.

[0012] Next, how to use this apparatus will be explained.

[0013] Patient who can freely move his / her hand but has poor legs and who can not walk easily operates the operation panel 14 on the bed A 5, lowers the belt 2 a of the suspender 2 to a position easily hung on his / her side, When hanging the hoisting tool 2 to a desired position by operating the operation buttons of the operation panel 14 by hanging the belts 2 a and 2 a by himself, the patient is suspended from the suspender 2 as shown in FIG. 1 . Therefore, by operating the operation button of the operation panel 14 and then moving the hanger tool 2 in the desired direction, the patient himself can go to the desired equipment B position without having to bother the care giver, I can finish it.

[0014] After the care giver manipulates the operation panel 14 to lower the boat 2 b of the suspender 2 shown in FIG. 5 to a predetermined position, the care giver puts the patient on the boat 2 b, then operates the operation panel 14 , The patient can be lifted with the hanger tool 2 by lifting the hanger tool 2 to a desired position. Therefore, by operating the operation panel 14 and moving the hoisting tool 2 in the desired direction, it is possible to easily transport the patient to the predetermined equipment B position. If the patient is more or less freedom of hands, the operation panel 14 is fixed to the saddle 5 and is in a stable state, so that it is possible to simply operate the operation button.

[0015] According to the invention of claim 1 of the present application, since the operation panel is fixed to the saddle in a stable state, the operation panel is fixed with one hand and the operation button is operated as in the conventional case It is unnecessary to operate the operation button easily with one hand or an appropriate part of the body, and it can be easily operated even by a handicapped patient or the like.

[0016] In addition, since it can be operated with one hand, when a caretaker operates, it is possible to operate the operation button while supporting the patient with one hand, and it is easy for a care giver to handle.

[0017] According to the invention of claim 2 of the present application, it is possible to position the operation panel at a height position that is easy to use by a patient and a care giver.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view showing an example of an embodiment of the present invention

FIG. 2 is a cross-sectional plan view

FIG. 3 is an enlarged view showing a main part of a self-propelled overhead traveling crane

FIG. 4 is an enlarged view of the operation panel

FIG. 5 is a view showing a modified example of the suspending tool

[Explanation of sign]

1 Self-propelled overhead traveling crane

2 Hanger tool

3 Guide rail

4 Moving rail

5 Saddle

6 hoisting machine

10 electric motor

11 electric motor

14 operation panel

A Nursing care room

B facilities

Claims:

What is claimed is:

1. A cabin of a care room having facilities necessary for the life of a patient, comprising: a guide rail arranged in one direction; and a movable rail which moves self-propelled along the guide rail in a direction perpendicular to the guide rail; a self-propelled overhead traveling crane comprising a rail, a saddle traveling along the moving rail, and a hoisting machine provided on the saddle is provided, a hoisting machine for hanging a patient is attached to the hoisting machine, and the traveling crane is operated In which a hanger of the hanger can be freely moved vertically and horizontally by operation of an operation button provided on an operation panel, and the height position can be adjusted, wherein the operation panel is provided with a saddle fixed to the saddle, and a lower end portion of a rod-like body protruding downward from the lower end of the rod.

2. The care room apparatus according to claim 1, wherein the rod-shaped body is expandable and contractible.

⑲日本国特許庁（JP）　⑪実用新案出願公開

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⑬公開　平成2年(1990)11月1日

審査請求　未請求　請求項の数 1　(全3頁)

⑤4考案の名称　身障者用トランスファ装置の充電機構

⑳実　願　平1−41920

㉒出　願　平1(1989)4月10日

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⑦4代 理 人　弁理士　鈴木　和夫

⑤7実用新案登録請求の範囲

天井に設けたレールに装着したローラによつて移動されるキヤリア本体と、該キヤリア本体に装着されたベルトに連結された吊り具を上下動するようにした身障者用トランスファ装置において、直流電源にリード線を介して接続された導電固定子を絶縁支持体により前記レールの複数個所に装着するとともに、前記キヤリア本体の上部に設けた絶縁支持体に、前記導電固定子と接触するように導電移動刷子を装着し、該導電移動刷子にリード線を介して充電式バツテリを接続したことを特徴とする身障者用トランスファ装置の充電機構。

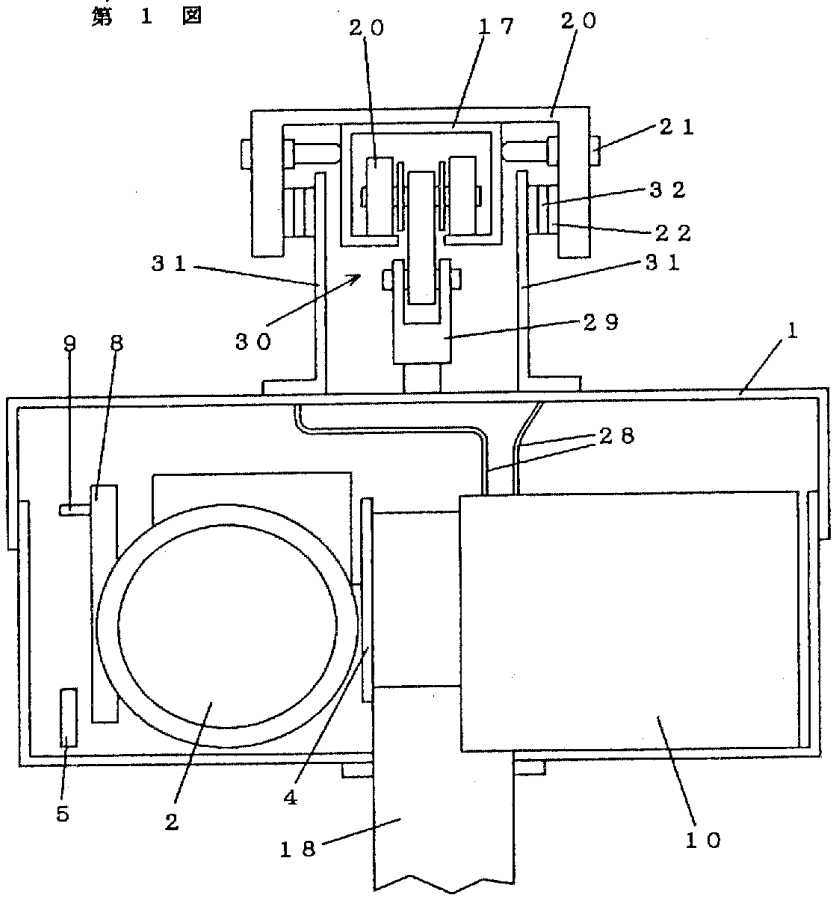
図面の簡単な説明

第1図は本考案の実施例の充電機構を設けた身障者用トランスファ装置の正面断面図、第2図は第1図の充電機構の拡大図、第3図は身障者用トランスファ装置のキヤリア本体の内部の構成図、第4図は従来の電源装置の概略構成図である。

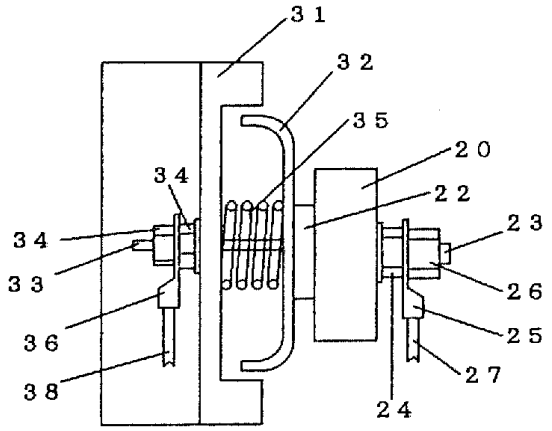
1……キヤリア本体、2……モータ、3……減速機、4……ドラム、5……上限リミツトスイツチ、8……リミツトスイツチストライカー、9……突起、10……バツテリ、17……レール、18……ベルト、20……絶縁支持体、21……ねじ、22……導電固定子、23……ビス、24……ナツト、25……端子、26……ナツト、27……リード線、28……ローラ、29……懸垂部材、30……懸吊機構、31……絶縁支持体、32……導電移動刷子、33……ビス、34……ナツト、35……ばね、36……端子、37……ナツト、38……リード線。

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第　１　図

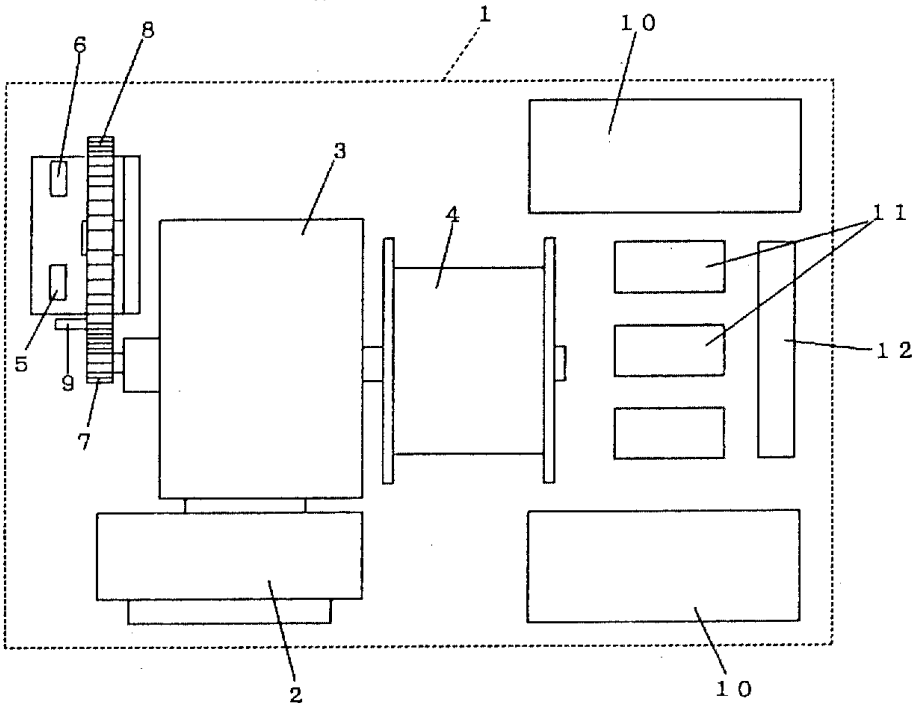


第　２　図

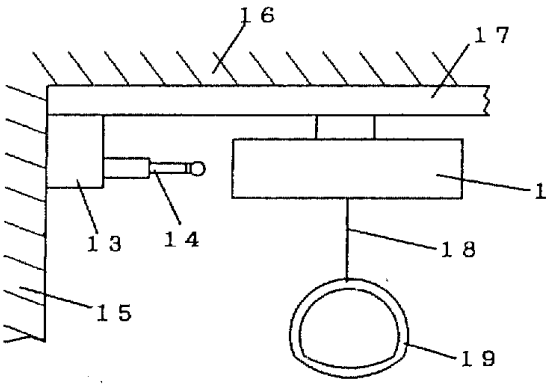


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第　３　図



第　４　図



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審査請求　未請求　請求項の数 1　（全　頁）

⑤4考案の名称　身障者用トランスファ装置の充電機構

⑳実　願　平1−41920

㉒出　願　平1(1989)4月10日

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⑦4代理人　弁理士　鈴木　和夫

明　細　書

１．考案の名称

身障者用トランスファ装置の充電機構

２．実用新案登録請求の範囲

１．天井に設けたレールに装着したローラによって移動されるキャリア本体と、該キャリア本体に装着されたベルトに連結された吊り具を上下動するようにした身障者用トランスファ装置において、直流電源にリード線を介して接続された導電固定子を絶縁支持体により前記レールの複数個所に装着するとともに、前記キャリア本体の上部に設けた絶縁支持体に、前記導電固定子と接触するように導電移動刷子を装着し、該導電移動刷子にリード線を介して充電式バッテリを接続したことを特徴とする身障者用トランスファ装置の充電機構。

３．考案の詳細な説明

［産業上の利用分野］

本考案は、キャリア本体に設けた直流モータを

駆動するバッテリに充電するようにした身障者用トランスファ装置の充電機構に関する。

[従来技術]

最近、屋内の天井にレールを張りめぐらし、そのレールにキャリア本体を移動できるように吊り下げ、また、キャリア本体のロールに巻き取りまたは引き出し可能なベルトを装着し、このベルトに吊り具を設け、吊り具で身障者を吊り下げ、コントローラのボタンを操作することにより、介添者によって、または身障者自身が自由に屋内を移動できるようにした身障者用トランスファ装置が提案されている。

このような装置において、キャリア本体及びロールの巻き取りまたは引き出しを行うための駆動源として、最近は直流モータが用いられ、キャリア本体に充電式のバッテリを内蔵するものが提案されている。

この身障者用トランスファ装置としては、第3図に示すように、キャリア本体1にモータ2を設け、このモータ2に減速機3を介してドラム4を

設けるとともに、ドラム４に巻かれたベルトの巻き上げ及び巻き下ろし位置を規制するために、上限リミットスイッチ５、下限リミットスイッチ６を設け、また減速機３に歯車７を介して連結されたリミットスイッチストライカー８を設け、ドラム４の回転とともに回転するリミットスイッチストライカー８の突起９によって、上限のリミッチスイッチ５または下限のリミットスイッチ６を押すようにしている。さらに、キャリア本体１には、充電式のバッテリ１０、モータ等を駆動するリレー１１、端子盤１２が設けられている。

このように構成された身障者用トランスファ装置において、その充電機構としては、４図に示すように、商用交流電源を直流に変換する整流器を内蔵した電源装置１３に端子１４を突出させ、電源装置１３を部屋の隅の壁１５の側面に設けたものが提案されている。

この電源機構は、使用後に天井１６に設置されたレール１７に懸吊されたキャリア本体１を部屋の隅に移動して、キャリア本体１の側面に設けた

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端子挿入孔（図示せず）に電源装置１３の端子１４を挿入して充電するようにしている。なお、キャリア本体１のドラム４にベルト１８が巻かれ、またベルト１８の下端に吊り具１９が接続されている。

［考案が解決しようとする課題］

しかしながら、このように構成された身障者用トランスファ装置の充電機構では、電源装置１３が屋内の一個所にしかないため、充電を忘れた場合には、身障者を吊り下げているときにバッテリ１０の電力が少なくなったり、他の部屋でバッテリ１０の電力が無くなったときには、キャリア本体１を電源装置１３の設置場所に手動で動かさなければならず、非常に手間がかかるという問題があった。また、キャリア本体１のバッテリ１０を充電するときには必ず電源装置１３の設置場所に移動しなければならないので、電源設置１３から離れた所に身障者のベッドがある場合には、非常のときに身障者をすぐ移動することができないという問題があった。

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本考案は、キャリア本体のバッテリに適当な個所で充電することができる身障者用トランスファ装置の充電機構を提供することを目的とするものである。

［課題を解決するための手段］

本考案は、上記目的を達成するために、天井に設けたレールに装着したローラによって移動されるキャリア本体と、該キャリア本体に装着されたベルトに連結された吊り具を上下動するようにした身障者用トランスファ装置において、直流電源にリード線を介して接続された導電固定子を絶縁支持体によって前記レールの複数個所に装着するとともに、前記キャリア本体に設けた絶縁支持体に導電移動刷子を装着し、該導電移動刷子にリード線を介して充電式バッテリを接続したものである。

［作用］

本考案によれば、レールの多数個所に導電固定子を設置することにより、キャリア本体を任意の導電固定子の設置場所に移動して、内蔵するバッ

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テリに充電することができるので、バッテリの充電量が少ないときでも、導電固定子の設置場所をたどりながらキャリア本体を移動させることができ、また、身障者が使用していない少しの時間にバッテリに充電することができる。

［実施例］

第１図を参照すると、本考案の身障者用トランスファ装置の充電機構において、１はキャリア本体、２はモータ、３は減速機、４はドラム、５は上限リミットスイッチ、８はリミットスイッチストライカー、９は突起、１０はバッテリ、１７はレール、１８はベルトであり、これらの構成は前記従来例と同じであるので、説明は省略するが、本実施例ではレール１７に絶縁支持体２０がねじ２１により固定され、また絶縁支持体２０に第２図に示すように導電固定子２２がビス２３及びナット２４により固着され、また、ビス２３に端子２５が嵌着され、ナット２６により締め付け固定されている。なお、端子２５にはリード線２７が接続され、交流電源を整流した直流電源（図示せ

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ず）に接続されている。さらに、キャリア本体１の上部に設けたローラ２８及び懸垂部材２９からなる懸吊機構３０の近傍に絶縁支持体３１が固着され、この絶縁支持体３１に導電移動刷子３２を一端に設けたビス３３が遊嵌され、このビス３３にナット３４が嵌着され、導電移動刷子３２と絶縁支持体３１の間にばね３５が装着されている。そして、ビス３３に端子３６が嵌着され、ナット３７により固定されている。また、端子３６にリード線３８が接続され、バッテリ１０に接続されている。

このように構成した本考案の充電機構では、レール１７の多数個所に絶縁支持体２０を設け、また絶縁支持体２０に導電固定子２２を設け、さらに、キャリア本体１に設けた絶縁支持体３１に導電移動刷子３２を設けることにより、キャリア本体１を導電固定子２２の任意の個所に移動して、キャリア本体１のバッテリ１０に充電することができる。

［考案の効果］

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本考案は、以上のように構成されているので、レールの多数個所に導電固定子を設置することにより、キャリア本体を導電固定子の設置場所に移動して、内蔵するバッテリに充電することができるので、バッテリの充電量が少ないときでも、導電固定子の設置場所をたどりながらキャリア本体を移動させることができ、また、身障者が使用していない少しの時間にキャリア本体のバッテリに充電することができ、さらに、身障者のベットの近傍に導電固定子を設置して、キャリア本体のバッテリに充電することができるので、火災などの非常事態に身障者を早く避難させることができるなどの利点がある。

4．図面の簡単な説明

第1図は本考案の実施例の充電機構を設けた身障者用トランスファ装置の正面断面図、第2図は第1図の充電機構の拡大図、第3図は身障者用トランスファ装置のキャリア本体の内部の構成図、第4図は従来の電源装置の概略構成図である。

1・・・キャリア本体、2・・・モータ、3・・・減速機、

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４・・・ドラム、５・・・上限リミットスイッチ、８・・・リミットスイッチストライカー、９・・・突起、１０・・・バッテリ、１７・・・レール、１８・・・ベルト、２０・・・絶縁支持体、２１・・・ねじ、２２・・・導電固定子、２３・・・ビス、２４・・・ナット、２５・・・端子、２６・・・ナット、２７・・・リード線、２８・・・ローラ、２９・・・懸垂部材、３０・・・懸吊機構、３１・・・絶縁支持体、３２・・・導電移動刷子、３３・・・ビス、３４・・・ナット、３５・・・ばね、３６・・・端子、３７・・・ナット、３８・・・リード線。

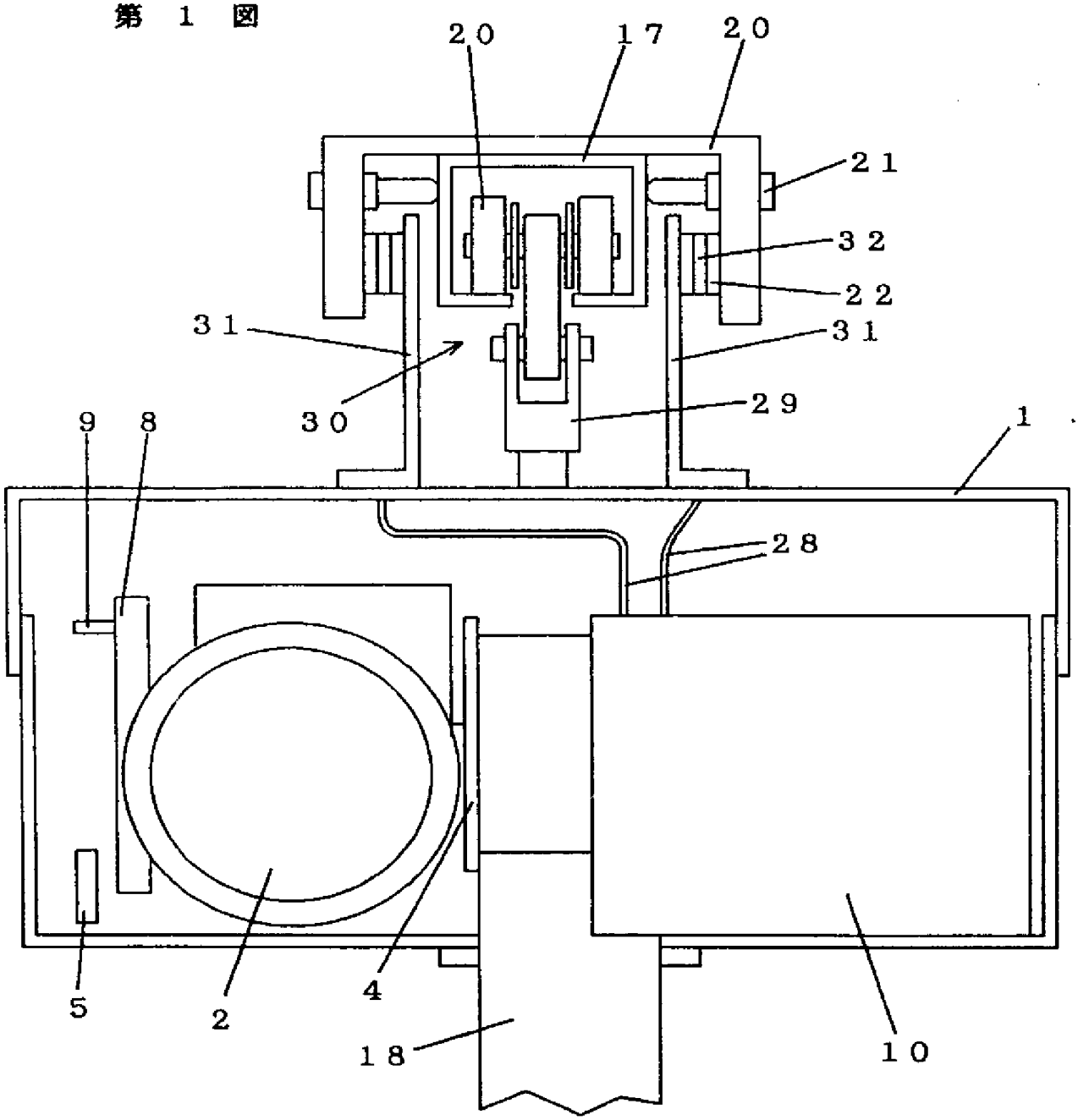
実用新案登録出願人　大邦機電有限会社

代理人弁理士　鈴　木　和　夫

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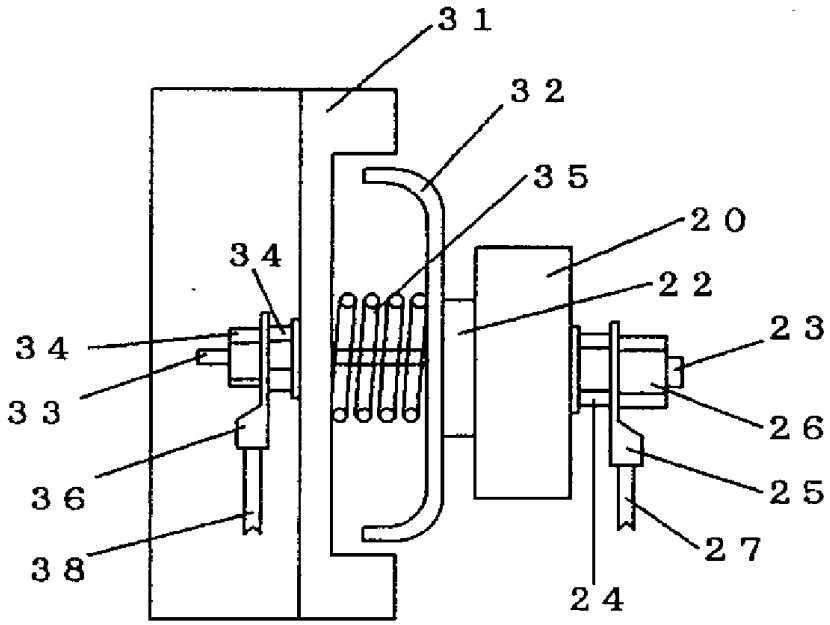
第 1 図



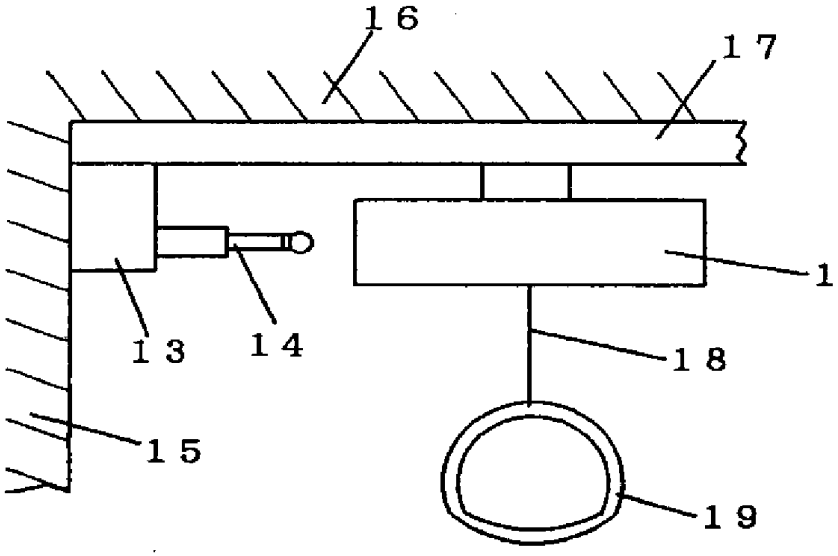
出願人 大邦機電株式会社
代理人 鈴 木 和 夫

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第　2　図



第　4　図

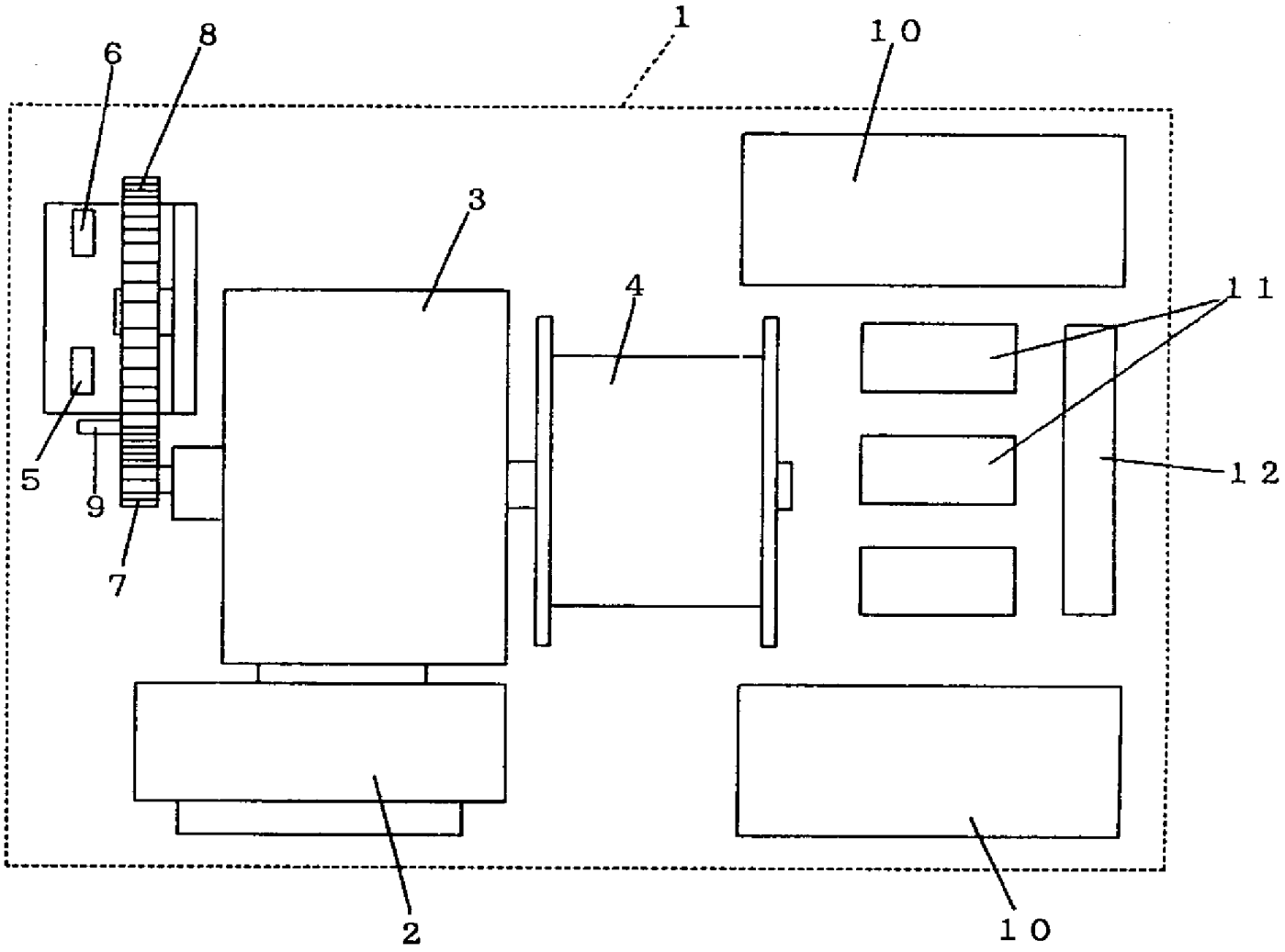


出願人　大邦機電株式会社
代理人　鈴　木　和　夫

実開2-131435

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第 3 図



出願人 大邦機電株式会社
代理人 鈴木和夫

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JPH02-131435

Abstract (Machine Translation)

Scope of utility model registration request

What is claimed is: 1. A transfer device for handicapped persons, comprising: a carrier body which is moved by a roller mounted on a rail provided on a ceiling; and a suspended member connected to a belt attached to the carrier body. A conductive stator connected via a wire is attached to a plurality of portions of the rail by an insulating support member and an insulating support provided on an upper portion of the carrier body is provided with a conductive transfer brush. Wherein a rechargeable battery is connected to the conductive transfer brush via a reel wire.

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Japanese Close

Document Display Help

2 of 4 Display

JP,50-020727,B(1975)

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3. In the drawings, any words are not translated.

Detailed Description

Close

Japanese Patent Application No. 45 - 7681 [Phase] Application No. 45 (1970) January 30. Applicant's 0 Applicant Omura - Live Tokorozawa City Large character Kamiarai 22010 Attorne y Attorney's ** Alien 1.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows an embodiment of the invention, FIG. 2 being a top view, FIG. 3 being a front vi ew, FIG. 4 being a top view of the latch device, FIG. 5 being a front view, and FIG. 3 being a s ectional view taken along the line A-A in FIG. 3 ;.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a switching device for a molrail which supports a running ho

t or the like.

In the case of switching and moving the switching device by a rope or the like, a structure of a portion connecting the latch device and a latch device for locking the movable portion to the fixed portion is complicated and easily causes wear. It is an object of the present invention to provide a molrail switching device which eliminates the above-mentioned drawbacks, and whic h has a drawback in that, when a rope is arranged in an endless manner, a slack is generated in a rope and a slip is easily generated between the rope and a winding drum when the rope i s driven by power driving the rope. 0.

Referring now to the drawings, and in particular to FIG. 1, there is shown an embodiment of t he present invention, which is a fixed flat spring which is fixed at a high position and which is formed by connecting both ends of 1 pairs of parallel beams 2 and an angle 3 provided paralle l between the two beams at an end member 4.

The beam 2 has a horizontal portion 5 and a vertical portion 6 and is adapted to mount the fr ame 1 on the ceiling.

A square beam 8,9 is fixed at a position below the center of both beams 2 and in a direction p erpendicular to the beam.

Both lateral portions of the lower end of the beam 8,9 are at the same height and become a r ail 10.11 of the hoist wheel.

In one of the beams 2, a square beam 12.13 having a structure similar to that of the beam 9 i n the longitudinal direction of the frame 2 and having a similar structure is fixed to the frame 2 at an angle of approximately 45 degrees relative to each other, and the lower side horizonta l portions of the beam are set as rails 14.15.

An inner end of the rail 10,ICl3,15 substantially coincides with an inner edge 16 of a horizonta l portion 5 of the beam 2.

17 a pair of beams 1 b which are mounted on the horizontal part 5 and which can slide longitu dinally on the frame 1 by guiding the inner surface of the vertical part 6 or the inner edge 16 of the frame 1. This beam is composed of a square beam 20,21,22 fixed at both ends to a ste p member 19 fixed below a horizontal part 5 and a square beam 23 and a curved v 24.25. 10. ICl3,15.

When the movable frame 17 is in the central position, both ends of the linear rail 23 align with the inner end of the rail 10,11. When the movable frame 17 moves to the right position show n in FIG. 1, both ends of the curved rail 24 align with the inner ends of the rails 10 and 14, re spectively, and when the movable frame 17 moves to the left position, both ends of the curve d rail 25 align with the inner ends of the rails 10 and 15.

When the rail 10 is an entry rail and the rail 11,14,15 is an advanced rail, the hoist entering fr om the entry rail 10 is branched into one of the advancing rails IL 14,15 according to the posit ion of the movable frame 17.

When the hoist is allowed to run, a trolley wire is arranged on the movable frame 17 along a s traight rail 23 and a curved rail 24.25.

A mounting plate 26 is fixed on an upper surface of the beam 2 L 22, and a latch device 27 is mounted on the mounting plate as shown in FIG. 3.4.5.
Reference numeral 28 denotes a cylinder fixed on a mounting plate 26, and a rear end of the cylinder is fixed with an L-shaped member 29, and a lever 32 is pivotally mounted on a pin 31 fixed on an upper surface of the flange member 30.

A rope 34 is fastened at the front end of the lever by a clamp 33, and a locking part 35 is ben t downward at both sides of the rear end of the lever 32.
A latch 36 with a rounded tip is loosely fitted in a cylinder 28, and a small diameter part 37 at a rear part of the latch is passed through a hole provided in an L-shaped member 29 and a loc king plate 38 penetrating through a rear end part is prevented from being pulled out by a nut 39.
A compression coil spring 40 is inserted into the small diameter part 37 between the rear end of the lunch 36 and an L-shaped member 29. Both sides of the locking plate 38 are brought in to contact with the rear end face of the locking part 35 of the lever 32 by the spring, and the t ip of the latch 36 is projected from the cylinder 28, and the nut 39 is tightened so that the pro jecting amount becomes a predetermined dimension, and the position of the locking plate 38 i s adjusted.
When the movable frame 17 is moved and the linear rail 23 and the curved rail 24.25 are in a position where the rail 10 of the fixed frame 1 is aligned with the rail 36 of the fixed frame 1, the leading end of the latch 3 fits into a latch hole 41 provided in a vertical portion of an angle of the fixed frame 1 and locks the movable frame 17 with respect to the fixed frame.
A liner 42 is inserted under the mounting plate 26 to match the height of the latch 36 to the l atch hole 41.
In this case, a rope 34 hanging down through a seal 44 attached to an end member 4 of an O fixing frame 1 which is a mounting hole of a mounting plate 26 is pulled down and a lever 32 i s pulled to one of right and left sides of the rope 43. Since the lever 32 rotates about the pin 31 and the locking part 35 of the lever pushes the locking plate 38, the latch 36 is pulled into the cylinder 28 against the spring 40 and pulled out of the latch hole 41, so that the locked st ate between the movable frame 17 and the fixed frame 1 is released.
Further, when the rope 34 is pulled down, one side of the lever 32 abuts on the stop piece 45 fixed to the mounting plate 26, and the indexing force of the rope 34 is transmitted to the mo vable frame 17 via the stop piece 45 to move the movable frame 17.
If the lowering of the rope 34 is stopped when the movable frame 17 reaches another predete rmined switching position, the movable frame 17 stops immediately and the lever 32 is return ed to the central position by the force of the spring 40, and the latch 36 is fitted into the latch hole 41 to lock the movable frame 17.
Thus, in the locked position, in which the movable frame 17 is moved to the right end as show n in FIG. 1, for example, the rail 10 is curved and connected to the rail 14 via the one piece

4.

As described above, in the rail switching device of the present invention, by lowering the rope 34, the lock of the movable frame 17 is released first. Then, when the movable frame 17 is m oved to reach the other rail switching position and the lowering of the rope 34 is stopped, the movable frame 17 is locked at this position and the switching of the rail is completed. As a res ult, not only is it easy to operate the cable 34, but also the movable frame 17 is always locked to the respective switching positions, so that safe running of the hoist or the like is ensured. Also, since the rope 34 is fixed to the lever 32, even when the rope 34 is arranged in an endle ss manner and is driven by a reversible motor, there is no possibility that a slip will be generat ed between the rope and the rope driving drum because the rope is not loosened.

When a latch device 27 pulls a rope 34 to rotate a lever 32 in either direction, a lock plate 38 i s retreated to release the lock by a similar operation. If the tension of the rope 34 is stopped, the latch device 27 can be immediately returned to a lockable state, and it is made of a comp onent part which is hardly worn and is easy to be processed, and is thus capable of withstandi ng the mechanical strong and frequent operation.

In the above embodiment, a switching device having 1 entrance rails and 3 exit rails is shown. It is also possible to provide a plurality of entry rails, a plurality of advance rails, a plurality of rails which can be aligned with the entry rail and the exit rail, and a plurality of latch holes 41 which coincide with the respective alignment positions of the rails and are provided on the am plifier v 3 so that a greater number of the rails can be switched by the 1 latch devices.

The scope of O claim for patent

The movable frame has a fixed frame provided with an entrance rail on the 1 - side and provid ed with a plurality of advancing rails on the other side, and a movable frame provided linearly movably along the frame and having a ** number of rails. A molerail switching device for alig ning a rail on the movable frame with a desired rail of the advancing rail and the plurality of a dvancing rails by moving the movable frame. It is guidance on the aforementioned movable fr ame -- * it is supported slidably, it puts the aforementioned rope for movable frame movemen t firmly on at a tip with the latch energized that it should insert in the latch hole of the aforem entioned fixing frame, and it pivotally mounts the back end on the aforementioned movable fr ame so that horizontally moving is possible, and it has a locking part on rear end part both sid es -- [1111111

The molrail switching device has a bar, a locking plate which is pressed against the locking par t by the energizing force, and a stop piece which is provided at a lever turning position where the latch is released from the latch hole.

[Phase] Publication No. 38 22057 4 - 9342

Brief description of the drawings Open

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⑤1 Int・Cl².
E 01 B 25／12

⑤2日本分類
78 C 0

⑲日本国特許庁

⑪特許出願公告
昭50—20727

特許公報

⑭公告 昭和50年(1975) 7月17日

庁内整理番号 7401－26

発明の数 1

(全 4 頁)

1

⑤4モノレール切換装置

⑵1特願 昭４５－７６８１
⑵2出願 昭４５(１９７０)１月３０日
⑦2発明者 出願人に同じ
⑦1出願人 大村一生
所沢市大字上新井２２０１
⑦4代理人 弁理士 祐川尉一 外１名

図面の簡単な説明

図面はこの発明の一実施例を示し、第1図は平面図、第2図は正面図、第3図はラツチ装置の平面図、第4図は同じく正面図、第5図は第3図A—A線断面図である。

発明の詳細な説明

この発明は走行ホイスト等を支持するモノレールの切換装置に関する。従来この種切換装置をロープ等にて切換移動せしめる場合には可動部分を固定部分にロツクするラツチ装置と前記ロープとを結合する部分の構造が複雑で磨耗を生じ易く、且ロープを無端状に配置して該ロープを動力駆動する場合にはロープにたるみを生ずるので巻取ドラムとの間にスリツプを生じ易い欠点があつた。

本発明は前記欠点を除去したモノレール切換装置を提供することを目的とする。

本発明の一実施例を図面にしたがつて説明すると、1は高所に固定された固定フレームで、1対の平行なビーム2と、該両ビーム間に平行に設けたアングル3との両端を端部材4にて結合して形成する。前記ビーム2は水平部5と垂直部6とを有し、またフレーム1を天井に取付けるための取付片7を垂直部6の側方に適当間隔をもつて固定する。前記両ビーム2の中央部下方において該ビームに対し直角方向に相対してＩ形ビーム８，９を固定する。Ｉ形ビーム８，９の下端の両側水平部は同じ高さにあつてホイスト走行車輪のレール

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１０，１１となる。ビーム2の一方には、フレーム2の縦方向においてＩ形ビーム9の左右にこれと同様の構造を有し、フレーム2に対して略４５度の角度をもつて互に外方に傾斜するＩ形ビーム１２，１３を固定し、該ビームの下方の両側水平部を夫々レール１４，１５とする。前記レール１０，１１，１４，１５の内端はビーム2の水平部5の内縁１６に略一致する。１７は可動フレームであつて、前記水平部5の上に載加され且前記垂直部6の内面又は前記内縁１６を案内としてフレーム1上を縦方向に滑動しうる1対のビーム１８と、該両ビームに水平部5よりも下方において固定した段部材１９に両端の上面を固定したＩ形ビーム２０，２１，２２とよりなり、該ビームは夫々レール１０，１１，１４，１５と同じ高さの直線レール２３及び彎曲レール２４，２５とを有する。可動フレーム１７が中央位置にあるときは直線レール２３の両端はレール１０，１１の内端と夫々整合し、可動フレーム１７が第1図に示した右位置に移動したときは彎曲レール２４の両端がレール１０およびレール１４の内端に夫々整合し、可動フレーム１７が左位置に移動したときは彎曲レール２５の両端がレール１０およびレール１５の内端に夫々整合する。レール１０を進入レールとし、レール１１，１４，１５を進出レールとすれば進入レール１０より進入したホイストは可動フレーム１７の位置に応じて進出レール１１，１４，１５のいづれかに分岐される。ホイストを自走せしめる場合には可動フレーム１７にも直線レール２３および彎曲レール２４，２５に沿つてトロリー線を配置する。

Ｉ形ビーム２１，２２の上面に取付板２６を固着し、該取付板上には第３，４，５図に示すようにラツチ装置２７を取付ける。２８は取付板２６上に固定された円筒で、その後端にはＬ形部材２９が部材３０と共に固着され、該Ｌ形部材の上面に固着したピン３１にレバー３２を枢着する。

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該レバーの前端部にはクランプ３３によつてロープ３４を締着し、またレバー３２の後端部両側には係止部３５を下方に折曲げ形成する。円筒２８内には先端を丸めたラツチ３６が遊嵌され、該ラツチの後部の細径部３７はＬ形部材２９に設けた孔を貫通し後端部に貫挿した係止板３８をナット３９にて抜止め係止する。前記細径部３７にはラツチ３６の後端とＬ形部材２９との間において圧縮コイルばね４０を挿通せしめ、該ばねにより係止板３８の両側がレバー３２の係止部３５の後端面に当接するとともにラツチ３６の先は円筒２８より突出し、その突出量が所定の寸法になるように前記ナット３９を締めて係止板３８の位置を調節しておく。

可動フレーム１７が移動し、直線レール２３および彎曲レール２４，２５のいづれかと固定フレーム１のレール１０とが整合する位置にある場合に、ラツチ３６の先端部は固定フレーム１のアングル３の垂直部に設けたラツチ孔４１に嵌入して、固定フレーム１に対して可動フレーム１７をロツクする。ラツチ孔４１に対しラツチ３６の高さを合致せしめるために取付板２６の下にライナー４２を挿入する。４３は取付板２６の取付孔である。

固定フレーム１の端部材４に取付けたシーブ４４を経て垂下するロープ３４を引下げてレバー３２を左右いづれか一方に引けば、レバー３２はピン３１を中心として回転し、該レバーの係止部３５が係止板３８を押圧後退せしめるので、ラツチ３６はばね４０に抗して円筒２８内に引込まれラツチ孔４１より引出されるので可動フレーム１７と固定フレーム１とのロツク状態が解除される。更にロープ３４を引下げればレバー３２の一側は取付板２６に固着した停止片４５に当接し、ロープ３４の索引力は該停止片４５を介して可動フレーム１７に伝達され可動フレーム１７を移動せしめる。可動フレーム１７が他の所定の切換位置に達したときにロープ３４の引下げを停止すれば、可動フレーム１７は直ちに停止すると共にレバー３２はばね４０の力によつて中央位置に復帰し、同時にラツチ３６がラツチ孔４１に嵌入して可動フレーム１７をロツクする。従つて可動フレーム１７が例えば第１図のように右端に移動してロツクされた位置においてはレール１０は彎曲レール２４を経てレール１４に接続される。

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以上のように本発明のレール切換装置においては、ロープ３４を引下げることによつて先づ可動フレーム１７のロツクを解除し、次いで可動フレーム１７を移動して他のレール切換位置に達したときロープ３４の引下げを中止すれば該位置において可動フレーム１７がロツクされてレールの切換が完了されるから、切換操作はロープ３４を引くのみで足り操作が極めて簡単であるのみならず、可動フレーム１７は各切換位置に必ずロツクされるからホイスト等の安全な走行が確保される。

またロープ３４はレバー３２に固着されるから、ロープ３４を無端状に配置し、可逆電動機をもつて駆動する場合にも、ロープが弛緩しないからロープ駆動ドラムとの間にスリツプを生ずるおそれがない。ラツチ装置２７はロープ３４を引いてレバー３２をいづれの方向に回転せしめても係止板３８が後退して同様な作動によつてロツクを解除し、ロープ３４の引張を中止すればラツチ装置２７は直ちにロツク可能な状態に復帰しうる構造であり、また磨耗する部分が殆んどなく且加工容易な構成部分品からなるから機械的に丈夫で頻繁な操作にも耐えることができる。

上記実施例には１個の進入レールと３個の進出レールとを有する切換装置を示したが、進入レール、進出レール共複数とし、進入レールと進出レールに整合しうる複数のレールを可動フレームに設け、レールの各整合位置に合致するラツチ孔４１をアングル３に設ければ１個のラツチ装置をもつて更に多数のレール間の切換操作を行なうことも可能である。

㊼特許請求の範囲

１　一側に進入レールを具え、他側に複数の進出レールを具えた固定フレームと、該フレームに沿つて直線移動可能に設けられ且複数のレールを具えた可動フレームとを有し、該可動フレームの移動によつて前記進入レールと前記複数の進出レールのうちの所望のレールとに前記可動フレーム上のレールを整合せしめるモノレール切換装置において、前記可動フレーム上に案内摺動可能に支持され前記固定フレームのラツチ孔に嵌入すべく付勢されたラツチと、先端に前記可動フレーム移動用ロープを締着し後端を前記可動フレームに水平回動可能に枢着し後端部両側に係止部を有するレ

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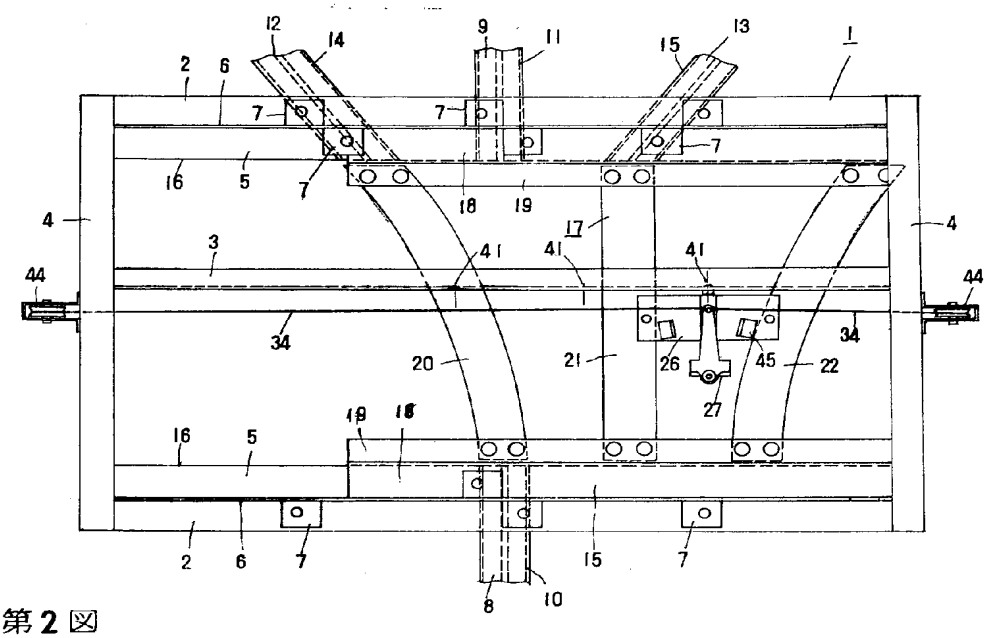
バーと、前記付勢力により係止部に圧接される係止板と、ラッチがラッチ孔より脱出するレバー回動位置に設けた停止片とを有することを特徴とするモノレール切換装置。

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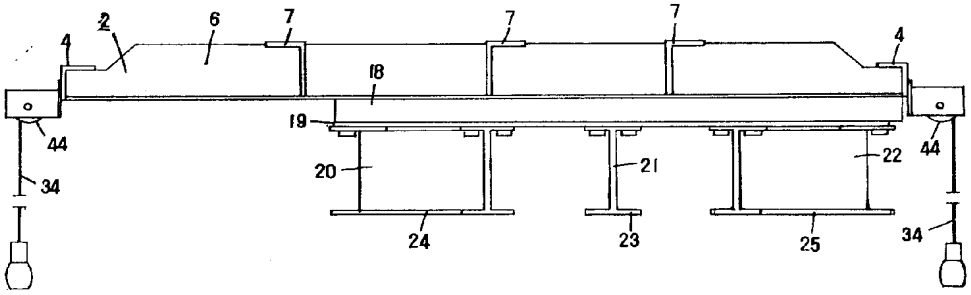
㊺引用文献
特　　公　昭３８－２２０５７
実　　公　昭４－９３４２

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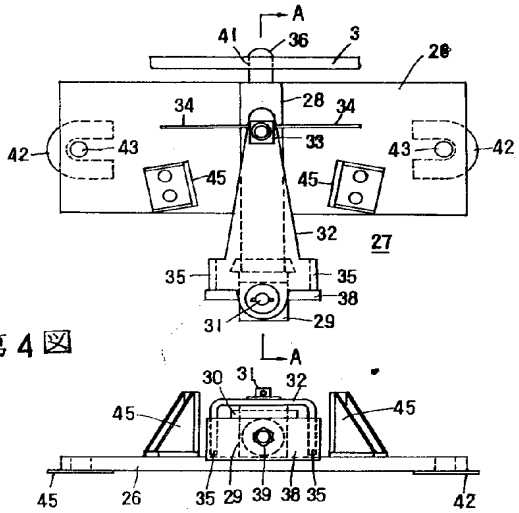
第１図



第２図

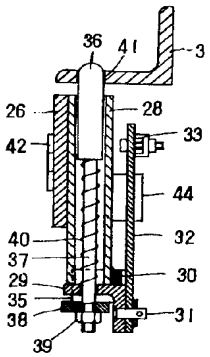


第３図



第４図

第５図



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Espacenet

Bibliographic data: JP2001299842 (A) — 2001-10-30

PATIENT REHABILITATION HELPING INSTRUMENT FOR ADJUSTING SPEED OF CIRCULATING BELT OF GAIT TRAINING DEVICE SO AS TO BE SUITED TO GAIT CYCLE OF USER'S OWN BASED ON LENGTH OF LEG AND STEP

Inventor(s): MARTIN MATTHEW; BEHAN EDWARD; CHILLEME JOSEPH ± (MARTIN MATTHEW, ; BEHAN EDWARD, ; CHILLEME JOSEPH)

Applicant(s): BIODEX MEDICAL SYSTEMS INC ± (BIODEX MEDICAL SYSTEMS INC)

Classification: - international: ***A61H1/02; A61H3/00; A63B22/06; A63B23/04; A63B22/02;*** (IPC1-7): A61H1/02; A63B22/06; A63B23/04

- cooperative: **A61B5/1038 (EP); A61B5/486 (EP); A63B22/0242 (EP); A63B69/0059 (EP); A63B71/0009 (EP); A63B71/0622 (EP);** A61H2201/1621 (EP); A61H2201/163 (EP); A61H2201/164 (EP); A61H2201/1642 (EP); A61H2201/1652 (EP); A61H2201/5043 (EP); A61H3/008 (EP); A61H3/04 (EP); A63B2022/0094 (EP); A63B2071/0072 (EP); A63B2071/065 (EP); A63B2071/0652 (EP); A63B2071/0658 (EP); A63B22/0285 (EP); A63B2208/12 (EP); A63B2220/13 (EP); A63B2220/51 (EP); A63B2230/06 (EP); A63B2230/207 (EP); A63B2230/625 (EP)

Application number: JP20010049246 20010223

Priority number(s): US20000546593 20000410

Also published as: AU3344401 (A) EP1145682 (A2) US6645126 (B1)

Abstract of JP2001299842 (A)

PROBLEM TO BE SOLVED: To provide a gait training device safely controlled and driven at a speed comfortable to a patient. SOLUTION: This gait rehabilitation helping instrument 10 is provided with a circulating belt driven with speed, an input device for a user and a control panel 12 (controller) capable of setting the speed of the circulating belt so as to be suited to a proper gait cycle based on information such as a step rhythm and the length of legs.

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号
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（P2001－299842A）
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(51)Int.Cl.[7]	識別記号	ＦＩ		ﾃｰﾏｺｰﾄﾞ(参考)
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Ａ６３Ｂ　22/06		Ａ６３Ｂ	22/06	Ｍ
23/04			23/04	Ｎ

審査請求　有　　請求項の数25　ＯＬ　（全 15 頁）

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(32)優先日　平成12年４月10日(2000.4.10)

(33)優先権主張国　米国（ＵＳ）

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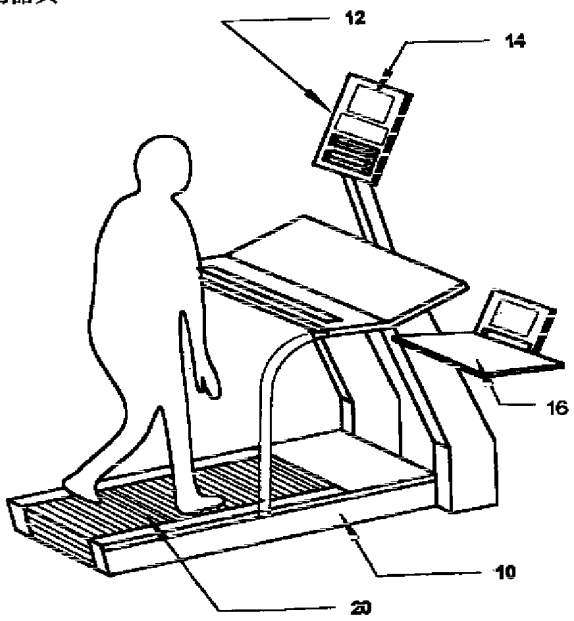
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最終頁に続く

(54)【発明の名称】　脚の長さや歩幅に基づく使用者独自の歩行サイクルに適合し得るよう歩行練習装置の周回ベルトの速度調節を行う患者リハビリテーション補助器具

(57)【要約】
【課題】　安全に制御されており患者にとって快適な速度で運転される歩行練習装置を提供すること。
【解決手段】　歩行リハビリテーション補助器具１０であって、速度をもって駆動される周回ベルトと；使用者用入力デバイスと；歩行リズムや脚の長さといったような入力情報に基づく適切な歩行サイクルに適合させるよう周回ベルトの速度をセットすることができる制御パネル１２（コントローラ）と；を具備している。



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【特許請求の範囲】
【請求項１】　歩行リハビリテーション補助器具であって、
速度をもって駆動される周回ベルトと；使用者用入力デバイスと；該使用者用入力デバイスに対しての歩行リズムや脚の長さといったような情報の入力に応じて、これら情報に基づく適切な歩行サイクルに適合させるよう前記周回ベルトの前記速度をセットすることができるコントローラと；を具備することを特徴とする歩行リハビリテーション補助器具。
【請求項２】　請求項１記載の補助器具において、
前記コントローラが、プロセッサとセンサとを備え、
前記センサは、歩行パラメータに関連するデータを検出し得るように構成されて配置され、
前記プロセッサは、前記センサによる検出データに応じて、歩幅やリズムや歩行速度や歩行パターンに関するデータの変遷経過をもたらし得るものとされていることを特徴とする歩行リハビリテーション補助器具。
【請求項３】　請求項２記載の補助器具において、
さらに、前記プロセッサに接続されていて、前記使用者用入力デバイスから生成された適切な信号を受けた時には前記変遷経過をプリントするプリンタを具備していることを特徴とする歩行リハビリテーション補助器具。
【請求項４】　請求項１記載の補助器具において、
前記使用者用入力デバイスは、情報を表示するための、メニュー駆動方式とされたスクリーンディスプレイを備えていることを特徴とする歩行リハビリテーション補助器具。
【請求項５】　請求項４記載の補助器具において、
さらに、プロセッサを具備し、
メニュー駆動方式とされた前記スクリーンディスプレイは、前記プロセッサからの信号を受けることによって、適切な歩行サイクルにおける理想的な足跡をスクロール表示することを特徴とする歩行リハビリテーション補助器具。
【請求項６】　請求項４記載の補助器具において、
さらに、プロセッサを具備し、
メニュー駆動方式とされた前記スクリーンディスプレイは、前記プロセッサによって決定された、歩行パラメータの変遷経過に関する結果を表示することを特徴とする歩行リハビリテーション補助器具。
【請求項７】　請求項４記載の補助器具において、
メニュー駆動方式とされた前記スクリーンディスプレイは、右脚と左脚との双方に関しての脚の長さの入力値と、右脚と左脚との双方に関しての正常な歩幅と、右脚と左脚との双方に関しての変動率と、右脚と左脚との時間分布比率と、を表示することを特徴とする歩行リハビリテーション補助器具。
【請求項８】　請求項４記載の補助器具において、
さらに、プロセッサを具備し、
メニュー駆動方式とされた前記スクリーンディスプレイは、前記プロセッサによって決定された、歩行パラメータに関するデータの変遷経過に基づく歩行インデックス値を表示することを特徴とする歩行リハビリテーション補助器具。
【請求項９】　請求項５記載の補助器具において、
さらに、プロセッサを具備し、
メニュー駆動方式とされた前記スクリーンディスプレイは、適切な歩行サイクルに従った足跡を示す各表示を順次的にかつ繰返し的に表示することを特徴とする歩行リハビリテーション補助器具。
【請求項１０】　請求項１記載の補助器具において、
さらに、前記周回ベルト上における実際の足の着地に対応した足跡と、適切な歩行サイクルに従ってスクロール表示される理想的な足跡と、の双方を表示するディスプレイを具備していることを特徴とする歩行リハビリテーション補助器具。
【請求項１１】　請求項１記載の補助器具において、
さらに、プロセッサを具備し、
メニュー駆動方式とされたディスプレイが、前記プロセッサからの信号を受けることによって、歩行特性の改良を補助するような視覚的プロンプト表示をもたらし、
前記プロセッサは、メニュー駆動方式とされた前記ディスプレイに対してフィードバック信号を送出し、これにより、歩行パラメータに関するデータを検出し得るよう構成されて配置されたセンサに応じて、視覚的プロンプト表示を引き起こすことを特徴とする歩行リハビリテーション補助器具。
【請求項１２】　請求項１０記載の補助器具において、
さらに、前記プロセッサに接続されていて、実際の足の着地と理想的な足跡とに対応した歩行パラメータの概要をプリントするプリンタを具備していることを特徴とする歩行リハビリテーション補助器具。
【請求項１３】　請求項２記載の補助器具において、
前記コントローラが、プロセッサとセンサとを備え、
前記センサは、前記補助器具上への右足の着地と左足の着地とに関するデータを個別的に検出し得るように構成されて配置され、
前記プロセッサは、前記センサによる検出データに応じて、前記着地による衝撃力に関するデータの変遷経過をもたらし得るものとされていることを特徴とする歩行リハビリテーション補助器具。
【請求項１４】　歩行リハビリテーションを補助するための方法であって、
脚の長さの測定値とリズムとの一方に基づいて適切な歩行サイクルに適合する速度に、周回ベルト速度をセットし；周回ベルト速度の前記セット値に到達するまで、前記周回ベルトの速度を増加させ、
前記適切な歩行サイクルに従った足跡を、ディスプレイ内においてスクロール表示する；ことを特徴とする方

法。
【請求項１５】　請求項１４記載の方法において、
前記周回ベルトの駆動時に、歩行パラメータを観測して、歩幅やリズムや歩行速度や歩行パターンに関する歩行パラメータの変遷経過を把握することを特徴とする方法。
【請求項１６】　請求項１５記載の方法において、
前記歩行パラメータの前記変遷経過をプリントすることを特徴とする方法。
【請求項１７】　請求項１４記載の方法において、
ディスプレイスクリーン上に、前記周回ベルト上における実際の足の着地に対応した足跡と、前記適切な歩行サイクルに従った前記足跡の前記スクロール表示と、表示することを特徴とする方法。
【請求項１８】　請求項１４記載の方法において、
さらに、脚の長さを測定し、
脚の長さの測定値を、使用者用入力デバイスに入力し、入力値に基づいて、周回ベルト速度をセットすることを特徴とする方法。
【請求項１９】　請求項１４記載の方法において、
補助器具上への右足着地の衝撃力と左足着地の衝撃力とを測定し、
付加的には、これら２つの力の差を測定することを特徴とする方法。
【請求項２０】　請求項１９記載の方法において、
さらに、前記衝撃力、あるいは、前記衝撃力どうしの間の差、を評価することを特徴とする方法。
【請求項２１】　歩行リハビリテーション補助器具であって、
ベルト速度をもって動作する歩行練習装置と；使用者用入力デバイスと；ディスプレイスクリーンと；歩行パラメータを検出するために前記歩行練習装置内に配置されたセンサと；前記センサによる検出結果を受けて、前記ディスプレイスクリーン上に、前記センサによる歩行パラメータの検出結果に対応した足跡を表示させるプロセッサと；を具備してなり、
前記プロセッサは、前記使用者用入力デバイスへの入力情報に対応して、前記歩行練習装置の前記ベルト速度を変更することを特徴とする歩行リハビリテーション補助器具。
【請求項２２】　請求項２１記載の補助器具において、
前記プロセッサは、前記使用者用入力デバイスへの入力情報に対応して、前記ディスプレイスクリーン上における前記足跡のパターンをスクロール表示させることを特徴とする歩行リハビリテーション補助器具。
【請求項２３】　請求項２２記載の補助器具において、
さらに、前記入力情報が、脚の長さとリズムとのいずれかであることを特徴とする歩行リハビリテーション補助器具。
【請求項２４】　歩行リハビリテーションを補助するための方法であって、
使用者用入力デバイスを使用して、脚の長さの測定値とリズムとの一方に関する情報を入力し；該情報に基づいて適切な歩行サイクルを決定し；該適切な歩行サイクルに適合した速度でもって、歩行練習装置の周回ベルトを駆動し；前記歩行練習装置の前記周回ベルト上への足の着地を検出し；ディスプレイスクリーン上に、前記適切な歩行サイクルに従った足跡を表示する；ことを特徴とする方法。
【請求項２５】　請求項２４記載の方法において、
前記ディスプレイ上に、適切な歩行サイクルに従った理想的足跡をスクロール表示し；前記ディスプレイ上にスクロール表示されている前記理想的足跡に対して、検出された着地位置の表示を合わせるように、歩幅を変更することを特徴とする方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、脚の長さや歩幅に基づく使用者独自の歩行サイクルに応じた速度に周回ベルトの速度をセットすることができるような歩行練習装置の形態とされたリハビリテーション補助器具に関するものである。この歩行練習装置は、脚の長さや歩幅の関数として表現される使用者独自の歩行サイクルに適合し得るように歩様特性や歩行周波数や歩幅を改良することによって、脳血栓患者や脊髄障害患者や頭部障害患者や肢切断患者や整形外科的患者や神経系障害患者や前庭障害患者といった患者のリハビリテーションを補助する。
【０００２】
【従来の技術】米国特許明細書第５，６２３，９４４号は、“METHOD FOR CHARACTERIZINGGAIT（歩様特性の決定方法）”と題するものであって、１９９７年４月２９日付けで Nashner氏に対して付与された特許である。この特許文献においては、歩様分類が記載されており、また、歩行練習装置を使用した特性決定が記載されている。従来技術の方向性を説明するあたってこれらの記載が適切であるので、これらの記載をここに再現する。
【０００３】［歩様の分類］ヒトの歩様の各段階については、多くの先人が記述を行っている。いくつかを例示すれば、Inman 氏他による“Human Walking （ヒトの歩行）”Williams andWilkins, Baltimore(1981)や、Winter, D.A. 氏による“Biomechanical MotorPatterns in Normal Walking（通常歩行における生体力学的駆動パターン）”Journal of Motor Behavior 15: 302-330 (1983)や、Winestein 氏他による“Quantitative Dynamics of Disordered Human Locomotion: a PreliminaryInvestigation （調子の乱れたヒトの運動の定量的動特性：初期的調査）”Journal of Motor Behavior 21: 373-391 (1989)、がある。ヒトの歩様は、歩行および走行という一般的分類に分類することができる。歩行時には、少なくとも一方の足が、支持面に対して常に着地してお

り、両方の足が支持面に対して着地しているような時間間隔を、ゼロよりも大きな時間間隔として測定することができる。走行時には、両方の足が支持面に対して着地していないような時間間隔を、ゼロよりも大きな時間間隔として測定することができ、両方の足が支持面に対して着地しているような時間間隔が、存在しない。

【０００４】歩行は、４つの段階に区分することができる。４つの段階とは、左脚を前方側として両脚が着地している段階、左脚だけが着地している段階、右脚を前方側として両脚が着地している段階、右脚だけが着地している段階、である。これら４段階どうしの間における移行は、『かかと着地』事象および『つま先離れ』事象と通称されるような事象によって区分される。足の第１接触ポイントは、『かかと着地』と称される。その理由は、正常な成人においては、通常は、足のかかと（靴を履いている場合には、靴底の最後尾部分）が、支持面に対して接触する第１ポイントであるからである。しかしながら、かかと着地は、支持面に対して最初に着地する足の他の部分によって得ることができる。走行時には、正常な成人であれば、母指球（靴を履いている場合には、靴底の前方部分）から着地する場合がある。整形外科的障害や神経筋障害を有した人であれば、支持面に対して常に足の他の部分から着地することとなる、あるいは、靴を履いている場合には、靴底周縁部に沿った部分であってかかと以外の部分から着地することとなる。同様に、正常成人の場合には、つま先離れ事象時に、母指球およびつま先が、支持面に対しての最終接触ポイントとなるけれども、患者の場合には、最終接触ポイントは、他の部分となることがある。よって、実際の接触ポイントにかかわらず、かかと着地という用語およびつま先離れという用語は、足のうちの、支持面に対して最初に接触する部分および支持面に対して最後まで接触する部分のそれぞれを指すものとする。

【０００５】［歩行練習装置を使用した歩様の特性決定］限られた空間内でおいて所定範囲の歩行速度や走行速度で運動することを可能とする歩行練習装置は、従来技術において既に開示されている（Travel氏他による“A Speed-Related Kinematic Analysis of Overground and TreadmillWalking”(1983)や、Winter 氏他（編集）による Biomechanics XI, HumanKinetics Publishers, Champaign, pp. 423-426 や、Nelson氏他による“Biomechanics of Overground Versus Treadmill Running”Medicine andScience in Sports 4: 233-240 (1972)や、Charteris氏他による“The processof Habitation to Treadmill Walking: a Kinetic Analysis”Perceptual andMotor Skills 47: 659-666(1978)）。歩行練習装置は、周回ベルトの速度および傾斜を個別的に制御することにより、歩様の困難性に正確にセットすることができる。歩様速度と周回ベルトの移動速度とを一致させることにより、被験者は、周回ベルトの直下の支持面に対して一定の位置に維持される。いくつかの従来技術における研究においては、機械的に連結された力変換機構を備えた単一の受力プレートが周回ベルトの直下に直接的に取り付けられている歩行練習装置が開示されている。Kram氏他は、彼らの文献である“A Treadmill-Mounted ForcePlatform（受力プラットホームが設けられた歩行練習装置）”Journal of TheAmerican Physiological Society, 1989, pages 1692-1698 において、単一の受力プレートを備えた歩行練習装置を開示している。この文献の内容は、参考のためここに組み込まれる。単一の受力プレートは、歩行時に周回ベルト上において２本の足の複合作用によってもたらされる力の連続的な測定を可能とした。

【０００６】時に、固定された力検出面に対して移動している支持面に対して足が接触しているときに、足の特定の解剖学的特性点がなす座標に関しての、力の中心の位置を決定することが要望されることがある。これは、例えば、歩行練習装置の周回移動ベルトが力検出面を覆っていて、足が周回ベルトに接触している場合に発生する。足の特定の解剖学的特性点がなす座標に対しての力の中心位置を決定するために、２つの座標変換が実行される。第１に、力の中心位置が、歩行練習装置の周回移動ベルトがなす座標に対して決定される。第２に、歩行練習装置の周回移動ベルトの位置が、足の特定の解剖学的特性点がなす座標に対して決定される。これら座標変換のうちの第１のものを行うには、連続ベース上における固定された力検出面の位置に対しての、歩行練習装置の周回ベルト位置に関する情報が必要とされる。上記座標変換のうちの第２のものを行うには、歩行練習装置の周回ベルトに対しての、足の特定の解剖学的特性点の位置に関する情報が必要とされる。足の位置および足の解剖学的特性点の位置が、各かかと着地事象が起こってからその後のつま先離れが起こるまでの間については、歩行練習装置の周回ベルトに対して変化することがないから、足の特定の解剖学的特性点の位置は、各歩行ステップに関してかかと着地後にだけ決定するだけで良い。

【０００７】固定された力検出面の位置に対しての、連続ベース上における歩行練習装置の周回ベルトの位置を決定するための１つの方法は、従来技術において開示されているいくつかの複雑な市販の歩行練習装置の中から、連続ベース上における歩行練習装置の周回移動ベルトの前後方向速度を測定できかつ連続ベース上におけるベルトの前後方向速度の調節手段を備えた歩行練習装置を選択して使用することである。自動速度制御システムとベルト速度測定システムとを備えた市販の歩行練習装置の１つの例は、カリフォルニア州 Tustin 所在の Unisen 社によって製造された Star Trac 2000 である。このような歩行練習装置が使用されたときには、直下に位置した受力プレートに対しての歩行練習装置の周回ベルトの連続的な位置を決定するために必要な情報は、連続

ベース上におけるベルト速度信号を数学的に積分することによって、得られる。

【０００８】従来技術において開示された方法の中には、かかと着地時における、足の特定の解剖学的特性点に対しての、歩行練習装置の周回移動ベルトの位置を決定するために使用できるものが存在する。１つの方法は、いくつかの市販の光学的移動体解析システムの中の１つをを使用することである。移動時におけるヒトの体のいくつかの識別点の動きを追跡するという応用を意図している市販の移動体解析システムの２つの例は、カリフォルニア州 Santa Rosa 所在の MotionAnalysis社によって製造された ExpertVision システムと、英国 Oxfordshire 所在のOxford Medilog Systems 社によって製造された Vicon システムと、がある。この方法によれば、１つまたは複数のマーカーが、足の解剖学的特性点の上に配置される。１つまたは複数の付加的なマーカーが、歩行練習装置の周回ベルト上の所定位置に配置される。解剖学的特性点上におけるまた歩行練習装置の周回ベルト上における光学的マーカーの数および配置は、システム製造メーカーによって特定されたような測定における精度を決定する。その場合、かかと着地時に、歩行練習装置の周回ベルト上における１つまたは複数のマーカーの位置が、システム製造メーカーによって特定された方法に従って配置された解剖学的特性点上の１つまたは複数のマーカーの位置に対して、決定される。

【０００９】米国特許明細書第５，６２３，９４４号には、ステップサイクルのすべての段階において歩行練習装置の周回ベルト支持面に対して各足によってもたらされる力に関連した量を個別的に決定するためのデバイスおよび方法が開示されており、また、歩様パターンの変更のための訓練用に、歩行練習装置の周回ベルト上の固定ポイントに対してあるいは足の特定の解剖学的特性点に対して各足によってもたらされる力の中心位置に関連した量を決定するための手段が開示されている。対象者の歩様を特徴づけるための方法および装置においては、複数の変換器が直下に取り付けられている可動支持面を有した歩行練習装置を使用する。対象者は、可動面上における移動を行う。コンピュータは、各変換器から一連の信号を受け取り、かかと着地事象およびつま先離れ事象の発生を認識する。コンピュータは、歩いたりまたは走ったりするときの、対象者の活動度を認識する。コンピュータは、２つの足に関してゼロよりも大きな力を測定する互いに非接触の２群の変換器を認識し、歩行または走行の各段階において各足によってもたらされる力に関連する量を計算する。

【００１０】しかしながら、本発明者らは、歩行訓練時に以下のようないくつかのことを観測した。

【００１１】健康全体の最も明確なインジケータの１つは、歩行速度である。歩様に問題点を有した人は、非対称な歩幅または短い歩幅を有している。歩様に問題点を有した人は、典型的には、脳血栓患者や脊髄障害患者や頭部障害患者や肢切断患者や整形外科的患者や神経系障害患者や前庭障害患者である。このような患者は、正常な歩行パターンを達成するように努力する。しかしながら、バランスや筋肉協調や移動強度や移動範囲や心臓血管の能力や持久力に改良を必要とする。

【００１２】患者が歩行速度を増大させるためには、２つの方法がある。１つは、歩幅を増大させることであり、他は、ステップ周波数を増大させることである。歩幅にかかわらず、人は、１秒あたりに約２ステップというリズムが、歩行において最も快適である。理想的な歩幅は、患者の脚の長さを測定することによって、決定することができる。

【００１３】

【発明が解決しようとする課題】患者が、広い歩幅のすり足で歩くことがある。このような患者は、このような歩様パターンが弱さのせいではなく、自信のなさからくるものであって失敗を恐れることの結果であると解することができる。したがって、安全に制御された環境であってそのような患者が自信を取り戻すことを補助するような環境を提供することが必要である。

【００１４】従来の歩行練習装置は、一定の速度にセットしなければならない。使用速度における使用者のリズムを決定するための手段がない。実際、快適な歩行速度は、歩幅によって変わることとなる。集団歩行のためには、患者は、少なくとも０．６ｍ／秒で歩かなければならない。この値は、機能的独立性のためのガイドラインである。そのような患者が集団歩行者となり得るよう、患者の歩幅やリズムや歩行速度や歩行パターンを評価してその後定量化された文書をもたらすような装置が、要望されている。

【００１５】歩行のリハビリテーションが必要な患者を担当している治療者は、時間的な改良度を評価するために、そのような患者の重要な歩様パラメータを文書で示す必要がある。明瞭で簡潔な定量化された文書は、患者やヘルスケア提供者や第３者支払人に対して、治療の効果を強く提示する。さらに、治療者と患者との双方に関し、双方にとって安全であるような環境内でリハビリテーションプロセスを開始する必要がある。

【００１６】装置を使用する患者に対して適切な歩幅および適切な歩行サイクルを喚起することによって上記のすべての要望を満たすような装置および技術を提供することが望ましい。

【００１７】

【課題を解決するための手段】本発明のある１つの見地は、脚の長さや歩幅に基づく使用者独自の歩行サイクルに対して周回ベルト速度を適合させるとともに使用者の歩幅やリズムや歩行速度や歩行パターンに関しての良化経過を提供するような歩行練習装置である。使用者独自の歩行サイクルに従って決められた理想的足跡パターン

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と、歩行練習装置上への実際のかかと着地事象に対応した着地位置と、がディスプレイスクリーン上にスクロール表示される。

【００１８】

【発明の実施の形態】本発明のより良好な理解のために、以下の説明や添付図面を参照することができる。ただし、本発明の範囲は、請求範囲によって規定される。

【００１９】図１は、本発明の一実施形態に従って、脚の長さに基づく歩行サイクルに対して周回ベルト速度が適合可能とされているような歩行練習装置を示す斜視図である。図２は、本発明の他の実施形態に従って、部分荷重支持治療のための非検量システムと共に使用される図１の歩行練習装置を示す斜視図である。図３は、歩幅を概略的に示す図である。図４は、本発明の実施形態が最初に起動されたときに現れるスクリーンディスプレイを示す図である。図５は、メインメニューを表示しているスクリーンディスプレイを示す図である。図６は、歩行トレーニングの設定項目を表示しているスクリーンディスプレイを示す図である。図７は、歩行トレーニングの結果と制御項目とを表示しているスクリーンディスプレイを示す図である。図８は、ポーズ画面を表示しているスクリーンディスプレイを示す図である。図９は、トレーニングデータを表示しているスクリーンディスプレイを示す図である。図１０は、主要歩行パラメータについての標準データを表示しているスクリーンディスプレイを示す図である。図１１は、順次的に繰り返される１セットをなす４つのスクリーンディスプレイを示す図である。図１２は、トレーニングのグラフ表示を表示しているスクリーンディスプレイを示す図である。図１３は、歩行練習装置のベッドを概略的に示す図である。図１４は、歩行練習装置の支持バーおよびベースプレートを概略的に示す図である。図１５は、歩行練習装置の支持バーおよびベースプレートを概略的に示す側面図である。図１６は、歩行練習装置の歪みゲージからの出力を電気的に増幅するための回路を概略的に示す図である。図１７は、歩行練習装置のための校正調整回路を概略的に示す図である。

【００２０】図面を参照すると、図１は、歩行練習装置１０を示している。歩行練習装置１０は、制御パネル１２と、スクリーンディスプレイ１４と、プリンタ１６と、を具備している。図２は、図１のものと同じ歩行練習装置を示している。ただしこの場合には、部分荷重支持治療のための非検量システム１８も示されている。双方の実施形態は、ニューヨーク州 Shirley所在の Biodex Medical 社により、BIODEX GAIT TRAINER TREADMILL および BIODEX UNWEIGHING SYSTEM として市販されている。

【００２１】歩行練習装置１０は、器具を有した歩行面２０を特徴としている。歩行時の実際の着地位置２２（図３）が、スクリーンディスプレイ１４上に表示される。歩幅とは、連続した着地位置どうしの間の距離である。制御パネル１２により、患者の歩行サイクルに適合させるように周回ベルト速度を制御することができる。

【００２２】器具付き歩行面２０における左足の着地または右足の着地を検出することにより、本発明においては、歩幅（速度を知ることによって求められる）およびリズムを決定することができる。この情報を使用することにより、快適なリズムを作り出すために、歩行練習装置の速度を、この情報に応じて自動的に制御することができるすなわち自動的に変更することができる。理想的な歩幅は、歩行練習装置のディスプレイに歩幅の測定結果を入力することにより、正確に予設定することができる。所望の歩行サイクル（リズム）は、制御パネルに歩幅の測定結果を入力することにより、予設定される。

【００２３】さらに、トレーニングの維持を補助するための音および画像によるフィードバックを、オンとしたりあるいはオフとしたりすることができる。補正的な動作のための、また、良好な傾向を補助するための、視覚的なプロンプト表示（あるいは、点滅表示）を、表示することができる。直地目標は、正確な方向サイクルシーケンスのために、肢長さに対して標準化され、理想的な足跡として表示されて、スクリーンディスプレイ１４内でスクロール表示される。成果を追跡するためにまた文書作成のために、終了時には、プリンタ１６を起動することにより、トレーニング概要のレポートをプリントすることができる。このレポートを例示するならば、次のようなものとなる。

【００２４】

［BIODEX GAIT TRAINING によるトレーニングの概要］

名前：＿＿　　日付：＿＿

身長：＿＿　　年令：４０

体重：＿＿　　性別：男性

	実際	標準範囲
トレーニングの合計時間	２：００分	
合計距離	１３２ｍ	
平均心拍数／SpO_2	９５回／分　９７SpO_2	
平均歩行速度	１．１０ｍ／ｓ	
平均歩行サイクル	０．８２サイクル／ｓ	
	右　　左	

脚長さの入力値	０．８４０ｍ	０．８４０ｍ
平均歩幅	０．６５ｍ	０．７０ｍ
変動率	２５％	２９％
右／左の時間分布	５２％	４８％

歩行インデックス　　９６　目標値＝１００

※歩行インデックスとは、左右の足の時間分布の比率および平均歩行サイクルに基づいた、１００に対しての複合スコアである。

コメント欄：＿＿＿＿＿＿＿＿＿＿

【００２５】本発明においては、患者の歩行速度の改良を補助するために、また、歩行周波数や歩幅を増大させるように患者の歩行特性の改良を補助するために、さらに、患者が移動能力および独立性を最適レベルとすることを補助するために、バイオフィードバックが設けられている。バイオフィードバックは、患者の脚の長さに対して対称かつ正常なものとし得るように患者の歩幅の変更を補助する。患者や治療者や第３者支払人等を補助するために、定量化測定のための集中的レポートシステムが設けられている。

【００２６】従来の歩行練習装置とは異なり、本発明においては、周回ベルト速度を、機能的歩行パラメータに対して、特に、歩幅および脚の長さに基づく患者自身の歩行サイクルに対して、一致させる。患者自身の歩行サイクルおよび理想的歩幅に対して周回ベルト速度を適合させることにより、本発明においては、適切な歩幅を有した正常な歩様パターンを喚起するための十分な神経系応答をトリガーする。繰り返すことによって、対称的な態様で患者が周波数と歩幅との双方を増大させることを補助することにより、患者は、無意識に、歩行シーケンスを再学習する。

【００２７】本発明においては、患者の歩幅やリズムや歩行速度や歩様パターンが評価される。これにより、定量化に関する文書がもたらされる。このような文書は、歩行のための基準として有効である。集団歩行者となるためには、患者は、少なくとも０．６ｍ／秒で歩かなければならない。

【００２８】患者が神経損傷患者であってもまたは整形外科的患者であっても、本発明においては、それぞれの患者にとって適切な歩幅を喚起させる。本発明は、脳血栓患者や脊髄障害患者や頭部障害患者や肢切断患者や整形外科的患者や神経系障害患者や前庭障害患者といった患者に関しての正常な歩幅のリハビリテーションにとって有効である。本発明は、そのような患者が、バランスや筋肉協調や移動強度や移動範囲や正常な歩行パターンや心臓血管の能力の増大や持久力の増大を改良することを、補助する。本発明は、また、患者と治療者との双方にとって安全な環境を作り出すとともに、重要な歩行パラメータに関する文書を作成する。

【００２９】本発明による歩行練習装置は、好ましくは、４Ｑパルス変調制御を行う１４９１ワット（２馬力）のモータを使用する。これにより、０．１６ｋｍ／ｈ（０．１ｍｐｈ）という増分でもって、０～１２．９ｋｍ／ｈ（０～８ｍｐｈ）という範囲の前方速度が得られ、０～４．８ｋｍ／ｈ（０～３ｍｐｈ）という範囲の逆方向速度が得られる。歩行面デッキは、好ましくは、高密度複合ファイバによって含浸されて構成されている。０．１６ｋｍ／ｈ（０．１ｍｐｈ）という増分でもって常に０ｋｍ／ｈから開始することにより、周回ベルトを跨いで立つ必要はない。好ましくは、歩行練習装置は、Biodex Medical System における型番RTM500として市販されている。

【００３０】本発明の制御方式は、メニュー駆動方式であって、専用のキーパッドボタンを使用した『次スクリーン／前スクリーン』タイプのフローを使用している。好ましくは、NEC 社による V25プロセッサが、Yamaha社による V6366C ＬＣＤドライバと共に使用される。入力手段としては、キー入力、歩行Ｌ／Ｒ表示器、心拍数／酸素モニタからの入力、および、歩行練習装置のコントローラ基板から報告される基本速度、がある。他の専用キーとしては、『開始』、『終了』、および、『エンター』がある。４個のソフトキーは、選択／パラメータ変更を可能とする。

【００３１】使用時には、本発明は、歩行練習装置の起動時にスクリーン上に現れる開始オプションを選択することにより、アクセス可能である（図４）。第１画面（図４）上において開始を選択すると、メインメニュー画面（図５）が呼び出される（図５）。歩行トレーニングというオプション（選択肢）は、歩行トレーニングオプションが画面上で強調される（図５）まで適切な選択矢印キーを押すことにより、メニュー駆動制御（図５）の中から選択される。歩行トレーニングオプションを選択した状態で、NEXT SCREEN TO CONTINUE （次画面へ）を押すことにより、ディスプレイは、図６に示す歩行トレーニングの条件設定画面へと切り替わる。

【００３２】理想的な歩幅は、患者の脚の長さを測定し脚の長さに関する情報を歩行練習装置のディスプレイスクリーン内へと入力することにより、決定される。その後、歩行練習装置が開始し、速度は、適切なリズムが作り出されるようにして、自動的に制御される。ディスプレイは、スクリーンまたは他の手段をスクロールする『足跡』として適切な歩幅を表示することができる。患者は、（スクリーン上に表示されている）自身の着地を、スクリーン上でスクロール表示されている理想的足

跡に適合させることによって、適切な歩幅となるように努力する。歩行練習装置の速度は、歩幅や脚の長さに応じた理想的な速度および理想的なリズムに患者がついていけなくなったときには、快適なリズムを維持するように、小さめのリズムに調節することができる。

【００３３】右脚および左脚の脚の長さを入力に際しては、測定結果が、例えばｃｍという単位で、入力される。脚の長さに対しての歩幅の比率は、０．６９～０．８６である。正常な歩幅は、右足のかかとのラインおよび左足のかかとのラインとして、結果画面（図７）に示される。右足のかかとの中心から左足のかかとの中心までの診断測定は、最も信頼性のあるタイプの測定であるけれども、そのような測定は実施が困難であり、そのため、連続した２つのかかと着地どうしの間にわたっての周回ベルトの移動距離が、歩幅として扱われる。

【００３４】視覚的なフィードバックのために、目標となる歩幅変動の許容値を、セットすることができ、聴覚的なフィードバックのために、メトロノームリズム発生器間隔のための音量制御を、セットすることができる。これらは、駆動することもオフとすることもできる。患者は、バイオフィードバックに依存することができる。そのため、バイオフィードバックの間欠的オン／オフサイクル時間を調節することにより、バイオフィードバックのオンオフを間欠的に行うことができる。

【００３５】歩行トレーニング結果は、スクリーン上において可視化することができる（図７）。画面右側の４個のソフトキーは、パラメータを選択して変更するために使用される。４つのソフトキーは、特に、上向き矢印のキーと、下向き矢印のキーと、＋符号のキーと、－符号のキーと、される。１つの歩幅全体を表示すべきである。目標からの実際の着地のズレ（変動）を観測して、変動率を計算するべきである。本発明においては、実際の着地が３ｃｍ以内という所定許容範囲を超えたものである場合には調整を行うために、あるいは、患者の実際の着地が所定範囲内であって目標内のものである場合には賞賛するために、患者にアドバイスを与えるための視覚的プロンプトメッセージを与えることができる（図８）。

【００３６】例えば、左足が所定範囲だけ目標値を外れている場合には、右足を早く出すことをアドバイスするようなメッセージが、表示されるべきである。また、右足が目標値を外れている場合には、左足を早く出すことをアドバイスするようなメッセージが、表示されるべきである。賞賛のメッセージは、単純に「GOOD JOB ！（良くできました！）」とすることができる（図８）。

【００３７】スクリーンディスプレイにおいては、他の結果を示すことができる（図９）。限定するものではないが、このような結果は、合計トレーニング時間、合計距離、および、平均速度がある。他の結果は、図９に表示されている。プリントされる結果は、以下のような表（＿＿部分は、結果に基づいてプリントされる）のプリント時に表示される。

【００３８】

［トレーニングデータ画面：テスト後の概要（プリント可能）］

トレーニングの合計時間	＿＿分	
合計距離	＿＿ｍ	
平均SpO_2	＿＿％SpO_2	
平均心拍数	＿＿回／分	
平均歩行サイクル	＿＿秒	
	右	左
脚長さの入力値	＿＿ｃｍ	＿＿ｃｍ
正常歩幅	＿＿ｃｍ	＿＿ｃｍ
変動率	＿＿	＿＿
右／左の時間分布	＿＿％	＿＿％
歩行インデックス	＿＿ 目標値＝１００	

「開始」を押すと、プリント開始

「次画面」を押すと、メインメニューに戻る。

【００３９】［定義］トレーニングの合計時間とは、トレーニングを継続した合計時間のことである。合計距離とは、ｍという単位で表したときの合計距離のことである。平均心拍数とは、トレーニング時間にわたっての心拍数の平均値のことである。この項目は、場合によって設けられる。平均SpO_2とは、血流中の溶解酸素のレベルを表す量である。平均歩行サイクルとは、一方の足のかかと着地から、他の足のかかと着地を経て、さらに最初の足のかかと着地までの、単位を秒としたときの平均時間のことである（２歩に要する時間が、歩行サイクルに等しい）。右足および左足の長さの入力値は、第３画面からのものである。右足および左足の平均歩幅は、実際の患者の着地から測定されたものである。右足および左足の正常歩幅は、参照表から得られるものである。右／左の時間分布とは、右足に要した合計時間と左足に要した時間との比率である。歩行インデックスとは、正常な目標値と比較して表した単一の数字として定義される。１００を目標としたときに、１００をベースとしな

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ければならない。歩行インデックスは、以下の特性を有しているべきである。すなわち、右／左の時間分布に関しては、理想的な比が１：１。右／左の変動率に関しては、理想的な比が１：１。歩行サイクルに関しては、理想的な目標は、１秒あたりに１サイクル。

【００４０】図１０は、主要歩行パラメータについての標準データを示すスクリーンディスプレイを表している。このようなスクリーンディスプレイは、男性に対してあるいは女性に対してあるいは子供に対して、利用可能である。

【００４１】図１１は、一連のサイクルをなす４つのスクリーンディスプレイを示している。矩形の囲み内に示された数字１～４は、移動している足の目標位置または実際位置を示している。１番下の列は、次なる目標物を示しており、先の第２列の実際位置に対して配置されている。上の列の目標物は、画面から削除される。データは、結果特性を測定するための適切な計算に使用するために、上述のようにして保持される。図１２は、トレーニングを図的に表したレポートを示すスクリーンディスプレイであって、右足の平均歩行と左足の平均歩行と平均歩幅とを図的に示している。

【００４２】以下の表は、歩幅や歩様の関数としての周回ベルト速度の例を示している。

【表１】

歩幅 [ｃｍ]	歩幅 [フィート]	歩様リズム [回／秒]	周回ベルトの速度 [フィート／ｓ]	周回ベルトの速度 [km/h] ([mph])
75.00	2.46	0.05	0.25	0.272(0.17)
75.00	2.46	0.10	0.49	0.544(0.34)
75.00	2.46	0.25	1.23	1.344(0.84)
75.00	2.46	0.50	2.46	2.688(1.68)
75.00	2.46	0.75	3.69	4.032(2.52)
75.00	2.46	1.00	4.92	5.376(3.36)
75.00	2.46	1.25	6.15	6.704(4.19)
75.00	2.46	1.50	7.38	8.048(5.03)
75.00	2.46	1.75	8.61	9.392(5.87)
75.00	2.46	2.00	9.84	10.736(6.71)
75.00	2.46	2.25	11.07	12.080(7.55)
75.00	2.46	2.50	12.30	13.424(8.39)

【００４３】歩行トレーニング練習装置のベッドは、左足および右足がベルト面に接触したタイミング（時点、時刻）を決定できるように構成されている。周回ベルトの速度と、足が離れる時刻どうしの間の時間と、着地位置と、を知ることにより、歩幅が決定される。

【００４４】歩行練習装置のベッド１（図１３）は、複合材料基板から形成することができる。このベッド１上を周回ベルトがスライドする。ベッド１は、周回ベルトと使用者とを支持する。使用者の体重は、ベッド１へと伝達され、さらに、ベッド１から支持フレームへと伝達され、最終的には床へと伝達される。ベッド１は、４個のクロスブレース２に対してボルト止めされている。クロスブレース２は、両サイドにおいて、支持チューブ３に対して連結されている。このようにして、クロスブレース２と支持チューブ３とは、完全にベッド１を支持している。

【００４５】前後のクロスブレース２２が、４個のバー５に対して取り付けられている。各バー５には、歪みゲージ４が取り付けられている。各バー５は、ベースプレート９に対して取り付けられている（図１４）。この場合、バー５が、ベッド１にかかる全負荷と、ベッド上に印加されるすべての力と、を支持する。バー５は、スペーサ１５の分だけ、ベースプレート９からわずかに離間して保持されている（図１５）。これにより、バー５は、各バー５が支持している相対荷重を歪みゲージ４によって測定し得るよう、わずかに撓むだけの間隙を有している。

【００４６】使用者の足によって印加される力の絶対値を解析して表示することがない点に注意されたい。力の測定は、定性的なものであって、定量的なものではない。歪みゲージ４は、足が離れるタイミングおよび位置を決定するためだけに使用される。これらは、リズムと歩幅とを決定するための情報に過ぎない。これらパラメータを使用することによって、歩行練習装置の速度が制御される。

【００４７】患者が歩くときには、右足は、左足が着地する場所よりも右側よりの場所において、ベッド１に対して着地する。このことは、患者が走らない限り、正しいことである。というのは、患者が走ってしまうと、着地どうしが一直線上に並んでしまったりあるいは逆側に

交差してしまうことさえあるからである。４個の歪みゲージ４からの信号は、標準的な電子ハードウェアを使用して個別的に測定され、その後、個別のデジタル信号へと変換されて、マイクロプロセッサへと供給される。右側のゲージに由来する信号がソフトウェアアルゴリズムを使用して加算され、また、左側のゲージに由来する信号がソフトウェアアルゴリズムを使用して加算される。患者の体重が左足上に乗っている場合には、ベッドの左側に、力が印加される。左側のバー５の方が、より多くの負荷を負担する。なぜなら、左足が左端寄りに着地するからである。よって、右側のバー５によって支持される力の合計は、低下する。左側の歪みゲージに由来する信号の合計は、左足が着地している時には、上昇する。右足が着地しているときには、右側の歪みゲージに由来する信号の合計が上昇する。患者がベッド上を前方側に歩いているとき、後方側に歩いているとき、また、ベッドの左端を歩いても、ベッドの右端を歩いても、この原理が当てはまることは、理解されるであろう。両足が交差しない限り、システムは正常に動作する。

【００４８】しかしながら、実際の歩幅を決定するためには、さらなる情報が必要とされる。歪みゲージからのデジタル信号が個別的に保持されていることにより、他の情報を調べることができる。標準的な力の等式を使用することにより、ベッドに対して力が印加されている場所（足の位置）の前後方向相対位置を、決定することができる。真の足の位置は、一方の足だけがベッドに対して着地している時にしか決定できないことに注意しなければならない。歩行時には、前方側の足のかかと着地は、後方側の足がベッドに対して未だ接触したままである時に起こる。上記のシステムであると、かかと着地が起こったタイミングを決定できるものの、かかと着地が起こった場所については、即座には決定できない。後方の足がベッドを離れた後に（力の決定が、最前方位置を示したとき）、前方の足が着地した正確な前後方向位置が決定される。上記のようにかかと着地のタイミングが既知となりまた周回ベルトの正確な速度が既知であることにより、かかと着地が起こった時点での足の正確な位置が決定される。この時点では、かかと着地のタイミングが、位置と同様に、既知である。次なるかかと着地のタイミングが決定され、同様にして、次なるかかと着地の位置が決定される。先にかかと着地を起こした足のタイミングおよび位置が既知とされ、次なるかかと着地が起こった時点でのその足の位置は、その足がベルトに着地してからの時間と周回ベルトの正確な速度とを知ることによって、決定される。新たなかかと着地と、このかかと着地が起こった時点での先の足の位置と、の間の距離が、歩幅である。

【００４９】図１６は、歩行練習装置の歪みゲージからの出力を電気的に増幅するための回路を示す図である。歩行練習装置の前方、中間前側、中間後側、後方の各位置に対応して、４つの回路が使用されている。

【００５０】図１７は、歩行練習装置のための歪みゲージのゼロ点調整用回路を概略的に示す図である。歩行練習装置の前方、中間前側、中間後側、後方の各位置に対応して、４つの回路を使用することができる。製造上の都合や他の都合によっては、処理方式や数が相違するような他の回路構成を使用することもできる。

【００５１】上記の説明および添付図面は、本発明のいくつかの好ましい実施形態を示しているけれども、本発明の精神および範囲を逸脱することなく、様々な変更や修正を加え得ることは、理解されるであろう。

【図面の簡単な説明】

【図１】　本発明の一実施形態に従って、脚の長さに基づく歩行サイクルに対して周回ベルト速度が適合可能とされているような歩行練習装置を示す斜視図である。

【図２】　本発明の他の実施形態に従って、部分荷重支持治療のための非検量システムと共に使用される図１の歩行練習装置を示す斜視図である。

【図３】　歩幅を概略的に示す図である。

【図４】　本発明の実施形態が最初に起動されたときに現れるスクリーンディスプレイを示す図である。

【図５】　メインメニューを表示しているスクリーンディスプレイを示す図である。

【図６】　歩行トレーニングの設定項目を表示しているスクリーンディスプレイを示す図である。

【図７】　歩行トレーニングの結果と制御項目とを表示しているスクリーンディスプレイを示す図である。

【図８】　ポーズ画面を表示しているスクリーンディスプレイを示す図である。

【図９】　トレーニングデータを表示しているスクリーンディスプレイを示す図である。

【図１０】　主要歩行パラメータについての標準データを表示しているスクリーンディスプレイを示す図である。

【図１１】　順次的に繰り返される１セットをなす４つのスクリーンディスプレイを示す図である。

【図１２】　トレーニングのグラフ表示を表示しているスクリーンディスプレイを示す図である。

【図１３】　歩行練習装置のベッドを概略的に示す図である。

【図１４】　歩行練習装置の支持バーおよびベースプレートを概略的に示す図である。

【図１５】　歩行練習装置の支持バーおよびベースプレートを概略的に示す側面図である。

【図１６】　歩行練習装置の歪みゲージからの出力を電気的に増幅するための回路を概略的に示す図である。

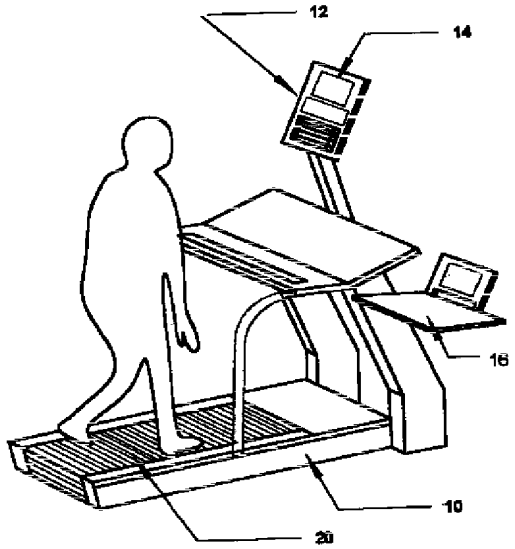
【図１７】　歩行練習装置のための校正調整回路を概略的に示す図である。

【符号の説明】

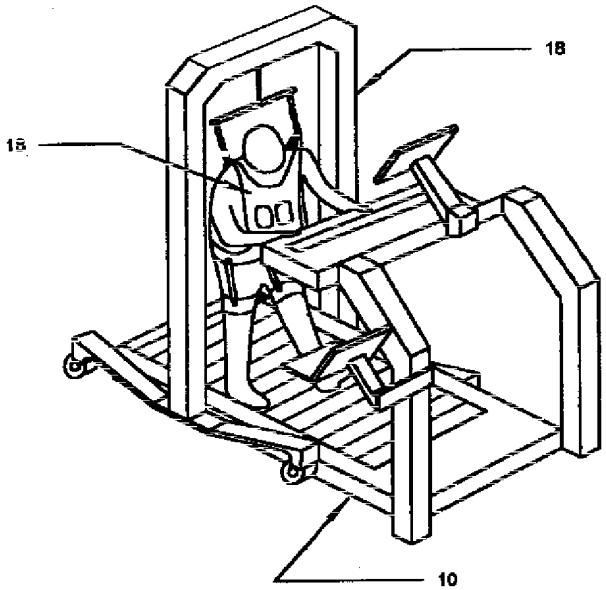
１　ベッド

４　歪みゲージ（センサ）
１０　歩行練習装置（リハビリテーション補助器具）
１２　制御パネル（コントローラ）
１４　スクリーンディスプレイ
１６　プリンタ
２０　歩行面
２２　着地位置

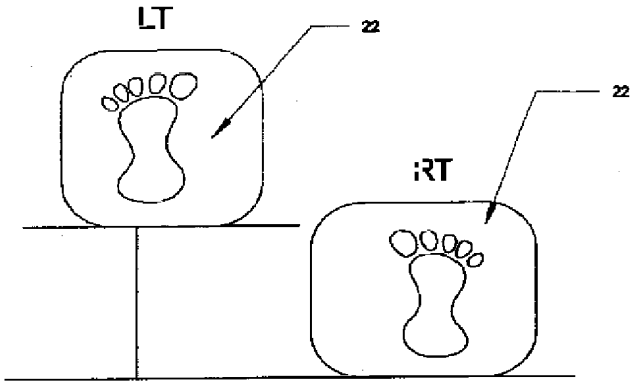
【図１】



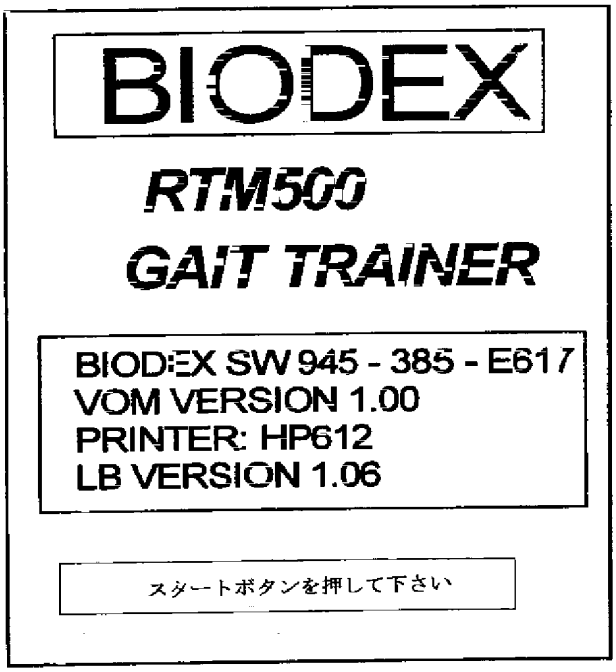
【図２】



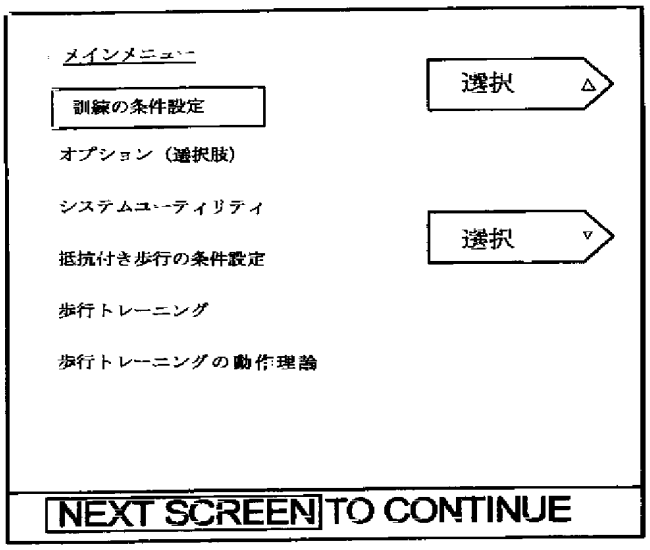
【図３】



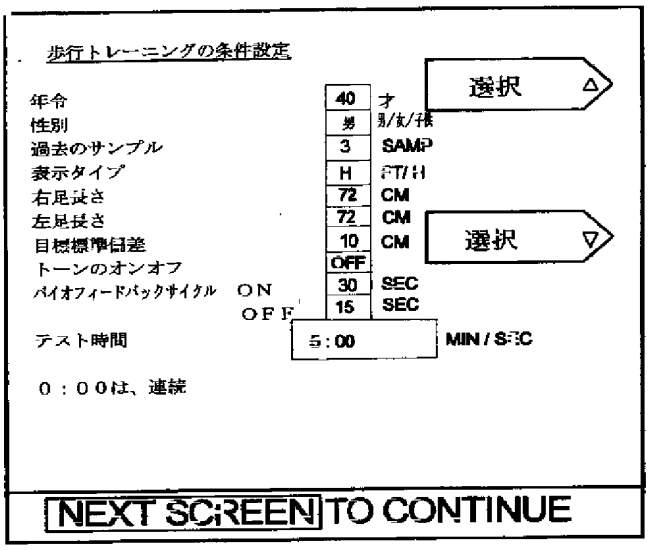
【図４】



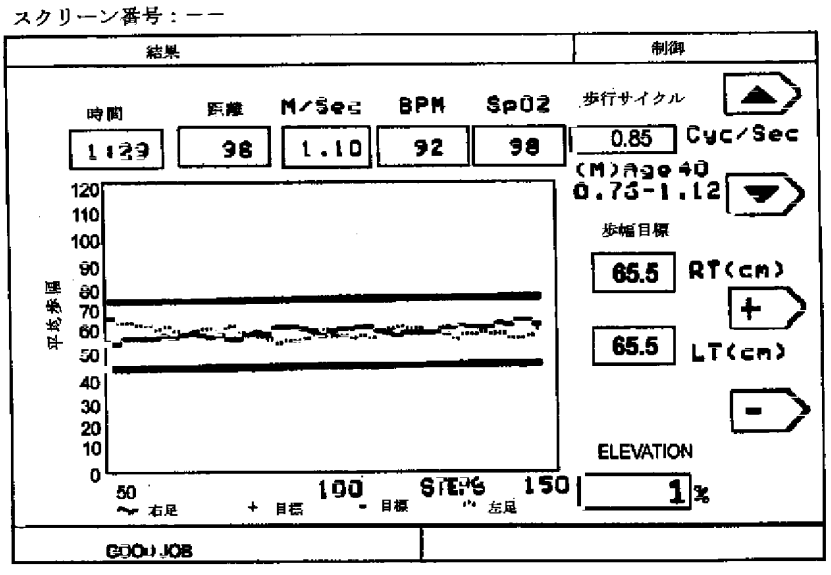
【図5】


メインメニュー
訓練の条件設定
オプション（選択肢）
システムユーティリティ
抵抗付き歩行の条件設定
歩行トレーニング
歩行トレーニングの動作理論
選択
選択
NEXT SCREEN TO CONTINUE

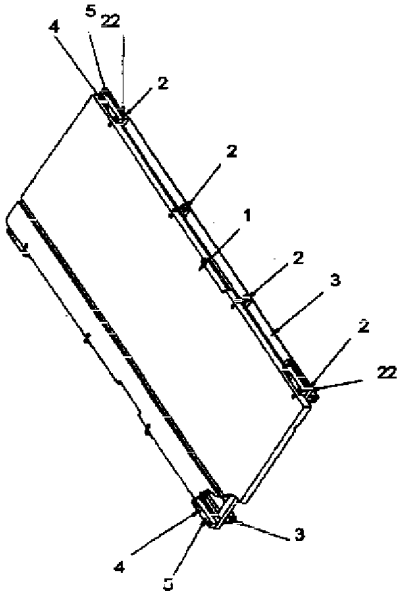
【図6】


歩行トレーニングの条件設定
年令 40 オ
性別 男 男/女/指
過去のサンプル 3 SAMP
表示タイプ H FT/H
右足長さ 72 CM
左足長さ 72 CM
目標標準偏差 10 CM
トーンのオンオフ OFF
バイオフィードバックサイクル ON 30 SEC
OFF 15 SEC
テスト時間 5:00 MIN / SEC
0：00は、連続
選択
選択
NEXT SCREEN TO CONTINUE

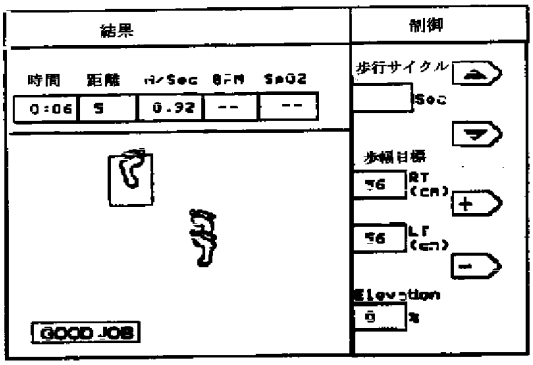
【図7】


スクリーン番号：－－
結果
制御
時間
距離
M/Sec
BPM
SpO2
1:29
98
1.10
92
98
歩行サイクル
0.85
Cyc/Sec
(M)Age 40
0.73-1.12
歩幅目標
65.5
RT(cm)
65.5
LT(cm)
ELEVATION
1%
平均歩幅
120
110
100
90
80
70
60
50
40
30
20
10
0
50
100
STEPS
150
右足
目標
目標
左足
GOOD JOB

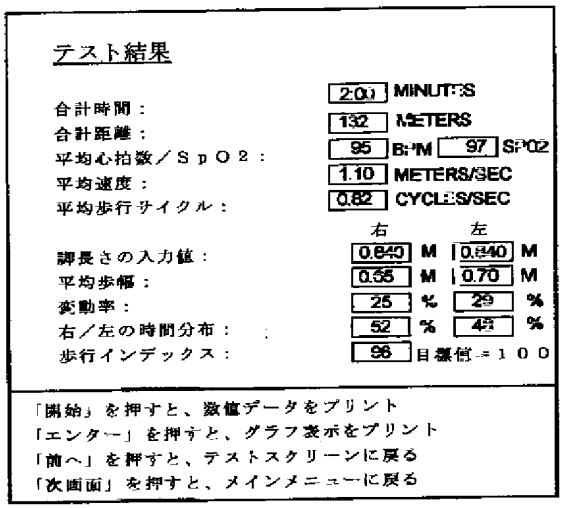
【図13】


5
22
4
2
2
1
2
3
2
22
3
4
5

【図８】



【図９】



スクリーン番号：４５

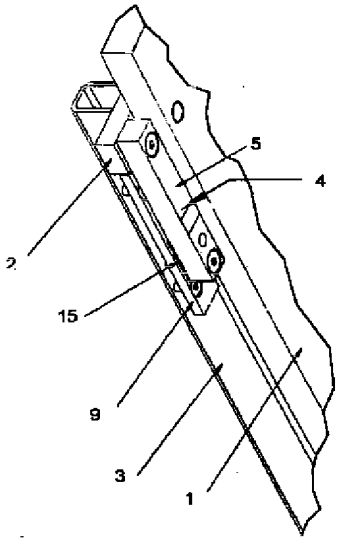
【図１０】

標準歩行パラメータ表　男性用

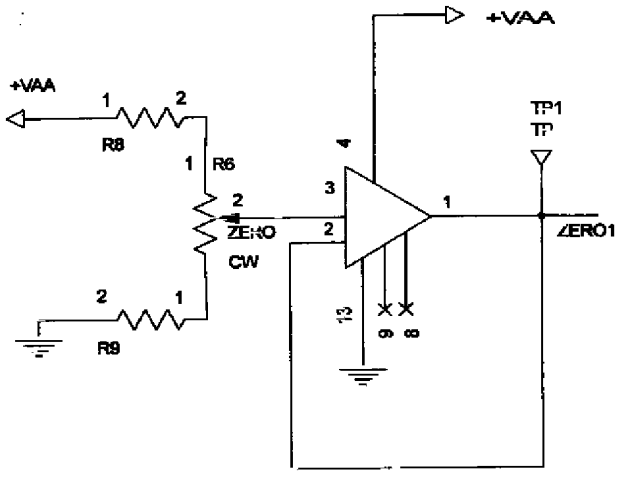
年令 才	リズム STEPS/MIN	サイクル時間 SECONDS	歩幅 METERS	速度 M/SEC
13 - 14	100 - 149	0.81 - 1.20	1.06 - 1.64	0.85 - 1.67
15 - 17	96 - 142	0.85 - 1.25	1.15 - 1.75	1.03 - 1.75
18 - 49	91 - 135	0.89 - 1.32	1.25 - 1.85	1.10 - 1.82
50 - 64	82 - 126	0.95 - 1.46	1.22 - 1.82	0.98 - 1.38
65 - 80	81 - 125	0.96 - 1.48	1.11 - 1.71	0.81 - 1.31

前へ：　戻る
次へ：　次のスクリーンに進む
開始：　結果の印刷を開始する

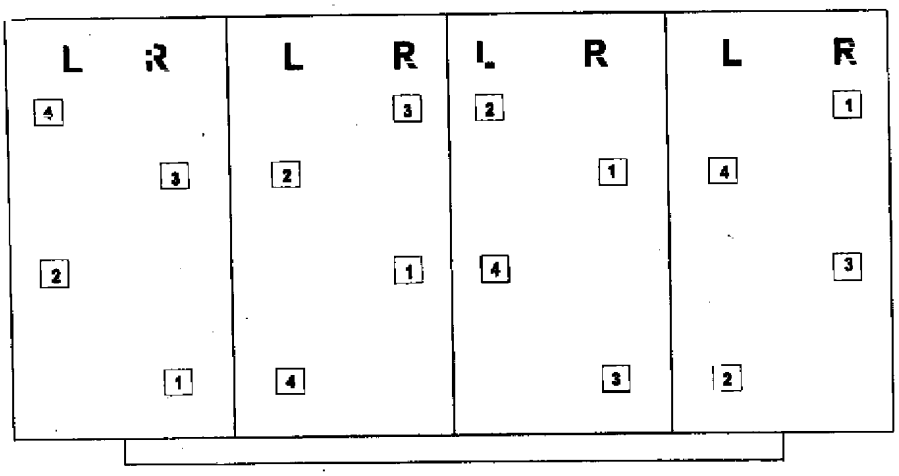
【図１４】



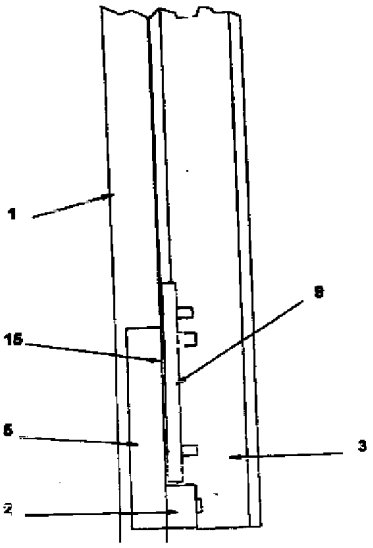
【図１７】



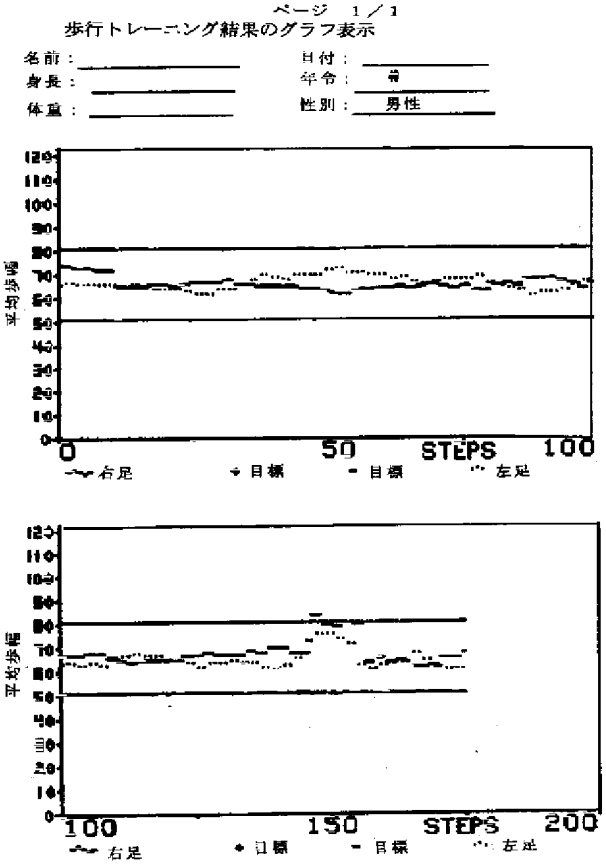
【図11】


L
R
L
R
L
R
L
R
4
3
2
1
3
2
1
4
2
1
4
3
1
4
3
2

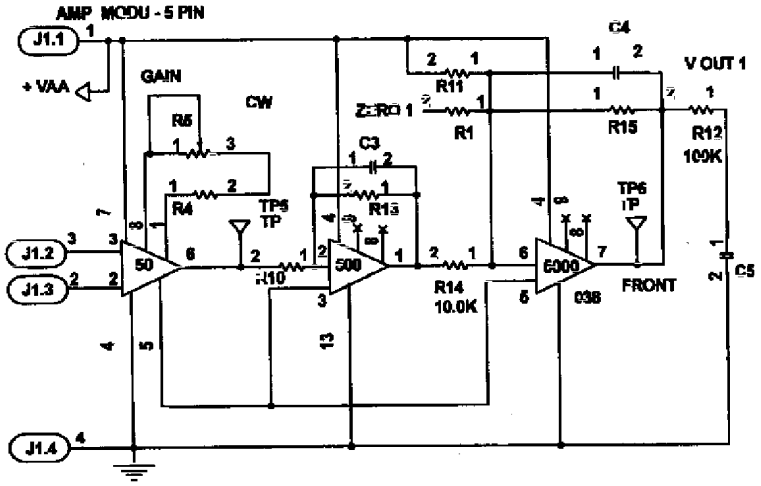
【図15】


1
15
5
2
8
3

【図12】


ページ 1／1
歩行トレーニング結果のグラフ表示
名前：
身長：
体重：
日付：
年令：
性別：
男性
平均歩幅
0
50
STEPS
100
右足
目標
目標
左足
平均歩幅
100
150
STEPS
200
右足
目標
目標
左足

【図16】



フロントページの続き

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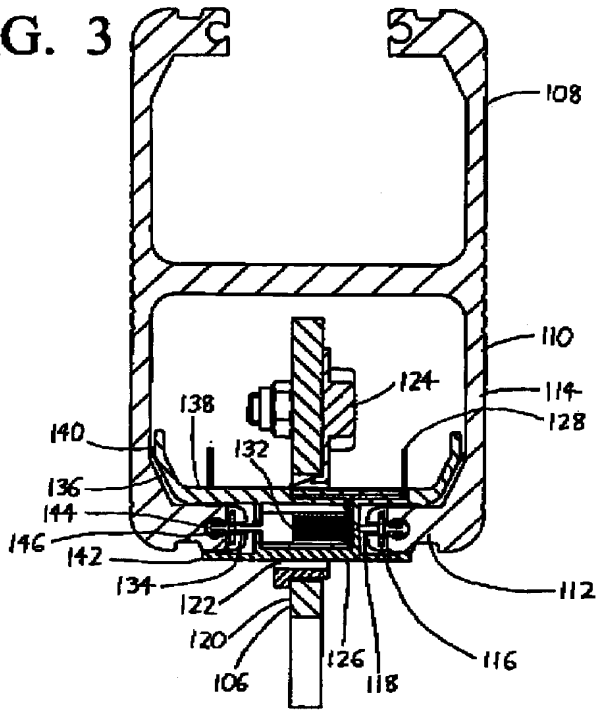
(74) Agent: **BERESKIN & PARR LLP**; 40 King Street West, 40th Floor, Toronto, Ontario, M5H 3Y2 (CA).

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[Continued on next page]

(54) Title: CONDUCTIVE CONNECTION FOR TRACK-RIDING PATIENT HOISTS



(57) Abstract: A patient hoist is provided on a trolley which tides along a track, with the hoist being powered by a conductor extending along the track. A contact carrier is loosely fit within the trolley, and it bears a contact which elastically biased against the track conductor, with die contact being in electrical communication with the hoist: The contact carrier is tree to laterally displace with respect to the trolley so that it (and its contact) follows the contour of the track, with the contact remaining in electrical communication with the track conductor.

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TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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CONDUCTIVE CONNECTION FOR TRACK-RIDING PATIENT HOISTS

Field of the Invention

This document concerns an invention relating generally to hoists which ride on ceiling-mounted or other tracks to various locations to lift or convey patients or equipment, and more specifically to hoists of this nature which require electric power supply at various locations along the track.

Background of the Invention

Hoists which ride on ceiling-mounted or other tracks are commonly used in hospitals and other care centers, as well as in the homes of those with mobility impairments, to convey people and/or equipment to different areas (e.g., from a bed to a bathroom). Examples of such hoists are provided, for example, in U.S. Patent 7,237,491 to *Faucher et al.*, International (PCT) Patent Appln. Publication WO 88/09159, and in other patents cited in (and citing to) these references. Such hoists are usually electrically-powered, and they may ride on the tracks via manually-driven trolleys, or trolleys which are themselves electrically driven to assist in driving the hoists along their tracks. Power may be provided to the hoists via elongated flexible cables that follow the hoists along their tracks, but these can cause difficulties owing to the length of cable needed where the hoists are to travel long distances, and owing to the desire to avoid cable slack and dangling cable. Hoists have also been developed which are powered by rechargeable batteries, with the batteries being recharged when the hoist is placed at a docking position near the end of a track (or at any one of several docking positions along the track). These too pose difficulties in that users often forget to place the hoists back in their docking positions after use, leading to dead batteries and hoists which are inoperative until they are recharged (which can lead to hardships for their users). Some hoists have a feature wherein their trolleys automatically drive the hoists

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to a charging station when not in use, thereby better ensuring that their batteries remain charged. However, such "return-to-charger" features are sometimes thwarted when objects (such as curtains, IV equipment, monitors, etc.) obstruct the return paths of the hoists. Additionally, return-to-charger features cannot easily be implemented in "moving-track" systems such as the ones shown in U.S. Patent 7,237,491, wherein the track on which the hoist rides itself rides on another track (e.g.,a first track aligned along one direction is relocatable on a second track oriented perpendicularly from the first track). In such systems, the hoist can move in a variety of directions (e.g., about a plane), but it is difficult to devise an inexpensive and reliable arrangement for having both the hoist and the track on which it rides reliably return to a charging station.

Owing to the foregoing problems, there has long been interest in development of a hoist which receives (or is capable of receiving) power at all times, regardless of its position along the track, and without the need for umbilical cables, and which is suitable for use in moving-track systems. One possible solution that might be contemplated is to have the track (or a portion thereof) conduct power to the trolley, which could in turn power the hoist, in a manner similar to the way in which a "third rail" powers an electric train and the components therein. However, the arrangements used in trains and the like are not reliably and inexpensively reproducible on the scale of a hoist, since hoists use substantially smaller tracks (which tend to travel along paths having substantially sharper radii of curvature than train tracks and the like). A key difficulty is in maintaining a reliable conductive connection between the trolley and track, particularly when the trolley travels about a curve in the track; at this time, the contacts between the trolley and track are more likely to disengage, causing loss of power to the trolley in hoist systems.

Summary of the Invention

The invention, which is defined by the claims set forth at the end of this document, is directed to devices which at least partially alleviate the aforementioned problems. A basic

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understanding of some of the features of preferred versions of the devices can be attained from a review of the following brief summary of the invention, with more details being provided elsewhere in this document. To assist in the reader's understanding, the following review makes reference to the accompanying drawings of an exemplary preferred version of the devices (with these drawings being briefly reviewed in the "Brief Description of the Drawings" section following this Summary section of this document).

Initially referring to **FIG. 1**, a patient lift **100** includes a hoist **102** with an electrically-actuated lifting member **104** which is movable between raised and lowered states (with the lifting member **104** here being depicted as a harness bar, though slings, seats, baskets, or other lifting members are possible). A hoist trolley **106** is attached to the hoist **102**, with the hoist trolley **106** riding along a track **108** to transport the hoist **102** to different locations. The track **108** has opposing spaced track sides **110** (see also **FIG. 2**), each of which has an elongated track floor **112** which is oriented at least substantially horizontally, and an elongated track wall **114** extending upwardly from the track floor **112**. Preferably, each track side **110** bears a track conductor **116** which, as will be discussed below, is intended to communicate power to the hoist **102** to enable actuation of its lifting member **104**. In the exemplary patient lift **100** shown in the drawings, the track conductors **116** are provided on the opposing edges of the track floors **112** of the track sides **110**. At least a portion of the hoist trolley **106** rides between the track sides **110**, with wheels, pinions, or other drive members allowing the hoist trolley **106** to roll or be driven along the track **108**. The hoist trolley **106** then bears trolley contacts **118** (see **FIG. 3**) which are biased outwardly into contact with the track conductors **116**, with the trolley contacts **118** being in electrical communication with the hoist **102**. As a result, electrical power borne by the track conductors **116** is communicated to the trolley contacts **118** and in turn to the hoist **102**.

The hoist trolley **106** has opposing right and left trolley sides **120** (with only the right side being visible in **FIG. 1**), and a contact carrier channel **122** (best seen in **FIG. 2**, provided on an insert **124** received within the hoist trolley **106**) extends between the right

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and left trolley sides **120**. A contact carrier **126** is fit within the contact carrier channel **122**, and the contact carrier **126** includes the trolley contacts **118** (**FIG. 3**) thereon so that the trolley contacts **118** extend outwardly from the opposing sides of the contact carrier **126**. The contact carrier **126** is movable within the contact carrier channel **122** so that it may move in at least one dimension with respect to the hoist trolley **106** and hoist **102**, namely, in the lateral (rightward / leftward) direction. Preferably, the contact carrier channel **122** is dimensioned such that its bounds (inner perimeter) are at least slightly greater than the bounds (outer perimeter) of the contact carrier **126**, so that the contact carrier **126** may also move at least vertically within the hoist trolley **106**. When the hoist trolley **106** is installed to ride on the track **108** (see particularly **FIG. 3**), the contact carrier **126** is situated between the track sides **110** with the trolley contacts **118** extending into contact with the track conductors **116**. The trolley contacts **118** are in conductive communication with contact connectors **128**, which can in turn be connected to hoist connectors **130** (see **FIG. 1**) which communicate power to the hoist **102**. Thus, power supplied to the track conductors **116** (see **FIG. 3**) is in turn communicated to the trolley contacts **118**, and then in turn to the contact connectors **128**, the hoist connectors **130** (**FIG. 1**), and the hoist **102**, whereby a hoist **102** riding along the track **108** may receive power at various locations along the track **108**. The contact carrier **126**, which is only restrained to the hoist trolley **106** and hoist **102** by the inner bounds of the contact carrier channel **122** (and by the flexible connection between the contact connectors **128** and hoist connectors **130**, see **FIG. 1**), is therefore urged along the track sides **110** by the hoist trolley **106**, but is displaceable with respect to the hoist trolley **106** as the hoist trolley **106** rides between the track sides **110** so that the trolley contacts **118** may always remain in conductive communication with the track conductors **116**. This conductive communication is also assisted by biasing the trolley contacts **118** elastically outwardly from the contact carrier **126** sides, as by the springs **132** shown in **FIGS. 2** and **3**, so that the trolley contacts **118** remain in contact with the track conductors **116**. Because the contact carrier **126** displaces between the track sides **110** to

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follow their contours (and since the trolley contacts **118** are elastically biased into contact with the track conductors **116**), the contact problems that may arise as the hoist trolley **106** and hoist **102** travel about the track **108** are at least substantially avoided.

Other useful features may be implemented to maintain and enhance conductive communication between the trolley contacts **118** and the track conductors **116**. As one example, best seen in **FIGS. 2-3**, each track conductor **116** may be situated within a conductor groove **134** in its track side **110**, with each trolley contact **118** extending within a conductor groove **134** to contact one of the track conductors **116**. The track conductors **116** are thereby guided by the surfaces of the conductor grooves **134** to remain in contact with the track conductors **116**.

As another example, upper contact covers **136** (see **FIGS. 2-3**) may be provided to extend outwardly from the contact carrier **126** above the trolley contacts **118**, with the upper contact cover **136** riding above and closely adjacent to the track sides **110** so that the track sides **110** urge the upper contact covers **136** (and thus the contact carrier **126** and trolley contacts **118**) into proper conductive alignment as the hoist trolley **106** and contact carrier **126** travel along the track **108**. Each upper contact cover **136** preferably includes a first upper contact cover portion **138** extending outwardly from the hoist trolley **106** above and closely adjacent to one of track floors **112**, and a second upper contact cover portion **140** extending upwardly from the first upper contact cover portion **138** closely adjacent to one of the track walls **114**. The second upper contact cover portion **140** usefully helps to guide the contact carrier **126** between the track sides **110**, while the first upper contact cover portion **138** assists in preventing detritus from falling between the trolley contacts **118** and track conductors **116**. Lower contact covers **142** can also be provided to extend outwardly from the contact carrier **126** sides below and closely adjacent to the track sides **110** to provide further protection against foreign matter, as well as protection against inadvertent contact of the conductive components by personnel servicing the hoist **102** and hoist trolley **106**.

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To assist in easy maintenance of the track conductors **116**, they are preferably provided as strips which are readily installable and removable within the track sides **110**. Thus, as best seen in **FIGS. 2-3**, each track conductor **116** may bear a protruding connection tongue **144**, and each track side **110** may bear a connection groove **146**, with the connection tongue **144** being removably fit within the connection groove **146**.

The foregoing arrangements may be usefully implemented in both fixed-track systems (as in **FIG. 1**) and in moving-track systems (as in **FIG. 4**). Looking to the exemplary moving-track system of **FIG. 4**, the hoist **102** and its hoist trolley **106** may electrically communicate with the (lower) track **108** as described above, and the lower track **108** may then bear a track trolley **148** which rides on an upper track **150**. The upper track **150** may then include an upper track conductor **152** (e.g., track conductors similar to those discussed previously) in electrical communication with the track conductors **116** of the lower track **108**. One end of the lower track **108** bears a stationary contact carrier **154** in conductive communication with the track conductors **116** of the lower track **108**, with leads from this stationary contact carrier **154** leading to a mobile contact carrier **156** within the track trolley **148** (this mobile contact carrier **156** being shown in **FIG. 4** in a position "exploded" downwardly from the track trolley). The upper track **150** then has a stationary contact carrier **158** leading to a power supply (not shown). Thus, the power supply supplies power in turn to the stationary contact carrier **158** of the upper track **150**, the track conductor(s) **152** of the upper track **150**, the mobile contact carrier **156** of the track trolley **148**, the stationary contact carrier **154** of the lower track **108**, the track conductors **116** of the lower track **108**, and finally the mobile contact carrier **126** of the hoist trolley **106**, and thus to the hoist **102**.

Further versions, features, and advantages of the invention will be apparent from the remainder of this document in conjunction with the associated drawings.

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Brief Description of the Drawings

FIG. 1 is a partially exploded perspective view of a patient lift **100** including a hoist **102** having a hoist trolley **106** which travels along the track **108** (the hoist trolley **106** being shown ready for installation within the track **108**), with a stopping mechanism **160** for the hoist trolley **106** and an endcap **162** also being shown spaced away from the track **108** wherein they are installed.

FIG. 2 is an exploded perspective view of a section of the track **108** (and its track conductors **116**) shown with the insert **124** of the hoist trolley **106**, and with the contact carrier **126** shown disassembled into its component lower carrier portion **172**, upper carrier portion **174**, trolley contacts **118** (and biasing springs **132**), contact connectors **128**, and carrier cover **176**.

FIG. 3 is an elevational view of the track **108** (and its track conductors **116**) with the insert **124** and contact carrier **126** installed, shown sectioned so that the contact between the track conductors **116** and trolley contacts **118**, and the complementary shaping of the upper contact covers **136** and the interior of the track **108**, are visible.

FIG. 4 is a partially exploded perspective view of the patient lift **100** of **FIG. 1** installed in a moving-track system wherein the (lower) track **108** is provided on a track trolley **148**, with the track trolley traveling along an upper track **150**, so that the hoist **102** can move in two dimensions (in both the direction of the lower track **108** and the direction of the upper track **150**).

Detailed Description of Preferred Versions of the Invention

Expanding on the discussion above, the hoist **102** and track **108** illustrated throughout the drawings are adapted from the KWIKtrack and hoist system of BHM Medical Inc. (Magog, QC, Canada), which is available with a number of different track and hoist configurations. The exemplary track **108** illustrated throughout the drawings is configured similarly to a pair of C-channels which are joined with their mouths facing in

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opposing directions, as best seen in **FIG. 3**. Usefully, some versions of the KWIKtrack track already include the connection grooves **146**, which can be used to receive the connection tongues **144** of the track conductors **116** as previously described. Thus, the track **108** is readily constructed by simply installing the track conductors **116** therein. Once the track conductors **116** are installed within the track **108**, the hoist trolley **106** may be installed on the track **108** by slipping the hoist trolley **106** between the track sides **110** (as illustrated in **FIG. 1**). At the same time, the trolley contacts **118** may be biased inwardly against the force of the springs **132** (best in seen in **FIGS. 2-3**) so that the trolley contacts **118** fit within the conductor grooves **134**, and so that the upper contact covers **136** and lower contact covers **142** are situated on the opposing upper and lower sides of the track floor **112**. **FIG. 1** also illustrates a stopping mechanism **160** which may be fit within the track sides **110** at the end of the track **108**, with the stopping mechanism **160** bearing a contact switch or other means for detecting when the hoist trolley **106** reaches or approaches the end of the track **108** (and thereby triggers the stopping mechanism **160**). An end cap **162** which may be fixed to the end of the track **108** to close it is also shown.

The hoist trolley **106** illustrated in **FIG. 1** is shown as being of a type wherein four wheels **164** drive the hoist trolley **106** along the track **108**, with the wheels **164** being driven by an appropriate drive situated on or within the hoist **102** to have wheels **164** roll along the track floor **112**. However, it should be understood that any number of drive wheels **164** (or pinions or other drive mechanisms) could be used instead, and/or that these drive mechanisms might engage one or more of the track walls **114** rather than one or both sides of the track floors **112**. It is also possible that the hoist trolley might be driven along the track **108** by a belt, cable, or other drive rather than being driven by the wheels **164**.

Looking particularly to **FIG. 2**, the contact carrier channel **122** is provided within the insert **124**, which in turn fits into the hoist trolley **106** (as seen in **FIG. 1**). As **FIG. 1** illustrates, the insert **124** bears a clip **166** for restraining the leads extending from the hoist **102** to the hoist connectors **130**, and for allowing one of these leads to pass from one side

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of the hoist trolley **106** to the other via a passage **168**. A bolt hole **170** (see **FIG. 2**) allows insertion of a fastener to affix the insert **124** to the hoist trolley **106**. The insert **124** is not required, and the contact carrier channel **122** might instead be situated directly within the hoist trolley **106**, but use of the insert **124** can assist in manufacturing, installation, and maintenance.

As illustrated in **FIG. 2**, the contact carrier **126** is formed in several parts which are readily fit together to construct the contact carrier **126**: a lower carrier portion **172** which bears the lower contact covers **142**, and which slidably receives the trolley contacts **118** and their springs **132**; an upper carrier portion **174** which also slidably receives the trolley contacts **118** therein, with the springs **132** biasing the trolley contacts **118** outwardly through apertures defined between the lower carrier portion **172** and upper carrier portion **174**; the contact connectors **128**, which extend upwardly from a conductive connection with the springs **132** and trolley contacts **118** so that the hoist connectors **130** (**FIG. 1**) may be fit thereover; and a carrier cover **176** which snap-fits into the upper carrier portion **174** to better prevent detritus from falling into the contact carrier **126**. The assembled contact carrier **126** may then be seen (in cross-section) installed within the track **108** in **FIG. 3**. The trolley contacts **118** may be formed similarly to brushes found in DC motors and similar devices, with preferred versions of the invention using copper-graphite trolley contacts **118** in communication with copper contact connectors **128** and springs **132**. The springs **132** need not be conductive, and the trolley contacts **118** may communicate with the contact connectors **128** via wires.

Turning to **FIG. 4**, the hoist **102** (with its associated hoist trolley **106** and contact carrier **126**) rides along the lower track **108** in the manner described above. As previously discussed, the track conductors **116** of the lower track **108** are supplied with power from a stationary contact carrier **154** situated near the end of the track **108**, between the stopping mechanism **160** and the endcap **162**. Lead connectors **178** fit over the contact connectors **180** of the stationary contact carrier **154** so that the stationary contact carrier **154** may

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receive power via leads **182** from the mobile contact carrier **156** within the track trolley **148**. The track trolley **148** functions to drive the connected lower track **108** along the upper track **150** similar to the manner in which the hoist trolley **106** drives the hoist **102** along the lower track **108**. The contact carrier **156** of the track trolley **148** communicates with the track conductors **152** in the upper track to carry power from a power source, with the power source communicating with the upper track conductors **152** via stationary contact carrier **158**.

The stationary contact carrier **154** of the lower track **108** is shown communicating with the trolley contact carrier **156** via leads **182** since it is contemplated that the track trolley **148** will only travel across the upper track **150**, with the lower track **108** remaining fixed to the track trolley **148** in the position shown. However, it is also possible to have the lower track **108** travel along the track trolley **148**, so long as the lower portion of the track trolley **148** (the portion situated within the upper channel of the track **108**) is appropriately configured (e.g., if configured similarly to the hoist trolley **106**). In this case, it would be inconvenient to include the leads **182** since these would serve as an umbilical tether which restricts the movement of the lower track **108** on the lower portion of the track trolley **148**. It would instead be preferable to have the leads **182** extend from the stationary contact carrier **154** in the lower channel of the lower track **108** to a similar stationary contact carrier situated in the upper channel of the lower track **108**, so that power is communicated between the track conductors **116** of the lower channel of the lower track **108** to the track conductors (not shown) of the upper channel of the lower track **108**. A contact carrier on the lower portion of the track trolley **148** (the portion riding within the upper channel of the lower track **108**) can then be provided in conductive communication with the track trolley contact carrier **156**. Thus, power can be communicated from the power source, to the upper track stationary contact carrier **158**, to the upper track conductors **152**, to the upper track trolley contact carrier **156**, to the lower track trolley contact carrier (not shown), to the track conductors (not shown) in the upper channel of the track **108** and to their stationary contact

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carrier (not shown), then to the lower stationary contact carrier **154** provided in the lower channel of the track **108**, and finally to the track conductors **116** of the lower track **108**, the hoist trolley **106**, and the hoist **102**.

The invention is usable to provide power to the hoist **102** regardless of the hoist's location along a track **108** (or tracks **108 / 150**), whether for the purpose of charging batteries within the hoist **102** or for simply directly powering the hoist **102** (and/or any drive system for driving the hoist trolley **106** along the track **108**).

It is notable that owing to the use of a contact connection which engages track conductors **116** regardless of variations in the relative positions of the track **108** and the hoist trolley **106**, and/or regardless of variations in the spacing of the track sides **110**, the invention may be usable with flexible or articulated tracks – that is, tracks which are bendable so that they may be oriented as desired. Consider, for example, a track **108** made of semi-flexible plastic material rather than metal or rigid plastic, whereby the track **108** may be curved as needed and affixed to a ceiling or other support. Bending such a track **108** would tend to cause variations in the spacing between the track sides **110** (and thus variations in the location of the track conductors **116**), thereby making it difficult to ensure conductive contact as the hoist trolley **106** travels along the track **108**. However, the exemplary version of the invention described above can accommodate such variations since its contact carrier **126** will move to fit track variations, and its elastically-biased contacts **118** will work to maintain contact with the track conductors **116**.

The various components described above may be made of any suitable materials. Preferably, the contact carrier **126** is made of plastic (for insulating purposes), whereas the hoist trolley **106** and track **108** are made of metal for strength and durability. The track conductors **116** are then preferably formed of conductive strips coextruded within plastic sheaths, with these sheaths bearing the connection tongues **144** for attachment within the connection grooves **146** in the track sides **110** so that the track conductors **116** are insulated

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from the (metal) track **108** and its track sides **110**. While not preferred, it is possible for a metal track **108** to serve as one of the track conductors **116**.

It should be understood that the contact arrangements discussed above are merely exemplary, and other arrangements are possible. For example, the track conductors **116** might be provided on one of the track sides **110** – e.g., with one situated below the other – and the trolley contacts **118** might then be biased outwardly from one side of the contact carrier **126** to conductively engage the track conductors **116**. The trolley contacts **118** can also be aligned to engage track conductors **116** situated on horizontal or vertical surfaces of the track sides **110**, either within or outside the channels formed within the track **108**. In any case, the displaceable contact carrier **126**, and/or the spring-biased trolley contacts **118**, can assist in maintaining conductive communication between the trolley **106** and the track conductors **116**.

It should also be understood that the versions of the invention described above are merely exemplary, and the invention is not intended to be limited to these versions. The invention may assume forms which have appearances, components, uses, and functions which are vastly different than those noted above; for example, the invention might be utilized with tracks having configurations different from the one shown. As another example, the invention might be implemented in the patient lifts of the patents and publications noted at the outset of this document, or features of those patient lifts might be incorporated into versions of this invention. Thus, the scope of rights to the invention is limited only by the claims set out below, with the invention encompassing all different versions that fall literally or equivalently within the scope of these claims.

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Claims

What is claimed is:

1. A patient lift including:
   a. a hoist, the hoist including an electrically-actuated lifting member movable between raised and lowered states;
   b. a hoist trolley attached to the hoist;
   c. a track having opposing spaced track sides:
      (1) wherein at least a portion of the hoist trolley rides between the track sides, and
      (2) each bearing a track conductor;
   herein the hoist trolley bears trolley contacts biased outwardly from the hoist olley into contact with the track conductors, the trolley contacts being in electrical communication with the hoist, whereby electricity borne by the track conductors is communicated to the trolley contacts and in turn to the hoist.

2. The patient lift of claim 1 wherein the hoist trolley further includes a contact carrier:
   a. bearing the trolley contacts thereon, and
   b. resting within a contact carrier channel extending between opposing sides of the hoist trolley, wherein the bounds of the contact carrier within the contact carrier channel are smaller than the bounds of the contact carrier channel, whereby the contact carrier is displaceably fit within the contact carrier channel.

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3. The patient lift of claim 1 wherein the hoist trolley further includes a contact carrier:
   a. situated between the track sides;
   b. bearing the trolley contacts thereon; and
   c. being movably engaged to the hoist trolley, whereby the contact carrier:
      (1) is urged along the track sides by the hoist trolley, and
      (2) is displaceable with respect to the hoist trolley as the hoist trolley rides between the track sides.

4. The patient lift of claim 1 wherein:
   a. the hoist trolley has opposing trolley sides oriented toward the track sides, and
   b. a contact carrier is fit within the hoist trolley to laterally extend between the trolley sides, with the contact carrier being displaceable within the hoist trolley to move laterally within the hoist trolley; and
   c. the trolley contacts are situated on the contact carrier and are biased outwardly therefrom.

5. The patient lift of claim 1 further including upper contact covers extending outwardly from the hoist trolley above the trolley contacts, wherein the upper contact cover rides above and closely adjacent to the track sides.

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6. The patient lift of claim 5 wherein:

a. each track side includes:

(1) an elongated track floor, the floor being oriented at least substantially horizontally, and

(2) an elongated track wall extending upwardly from the track floor,

b. each upper contact cover includes:

(1) a first upper contact cover portion extending outwardly from the hoist trolley above and closely adjacent to one of track floors, and

(2) a second upper contact cover portion extending upwardly from the first upper contact cover portion closely adjacent to one of the track walls.

7. The patient lift of claim 5 further including lower contact covers extending outwardly from the hoist trolley below the trolley contacts, wherein the lower contact cover rides below and closely adjacent to the track sides.

8. The patient lift of claim 1:

a. wherein the track is a lower track;

b. further including an upper track whereupon the lower track rides, the upper track bearing an upper track conductor in electrical communication with the track conductors of the lower track.

9. The patient lift of claim 1 wherein:

a. each track conductor is situated within a conductor groove in its track side, and

b. each trolley contact extends within a conductor groove to contact one of the track conductors.

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10. The patient lift of claim 1 wherein:

a. each track conductor bears a protruding connection tongue, and

b. each track side bears a connection groove, with the connection tongue being removably fit within the connection groove.

11. A patient lift including:

a. a hoist, the hoist including an electrically-actuated lifting member movable between raised and lowered states;

b. a hoist trolley attached to the hoist, the hoist trolley having:

(1) opposing right and left trolley sides;

(2) a contact carrier channel extending between the right and left trolley sides;

(3) a contact carrier fit within the contact carrier channel, the contact carrier including a trolley contact extending therefrom, wherein:

(a) the trolley contact is in electrical communication with the hoist, and

(b) the contact carrier is movable rightwardly and leftwardly within the contact carrier channel.

12. The patient lift of claim 11:

a. further including a track:

(1) whereupon the hoist trolley rides, and

(2) having opposing spaced track sides, at least one track side bearing a track conductor,

b. wherein the contact carrier rides between the track sides with the trolley contact in contact with the track conductor.

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13. The patient lift of claim 12:

a. wherein the track is a lower track;

b. further including an upper track whereupon the lower track rides, the upper track bearing an upper track conductor in electrical communication with the track conductor of the lower track.

14. The patient lift of claim 11 wherein the contact carrier is also movable upwardly and downwardly within the contact carrier channel.

15. The patient lift of claim 11 wherein the trolley contact is elastically biased outwardly from the contact carrier.

16. The patient lift of claim 11:

a. wherein the contact carrier includes:

(1) upper contact covers extending outwardly therefrom above the trolley contact,

(2) lower contact covers extending outwardly therefrom below the trolley contact,

b. further including a track:

(1) whereupon the hoist trolley rides, and

(2) having opposing spaced track sides, at least one track side bearing a track conductor, wherein:

(a) the upper contact covers ride above and closely adjacent to the track sides, and

(b) the lower contact covers ride below and closely adjacent to the track sides.

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17. A patient lift including:

a. a hoist, the hoist including an electrically-actuated lifting member movable between raised and lowered states;

b. a track having opposing spaced track sides, each bearing a track conductor;

c. a contact carrier having opposing contact carrier sides, each contact carrier side including:

(1) an upper contact cover extending outwardly from the contact carrier side, wherein the upper contact cover rides above and closely adjacent to one of the track sides;

(2) a lower contact cover extending outwardly from the contact carrier side, wherein the lower contact cover rides below and closely adjacent to one of the track sides;

(3) a trolley contact extending outwardly from the contact carrier side, the trolley contact:

(a) being situated below the upper contact cover and above the lower contact cover, and

(b) being connected in electrical communication between the hoist and one of the track conductors,

wherein the contact carrier is:

i. restrained to, but

ii. displaceable in at least one dimension with respect to,

the hoist.

18. The patient lift of claim 17 further including a trolley:

a. affixed to the hoist,

b. riding between the opposing track sides, and

c. having the contact carrier displaceably mounted therein.

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19. The patient lift of claim 18 wherein the contact carrier is both horizontally and vertically displaceable with respect to the trolley.

20. The patient lift of claim 17 wherein the trolley contacts are elastically biased outwardly from the contact carrier sides.

21. The patient lift of claim 17 wherein:

a. each track side includes:

(1) an elongated track floor, the floor being oriented at least substantially horizontally, and

(2) an elongated track wall extending upwardly from the track floor,

b. each upper contact cover includes:

(1) a first upper contact cover portion extending outwardly from the hoist trolley above and closely adjacent to one of track floors, and

(2) a second upper contact cover portion extending upwardly from the first upper contact cover portion closely adjacent to one of the track walls.

22. The patient lift of claim 17:

a. wherein the track is a lower track;

b. further including an upper track whereupon the lower track rides, the upper track bearing an upper track conductor in electrical communication with the track conductors of the lower track.

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23. The patient lift of claim 17 wherein:

a. each track conductor is situated within a conductor groove in its track side, and

b. each trolley contact extends within a conductor groove to contact one of the track conductors.

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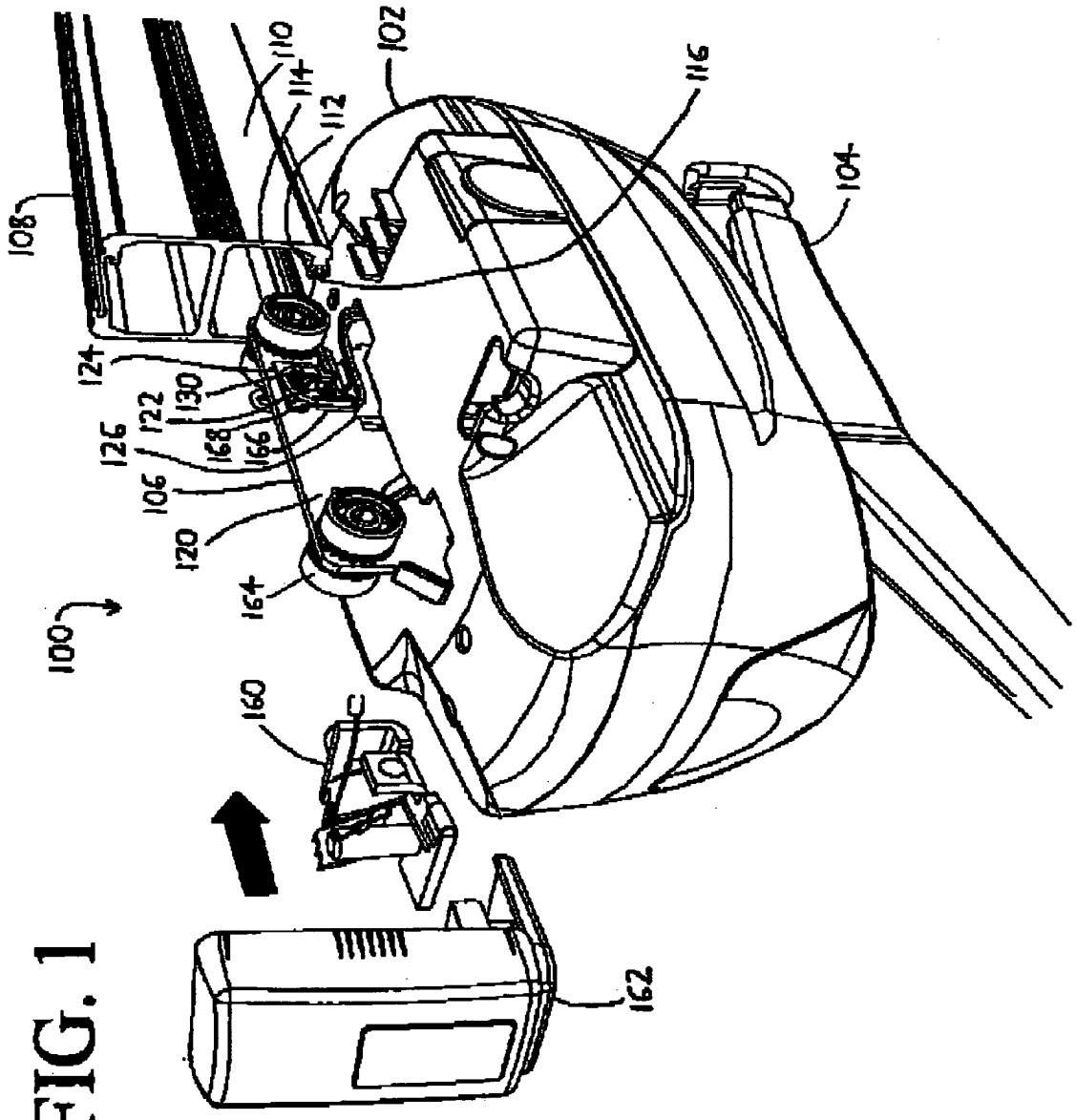
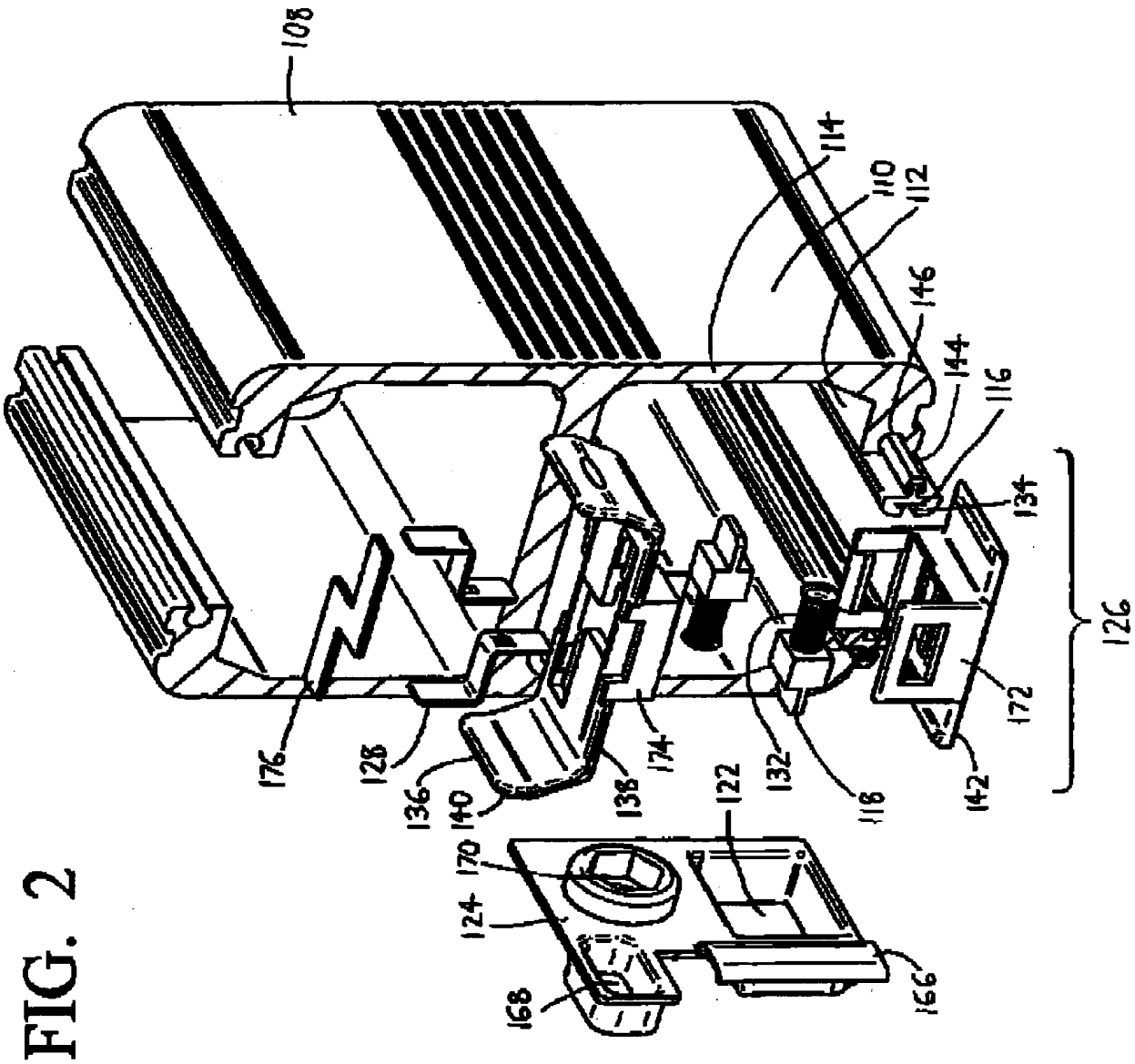


FIG. 1

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FIG. 2



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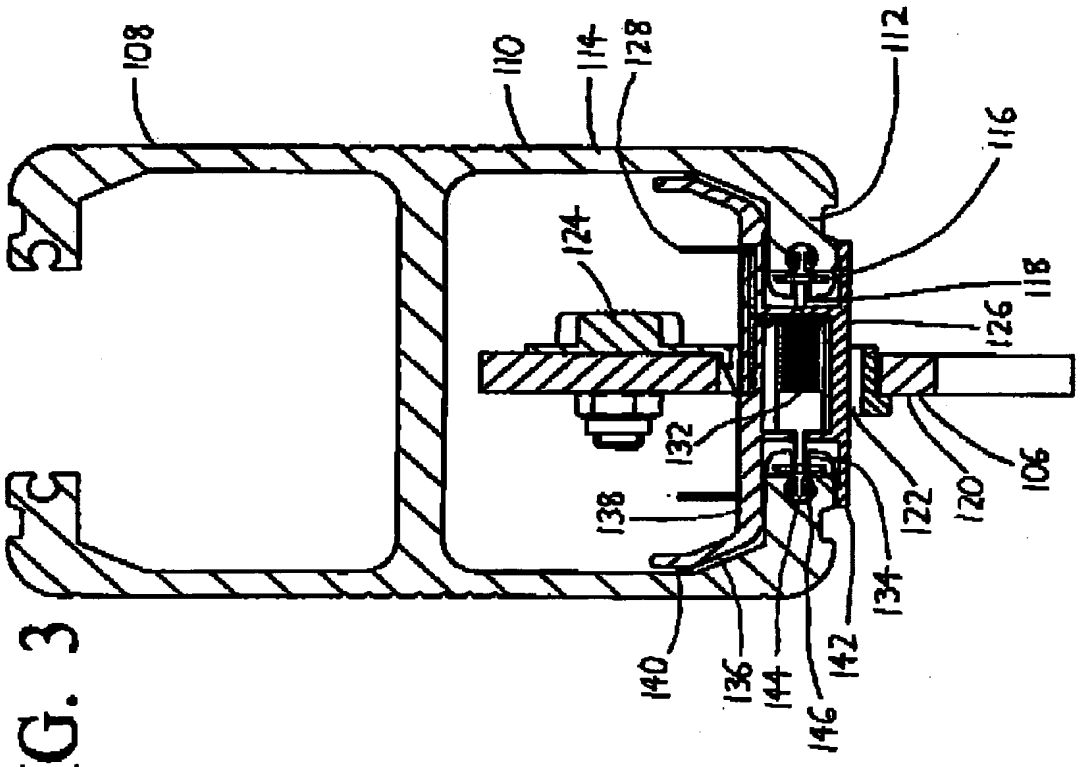
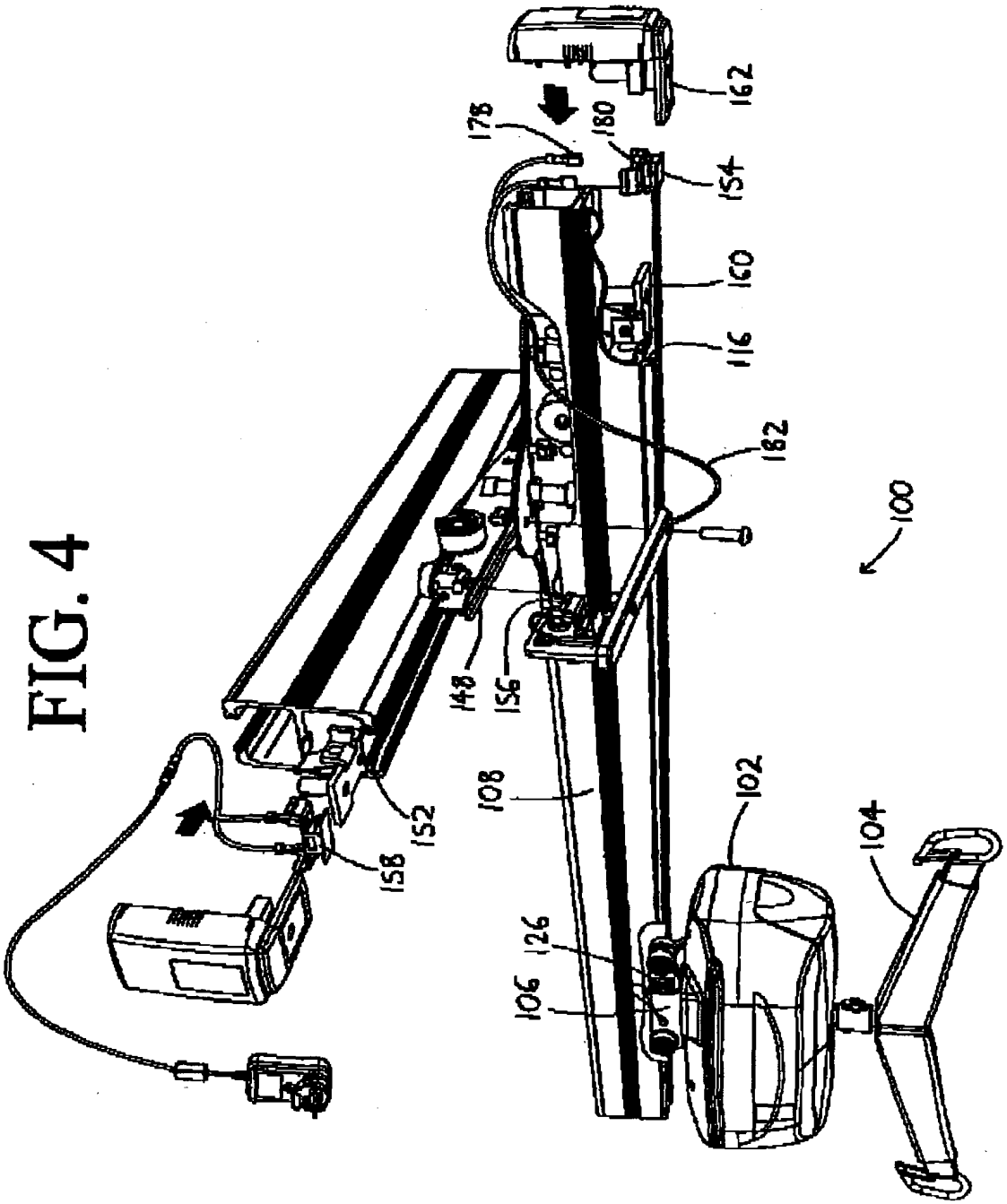


FIG. 3

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FIG. 4



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Declarations under Rule 4.17:

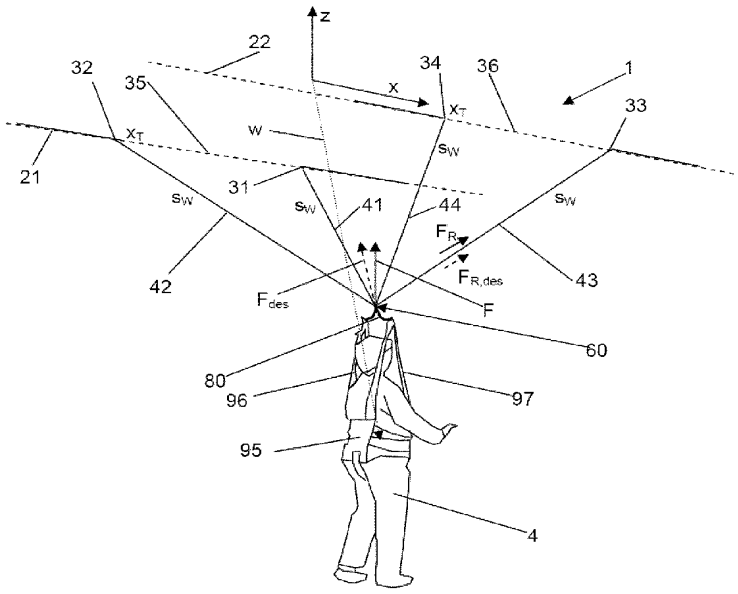
— *as to the identity of the inventor (Rule 4.17(i))*

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

[Continued on next page]

(54) **Title**: APPARATUS FOR UNLOADING A USER'S BODY WEIGHT DURING A PHYSICAL ACTIVITY OF SAID USER, PARTICULARLY FOR GAIT TRAINING OF SAID USER

Figure 7



(57) **Abstract**: The invention relates to an apparatus (1) for unloading a user's body weight during a physical activity of said user (4), particularly for gait training of said user (4), comprising: a plurality of ropes (41, 42, 43, 44), wherein each rope (41, 42, 43, 44) extends from an associated drive unit (510, 520, 530, 540), is deflected by a passively displaceable deflection device, e.g. a device that is displaceable by means of the forces in the deflected ropes, and then runs to a first free end (41 a, 42a, 43a, 44a) of the respective rope (41, 42, 43, 44), and a node (60) being coupled to said first free ends (41 a, 42a, 43a, 44a) and being designed to be coupled to said user (4), wherein the drive units (510, 520, 530, 540) are designed to retract and release the respective rope (41, 42, 43, 44) so as to adjust a current rope force (FR) along the respective rope (41, 42, 43, 44), which current rope forces add up to a current resulting force (F) exerted on said user (4) via said node (60) in order to unload the user (4) upon said physical activity. Further, the invention relates to a method for controlling such a system.

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Apparatus for unloading a user's body weight during a physical activity of said user, particularly for gait training of said user

Specification

The invention relates to an apparatus, particularly for (e.g. guidedly) unloading a user's body weight during a physical activity of said user, particularly for gait training of said user (e.g. patient). Of course, also animals, robots or any other object may be unloaded by the apparatus according to the invention. Thus, the term "user" may specifically refer to a human person, but may also mean any other object that is to unload.

Typically, in known devices of this kind, a user is statically suspended from a lift line while walking on a treadmill. Thus, the sort of physical activities (trainings) that can be performed by the user are rather limited.

Based on the above, the problem underlying the present invention therefore is to provide for an apparatus that allows for a variety of different physical activities or movements while safely supporting the user (object) at the same time in a defined manner.

This problem is solved by a device having the features of claim 1 as well as by a method having the features of claim 15.

Preferred embodiments are stated in the respective sub claims and are described below.

According thereto, the apparatus according to the invention comprises a plurality of ropes, wherein each rope is coupled to an associated drive unit being particularly connected to a suitable rigid support structure (for example a support frame or a ceiling) and extends from the respective drive unit to a (uniquely associated) deflection device for deflecting the respective rope and then to a first free end of the respective rope, and a node being coupled to said first free ends and being designed to be coupled to said user, wherein the drive units are designed to retract and release (e.g. wind and unwind) the respective rope so as to generate a current rope force along the respective rope, which current rope forces add to a current resulting force exerted on said user via said node in order to continuously unload the user

upon said physical activity. Particularly, the node can also be an extended body, e.g. a frame for instance. Particularly, the ropes must not necessarily meet in one point.

Preferably, the deflection devices are passively displaceable (i.e. can change their position in space, particularly in a guided manner), which particularly means that they do not themselves comprise a movement generating means for moving the respective deflection device actively, but can be displaced by forces induced into the deflection devices via the ropes. Particularly, the deflection devices may be connected to each other (for instance pairwise such that the respective two deflection devices can be displaced together while maintaining a constant distance between the deflections devices along the direction of displacement), and they may be guided by a guide rail or a plurality of guide rails or may be suspended from a support structure (e.g. support frame or ceiling of a room), particularly by means of a wire or another (elongated) supporting element such that their centers of mass can (passively) change position in space. Likewise, said guide rail(s) may be connected to a support structure (e.g. support frame or ceiling). A connection between two (or even more) deflection elements can be provided by means of an (e.g. separate) connecting means (element), which may be interchangeable. However, deflection devices may also be integrally connected to each other (i.e. form a single piece).

The rope forces may be controlled such that the resulting rope force is a purely vertically acting force, but may also have components in the horizontal plane so as to direct the user in a certain direction upon said physical activity (e.g. gait training). Further, not only forces can be controlled, also the position of the node. This can be used for transportation of loads (alternative application), or just to position the device above a user.

Preferably, the apparatus according to the invention is configured such that a user (or object) coupled to the node as intended can in principle perform a movement in a three dimensional space, i.e., is able to move horizontally, namely forwards backwards and also sideways, as well as vertically (e.g. climbing a staircase or some other object such as an inclined surface provided in the horizontally extending space accessible to the user being coupled to the node), and can rotate about the vertical axis, allowing walking curves or turning. Of course, the apparatus according to the invention can also be combined with known devices such as a treadmill etc.

However, in an embodiment of the invention, the deflection devices may be fixed such that they are not moving in space or along the guide rails. Particularly, the deflection devices are designed to be fixed in a releasable manner to the guide rails

so that the deflection units are temporarily lockable regarding their movement along the guide rails,

According to a further embodiment of the invention, the support frame comprises an upper frame part extending along a horizontal extension plane, wherein the support frame may comprise a plurality of vertically extending leg members via which the upper frame part can be supported on a floor.

According to a further aspect of the invention, the apparatus according to the invention comprises force sensors designed to directly or indirectly measure forces in the ropes or directly on the user. Particularly, each of the ropes interacts with an associated rope force sensor for determining the currently acting rope forces and thereby the current resulting force on the user. Alternatively, the current rope forces may be detected by means of electrical current sensors interacting with the drive units (for instance such sensors may be integrated into the actuators of the winches).

Preferably, these rope force sensors provide (e,g, analog or digital) output signals corresponding to the currently acting rope forces (current rope forces).

In an embodiment of the invention, said output signals are transmitted via a processing means which digitizes said output signals to a controlling unit (also denoted as control unit) that is able to determine the currently acting rope forces by means of said output signals provided by the rope force sensors.

According to an aspect of the invention, the controlling unit is designed to control said current resulting force (on the node/user) or the position of the node either directly via said drive units or indirectly by controlling said rope forces (i.e., the individual rope forces acting on the node) in an (inner) control loop in order to adjust said current resulting force for unloading (and eventually also pulling) the user in a pre-defined manner, wherein the controlling unit is preferably designed to calculate a currently desired (reference) rope force for each of the ropes and to control the drive units accordingly such that the current rope forces as determined with help of the respective rope force sensor (or another sensor) match (approach) the respectively desired rope force at least asymptotically after a certain period of time. Of course controlling is preferably conducted continuously, wherein particularly the desired rope forces (or desired resulting force) and current rope forces (or current resulting force) may be repeatedly calculated/sensed (e.g. at a constant rate). In both cases (e.g. indirect or direct control of the resulting rope force vector), the controlling unit may be designed to control not only the resulting rope force, but also to influence the

movement of the passively displaceable deflection units in a desired way at the same time. For example, in the case of four winches, the mapping from a three-dimensional resultant rope force correction to four individual winch force corrections is not unique. It represents an underdetermined system of equations. This results in freedom to influence the dynamics of the displaceable deflection units as well. For example, it can be desirable to enforce certain relative dynamics of the deflection units. In the case of two deflection units, enforcing a certain desired (for example asymptotically stable) relative displacement of the two deflection units (also denoted as trolleys) with respect to each other delivers the missing additional constraint in the equation system.

Alternatively (or in addition), the controlling unit may be designed to control the drive units such that the current (spatial) position of the node (e.g. with respect to a space-fixed coordinate system or with respect to said apparatus) approaches a (currently) desired position of the node.

In an embodiment of the invention, the apparatus comprises at least two ropes, preferably four ropes, namely a first, a second, a third and a fourth rope (preferably, but not necessarily, there is an even number of ropes). Preferably, the first rope extends from its associated drive unit towards a first deflection device, is deflected by the first deflection device and then connects to the node. Likewise, the second rope preferably extends from its associated drive unit towards a second deflection device, is deflected by the second deflection device and then connects to the node. Further, also the third rope (if present) preferably extends from its associated drive unit towards a third deflection device, is deflected by the third deflection device and then connects to the node. Finally, also the fourth rope (if present) extends from its associated drive unit towards a fourth deflection device, is deflected by the fourth deflection device and then connects to the node. Preferably, two or more deflection devices are connected to each other to form a deflection unit, so that their combined movement is governed by (multiple) rope forces acting on them.

In an aspect of the invention, each rope may be connected to the node via a spring element.

Particularly, the rope force sensors may be formed with help of such spring elements (being inserted into the respective rope) in combination with a means to measure the length of the respective spring element, e.g. a linear encoder or a wire sensor, which may be a cable-extension transducer comprising a measuring cable wound on a cylinder (spool) coupled to a shaft of a rotational sensor (e.g. a potentiometer),

wherein the respective rotational sensor is connected to an end of the respective spring element and wherein the respective measuring cable is connected to another end of the respective spring element. In case the transducer's measuring cable is now unreeled or reeled from the cylinder when the respective spring element is elongated or contracted, the cylinder and shaft rotate accordingly, thus creating an (electrical) output signal of the rotational sensor proportional to the measuring cable's linear extension. Knowing the spring constant of the respective spring element, the rope force can thus be determined via the spring force of the respective spring element. In this regard, it is to be noted that any other force sensor may also be employed in order to measure the individual rope forces acting on the ropes and/or directly the resultant rope force acting on the user. It is also possible to employ sensors that measure the angles of the ropes in space, and thereby the direction of forces (e.g. by angle sensors or by inertial measurement units), or sensors that measure the forces acting between connected deflection devices of at a deflection unit, and thereby indirectly the rope forces or components thereof.

Preferably, the force sensor is located close to the node, but it can also be located closer to the respective drive unit or winch, or even be based on measurement of the electrical current of the respective drive unit (e.g. actuator driving the respective winch).

According to an aspect of the invention, the apparatus comprises at least a first guide rail (for instance in case of two ropes and two deflection devices), preferably also a second guide rail, each running along a longitudinal axis. These longitudinal axes preferably extend horizontally with respect to an operating position of the apparatus, in which the apparatus can be operated (e.g. by the user) as intended. Preferably, the guide rail(s) can be connected to said support structure (e.g. support frame or ceiling of a room, in which the apparatus is arranged). In case of a support frame, the guide rail(s) may be connected to said upper frame part. Preferably, the guide rails are arranged such that they run parallel with respect to each other. Particularly, in case of two guide rails, each guide rail may be tilted about its longitudinal axis, particularly by an angle of 45°.

Preferably, the first and the second deflection device are slidably connected to the first guide rail, so that they can slide along the first guide rail along the longitudinal axis of the first guide rail. In case of four ropes, the third and the fourth deflection device are preferably slidably connected to the second guide rail, so that they can slide along the second guide rail along the longitudinal axis of the second guide rail.

In detail, the individual deflection devices may comprise a base (e.g. in the form of a cart) via which the respective deflection device can be slidably connected to the associated guide rail, and wherein each deflection device particularly comprises an arm hinged to the base of the respective deflection device so that the respective arm can be pivoted with respect to the respective base about a pivoting axis running parallel to the longitudinal axis of the respective guide rail. Further, the deflection devices may each comprise a deflection element connected to the respective arm, around which deflection element the respective rope is laid for deflecting said rope, and wherein the respective deflection element may be formed by a roller that is rotatably supported on the respective arm, so that particularly the respective roller can be rotated about a rotation axis that runs across the longitudinal axis of the respective guide rail. Further, an arresting means may be provided for each deflection device for arresting the respective deflection device with respect to the associated guide rail, for instance when using the apparatus with a treadmill.

According to a further aspect of the invention, the first and second deflection device are connected by a connecting element (or by an integral connection), which is preferably elastic (particularly such that the restoring force is proportional to the elongation of the elastic connecting element) or non-elastic, so as to form a first deflection unit (also denoted as first trolley). Likewise, in case of four ropes, the third and the fourth deflection device are preferably connected by a further connecting element (or by an integral connection), which may also be elastic or non-elastic (see above), so as to form a second deflection unit (also denoted as second trolley), wherein particularly said connecting elements comprise the same length along the longitudinal axis of the respective guide rail. Further, the connecting elements may be designed to releasably connect the associated deflection devices, in order to be able to substitute a connecting element with a connecting element having a different length along the respective longitudinal axis. Further, the respective connecting element may be a flexible rope member or a rigid rod (particularly produced out of a carbon fibre composite).

Preferably, the drive unit of the first rope and the drive unit of the second rope face each other along the longitudinal axis of the first guide rail, wherein the first deflection unit is arranged between said drive units along the longitudinal axis of the first guide rail. In a similar manner, in case of four ropes, additionally also the drive unit of the third rope and the drive unit of the fourth rope face each other along the longitudinal axis of the second guide rail, wherein the second deflection unit is arranged between

said drive units along the longitudinal axis of the second guide rail. Preferably, the drive units are arranged on the corners of a rectangle.

According to a further aspect of the invention, the drive units each comprise an actuator (particularly a servo motor) being connected to a winch, around which the respective rope is wound, particularly via a flexible coupling, wherein the respective actuator is designed to exert a torque on the respective winch via a drive axis of the respective winch so as to retract or release the respective rope, i.e. to adjust the length of the respective rope that is unwound from the winch. Optionally, the respective drive unit may comprise a brake for arresting the respective winch. Further, in order to prevent the respective rope from jumping off the associated winch or over a thread, the respective drive unit preferably comprises at least one pressing member, particularly in the form of a pressure roller that presses the respective rope being wound around the associated winch with a pre-definable pressure against the winch.

According to a further aspect of the invention, the drive units may be coupled to an actuator unloading system that is designed to compensate for the weight that is to be unloaded so that the actuators do not have to permanently exert the full torque on the winches, but are merely needed to support changes in movement or a portion thereof.

According to yet another aspect of the invention, the apparatus comprises a sensor means for determining a current state of the apparatus as well as the position of the user (node) with respect to the apparatus or a space-fixed coordinate system. Particularly, said current state is given by the lengths of the ropes being unwound from the respective winch and the positions of the deflection units along the respective guide rail.

In detail, the lengths unwound from the winches (i.e. the length of the portion of the respective rope that is unwound from the respective winch) is preferably detected by multi turn encoders being coupled to the drive axes of the winches, respectively. Other sensors (e.g. cable-extension transducers may also be employed for determining said lengths).

Further, from output signals provided by said multi turn encoders, the position of the node can also be determined by means of the controlling unit. Furthermore, the positions of the deflection units along the respective guide rails may be each captured by means of distance sensors, for example linear encoders, magnetic

transducers, or optical laser distance sensors, which distance sensors – in the case of laser sensors - may be arranged at a free end of each guide rail, and whose output signals may also be digitized by a signal processing unit and further transmitted to the controlling unit.

In case of elastic connecting elements between the deflection devices, the current rope forces can be calculated with help of the positions of the deflection devices (e.g. the apparatus is designed to calculate the current rope forces or directly force components on the node with help of the positions of the deflection devices). In this case force sensors at the node may be omitted.

Further, for determining the acceleration of the node, an acceleration sensor may be provided on the node, being capable of sensing the acceleration of the node along three orthogonal axes. The node may comprise an upper and a lower node member being rotatably connected to each other, wherein the ropes are connected to the upper node member and wherein a bail (see below) may be connected to the lower node member, such that the bail can be rotated about the vertical axis. For determining an angular velocity of the node (i.e. of the upper node member), a gyroscope may be provided on the node. For sensing orientation of the node (e.g. of the upper node member), a magnetometer may be provided on the node. Furthermore, for sensing a rotation angle of said bail about the vertical axis a potentiometer may be provided on the node that measures the angle between the upper and the lower member (part) of the node. The acceleration sensor, the gyroscope, the magnetometer, and the potentiometer may provide analog or digital output signals representing the respective quantity to be sensed, wherein particularly these sensors are preferably connected to a signal processing unit that is configured to digitize the respective output signals and/or to transmit them to the controlling unit, wherein said signal processing unit is preferably connected to the node by means of a flexible data line or a wireless connection. Further, the signal processing unit may also be arranged on the node. Preferably, the acceleration sensor, the gyroscope, and the magnetometer are integrated into an inertial measuring unit (IMU) arranged at the node, which IMU preferably provides digital output signals which are particularly forwarded by the signal processing unit. In the examples above the controlling unit may be designed to further process and/or analyze said (digitized) output signals provided by the individual sensors so as to determine the respective quantity, like the lengths of the ropes being unwound from the winches, the positions of the deflection units, or the position of the node (user).

Especially, the acceleration sensor, the gyroscope, the magnetometer and the potentiometer may be used to enhance measurement of the orientation of the resultant force as well as position detection of the user and the node.

According to a further preferred aspect of the invention, the controlling unit is designed to control the drive units, particularly the torque exerted by the respective actuator onto the respective winch, particularly depending on a current state of the apparatus and/or the spatial position of the user determined with help of the afore-described sensor means, such that the current resulting force on the user approaches (matches) the desired resulting force on the user or that the current position of the user (node) approaches (matches) a currently desired position (reference) of the user (node). In particular, the controlling unit can control this current resulting force either directly, i.e. by sending control signals to the drive units as a function of the error (e.g. difference) between a (currently) desired resulting force and the current resulting force, or indirectly, by controlling the current rope forces or winch positions (e.g. the lengths of the rope portions unwound from the winches) by means of a control loop denoted as inner control loop or inner loop.

To control the current resulting force directly, without such an inner loop, the controlling unit may be configured to apply a pre-defined torque to a plurality of the drive units at the same time as a function of said error in the current resulting force, in order to provide for a fast reaction in highly dynamical situations, for instance.

Thus, in one embodiment of the present invention, in case the walking direction of the user is pointing along the longitudinal axes of the guide rails for example, the controlling unit may be designed to perform a lateral correction on the user by commanding the respective drive units to pull the ropes of the first or the second deflection unit at the same time by the same amount. Likewise, the controlling unit may be designed to perform a forward or backward correction on the user by commanding the respective drive units to pull those two corresponding ropes at the same time by the same amount that oppose each other across the longitudinal axes of the guide rails.

In an alternative embodiment, said function can be defined like this: The winch forces Fw or the corresponding torques u = iF_w (with i denoting the geometric relation between winch force and winch torque, e.g. the winch radius, or the winch radius multiplied by a possible additional transmission ratio) exerted onto the winches are required to fulfill the equation:

$$\mathbf{J}\,\boldsymbol{F}_W = \boldsymbol{F}_{des} + (\mathbf{K}_P + \mathbf{K}_I/s)(\boldsymbol{F}_{des} - \boldsymbol{F}),$$

(this equation holds for the torques up to the constant factor i), where the matrix $\mathbf{J}$ is the 3x4 Jacobian, which only depends on the current geometry (node position, deflection unit positions), $\boldsymbol{F}$ is the current force vector on the user, and $\boldsymbol{F}$w is the vector of winch forces F_W. $\mathbf{K}_P$ and $\mathbf{K}_I$ are matrices containing proportional and integral gains, respectively, and s is the Laplace operator. As this is an underdetermined system of equations, there is still freedom of choice in the winch forces F_W. This can be solved by adding another equation that enforces desired movement of the deflection units, for example to achieve asymptotic attenuation of the relative displacement between the two deflection units. As the relative displacement is also a function of rope forces, the system of equations can be solved.

In case of said indirect controlling said inner loop (provided by the controlling unit) is particularly used to calculate the desired rope forces or winch positions being a reference for said inner loop by requiring a desired static equilibrium, where

- there is force equilibrium on the node,
- there is force equilibrium on the deflection units, and
- the deflection units both reside in the same position along the respective guide rail.

Particularly, the controlling unit (inner loop) is designed to control the drive units (e.g. the corresponding torques on the winches), such that the current winch positions or rope forces (which may be determined with help of the rope force sensors or positions of the deflection devices) each approach (match) the respective (currently) desired rope force or winch positions, respectively.

Further, in an embodiment of the invention, the controlling unit is configured to control the torques applied to the individual winches according to the following control law used by the controlling unit

$$\boldsymbol{u} = i(\boldsymbol{F}_{R,des} + \mathbf{K}_r(\boldsymbol{F}_{R,des} - \boldsymbol{F}_R)) + \boldsymbol{u}_{ff},$$

with $\boldsymbol{F}_{R,des} \in \mathbb{R}^{nx1}$ being the calculated reference rope forces (for example calculated according to said indirect control), $i \in \mathbb{R}$ being the transmission ratio of the respective winch, $\mathbf{K}_r \in \mathbb{R}^{nxn}$ being a positive definite rope force feedback matrix containing feedback gains, $n \in \mathbb{N}$ being the number of ropes (e.g. four), and $\boldsymbol{u}_{ff} \in \mathbb{R}^{nx1}$ being an optional additional term going to zero in static conditions of the apparatus by means

of which a pre-defined torque can be applied to a plurality of the winches at the same time (for example calculated according to said direct control).

According to a further aspect of the invention, the controlling unit may also be configured to control said torques such that a current position of the node approaches a respective desired position of the node.

Further, the afore-mentioned bail particularly comprises two opposing free ends, wherein particularly each of the two free ends comprises a receptacle (for instance in the form of a hook formed by the bail) for receiving a connection element for connecting a harness to the bail, which harness is to be put on by the user for connecting the latter to the node (via the connection elements and the bail). In a variant of the invention the connection elements are designed to be length adjustable for adapting the apparatus to the height of a user, for instance.

The signal processing unit that may connect to the acceleration sensor, the gyroscope, the magnetometer and the potentiometer (see above) may also be connected to the rope force sensors provided on the node, preferably through a (flexible) data line (cable). The signal processing unit thereby transmits output signals provided from the rope force sensors to the controlling unit, where they can be further processed.

For enabling the signal processing unit to follow the node upon movement of the node, the signal processing unit is preferably slidably connected to one of the guide rails or directly to the node. The signal processing unit may be driven by a further drive unit, wherein particularly the controlling unit is designed to also control the position of the signal processing unit along the guide rail depending on the position of the deflection units (or the node) and the signal processing unit along the guide rail, so as to maintain a constant distance between the deflection units or node and the moveable signal processing unit along the respective guide rail. The respective position of the movable signal processing unit may be sensed with a suitable sensor and compared to the current position of the node by the controlling unit.

The problem according to the invention is further solved by a method for controlling an apparatus for unloading, particularly the body weight of a user during a physical activity, as claimed in claim 15, wherein the method particularly uses an apparatus according to the invention.

The method according to the invention may comprise the steps of:

- particularly determining a current state of a system of a plurality of ropes each being connected to a node via a first free end of the respective rope, to which node a user (being enabled to displace the node horizontally and also vertically upon walking) or an object is coupled, which ropes can each be wound onto and unwound from a respective winch in order to adjust the rope forces acting along the respective ropes on the node, wherein the ropes are each deflected by a (uniquely) associated deflection device, which deflection devices are each (passively) movable (e.g. along a first direction) and particularly connected to each other, particularly as described above,
- particularly determining the position of the user (with respect to the apparatus or a space-fixed coordinate system),
- calculating a torque for each of the winches (or a corresponding winch force) depending on the current state of the apparatus and/or the position of the user, such that the force on the user approaches (matches) the respective desired force on the user, that the current position of the user (or node) approaches a (currently) desired position of the user (or node), and/or that the movable deflection devices (or units) approach desired movements, respectively, and
- exerting the respective torque onto the associated winches in order to let the current resulting force on the user (or node) approach the (currently) desired resulting force, to let the current position of the user (or node) approach a (currently) desired position of the user (or node), and/or to let the movable deflection devices (or units) approach certain desired movements, respectively.

Preferably, the deflection devices are grouped in pairs (or may comprise even more deflection devices), wherein the deflection devices of each pair are designed to be displaced together (i.e. maintaining a constant distance with respect to each other while being passively displaced), which pairs are denoted as deflection units. Particularly at least two ropes are provided that are deflected by a first deflection unit that may be displaceable as a function of the rope forces in the deflected ropes along a first direction (x-direction). Preferably, four ropes are provided, wherein the first and the second rope are deflected by the first deflection unit and the third and fourth rope are deflected by a second deflection unit being passively displaceable along the first direction (parallel to the first deflection unit).

Particularly, said current state is defined by the lengths of the ropes being unwound from the respective winch and the position(s) of the deflection unit(s) along the first direction.

Furthermore, the current torques for the winches are preferably calculated either directly based on the current error (e.g. difference) between a desired resulting force on the user and the current resulting force on the user, or indirectly, by controlling the individual rope forces or winch positions (e.g. lengths of the portions of the ropes being unwound from the respective winch) in a control loop denoted as inner control loop or inner loop (see also the corresponding description above). In the latter case, the desired rope force for each of the ropes is preferably determined from a desired static equilibrium, where

- there is force equilibrium on the node,
- there is force equilibrium on the deflection unit(s), and
- the deflection units both reside in the same position along the first direction (in case there are a two or more deflection units).

Here, the controlling unit is preferably designed to control the drive units (command torques to the drive units) such that the current rope forces approach the calculated desired rope forces.

In case of direct control of the force on the user, the method according to the invention may provide for applying a pre-defined torque to a plurality of the winches at the same time, particularly in order to let the current resulting force $\boldsymbol{F}$ on the user approach the desired resulting force $\boldsymbol{F}_{\mathrm{des}}$ on the user faster.

Particularly, in an embodiment of the present invention, the torques u (applied to the individual winches) may be determined according to

$$\boldsymbol{u} = i\boldsymbol{F}_{\mathrm{R,des}} + \mathbf{K}_{\mathrm{r}}(\boldsymbol{F}_{\mathrm{R,des}} - \boldsymbol{F}_{\mathrm{R}}) + \boldsymbol{u}_{\mathrm{ff}}$$

as already discussed above, where $\boldsymbol{F}_{\mathrm{R,des}}$ are the desired rope forces (references), $\boldsymbol{F}_{\mathrm{R}}$ are the current rope forces, $\mathbf{K}_{\mathrm{r}}$ is a matrix containing feedback gains and $\boldsymbol{u}_{\mathrm{ff}}$ is an optional additional term (being zero in static conditions of the apparatus) by means of which a pre-defined torque can be applied to a plurality of the winches at the same time, so as to achieve the control goal as fast as possible in dynamic situations (e.g. fast movements of the node/user).

According to a further embodiment, based on e.g. the current operation mode and e.g. current sensor information, the controlling unit may generally be designed to

determin a desired force $\boldsymbol{F}_{des}$ that should act on the user, or a desired position of the node. For example, the desired force could be a constant unloading force in vertical direction that is rendered as long as the user does not fall. When a fall is detected (based on current sensor information), the desired force is calculated such that it compliantly catches the user and stops the fall. In another example, the force could be a guiding force that helps the user follow a particular movement pattern (like a force that pulls the user forward in walking direction), or it could be a perturbing or resisting force that makes a motor task more difficult for the user. The desired force or position of the node can also be commanded by a human operator of the apparatus, e.g. by means of a software interface or a remote control unit.

In yet another embodiment, said torques are preferably calculated in function of an error between the desired force $\boldsymbol{F}_{des}$ and the current force $\boldsymbol{F}$ on the user and/or in function of an error between said desired and current movements of the deflection units (35, 36), particularly via a proportional-integral controller, wherein particularly said function is defined by the equations:

$$\mathbf{J}\,\boldsymbol{F}_W = \boldsymbol{F}_{des} + (\mathbf{K}_P + \mathbf{K}_I/s)(\boldsymbol{F}_{des} - \boldsymbol{F}),$$

$$\boldsymbol{r'}^T \boldsymbol{F}_W = k_T(\Delta x_{T,des} - \Delta x_T)$$

where the matrix $\mathbf{J}$ is the 3x4 Jacobian that describes the current geometric relation between rope forces and node force vector, $\boldsymbol{F}$ is current force on the user, and $\boldsymbol{F}_W$ is the vector of winch forces F_W being proportional to said torques $\boldsymbol{u}$. $\mathbf{K}_P$ and $\mathbf{K}_I$ are matrices containing proportional and integral gains, respectively, s is the Laplace operator, $\boldsymbol{r'}$ is a vector that describes the geometric relation between rope forces and forces that produce displacement of the deflection units, Δx_T is the relative displacement of the deflection units with respect to each other, $\Delta x_{T,des}$ is the desired relative displacement of trolleys, and k_T is a scalar proportional control gain. Regarding controlling it is also referred to the corresponding descriptions above.

It is to be noted that the use of the apparatus as described herein is not limited to medical uses, but may also be employed in any other field of transportation and unloading of objects, particularly in the field of construction.

Further features and advantages of the invention shall be described by means of a detailed description of embodiments with reference to the Figures, wherein

Fig. 1 shows an exemplary support frame of an apparatus according to the invention;

Fig. 2 shows a perspective view of the ropes, drive units, deflection units and the moveable signal processing unit;

Fig. 3 shows a perspective view of a drive unit according to Fig. 2;

Fig. 4 a perspective view of the spring elements, the rope force sensors, the node and the bail of the apparatus according to the invention;

Fig. 5 a perspective view of a deflection device (unit) of the apparatus according to the invention;

Fig. 6 a closer perspective view of the spring elements, the node, the rope force sensors and the bail of the apparatus according to the invention,

Fig. 7 a schematical, perspective view of the apparatus according to the invention when used by a user;

Fig. 8 a schematical perspective view of an arresting means for arresting a deflection device of the apparatus according to the invention; and

Fig. 9 another perspective view of an apparatus according to the invention.

Figure 1 shows in conjunction with Figs. 2 to 8 an apparatus 1 according to the invention for guidedly unloading a user 2 upon a physical activity (e.g. gait training as shown in Fig. 7).

The apparatus 1 comprises a suitable support structure (e.g. support frame) 10 having an upper frame part 100 being supported by a plurality of vertically extending leg members 101, such that the leg members 101 confine (together with the upper frame part 100) a three-dimensional working space 3, in which the user 4 can move along the horizontal x-y-plane (as well as vertically in case corresponding objects, e.g. inclined surfaces, staircases etc., are provided in the working space 3). Alternatively, a ceiling of a room can be used as a support structure. Said working space 3 then extends below said ceiling.

The upper frame part 100 is formed by two parallel longitudinal members 102 extending along the x-direction and five parallel cross members 103 extending along the y-direction and connecting the two longitudinal members 102. The longitudinal and cross members 102, 103 span the horizontally extending upper frame part 100.

A first and a second guiding rail 21, 22 are attached to the support structure 10 (e.g. to the upper frame part 100), wherein the two guide rails 21, 22 each extend along a respective longitudinal axis L, L'. The first guide rail 21 is designed to slidably support

a first and a second deflection device 31, 32 as shown in Fig. 2, whereas the second guide rail 22 is designed to slidably support a third and a fourth deflection device 33, 34. Here, the first and the second 31, 32 as well as the third and the fourth deflection device 33, 34 are connected by a rigid connecting means 350, 360 so that the two pairs of deflection devices 31, 32, 33, 34 each form a deflection unit (trolley) 35, 36, which can slide along the respective guide rail 21, 22. Preferably, the guide rails 21, 22 are pivoted by an angle W=45°C as shown in Fig. 5.

As indicated in Fig. 8, each deflection device 31, 32, 33, 34 may be arrested with respect to the associated guide rail 21, 22 by means of an arresting element C. Such an element C can be a separate element providing a stop for a deflection device 31, 32, 33, 34 but may also be integrated into a deflection device 31, 32, 33, 34 and may be designed to clamp the respective deflection device 31, 32, 33, 34 to the respective guide rail 21, 22. Particularly, arrested deflection devices 31, 32, 33, 34 may be used when the apparatus 1 is used with a treadmill.

Each deflection unit 35, 36 is configured to deflect two ropes 41, 42, 43, 44 as shown in Fig. 2, for instance. The individual ropes 41, 42, 43, 44 each extend from a drive unit 510, 520, 530, 540 comprising a winch 511, 521, 531, 541, respectively, on which the respective rope 41, 42, 43, 44 is wound, to an associated deflection device 31, 32, 33, 34 of the respective deflection unit 35, 36. From the deflection devices 31, 32, 33, 34 the ropes 41, 42, 43, 44 extend towards a node 60, to which a first free end of each rope 41, 42, 43, 44 is connected via a spring element 71, 72, 73, 74 as shown in Figs. 2, 4 and 6 for instance.

The mounting positions D of the individual drive units 510, 520, 530, 540 are indicated in Fig. 1. Each deflection unit 35, 36 is associated to two drive units 510, 520; 530, 540, which are positioned on either side of the respective guide rail 21, 22 along the respective longitudinal axis L, L'.

In Fig. 5 a single deflection device 34 is shown (the others are constructed analogously), wherein the connecting element 360 connecting said device 34 to its neighboring counterpart (not shown) is indicated by dashed lines. The deflection device 34 comprises a base 340 that slidably engages with the respective guide rail 22 so as to allow for sliding the base 340 along the guide rail 22. A u-shaped arm 341 is pivotably hinged to two protruding regions 342, 343 of the base 340 such that the arm 341 can be pivoted about a pivoting axis A running along the x-direction (longitudinal axis L'). The arm 341 serves for bearing a deflection element 344 in the

form of a roller being rotatable about a rotation axis A', around which roller 344 the respective rope 44 is laid for deflecting the latter.

In detail, as shown in Fig. 3, each drive unit 510, 520, 530, 540 comprises an actuator (servo motor) 512, 522, 532, 542 being connected via a (flexible) coupling 53 to a drive axis 55 of a winch 511, 521, 531, 541, on which the respective rope 41, 42, 43, 44 is wound. The respective winch 511, 521, 531, 541 and the respective actuator 512, 522, 532, 542 are mounted on a common platform 50, wherein two retaining elements 51, 52 protrude from the platform 50, on which elements 51, 52 the respective winch 511, 521, 531, 541 is rotatably supported. Further, the respective drive unit 510, 520, 530, 540 comprises at least one pressure roller 54 for pressing the respective rope 41, 42, 43, 44 against the associated winch 511, 521, 531, 541 so that the respective rope 41, 42, 43, 44 can be reeled an unreeled in a defined manner.

The drive units 510, 520, 530, 540 interact with a sensor means (that may consist of several individual sensors, see above) that is adapted to provide output signals that represent (or can be transformed into) the length s_w of (a portion of) the respective rope 41, 42, 43, 44 that is currently unwound from the respective winch 511, 521, 531, 541, the position s_T of the deflection units 35, 36 along the x-direction (i.e. along the respective guide rail 21, 22), as well as the position $\boldsymbol{n}$ of the node 60 (user 4).

As shown in Fig. 6, the ropes 41, 42, 43, 44 meet at the node 60, to which they are coupled via a spring element 71, 72, 73, 74, respectively. In order to be able to detect the rope forces $\boldsymbol{F}_R$ (c.f. Fig. 7) currently acting along the ropes 41, 42, 43, 44 onto the node 60 and thus onto the user 4, four rope force sensors 710, 720, 730, 740 in the form of cable-extension transducers are provided on the node 60, wherein the respective measuring cable 711, 721, 731, 741 of the respective transducer 710, 720, 730, 740 is connected to the first free end 41a, 42a, 43a, 44a of the respective rope 41, 42, 43, 44 (either directly or via connection element connecting the respective spring element 71, 72, 73, 74 to the first free end 41a, 42a, 43a, 44a of the respective rope 41, 42, 43, 44) while the corresponding potentiometer 712, 722, 732, 742 is coupled to (an upper member of) the node 60. In case a spring element 71, 72, 73, 74 is elongated, the corresponding measuring cable 711, 721, 731, 741 is drawn out and the transducer (potentiometer) 710, 720, 730, 740 generates an output signal corresponding to the drawn-out length of the measuring cable 711, 721, 731, 741 corresponding to the rope force F_R currently acting on the respective rope

41, 42, 43, 44 (and thereby elongating the respective spring element 71, 72, 73, 74). However, any other conceivable force sensor may be applied as well for determining the rope forces. Further, dedicated force sensors in/on the ropes 41, 42, 43, 44 can be omitted. Instead sensors for sensing the electrical current of the winch actuators 512, 522, 532, 542 can be used in order to estimate the respective winch torque. Such a sensor may be associated to each drive unit/winch 510, 520, 530, 540. Further, force sensors 710, 720, 730, 740 may be omitted in case the connecting elements are elastic, since then the rope forces can be determined from the position of the deflection devices 31. 32. 33. 34 along the guide rails 21, 22. Also in the case of non-elastic connections, at least components of the node force may be calculated from the positions of the deflection units (in the example embodiment, the node force component in x direction can be calculated purely based on positions of the trolleys, under the assumption that the trolleys have negligible dynamics such as mass and friction).

Further, the node 60 comprises – with respect to an operating state of the apparatus 1 - an upper node member 61, which is connected to the cable-extension transducers 710, 720, 730, 740, and a lower node member 62 being rotatably supported on the upper node member 61, so that a horizontally extending bail 80 being coupled to the lower node member 62 can be rotated about a vertical axis z.

The node 60 may comprise an acceleration sensor 90 as well as a gyroscope 91 and a potentiometer 92 for sensing the acceleration of the node 60 along three orthogonal axes (for instance x, y and z), for sensing the angular velocity of the node 60 and for sensing a rotation angle of the bail 80 about said vertical axis z with respect to the upper node member 61. Further, the node may comprise a magnetometer 190 for sensing orientation of about the three axes. The acceleration sensor 90, the gyroscope 91, and the magnetometer 190 may be integrated into an integrated measuring unit (IMU) 290 providing digital output signals of the respective sensor.

Corresponding output signals representing these quantities (or quantities that can be used to determine the desired quantities) are transmitted – together with the output signals from the rope force sensors 710, 720, 730, 740 - via a flexible data line (cable) 93 extending from the node 60 to a movable signal processing unit 94 as shown in Fig. 2. The signal processing unit 94 is slidably supported on one of the guide rails 21, 22.

The signal processing unit 94 can be driven by a further drive unit, wherein preferably the movement of the signal processing unit (also called signal box) 94 is controlled by a controlling unit (not shown), to which the signal processing unit 94 is connected so that the controlling unit is able to use the output signals transmitted by the signal processing unit 94 for controlling of the apparatus 1. Particularly, the controlling unit is configured to control the movement of the signal processing unit 94 such that the distance between the deflection units 35, 36 or node 60 and the signal processing unit 94 along the x-direction is constant. Particularly, the movement of the signal processing unit 94 along the respective guide rail 21, 22 (x-direction) is controlled such by the controlling unit that the signal processing unit is always arranged behind the node 60 (user 4) with respect to the current walking direction of the user 4.

As shown in Figure 7, the bail 80 is used for holding a harness 95 which is to be put on by the user 4. The harness 95 then supports the user 4 via two connection elements 96, 97 that are engaged with corresponding receptacles 81, 82 formed on the free ends of the bail 80, and via the node 60 to which the bail 80 is coupled.

Concerning control of the current resulting force $\boldsymbol{F}$ that is exerted onto the node 60, there are many ways in classical control theory how to approach tracking problems for nonlinear systems as the present one. For example, the system could be linearized and an optimal controller could be derived. In the following, controlling is described without loss of generality for four ropes, but may also be conducted analogously for two ropes or any larger number of ropes.

One idea is to control said output force vector $\boldsymbol{F}$ indirectly, by controlling individual rope forces subsumed in the vector $\boldsymbol{F}_R \in \mathbb{R}^4$ in an inner loop. These rope forces $\boldsymbol{F}_R$ are functions of both the device states $\boldsymbol{s}$, i.e., the lengths s_W of the unwound (portions of the) ropes 41, 42, 43, 44 (note, that the individual s_W of the ropes 41, 42, 43, 44 shown in Fig. 7 may well be different from one another) and the deflection unit's 35, 36 positions x_T, and the user position $\boldsymbol{w}$:

$$\boldsymbol{F}_R = \boldsymbol{h}(\boldsymbol{s},\boldsymbol{w})$$

The three-dimensional force vector $\boldsymbol{F}$ acting on the subject 4 is given by the sum of the four individual rope force vectors $\boldsymbol{F}_R$. Therefore, there would potentially be an infinite number of solutions for rope force vectors that give the same resulting force.

However, as stated above, the winch forces (torques) do not only affect rope forces, they also affect trolley (deflection unit) movement.

This can be used to formulate two additional control goals, which are a) to find a solution that is also valid in static conditions (Then, the sum of forces acting on the trolleys 35, 36 will be in equilibrium, and the position can be held), and b) to have the trolleys 35, 36 move in a similar way, so that they are always at the same position x (c.f. Fig. 7). For example, if a purely vertical force is desired and the person 4 is standing in the middle between the two linear guide rails 21, 22, the trolleys 35, 36 should be positioned such that the person 4 stands below the center of a square spanned by the pulleys (deflection devices) 31, 32, 33, 34.

The first goal can be formulated mathematically by requiring that in static conditions, where all speeds and accelerations are zero,

$ds_W/dt = 0$, $d^2s_W/dt^2 = 0$, $dx_T/dt = 0$, $d^2x_T/dt^2 = 0$, $dw/dt = 0$, $d^2w/dt^2 = 0$,

the correct force is applied on the user (object) 4, i.e. the current resulting force (output force) $\boldsymbol{F}$ of the controlling unit (controller) matches the desired resulting force $\boldsymbol{F}_{des}$ meaning equation $\boldsymbol{F}=\boldsymbol{F}_{des}$ is fulfilled. The requirement is found by force equilibrium on the two trolleys 35, 36.

In summary, this yields 3 equations from force equilibrium on the node 60, further 2 equations from force equilibrium on the two trolleys 35, 36 in x-direction, and one equation commanding the two trolleys 35, 36 to be at the same position x_T in x-direction. These 6 equations can be used to find the four desired rope forces $\boldsymbol{F}_{R,des}$ and the two trolley positions.

Appropriate measures (for example saturations) can be taken to make sure the ropes 41, 42, 43, 44 always remain in tension.

The desired rope forces $\boldsymbol{F}_R$ can then be used as a reference for the individual feedback loops for each winch 511, 521, 531, 541.

For example, the control law could be

$$\mathbf{u} = i(\boldsymbol{F}_{R,des} + \mathbf{K}_r(\boldsymbol{F}_{R,des} - \boldsymbol{F}_R)) + \mathbf{u}_{ff},$$

with $\boldsymbol{F}_{R,des}$ being the calculated desired (reference) rope forces, i the transmission ratio of the actuator-winch unit (drive unit) 510, 520, 530, 540, $\mathbf{K}_r \in \mathbb{R}^{4\times4}$ being a

positive definite rope force feedback matrix containing feedback gains, and $\boldsymbol{u}_{ff}$ denoting potential additional terms that go to zero in static conditions. The first two terms will ensure that the system asymptotically approaches the desired forces on the person 4, at least when the person 4 stands still.

In order to make the system react fast in dynamic conditions, the terms $\boldsymbol{u}_{ff}$ can be used. One possibility is to use a type of "synergy control", where actuators 512, 522 532, 542 work in groups. For example, using a diagonal feedback matrix $\mathbf{K}_C \in \mathbb{R}^{3\times3}$, a virtual input vector $\boldsymbol{u}^*$ in Cartesian space can be generated:

$$\boldsymbol{u}^* = \mathbf{K}_C(\boldsymbol{F}_{des} - \boldsymbol{F}) \in \mathbb{R}^3$$

This three-dimensional vector $\boldsymbol{u}^*$ then needs to be mapped to the four winch torques $\boldsymbol{u}$ by a function ρ:

$$\boldsymbol{u} = \rho\,(\boldsymbol{u}^*).$$

Similar to human muscles, this function could encode synergies, which lump actuators 512, 522, 532, 542 into functional groups.

For example, if the force component acting on the user 4 in vertical direction z is too low compared to the reference, so $u^*_z > 0$, all four winches 511, 521, 532, 541 could be pulling equally, which means that the vertical component u^*_z would simply be commanded to all winches 511, 521, 532, 541 equally. The component in x-direction, which is parallel to the guide rails 21, 22, could be distributed such that the winches on one side (depending on the sign, these could be 511 and 531, cf. Fig. 2) act as a pair and both pull equally, whereas the opposite pair 521, 541 does not produce additional torques. Necessary corrections in the direction orthogonal to the guide rails 21, 22 could be distributed in an analog manner, with either the winch pair 511, 521 or 531, 541 pulling, depending on the sign. This type of control law leads to a fast correction of the forces acting on the user (object) 4, and it also accelerates the movement of the passive trolleys 35, 36 towards their "ideal" asymptotic positions. In static conditions, this part of the controller will not generate any torques $\boldsymbol{u}$.

According to another embodiment illustrated in Fig. 9 In the chosen right-handed Cartesian coordinate system,z points upward and x points forward in the default gait direction, parallel to the guide rails 21, 22. As the joints in the node 60 ensure that

only forces are transmitted, the harness can be represented by a single cable that connects the node to a specific point $\boldsymbol{w} = (w_x, w_y, w_z)^T$ on the human (cf. Fig. 7).

A state vector is assembled that describes the current positions and velocities of the device components. Given the current position vector $\boldsymbol{w}$ of the human, the configuration is fully described by be the length of ropes that have been released from each winch 511, 521, 531, 541 subsumed in the vector $\boldsymbol{s}_W \in \mathbb{R}^4$:

$$\boldsymbol{s}_W = \begin{pmatrix} s_a & s_b & s_c & s_d \end{pmatrix}^T, \qquad (1)$$

and by the positions of the deflection units 35, 36, subsumed in the vector $\boldsymbol{x}_T \in \mathbb{R}^2$:

$$\boldsymbol{x}_T = \begin{pmatrix} x_{T,ab} & x_{T,cd} \end{pmatrix}^T. \qquad (2)$$

The state vector $\boldsymbol{s} \in \mathbb{R}^{12}$ contains these variables and their derivatives:

$$\boldsymbol{s} = \begin{pmatrix} \boldsymbol{s}_W^T & \boldsymbol{x}_T^T & \dot{\boldsymbol{s}}_W^T & \dot{\boldsymbol{x}}_T^T \end{pmatrix}^T \qquad (3)$$

We now assume that the force vector $\boldsymbol{F}_n$ on the user ("n" stand for the node; the force vector is also denoted shortly $\boldsymbol{F}$) acting on the user 4 is to be controlled while the user moves. Node position is $\boldsymbol{n} = (n_x, n_y, n_z)^T$. Cable (i.e. rope) forces are subsumed in the vector $\boldsymbol{F}_r \in \mathbb{R}_+$ (note, that the rope forces are also denoted as $\boldsymbol{F}_R$) with

$$\boldsymbol{F}_r = \begin{pmatrix} F_a & F_b & F_c & F_d \end{pmatrix}^T \qquad (4)$$

and the Cartesian force vector $\boldsymbol{F}_n \in \mathbb{R}^3$ on the user 4 is

$$\boldsymbol{F}_n = \begin{pmatrix} F_{nx} & F_{ny} & F_{nz} \end{pmatrix}^T \qquad (5)$$

Force equilibrium on the node 60 maps cable forces to forces $\boldsymbol{F}_n$ acting on the user 4:

$$\boldsymbol{F}_n = \mathbf{J}(\boldsymbol{x}_T, \boldsymbol{n})\boldsymbol{F}_r. \qquad (6)$$

The mapping **J** can be computed in an efficient way by first summing the rope forces within the two planes spanned by the ropes, via the matrix **R**, to obtain the x component and the force components F_{ab} and F_{cd}, and then converting these to Cartesian space via the matrix **S**:

$$\boldsymbol{J} = \begin{pmatrix} 1 & \mathbf{0} \\ \mathbf{0} & \mathbf{S} \end{pmatrix} \mathbf{R} \qquad (7)$$

with

$$\mathbf{S} = \begin{pmatrix} -\cos\varphi_{ab} & \cos\varphi_{cd} \\ \sin\varphi_{ab} & \sin\varphi_{cd} \end{pmatrix}, \qquad (8)$$

$$\mathbf{R} = \begin{pmatrix} \cos\varphi_a & -\cos\varphi_b & \cos\varphi_c & -\cos\varphi_d \\ \sin\varphi_a & \sin\varphi_b & 0 & 0 \\ 0 & 0 & \sin\varphi_c & \sin\varphi_d \end{pmatrix}. \qquad (9)$$

Current deflection unit 35, 36 positions x_T and the node position ***n*** define the angles in these matrices.

The movement of the deflection units 35, 36 is governed by the equations of motion:

$$m_T \ddot{\boldsymbol{x}}_{\boldsymbol{T}} = \mathbf{T}\boldsymbol{F}_r \qquad (10)$$

with

$$\mathbf{T} = \begin{pmatrix} \cos\varphi_a - 1 & 1 - \cos\varphi_b \\ \cos\varphi_c - 1 & 1 - \cos\varphi_d \end{pmatrix} \qquad (11)$$

The equations of motion for the winches 511, 521, 531, 541 are given by:

$$m_W \ddot{\boldsymbol{s}}_W = \boldsymbol{F}_r - \boldsymbol{F}_W, \qquad (12)$$

with the winch actuator forces $\boldsymbol{F}_W$ (e.g. the torques multiplied by a transmission ratio i). The rope forces are a linear function of the spring deflections of the springs 71, 72, 73, 74 (cf. Fig. 6):

$$\boldsymbol{F}_r = c_F(-\boldsymbol{s}_W + \mathbf{G}\boldsymbol{x}_T - \boldsymbol{l}) \qquad (13)$$

with the matrix

$$\mathbf{G} = \begin{pmatrix} 1 & 0 \\ -1 & 0 \\ 0 & 1 \\ 0 & -1 \end{pmatrix} \qquad (14)$$

and the vector $\boldsymbol{l}$ containing the distances from the four deflection devices 31, 32, 33, 34 to the node 60 (vector $\boldsymbol{n}$). To avoid offsets in these equations, the rope lengths s_W are defined appropriately.

Even without force sensors, it is still possible to implicitly measure the force in x direction, by means of deflection device 31, 32, 33, 34 positions. Assuming that the mass of the deflection devices 31, 32, 33, 34 is negligible, their positions are determined by the components of the cable forces acting in x direction: Static equilibrium on the deflection device 31, 32, 33, 34 is given by setting (10) to zero. Combined with (6), the force in x direction is then given by:

$$\begin{aligned} F_{nx} = & \quad F_{ab}\frac{\cos\varphi_b - \cos\varphi_a}{\sin\varphi_a - \sin(\varphi_a + \varphi_b) + \sin\varphi_b} \\ & + \quad F_{cd}\frac{\cos\varphi_d - \cos\varphi_c}{\sin\varphi_c - \sin(\varphi_c + \varphi_d) + \sin\varphi_d} \end{aligned} \qquad (15)$$

These angles are calculated based on geometry only (rope lengths, deflection device positions). To keep the estimation robust, F_{ab} and F_{cd} are taken preferably as the desired, not the actual values, even if force sensors are available.

Now, an ideal controller would command actuator torques $\boldsymbol{u}$, so that the outputs match the desired force vector $\boldsymbol{F}_{n,des}$ that acts on the subject (also denoted as user) 4:

$$\boldsymbol{F}_n \stackrel{!}{=} \boldsymbol{F}_{n,des}, \qquad (16)$$

regardless of the movement of the subject 4. Preferably, a force controller (provided by the controlling unit) is used in Cartesian space, which commands a Cartesian force vector ${}^{C}\boldsymbol{F}_{fc}$ that is to be realized by the winches. This force is calculated by PI (proportional-intergral) control and feedforward of the reference:

$${}^{C}\boldsymbol{F}_{fc} = \boldsymbol{F}_{n,des} + \left(\mathbf{K}_P + \frac{\mathbf{K}_I}{s}\right)(\boldsymbol{F}_{n,des} - \boldsymbol{F}_n), \qquad (17)$$

with s being the Laplace operator, $\mathbf{K}_P$ being a positive definite matrix of proportional gains, and $\mathbf{K}_I$ being a positive definite matrix of integral gains.

Cartesian forces need to be mapped to winch forces $\boldsymbol{F}_w$, which is the inverse problem of (6). Given that there are four winch forces and only three node force components, there are multiple solutions to (6) with a given node force. If the deflection devices 31, 32, 33, 34 were not movable, quadratic programming could be used to find the minimal cable forces that fulfill the constraints. However, in the current system, the rope forces do not only influence the output force vector, but they also influence the movement of the deflection devices 31, 32, 33, 34, according to (10). In turn, the position of the deflection devices 31, 32, 33, 34 defines the polygon of applicable forces.

Therefore, instead of minimizing rope forces, one may take deflection device dynamics into account to solve the rank deficiency in the inverse mapping of (6). The idea is that rope forces are applied in such a way that the deflection devices 31, 32, 32, 34 stay together, leading to a polygon with rectangular base. This behavior is enforced by the law:

$$m_T(\ddot{x}_{T,ab} - \ddot{x}_{T,cd}) \stackrel{!}{=} -k_T(x_{T,ab} - x_{T,cd}) \qquad (18)$$

with the positive constant k_T .

With (10), this yields

$$\begin{aligned} & F_a(1-\cos\varphi_a) - F_b(1-\cos\varphi_b) \\ & -F_c(1-\cos\varphi_c) + F_d(1-\cos\varphi_d) \\ & \qquad \stackrel{!}{=} k_T(x_{T,ab} - x_{T,cd}) \end{aligned} \tag{19}$$

Using this additional constraint on the forces, the control law maps desired forces in Cartesian space to winch forces, such that they work in synergy:

$$\boldsymbol{F}_w = \mathbf{R}'^{-1} \begin{pmatrix} \begin{pmatrix} 1 & \mathbf{0} \\ \mathbf{0} & \mathbf{S}^{-1} \end{pmatrix} {}^C\boldsymbol{F}_{fc} \\ k_T(x_{T,ab} - x_{T,cd}) \end{pmatrix} \tag{20}$$

with the desired reference force in Cartesian space $\boldsymbol{F}_{n,des}$ and the modified mapping matrix

$$\mathbf{R}' = \begin{pmatrix} \mathbf{R} \\ \boldsymbol{r}'^T \end{pmatrix}, \tag{21}$$

With

$$\boldsymbol{r}'^T = \begin{pmatrix} 1-\cos\varphi_a & \cos\varphi_b - 1 & \cos\varphi_c - 1 & 1-\cos\varphi_d \end{pmatrix}. \tag{22}$$

In the above, one may calculate the force in x direction as a linear combination (for example the mean value) of spring-based measurement and deflection device-based measurement.

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Claims

1. Apparatus, particularly for unloading a user's body weight during a physical activity of said user, particularly for gait training of said user, comprising:

   - a plurality of ropes (41, 42, 43, 44), wherein each rope (41, 42, 43, 44) extends from an associated drive unit (510, 520, 530, 540) to an associated deflection device (31, 32, 33, 34), is deflected by the latter, and then extends to a first free end (41a, 42a, 43a, 44a) of the respective rope (41, 42, 43, 44), wherein the deflection devices (31, 32, 33, 34) are designed to be displaced by forces induced into the deflection devices (31, 32, 33, 34) via the ropes (41, 42, 43, 44), and

   - a node (60) being coupled to said first free ends (41a, 42a, 43a, 44a) and being designed to be coupled to a user (4), wherein the drive units (510, 520, 530, 540) are designed to retract and release the respective rope (41, 42, 43, 44) so as to adjust a current rope force ($\boldsymbol{F}_R$) along the respective rope (41, 42, 43, 44), which current rope forces ($\boldsymbol{F}_R$) add up to a current resulting force ($\boldsymbol{F}$) exerted on said user (4) via said node (60) in order to unload the user (4) and/or to exert a force on the user (4) in a horizontal plane, particularly upon said physical activity.

2. Apparatus according to claim 1, **characterized in that** the apparatus comprises a plurality of force sensors (710, 720, 730, 740) for determining the current rope forces ($\boldsymbol{F}_R$).

3. Apparatus according to claim 1 or 2, **characterized in that** each of the ropes (41, 42, 43, 44) interacts with an associated rope force sensor (710, 720, 730, 740) for determining the current rope forces ($\boldsymbol{F}_R$), wherein particularly the rope force sensors (710, 720, 730, 740) are arranged at the node (60), wherein particularly each rope (41, 42, 43, 44) is connected to the node (60) via an associated spring element (71, 72, 73, 74), wherein particularly the respective rope force sensor (710, 720, 730, 740) measures the length of the spring element (71, 72, 73, 74) corresponding to the respective current rope force ($\boldsymbol{F}_R$), wherein particularly the respective rope force sensor (710, 720, 730, 740) is formed by a cable-extension transducer comprising a measuring cable (711, 721, 731, 741) wound on a cylinder coupled to a shaft of a rotational sensor (712, 722, 732, 742), wherein particularly the rotational sensor (712, 722, 732, 742) is connected to the node (60) and wherein particularly the measuring cable

(711, 721, 731, 741) is connected to the first free end (41a, 42a, 43a, 44a) of the respective rope (41, 42, 43, 44) being connected to the respective spring element (71, 72, 73, 74).

4. Apparatus according to one of the preceding claims, **characterized in that** the apparatus (1) comprises a controlling unit being designed to control said drive units (510, 520, 530, 540), in order to adjust said current resulting force (***F***), wherein the controlling unit is designed to control the drive units (510, 520, 530, 540) such that the current resulting force (***F***) approaches a desired force ($\boldsymbol{F}_{des}$) or that the current position of the node (60) approaches a desired position of the node (60).

5. Apparatus according to one of the preceding claims, **characterized in that** the apparatus (1) comprises at least a first and a second rope (41, 42), particularly also a third and a fourth rope (41, 42, 43, 44), wherein

- the first rope (41) extends from its associated drive unit (510) towards a first deflection device (31), is deflected by the first deflection device (31) and then extends towards the node (60),
- the second rope (42) extends from its associated drive unit (520) towards a second deflection device (32), is deflected by the second deflection device (32) and then extends towards the node (60),
- particularly the third rope (43) extends from its associated drive unit (530) towards a third deflection device (33), is deflected by the third deflection device (33) and then extends towards the node (60), and
- particularly the fourth rope (44) extends from its associated drive unit (540) towards a fourth deflection device (34), is deflected by the fourth deflection device (34) and then extends towards the node (60).

6. Apparatus according to one of the preceding claims, **characterized in that** the deflection devices are designed to be suspended, particularly from a support frame or from a ceiling of a room.

7. Apparatus according to one of the claims 1 to 6, **characterized in that** the apparatus (1) comprises at least a first guide rail (21) running along a longitudinal axis (L) that extends horizontally, wherein particularly the apparatus (1) also comprises a second guide rail (22) running along a longitudinal axis (L') that extends horizontally, wherein particularly each of the two guide rails (21, 22) is designed to be connected to a support structure, particularly to a support

frame (10) of the apparatus (1) or to a ceiling of a room, and wherein particularly the two guide rails (21, 22) run parallel with respect to each other, wherein particularly each guide rail (21, 22) is tilted about its longitudinal axis (L, L'), particularly by an angle of 45°.

8. Apparatus according to claims 5 and 7, **characterized in that** the first and the second deflection device (31, 32) are slidably connected to the first guide rail (21), so that they can slide along the first guide rail (21) along the longitudinal axis (L) of the first guide rail (21), and wherein particularly the third and the fourth deflection device (33, 34) are slidably connected to the second guide rail (22), so that they can slide along the second guide rail (22) along the longitudinal axis (L') of the second guide rail (22), wherein particularly the deflection devices (31, 32, 33, 34) each comprise a base (340) via which the respective deflection device (31, 32, 33, 34) is slidably connected to the associated guide rail (21, 22), and wherein particularly each deflection device (31, 32, 33, 34) comprises an arm (341) hinged to the base (340) of the respective deflection device (31, 32, 33, 34) so that the respective arm (341) can be pivoted with respect to the respective base (340) about a pivoting axis (A) running parallel to the longitudinal axis (L, L') of the respective guide rail (21, 22), and wherein particularly the deflection devices (31, 32, 33, 34) each comprise a deflection element (344) connected to the respective arm (341), around which deflection element (344) the respective rope (41, 42, 43, 44) is laid for deflecting said rope (41, 42, 43, 44), and wherein particularly the deflection element (344) is a roller that is rotatably connected to the respective arm (341), and wherein particularly an arresting means (C) is provided for each deflection device (31, 32, 33, 34) for arresting the respective deflection device (31, 32, 33, 34) with respect to the associated guide rail (21, 22).

9. Apparatus according to claim 5 or one of the claims 6 to 8 when referred back to claim 5, **characterized in that** the first and second deflection device (31, 32) are connected by a connecting element (350) so as to form a first deflection unit (35), and wherein particularly the third and the fourth deflection device (33, 34) are connected by a connecting element (360) so as to form a second deflection unit (36), wherein particularly said connecting elements (350, 360) are elastic or inelastic, wherein particularly said connecting elements (350, 360) comprise the same length, particularly in the absence of rope forces in the case of an elastic connecting element, along the longitudinal axis (L, L') of the respective guide rail

(21, 22), and wherein particularly the connecting elements (350, 360) are releasably connected to the respective deflection devices (31, 32; 33, 34), wherein particularly the respective connecting element (350, 360) is a rope member, a rigid rod, or a spring, and wherein particularly the first deflection unit (35) is arranged along the longitudinal axis (L) of the first guide rail (21) between the drive unit (510) of the first rope (41) and the drive unit (520) of the second rope (42), and wherein particularly the second deflection unit (36) is arranged along the longitudinal axis (L') of the second guide rail (22) between the drive unit (530) of the third rope (43) and the drive unit (540) of the fourth rope (44).

10. Apparatus according to one of the preceding claims **characterized in that** the drive units (510, 520, 530, 540) each comprise an actuator (512, 522, 532, 542) being connected to a winch (511, 521, 531, 541), particularly via a flexible coupling (53), around which winch (511, 521, 531, 541) the respective rope (41, 42, 43, 44) is wound, wherein the respective actuator (512, 522, 532, 542) is designed to exert a torque on the respective winch (511, 521, 531, 541) so as to retract or release the respective rope (41, 42, 43, 44), wherein particularly the respective drive unit (510, 520, 530, 540) may comprise a brake for arresting the respective winch (511, 521, 531, 541), and wherein particularly the respective drive unit (510, 520, 530, 540) comprises at least one pressing member (54), particularly a pressure roller being configured to press the respective rope (41, 42, 43, 44) being wound around the respective winch (511, 521, 531, 541) against the respective winch (511, 521, 531, 541), particularly so as to prevent the respective rope (41, 42, 43, 44) from jumping off the associated winch (511, 521, 531, 541) or over a thread.

11. Apparatus according to one of the preceding claims, **characterized in that** the apparatus (1) comprises a sensor means for determining a current state (***s***) of the apparatus (1) and/or the position (***w***) of the user (4), wherein said current state is particularly defined by the lengths (s_W) of the ropes (41, 42, 43, 44) being unwound from the respective winch (511, 521, 531, 541) and the positions (s_T) of the deflection units (35, 36) along the respective guide rail (21, 22).

12. Apparatus according to one of the preceding claims, **characterized in that** the controlling unit is designed to control the drive units (510, 520, 530, 540), particularly the torque (u) exerted by the respective actuator (512, 522, 532, 542) onto the respective winch (511, 521, 531, 541) or a quantity proportional to the respective torque such that a current force (***F***) on the user (4) approaches a

desired force ($\boldsymbol{F}_{des}$) on the user (4), wherein particularly the controlling unit is configured to control said torques to influence the current force ($\boldsymbol{F}$) such that it approaches a desired force ($\boldsymbol{F}_{des}$) and/or to control said torques to influence the movements of the moveable deflection units (35, 36) such that they approach a desired movement, respectively, wherein particularly the desired movements of the deflection units (35, 36) are defined such that the relative displacement between the two deflection units (35, 36) approaches zero, and wherein particularly the controlling unit is configured to calculate said torques ($\boldsymbol{u}$=i$\boldsymbol{F}_W$) in function of an error between the desired force ($\boldsymbol{F}_{des}$) and the current force ($\boldsymbol{F}$) on the user (4) and/or in function of an error between said desired and current movements of the deflection units (35, 36), particularly via a proportional-integral controller, and wherein particularly said function is defined as:

$\mathbf{J}\,\boldsymbol{F}_W = \boldsymbol{F}_{des} + (\mathbf{K}_P + \mathbf{K}_I/s)(\boldsymbol{F}_{des} - \boldsymbol{F})$, with

$\boldsymbol{r'}^T \boldsymbol{F}_W = k_T(\Delta x_{T,des} - \Delta x_T)$,

where the matrix $\mathbf{J}$ is the 3x4 Jacobian that describes the current geometric relation between rope forces ($\boldsymbol{F}_R$) and the current force $\boldsymbol{F}$ on the user (4), and $\boldsymbol{F}_w$ is the vector of winch forces F_W being proportional to said torques (u), and wherein $\mathbf{K}_P$ and $\mathbf{K}_I$ are matrices containing proportional and integral gains, respectively, and wherein s is the Laplace operator, and wherein $\boldsymbol{r'}$ is a vector that describes the geometric relation between rope forces ($\boldsymbol{F}_R$) and forces that produce displacement of the deflection units (35, 36), and wherein Δx_T is the relative displacement of the deflection units (35, 36), and wherein $\Delta x_{T,des}$ is the desired relative displacement of the deflection units (35, 36), and wherein k_T is a scalar proportional control gain.

13. Apparatus according to claim 11, **characterized in that** the controlling unit is designed to calculate the desired rope force ($\boldsymbol{F}_{R,des}$) for each of the ropes (41, 42, 43, 44) depending on the current state ($\boldsymbol{s}$) of the apparatus (1) and the position ($\boldsymbol{w}$) of the user (4) or a desired winch position ($s_{W,des}$), determined with help of the sensor means, particularly under the condition that

- there is force equilibrium on the node (60),
- there is force equilibrium on the deflection units (35, 36), and
- the deflection units (35, 36) both reside in the same position along the respective guide rail (21, 22),

wherein the controlling unit is designed to control the drive units (510, 520, 530, 540), particularly the torque (u) exerted by the respective actuator (512, 522, 532, 542) onto the respective winch (511, 521, 531, 541), such that the current rope forces ($\boldsymbol{F}_R$) approach the respective desired rope force ($\boldsymbol{F}_{R,des}$) or that the current position of the node (60) or user (4) approaches a desired position of the node (60) or user (4), wherein particularly the controlling unit is configured to command a pre-defined torque to a plurality of the drive units (510, 520, 530, 540) at the same time, particularly in order to let the current rope forces ($\boldsymbol{F}_R$) approach the desired rope forces ($\boldsymbol{F}_{R,des}$) faster, wherein particularly the controlling unit is configured to control the torques ($\boldsymbol{u}$) according to

$$\boldsymbol{u} = i\,(\boldsymbol{F}_{R,des} + \mathbf{K}_r(\boldsymbol{F}_{R,des} - \boldsymbol{F}_R)) + \boldsymbol{u}_{ff},$$

with $\boldsymbol{F}_{R,des}$ being the calculated desired rope forces, i being the transmission ratio of the respective winch, $\mathbf{K}_r \in \mathbb{R}^{nxn}$ being a positive definite rope force feedback matrix containing feedback gains, $n \in \mathbb{N}$ being the number of ropes, and $\boldsymbol{u}_{ff}$ being an optional additional term going to zero in static conditions of the apparatus by means of which a pre-defined torque can be applied to a plurality of the winches (511, 521, 531, 541) at the same time.

14. Apparatus according to one of the preceding claims, **characterized in that** the apparatus (1) comprises a bail (80) for coupling the node (60) to the user (4), wherein said bail (80) is rotatably connected to the node (60), so that particularly the bail (80) can be rotated about a vertical axis (z), wherein particularly the bail (80) comprises two opposing free ends (81, 82), wherein particularly each of the two free ends (81, 82) comprises a receptacle for receiving a connection element (96, 97) for connecting a harness (95) to the bail (80), which harness (95) is particularly designed to be attached to the user (4) in order to connect the user (4) to the node (60) via the bail (80), wherein said connection elements (96, 97) are designed to be length adjustable for adapting the apparatus (1) to the user (4).

15. Method for controlling an apparatus for unloading the body weight of a user, particularly using an apparatus according to at least one of the preceding claims, comprising the steps of:

- calculating torques ($\boldsymbol{u}$) for a plurality of winches (511, 521, 531, 541),
- exerting the torques ($\boldsymbol{u}$) onto the winches (511, 521, 531, 541) in order to adjust current rope forces ($\mathbf{F}_R$) acting along ropes (41, 42, 43, 44) coupled to

the winches (511, 521, 531, 541), respectively, wherein each rope (41, 42, 43, 44) is connected to a node (60) via a first free end (41a, 42a, 43a, 44a) of the respective rope (41, 42, 43, 44), to which node (60) a user (4) was coupled in beforehand such that the rope forces ($\boldsymbol{F}_R$) add up to a current resulting force (**F**) acting on the user (4) via the node (60), and wherein the ropes (41, 42, 43, 44) are each deflected by a deflection device (31, 32, 33, 34), the deflection devices (31, 32, 33, 34) being displaceable by forces induced into the deflection devices (31, 32, 33, 34) via the ropes (41, 42, 43, 44), and

- wherein the torques ($\boldsymbol{u}$) are calculated such that the position of the node (60) approaches a desired position of the node (60) or that said current resulting force ($\boldsymbol{F}$) on the user (4) approaches a desired force ($\boldsymbol{F}_{des}$) on the user (4) and/or such that the moveable deflection devices (31, 32, 33, 34) approach desired movements, respectively, when the calculated torques ($\boldsymbol{u}$) are exerted onto the winches (511, 521, 531. 541), wherein particularly a current state ($\boldsymbol{s}$) of the apparatus (1) and a current position ($\boldsymbol{w}$) of the user (4) is determined, and wherein particularly said torques ($\boldsymbol{u}$) are calculated depending on said current state ($\boldsymbol{s}$) and said current position ($\boldsymbol{w}$) of the user (4).

16. Method according to claim 15, **characterized in that** the deflection devices (31, 32, 33, 34) pairwise form deflection units (35, 36), such that the two deflection devices (31, 32; 33, 34) of a deflection unit (35, 36) are displaceable together, particularly along a first direction (x), wherein particularly a first and a second rope (41, 42) and an associated first deflection unit (35) are provided, and wherein particularly also a third and a fourth rope (43, 44) and an associated second deflection (36) unit are provided, and wherein particularly said current state ($\boldsymbol{s}$) is particularly defined by the lengths (s_W) of the ropes (41, 42, 43, 44) being unwound from the respective winch (511, 521, 531, 541) and the positions (x_T) of said deflection units (35, 36) along the first direction (x).

17. Method according to claim 16, **characterized in that** said torques ($\boldsymbol{u}$) are determined by means of an inner control loop that receives desired rope forces ($\boldsymbol{F}_{R,des}$) for each of the ropes (41, 42, 43, 44) or desired lengths ($s_{W,des}$) of the portions of the ropes (41, 42, 43, 44) being unwound from the respective winch (511, 521, 531, 541), which are particularly determined depending on the current

state (***s***) of the apparatus (1) and the current position (***w***) of the user (4) requiring the condition that

- there is force equilibrium on the node (60),
- there is force equilibrium on the deflection units (35, 36), and
- particularly the deflection units (35, 36) reside in the same position along the first direction (x).

18. Method according to claim 17, **characterized in that** a pre-defined torque is applied to a plurality of the winches (510, 520, 530, 540) at the same time, particularly in order to let the current rope forces ($\boldsymbol{F}_R$) approach the desired rope forces ($\boldsymbol{F}_{R,des}$) faster,

19. Method according to claim 17 or 18, **characterized in that,** the torques (***u***) are determined according to

$$\boldsymbol{u} = i\,(\boldsymbol{F}_{R,des} + \mathbf{K}_r(\boldsymbol{F}_{R,des} - \boldsymbol{F}_R)) + \boldsymbol{u}_{ff},$$

with $\boldsymbol{F}_{R,des}$ being the calculated desired rope forces, i being the transmission ratio of the winches, $\mathbf{K}_r \in \mathbb{R}^{nxn}$ being a positive definite rope force feedback matrix containing feedback gains, $n \in \mathbb{N}$ being the number of ropes, and $\boldsymbol{u}_{ff}$ being an optional additional term going to zero in static conditions of the apparatus (1).

20. Method according to claim 17, **characterized in that** said torques ($\boldsymbol{u}=i\boldsymbol{F}_w$) or quantities proportional to said torques are calculated in function of an error between the desired force ($\boldsymbol{F}_{des}$) and the current force ($\boldsymbol{F}$) on the user (4) and/or in function of an error between said desired and current movements of the deflection units (35, 36), particularly via a proportional-integral controller, wherein particularly said function is defined via the system of equations:

$$\mathbf{J}\,\boldsymbol{F}_W = \boldsymbol{F}_{des} + (\mathbf{K}_P + \mathbf{K}_I/s)(\boldsymbol{F}_{des} - \boldsymbol{F}),$$

$$\boldsymbol{r}'^T \boldsymbol{F}_W = k_T(\Delta x_{T,des} - \Delta x_T),$$

where the matrix **J** is the 3x4 Jacobian that describes the current geometric relation between rope forces and the current force ($\boldsymbol{F}$) on the user (4), and $\boldsymbol{F}_w$ is the vector of winch forces F_W being proportional to said torques (u), and $\mathbf{K}_P$ and $\mathbf{K}_I$ are matrices containing proportional and integral gains, respectively, s is the Laplace operator, ***r'*** is a vector that describes the geometric relation between rope forces and forces that produce displacement of the deflection units (35, 36), Δx_T is the relative displacement of deflection units (35, 36), $\Delta x_{T,des}$ is the desired

relative displacement of deflection units (35, 36), and k_T is a scalar proportional control gain.

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Figure 1

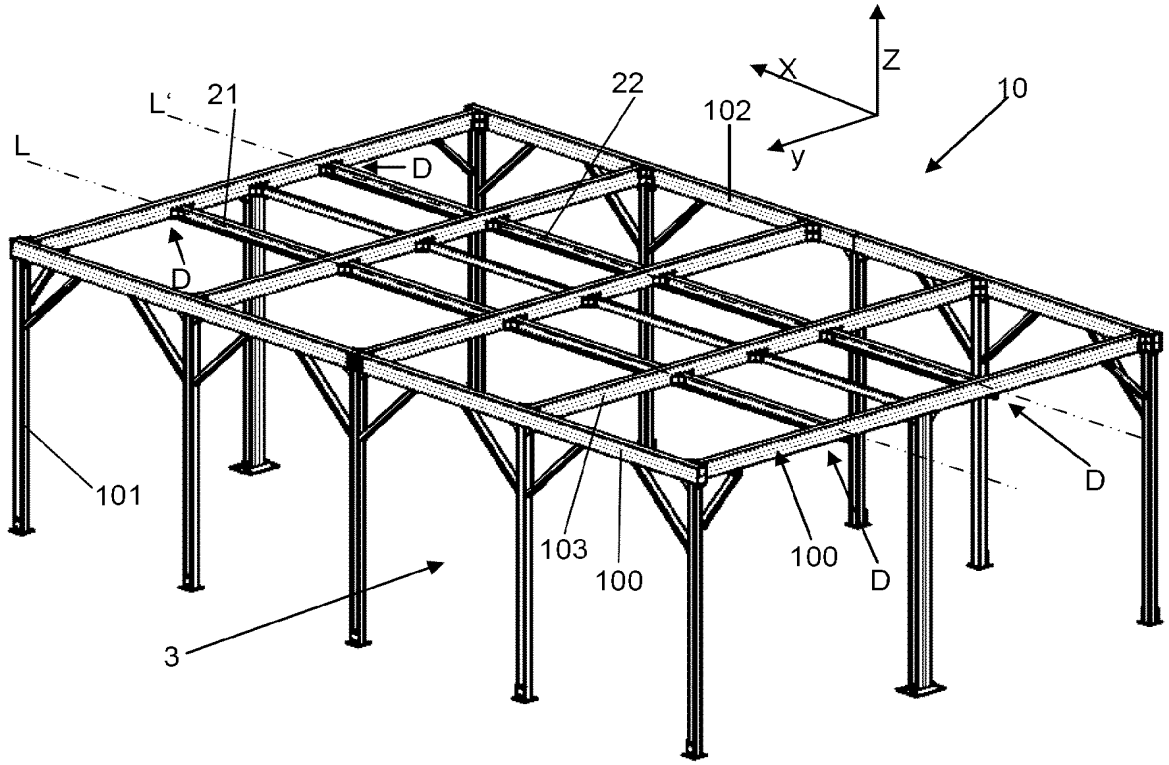


Figure 2

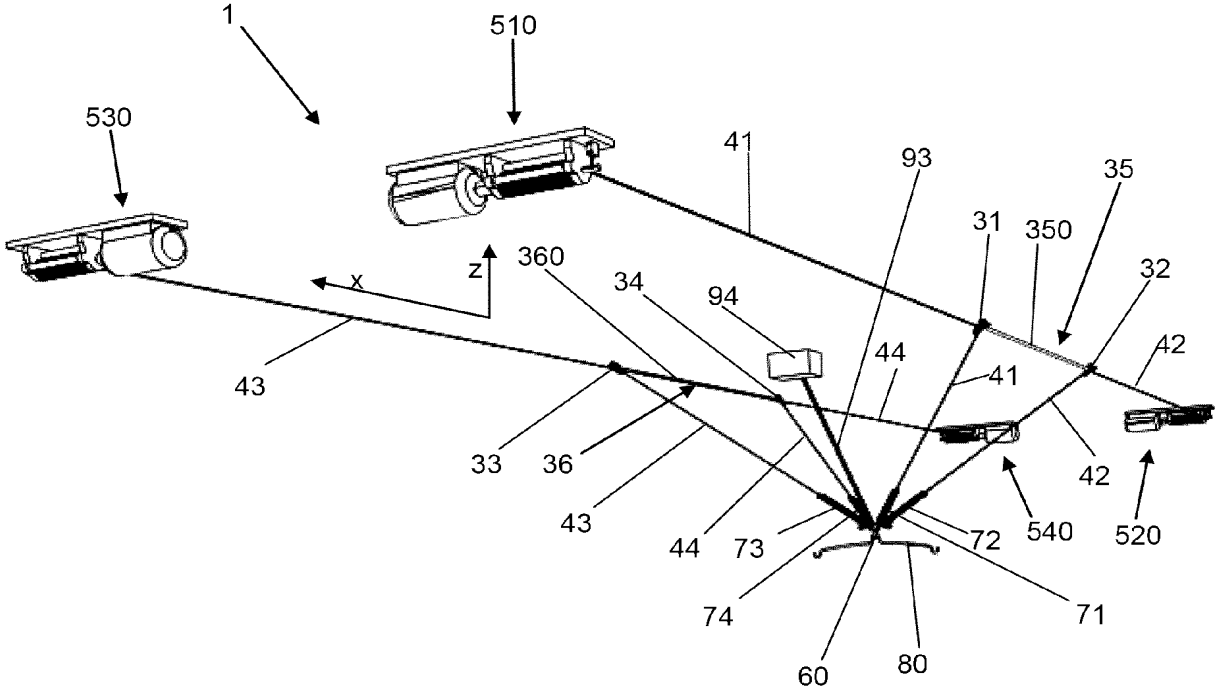


Figure 3

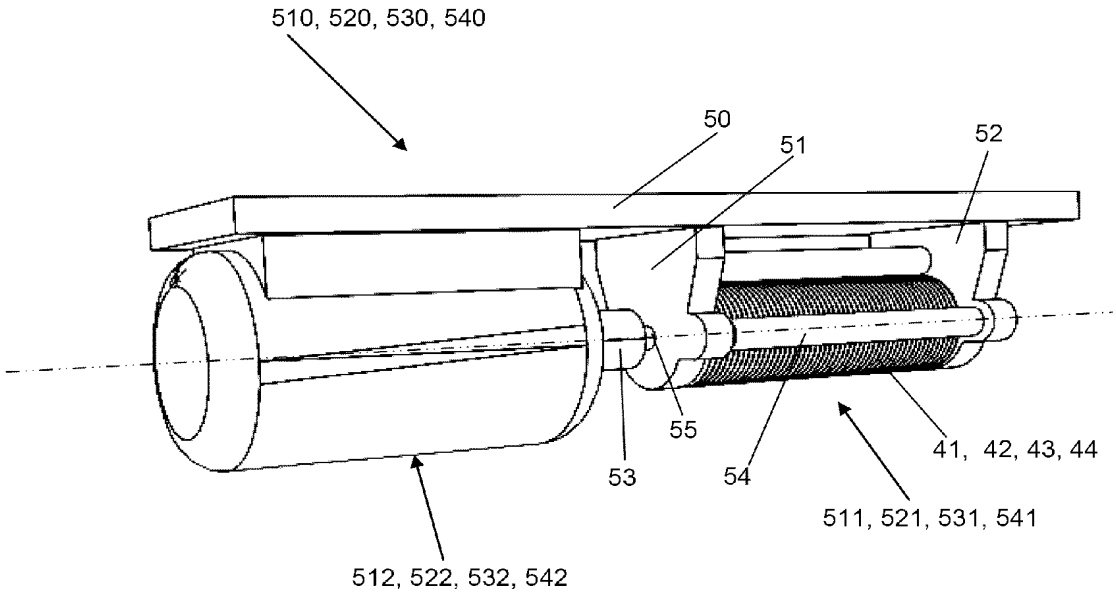


Figure 4

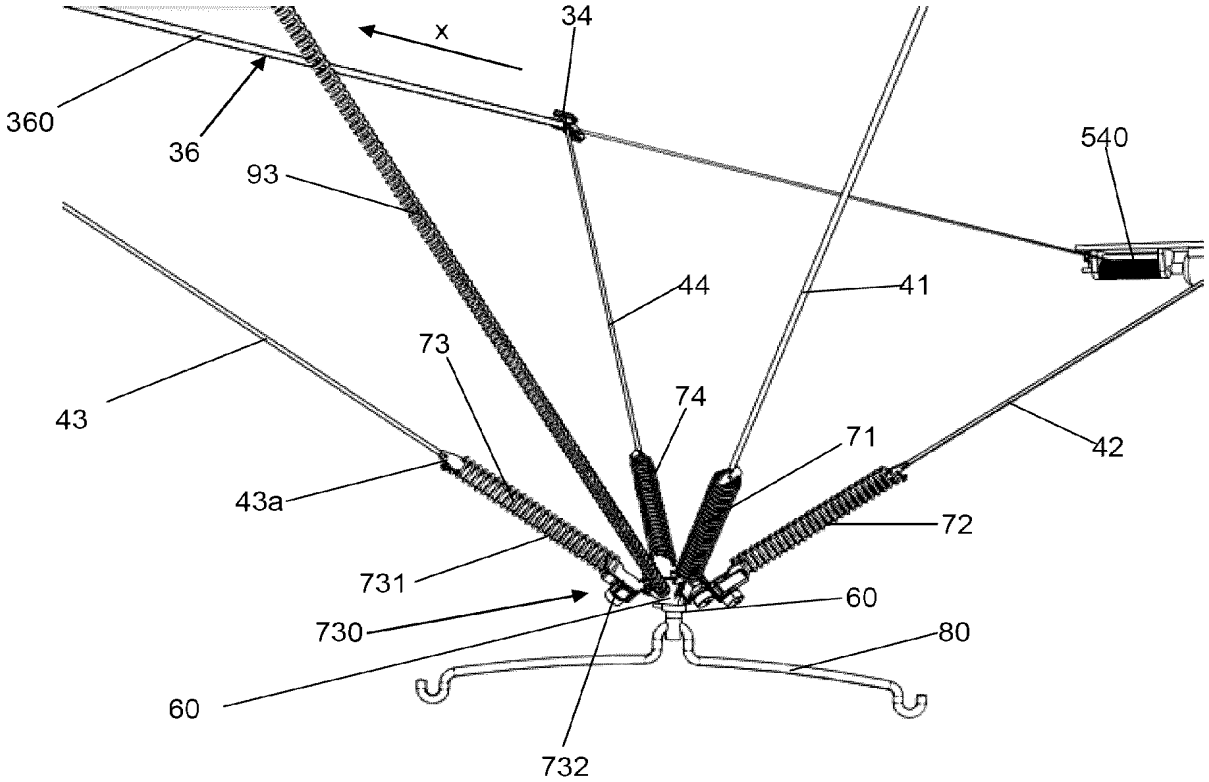


Figure 5

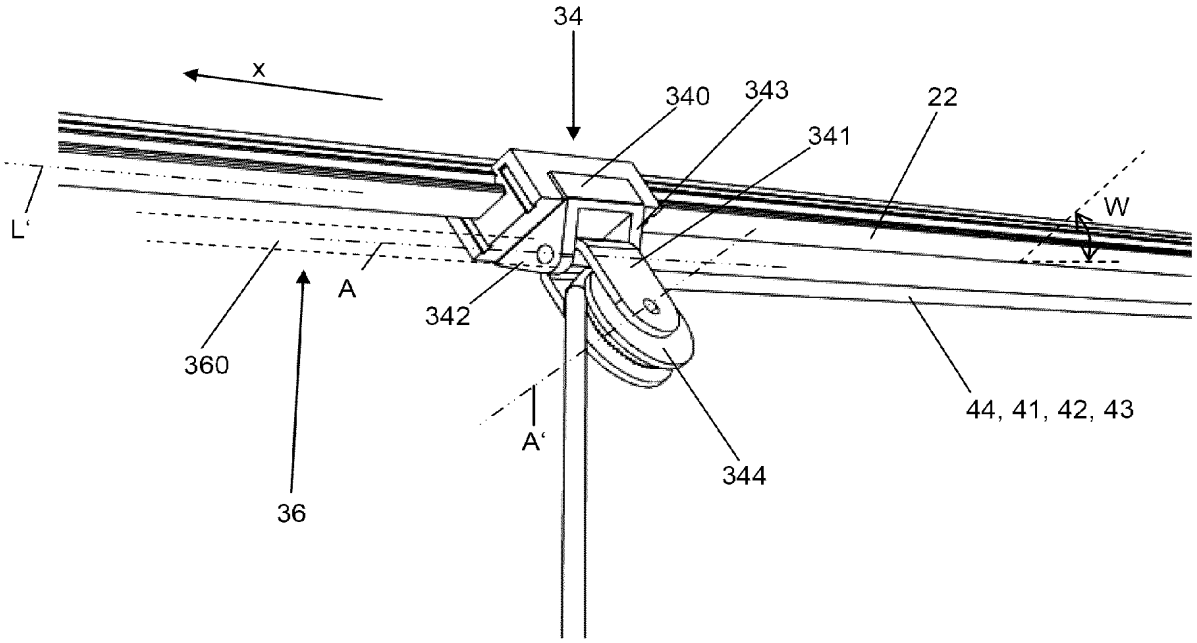


Figure 6

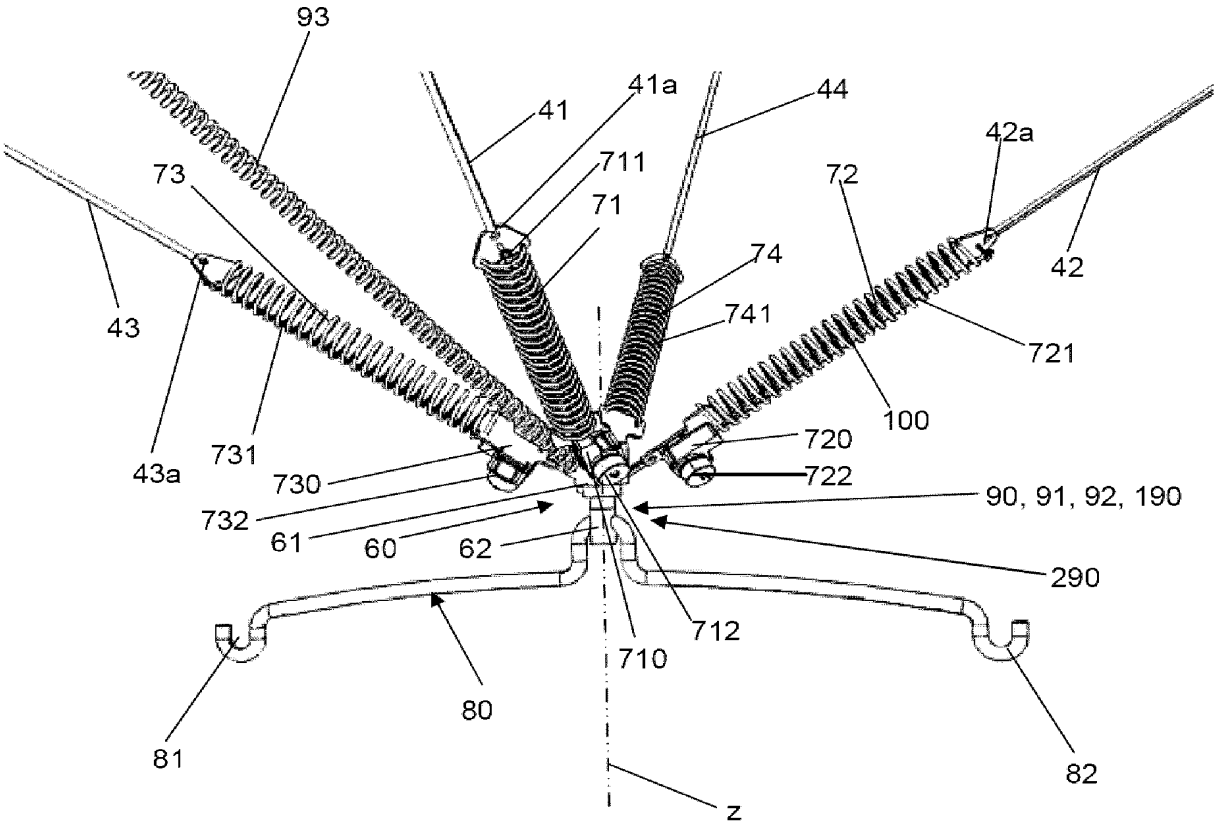


Figure 7

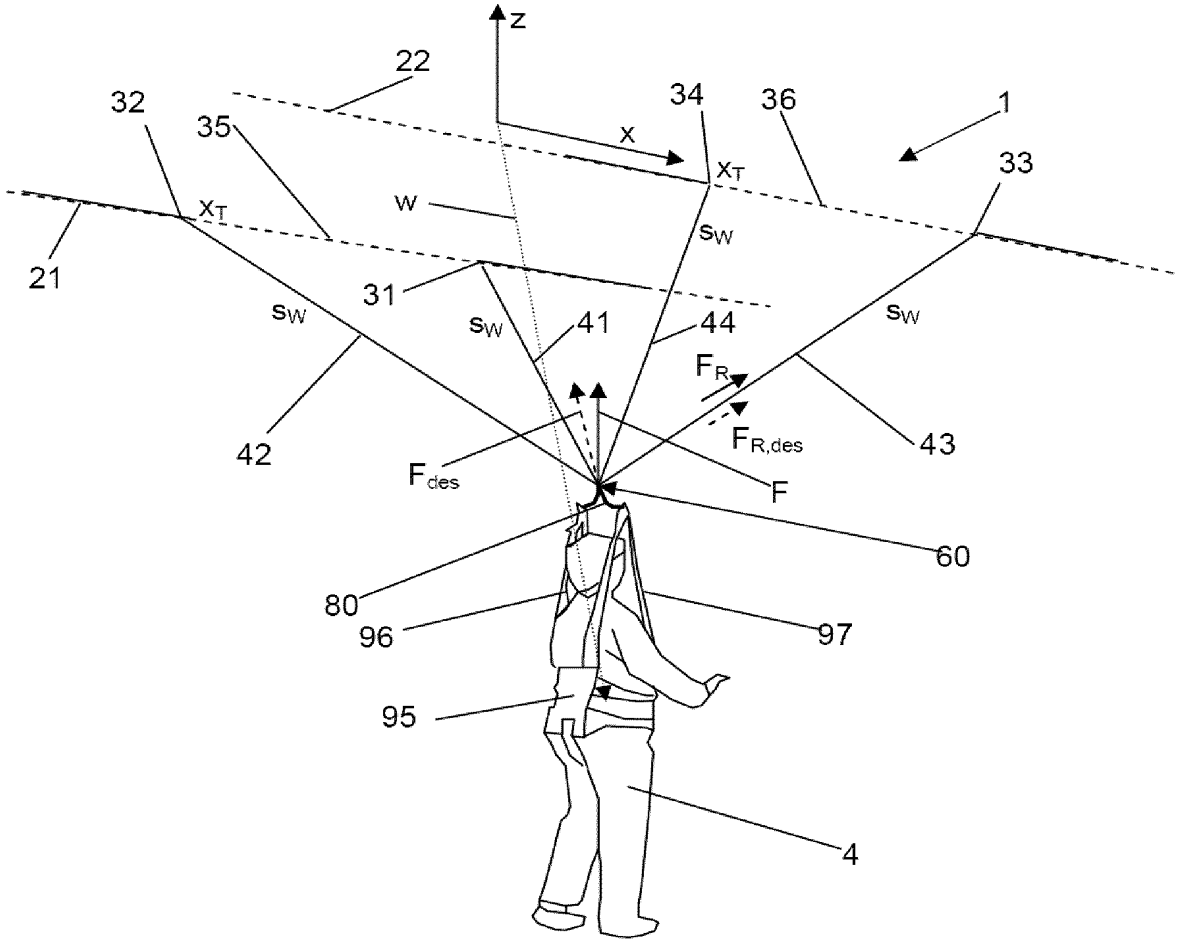


Figure 8

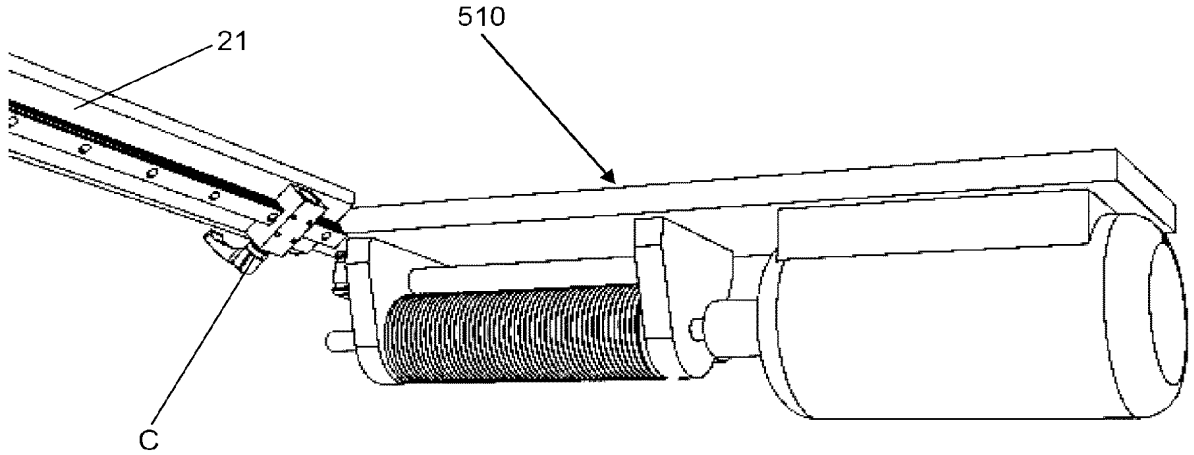
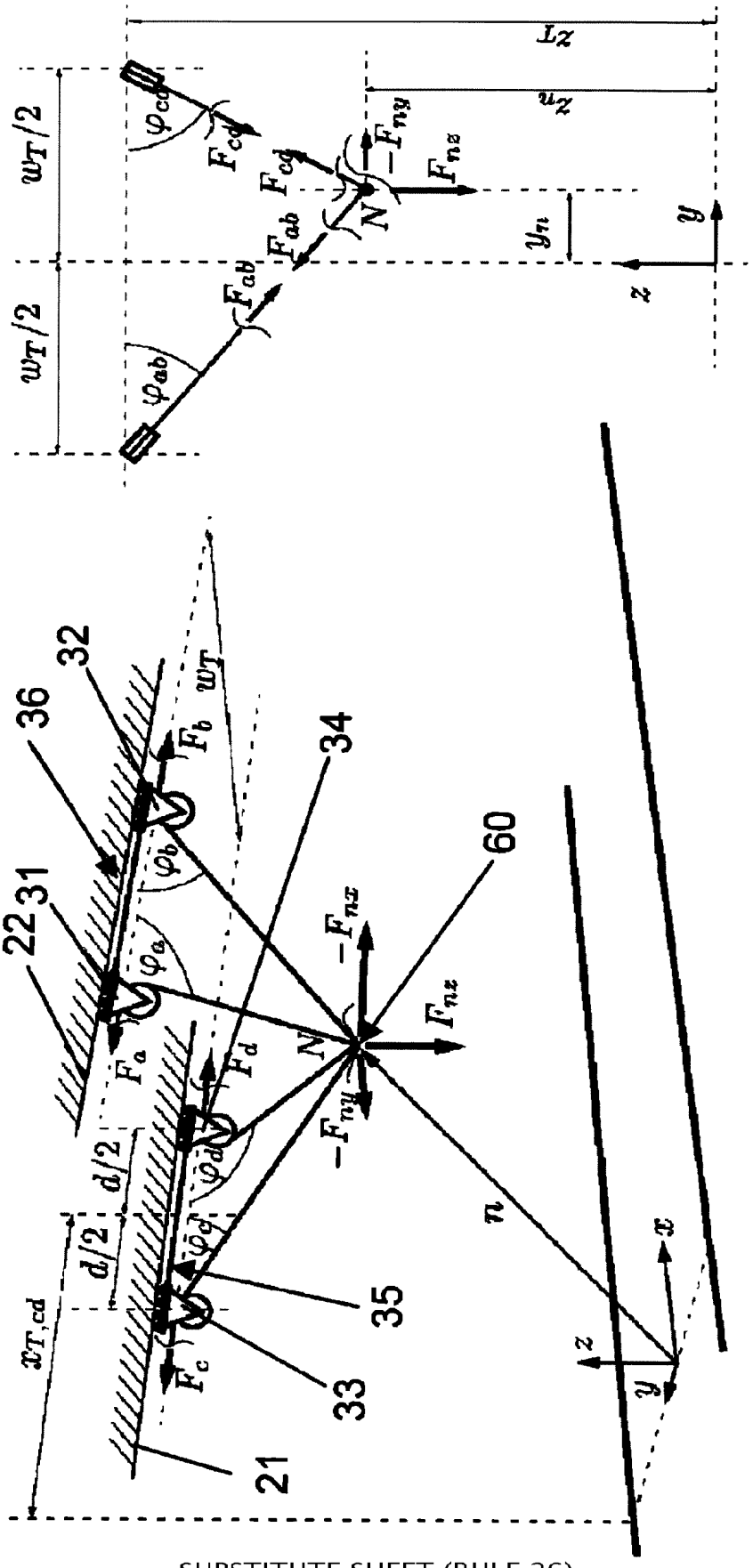


Figure 9



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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/052623

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61H3/00 A61G7/10
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61H A61G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 146 315 A (SCHOENENBERGER WILLI [CH]) 14 November 2000 (2000-11-14) column 3, lines 4-25; figure 2	1
A	US 2012/018249 A1 (MEHR CHRISTIAN [CH]) 26 January 2012 (2012-01-26) figures 1-7	1
A	WO 2011/079115 A1 (CABLECAM INC; WHARTON STEPHEN [US]) 30 June 2011 (2011-06-30) the whole document	1
A	WO 2006/017926 A1 (UNIV LAVAL [CA]; GOSSELIN CLEMENT [CA]) 23 February 2006 (2006-02-23) the whole document	1

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
5 June 2013	11/06/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	de Acha González, J

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Form PCT/ISA/210 (second sheet) (April 2005)

Aretech LLC - Exhibit 1004, Page 00517

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/052623

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 601 527 A (SELKOWITZ DAVID M [US]) 11 February 1997 (1997-02-11) the whole document -----	1

2

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2013/052623

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(74) Agents: **MILCH, Erik B.** et al.; Cooley LLP, 1299 Pennsylvania Ave., Suite 700, Washington, District of Columbia 20004 (US).

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(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

[Continued on next page]

(54) Title: APPARATUS AND METHODS FOR SUPPORT TRACK AND POWER RAIL SWITCHING IN A BODY WEIGHT SUPPORT SYSTEM

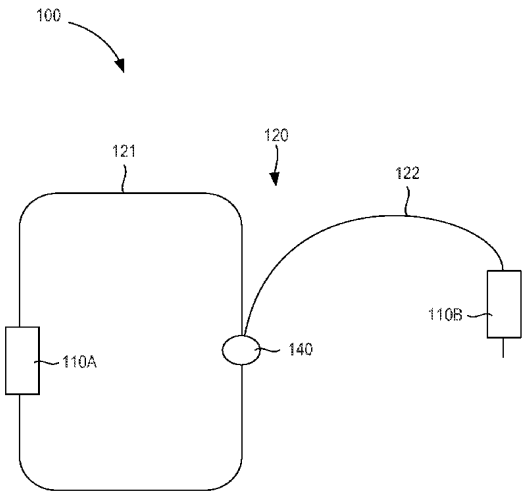


FIG. 1

(57) Abstract: A body weight support system includes a support track configured to movably suspend a trolley therefrom. A power rail of the system is coupled to the support track and is in electrical contact with the trolley. A switch included in the system has a support track portion and a power rail portion. The switch is configured to transition between a first configuration, in which a first portion of the support track and the support track portion of the switch define a first path, and a second configuration, in which a second portion of the support track and the support track portion of the switch define a second path. The trolley is configured to receive a flow of electric power from at least one of the power rail or the power rail portion of the switch that is operable to move the trolley along the first path or the second path.

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Published:

— *with international search report (Art. 21(3))*

APPARATUS AND METHODS FOR SUPPORT TRACK AND POWER RAIL SWITCHING IN A BODY WEIGHT SUPPORT SYSTEM

Cross-Reference to Related Applications

[1001] This application claims priority to and the benefit of U.S. Provisional Patent Application Serial No. 62/254,088 entitled, "Apparatus and Methods for Support Track and Power Rail Switching in a Body Weight Support System," filed November 11, 2015, the disclosure of which is incorporated herein by reference in its entirety.

Background

[1002] 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 support track and power rail switching while supporting a trolley of a body weight support system.

[1003] 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 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.

[1004] 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 over-ground gait support systems include a motorized trolley and rail system. The trolley in such systems is programmed to move along a rail system while following the subject's movement (e.g., supporting at least a portion of the subject's weight). In some such systems, the rail system is a closed loop or

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otherwise a single path along which the trolley moves. As such, some know rail systems do not allow for changing or switching of the rail system to allow the trolley to move along more than one predefined path, which can limit the therapeutic options during gait training. Moreover, such rail systems may lack a section of the rail system where one or more trolleys can be stored while not inhibiting or blocking a trolley moving along the rail system.

[1005] Thus, a need exists for improved apparatus and methods for support track and power rail switching while supporting a trolley of a body weight support system.

Summary

[1006] Apparatus and methods for support track and power rail switching while supporting a trolley of a body weight support system are described herein. In some embodiments, a body weight support system includes a support track configured to movably suspend a trolley therefrom. The trolley is configured to support at least a portion of a body weight of a patient. A power rail is coupled to the support track and is in electrical contact with the trolley. A switch included in the system has a support track portion and a power rail portion. The switch is configured to transition between a first configuration, in which a first portion of the support track and the support track portion of the switch define a first path, and a second configuration, in which a second portion of the support track and the support track portion of the switch define a second path. The trolley is configured to receive a flow of electric power from at least one of the power rail or the power rail portion of the switch that is operable to move the trolley along the first path when the switch is in the first configuration and along the second path when the switch is in the second configuration.

Brief Description of the Drawings

[1007] FIG. 1 is a schematic illustration of a portion of a body weight support system according to an embodiment.

[1008] FIG. 2 is a schematic illustration of a portion of a power rail and a trolley included in a body weight support system according to another embodiment.

[1009] FIG. 3 is a schematic illustration of a portion of a body weight support system according to another embodiment.

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[1010] FIGS. 4 and 5 are schematic illustrations of a portion of a body weight support system in a first configuration and a second configuration, respectively, according to another embodiment.

[1011] FIG. 6-11 are each schematic illustrations of a portion of a body weight support system according to various embodiments.

[1012] FIG. 12 is a flowchart illustrating a method of using a body weight support system according to an embodiment.

Detailed Description

[1013] In some embodiments, a body weight support system includes a support track configured to movably suspend a trolley therefrom. The trolley is configured to support at least a portion of a body weight of a patient. A power rail is coupled to the support track and is in electrical contact with the trolley. A switch included in the system has a support track portion and a power rail portion. The switch is configured to transition between a first configuration, in which a first portion of the support track and the support track portion of the switch define a first path, and a second configuration, in which a second portion of the support track and the support track portion of the switch define a second path. The trolley is configured to receive a flow of electric power from at least one of the power rail or the power rail portion of the switch that is operable to move the trolley along the first path when the switch is in the first configuration and along the second path when the switch is in the second configuration.

[1014] In some embodiments, a body weight support system includes a support track, a power rail, a switch, and a trolley. The support track has a first track portion and a second track portion discontinuous from the first track portion. The power rail has a first power rail portion and a second power rail portion discontinuous from the first power rail portion. The first power rail portion is coupled to the first track portion and the second power rail portion is coupled to the second track portion. The switch has a support track portion and a power rail portion. The switch is configured to transition between a first configuration, in which the support track portion of the switch is aligned with the first track portion and the power rail portion of the switch is aligned with the first power rail portion, and a second configuration, in which the support track portion of the switch is aligned with the second track portion and

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the power rail portion of the switch is aligned with the second power rail portion. The trolley is configured to support at least a portion of a body weight of a patient. The trolley is configured to be moved from a first position to a second position while the switch is in the first configuration. The trolley is movably suspended from the first track portion and in electrical contact with the first power rail portion when in the first position and the trolley is movably suspended from the support track portion of the switch and in electrical contact with the power rail portion of the switch when in the second position. The trolley is configured to be moved from the second position to a third position after the switch is transitioned from the first configuration to the second configuration. The trolley is movably suspended from the second track portion and in electrical contact with the second power rail portion when in the third position.

[1015] In some embodiments, a method includes moving, from a first position to a second position, a trolley configured to support at least a portion of a body weight of a patient. The trolley is movably suspended from a first support track portion and is in electrical contact with a first power rail portion when in the first position and is movably suspended from a support track portion of a switch and is in electrical contact with a power rail portion of the switch when in the second position. The switch is transitioned from a first configuration, in which the support track portion and the power rail portion of the switch are aligned with the first support track portion and the first power rail portion, respectively, to a second configuration, in which the support track portion of the switch is aligned with a second support track portion discontinuous from the first support track portion and the power rail portion of the switch is aligned with a second power rail portion discontinuous from the first power rail portion. The trolley is moved from the second position to a third position, in which the trolley is movably suspended from the second support track portion and is in electrical contact with the second power rail portion.

[1016] In some embodiments, a rail system includes a support track, a power rail, and a switch. The support track is configured to support a trolley of a body weight support system. The power rail is configured to be in electrical communication with the trolley to provide a flow of electric current to a portion of the trolley. The switch includes a support track portion and a power rail portion. The switch is configured to transition between a first configuration in which the support track and the support track portion of the switch define a first path and a second configuration in which the support track and the support track portion of the switch

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define a second path, different from the first path. At least one of the power rail and the power rail portion of the switch configured to provide a substantially uninterrupted flow of electric current to the portion of the trolley as the trolley moves along the support track.

[1017] As used in this specification, the singular forms "a," "an" and "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, the term "a member" is intended to mean a single member or a combination of members, "a material" is intended to mean one or more materials, or a combination thereof.

[1018] As used herein, the term "parallel" generally describes a relationship between two geometric constructions (e.g., two lines, two planes, a line and a plane or the like) in which the two geometric constructions are substantially non-intersecting as they extend substantially to infinity. For example, as used herein, a line is said to be parallel to another line when the lines do not intersect as they extend to infinity. Similarly, when a planar surface (i.e., a two-dimensional surface) is said to be parallel to a line, every point along the line is spaced apart from the nearest portion of the surface by a substantially equal distance. Two geometric constructions are described herein as being "parallel" or "substantially parallel" to each other when they are nominally parallel to each other, such as for example, when they are parallel to each other within a tolerance. Such tolerances can include, for example, manufacturing tolerances, measurement tolerances or the like.

[1019] FIG. 1 is a schematic illustration of at least a portion of a body weight support system 100 according to an embodiment. The body weight support system 100 (also referred to herein as "support system") includes at least a trolley 110A, a support track 120, and a switch 140. The support system 100 can be used, for example, in 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. In such instances, the support system 100 can be used to support at least a portion of the patient's body weight to facilitate the gait therapy. In other instances, the support system 100 can be used to simulate, for example, low gravity scenarios for the training of astronauts or the like. In some embodiments, a portion of the support system 100 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.

[1020] As described above, the support system 100 includes at least one trolley 110A. More particularly, the support system 100 shown in FIG. 1 includes the trolley 110A (e.g., a

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first trolley) and a second trolley 110B. In this embodiment, the trolleys 110A and 110B are substantially similar; thus, a discussion of the first trolley 110A applies equally to the second trolley 110B. The trolley 110A included in the support system 1000 can be any suitable shape, size, or configuration and can include one or more systems, mechanisms, assemblies, or subassemblies (not shown) that can perform any suitable function associated with, for example, supporting at least a portion of the body weight of a patient. For example, in some embodiments, the trolley 110A can include at least a drive system, a support mechanism, and an electronic system. In some embodiments, the drive system can be movably coupled to the support track 120 and configured to move (e.g., slide, roll, or otherwise advance) along a length of the support track 120. The support mechanism can be temporarily coupled to a harness or attachment device worn by or coupled to the patient (e.g., via a tether or other support device) to support a portion of the body weight of a patient and temporarily couple the patient to the trolley 110A.

[1021] The electronic system of the trolley 110A can control at least a portion of thereof. For example, the trolley 110A can include one or more motors configured to power (e.g., drive, rotate, spin, engage, activate, etc.) the drive system and/or the support mechanism (e.g., to allow the support mechanism to dynamically support at least a portion of a patient's weight). For example, the electronic system can include at least a processor (e.g., a general-purpose processor (GPU), a central processing unit (CPU), an accelerated processing unit (APU), an application specific integrated circuit (ASIC), and/or the like) and a memory (e.g., a random access memory (RAM), a memory buffer, a hard drive, a read-only memory (ROM), an erasable programmable read-only memory (EPROM), and/or the like). As such, the memory stores instructions to cause the processor to execute modules, processes, and/or functions associated with controlling one or more mechanical and/or electrical systems included in the trolley 110A (e.g., the motors, sensors, control devices, etc.). In some embodiments, control signals are delivered through a power rail (not shown) using, for example, a broadband over power-line (BOP) configuration. In some embodiments, the trolley 110A and/or 110B can be substantially similar to the those described in U.S. Patent Publication No. 2015/0143627 (the "'627 publication") entitled, "Methods and Apparatus for Body Weight Support System," filed February 3, 2015, the disclosure of which is incorporated herein by reference in its entirety.

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[1022] The support track 120 can be any suitable shape, size, or configuration. For example, in some embodiments, the support track 120 can be substantially linear or curvilinear. In some embodiments, the support track can be a beam (e.g., an I-beam or the like) included in a roof or ceiling structure from which at least a portion of the trolley 110A can "hang" (e.g., at least a portion of the trolley 110A can extend away from the beam). In other embodiments, at least one end portion of the support track can be coupled to a vertical wall or the like. In still other embodiments, the support track can be included in a freestanding structure such as, for example, a gantry or an A-frame. In some embodiments, the support track 120 can be a closed loop such as, for example, circular, oval, oblong, rectangular (e.g., with or without rounded corners), or any other suitable shape. As shown in FIG. 1, for example, the support track 120 includes a first portion 121 and a second portion 122. In this embodiment, the first portion 121 is a substantially closed loop portion of the support track 120 while the second portion 122 is not a closed loop portion of the support track 120.

[1023] The first portion 121 of the support track 120 and the second portion 122 of the support track 120 are selectively coupled via a switch 140. The switch 140 can be any suitable switch or the like. For example, although not shown in FIG. 1, the switch 140 can include a support track portion that collectively forms the support track 120 with at least one of the first portion 121 or the second portion 122. In some embodiments, the switch 140 can be an electromechanical device or mechanism configured to move relative to the support track 120 to transition the support track 120 between a first configuration and a second configuration. Specifically, the switch 140 can be placed in a first position and/or orientation to place the support track 120 in the first configuration. In first configuration, the support track portion of the switch 140 aligned with and/or can otherwise form a section of the first portion 121 of the support track 120. In such instances, for example, the support track portion of the switch 140 and the first portion 121 of the support track 120 can collectively define a closed loop in which the second portion 122 is at least partially isolated from the first portion 121 and/or the support portion of the switch 140. Conversely, the switch 140 can be moved to a second position and/or orientation to place the support track 120 in the second configuration. In the second configuration, the support track portion of the switch 140, the first portion 121 of the support track 120, and the second portion 122 of the support track can collectively define an open path in which the support track portion of the switch 140 at least

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operatively connects the first portion 121 of the support track 120 to the second portion 122 of the support track 120.

[1024] The switch 140 can be moved relative to the support track 120 in any suitable manner. For example, in some embodiments, the support system 100 can include a motor or device configured to move the switch 140 in a linear direction relative to the support track 120. In other embodiments, the motor or device can be configured to rotate 140 the switch relative to the support track 120 (e.g., the switch 140 can be a turntable or the like). In some embodiments, a user can control the switch 140 via a remote control operatively coupled thereto. For example, in some embodiments, the user can control the switch via a computer application run on a personal computer and/or laptop, a mobile application run on a mobile device such as a smartphone or tablet, a hand-held remote, and/or any other suitable remote control interface.

[1025] Although not shown in FIG. 1, the support system 100 can also include a power rail configured to provide electric power to one or more trolleys and/or to the switch 140. In some embodiments, the power rail can be disposed adjacent to the support track 120 and can follow a substantially parallel path. Moreover, the switch 140 can include a power rail portion configured to electrically connect to at least one of the first portion 121 and/or the second portion 122 of the support track 120 when the support track 120 is in the first configuration and/or the second configuration. In other words, the power rail portion of the switch 140 can function substantially similarly to the support track portion. In this manner, the user can control the support system 100 to place the support track 120 and/or the switch 140 in the first configuration or the second configuration. Accordingly, when the switch 140 places the support track 120 in the first configuration, the first trolley 110A and/or the second trolley 110B can be configured to move along the substantially closed loop formed by the first portion 121 and the support track portion of the switch 140. Conversely, when the switch 140 places the support track 120 in the second configuration, the first trolley 110A and/or the second trolley 110B can be configured to move along the first portion 121 and/or the second portion 122 of the support track 120.

[1026] By way of example, in some instances, it may be desirable to use the first trolley 110A to support a portion of a patient's weight during gait therapy and/or otherwise desirable to move the first trolley 110A along the support track 120, while the second trolley 110B is maintained in an unused, unpowered, and/or "powered off" configuration. In such instances,

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the user can, for example, move the switch 140 (e.g., via a controller) to place the support track 120 in the second configuration to allow the second trolley 110B to be moved onto and/or along the second portion 122 of the support track 120. Once the second trolley 110B is supported by the second portion 122 of the support track 120, the user can move the switch 140 to place the support track 120 in the first configuration such that the first portion 121 of the support track 120 forms a substantially closed loop. Thus, the first trolley 110A can be moved along the first portion 121 of the support track 120 while the second trolley 110B is supported by the second portion 122.

[1027] While the switch 140 is shown and described above with reference to FIG. 1 as switching between the first portion 121 and the second portion 122 of the support track, in other embodiments, the switch 140 can be configured to switch between any suitable number of portions of the support track 120. Moreover, while the support system 100 is shown as including a single switch, in other embodiment, the support system 100 can include any suitable number of switches operated at different locations along the support track 120.

[1028] FIG. 2 is a schematic illustration of a trolley 210 and a power rail 230 included in a support system according to another embodiment. The power rail 230 includes a first portion 231 and a second portion 232. The first portion 231 and the second portion 232 each include a flared end portion 235. As shown, the first portion 231 and the second portion 232 are separated by a distance D. For example, in some embodiments, the second portion 232 of the power rail 230 can be disposed on a switch or the like (not shown in FIG. 2) configured to transition the power rail 230 between a first configuration and a second configuration, as described above with reference to the support track 220. In some embodiments, the distance D is configured to allow for movement of the second portion 232 of the power rail 230 relative to the first portion 231 (e.g., in response to a movement of the switch).

[1029] The trolley 210 can be, for example, substantially similar to the trolley 110A described above with reference to FIG. 1. In the embodiment shown in FIG. 2, the trolley 210 includes a first electrical collector 212 and a second electrical collector 214. The electrical collectors 212 and 214 are each in electrical contact with the power rail 230. More specifically, the first electrical collector 212 is in electrical contact with the first portion 231 of the power rail 230 and the second electrical collector 214 is in electrical contact with the second portion 232 of the power rail 230. In this embodiments, the arrangement of the first electrical collector 212 and the second electrical collector 214 is such that the trolley 210 can

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remain in electrical connection with the power rail 230 as the second collector 214 or the first collector 212 is moved between the first portion 231 of the power rail 230 and the second portion 232 of the power rail 230. Moreover, the flanged end portion 235 can be configured to facilitate the movement of the electrical collectors between the first portion 231 and the second portion 232.

[1030] In other embodiments, a trolley can use a single electrical collector. In such embodiments, the trolley can have an internal power source (such as back-up battery) to enable the trolley to move across the distance D between the first portion 231 and the second portion 232 of the power rail 230.

[1031] FIG. 3 is a schematic illustration of a portion of a support system 300 according to another embodiment. In some embodiments, the portion of the support system 300 can be substantially similar, at least in part, to the support system 100 described above with reference to FIG. 1. For example, the portion of the support system 300 includes a support track 320, a power rail 330, and a switch 340. Although not shown in FIG. 3, in some embodiments, the support track 320 can be configured to support a trolley or the like included in the support system 300. Similarly, the power rail 330 can be configured to provide a flow of electrical current to a portion of the trolley (not shown in FIG. 3). Thus, the portion of the support system 300 can be used to, for example, support a trolley, which in turn, can support at least a portion of a patient's weight during gait therapy and/or the like.

[1032] As shown in FIG. 3, the support track 320 includes a first portion 321, a second portion 322, and a third portion 323. The power rail 330 includes a first portion 331 having at least one flared end 335, a second portion 332 having at least one flared end 335, and a third portion 333 having at least one flared end 335. The switch 340 includes a support track portion 341 having an axle 342 and a power rail portion 343 having an axle 344. Moreover, each end of the power rail portion 343 includes and/or forms a flare 345. As described above with reference to FIG. 2, the flared ends 335 of the first portion 331 and second portion 332 of the power rail 330 and the flared ends 345 of the power rail portion 343 of the switch 340 can facilitate a movement of one or more electrical collectors of the trolley between the first portion 331 and/or second portion 332 of the power rail 330 and the power rail portion 343 of the switch 340.

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[1033] As described above with reference to the support system 100 of FIG. 1, the switch 340 is configured to be moved relative to the support track 320 and the power rail 330 to transition the portion of the support system 300 between a first configuration and a second configuration. For example, as described above with reference to the support system 100, a user can manipulate a control device such as a personal computer, laptop, tablet, smartphone, and/or any other remote control device to send a control signal to the switch 340. In response to the control signal, the switch 340 can be moved (e.g., via an electromechanical device such as a motor) relative to the support track 320 and the power rail 330 between a first position and/or orientation and a second position and/or orientation. More specifically, in this embodiment, the control signal can result in the support track portion 341 being rotated about its axle 342 and the power rail portion 343 being rotated about its axle 344.

[1034] For example, as shown in FIG. 3, the switch 340 can be placed in a first position and/or orientation (e.g., in response to receiving a control signal) such that the support track portion 341 of the switch 340 operatively couples the first portion 321 of the support track 320 to the third portion 323 of the support track 320 and the power rail portion 343 operatively couples the first portion 331 of the power rail 330 to the third portion 333 of the power rail 330. Thus, a trolley (not shown in FIG. 3) can be moved along the first portion 321 of the support track 320 and the support track portion 341 of the switch 340 to the third portion 323 of the support track 320. Similarly, one or more electrical collectors of the trolley can be moved along the first portion 331 of the power rail 330 and the power rail portion 343 of the switch 340 to the third portion 333 of the power rail 330. In other instances, the switch 340 can be placed in a second position and/or orientation (not shown in FIG. 3) such that the trolley can be moved along the first portion 321 of the support track 320 and the support track portion 341 of the switch 340 to the second portion 322 of the support track 320 while the one or more electrical collectors is moved along the first portion 331 of the power rail 330 and the power rail portion 343 of the switch 340 to the second portion 332 of the power rail 330.

[1035] In some embodiments, the power rail 330 can be located on the other side of the support track 320, as compared to the relative position described above with reference to Fig. 3. While the switch 340 is described above as being moved between a first position and a second position, in some embodiments, the switch 340 can be moved, for example, to a third position. For example, as shown in FIG. 3, the support track 320 and the power rail 330 can

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each include a fourth portion 324 and 334, respectively. In this manner, the switch 340 can be configured to transition the support system between a first configuration corresponding to a first path along which the trolley can move, a second configuration corresponding to a second path along which the trolley can move, and a third configuration corresponding to a third path along which the trolley can move. While support track 320 and the power rail 330 are shown and described as including the optional fourth portions 324 and 334, respectively, in still other embodiment, the support track 320 and the power rail 330 can include any suitable number of portions and thus, any suitable number of paths along which one or more trolleys can move.

[1036] While the switch 340 is shown and described above with reference to FIG. 3 as being rotated or pivoted relative to the support track 320 and the power rail 330, in other embodiments, a switch can be moved in a linear motion relative to a support track and/or power rail. For example, FIG. 4 is a schematic illustration of a portion of a support system 400 according to another embodiment. In some embodiments, the portion of the support system 400 can be substantially similar, at least in part, to the support system 100 described above with reference to FIG. 1. For example, the portion of the support system 400 includes a support track 420, a power rail 430, and a switch 440. Although not shown in FIG. 4, in some embodiments, the support track 420 can be configured to support a trolley or the like included in the support system 400. Similarly, the power rail 430 can be configured to provide a flow of electrical current to a portion of the trolley (not shown in FIG. 4). Thus, the portion of the support system 400 can be used to, for example, support a trolley, which in turn, can support at least a portion of a patient's weight during gait therapy and/or the like.

[1037] As shown in FIGS. 4 and 5, the support track 420 includes a first portion 421, a second portion 422, and a third portion 423. The power rail 430 includes a first portion 431 having at least one flared end 435, a second portion 432 having at least one flared end 435, and a third portion 433 having at least one flared end 435. The switch 440 includes a first support track portion 441 and a second support track portion 451, and a first power rail portion 443 and a second power rail portion 453. The switch 440 may also contain a mounting frame and/or plate (not shown) that supports all elements of the switch 440 and enables to move them together when performing the switching action. Each end of the power rail portions 443 and 453 includes and/or forms a flare 445 and 455, respectively. As described above with reference to FIG. 2, the flared ends 435 of the first portion 431 and

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second portion 432 of the power rail 430 and the flared ends 445 and 455 of the power rail portions 443 and 453, respectively, of the switch 440 can facilitate a movement of one or more electrical collectors of the trolley between the first portion 431 and/or second portion 432 of the power rail 430 and the power rail portion 443 of the switch 440. Moreover, as shown in FIGS. 4 and 5, each portion 531, 532, and 533, of the power rail 530 includes an electrical line feed 536. That is to say, each portion 531, 532, and 533 of the power rail 530 can be independently connected (i.e., electrically) to a power source (not shown in FIG. 5). Similarly, the power rail portions 543 and 553 of the switch 540 each includes an electrical line feed 546 and 556, respectively, configured to electrically connect the power rail portions 543 and 553, respectively, of the switch 540 to the power source.

[1038] As described above with reference to the support system 100 of FIG. 1, the switch 440 is configured to be moved relative to the support track 420 and the power rail 430 to transition the portion of the support system 400 between a first configuration and a second configuration. For example, as described above with reference to the support system 100, a user can manipulate a control device such as a personal computer, laptop, tablet, smartphone, and/or any other remote control device to send a control signal to the switch 440. In response to the control signal, the switch 440 can be moved (e.g., via an electromechanical device such as a motor) relative to the support track 420 and the power rail 430 between a first linear position (FIG. 4) and a second linear position (FIG. 5). More specifically, in this embodiment, the control signal can result in the support track portion 441 being translated in a linear motion relative to the support track 420 and the power rail 430.

[1039] For example, as shown in FIG. 4, the switch 440 can be placed in a first position (e.g., in response to receiving a control signal) such that the first support track portion 441 of the switch 440 operatively couples the first portion 421 of the support track 420 to the second portion 422 of the support track 420 and the first power rail portion 443 operatively couples the first portion 431 of the power rail 430 to the second portion 432 of the power rail 430. Thus, a trolley (not shown in FIGS. 4 and 5) can be moved along the first portion 421 of the support track 420 and the first support track portion 441 of the switch 440 to the second portion 422 of the support track 420. Similarly, one or more electrical collectors of the trolley can be moved along the first portion 431 of the power rail 430 and the first power rail portion 443 of the switch 440 to the second portion 432 of the power rail 430. In other instances, the switch 440 can be moved in a translational motion and placed in a second

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linear position, as shown in FIG. 5. With the switch 440 in the second linear position, the trolley can be moved along the first portion 421 of the support track 420 and the second support track portion 451 of the switch 440 to the third portion 423 of the support track 420 while the one or more electrical collectors is moved along the first portion 431 of the power rail 430 and the second power rail portion 453 of the switch 440 to the third portion 433 of the power rail 430.

[1040] While the switch 440 is described above as being moved between a first position and a second position, in some embodiments, the switch 440 can be moved, for example, to a third position. For example, in some embodiment, the switch 440 can include a third support track portion and a third power rail portion (not shown in FIGS. 4 and 5) configured to operatively couple, for example, the first portion 421 of the support track 420 and the first portion 431 of the power rail 430 to a fourth portion of the support track 420 and the power rail 430, respectively (not shown). In this manner, the switch 440 can be placed in a third linear position to transition the support system 400 to, for example, a third configuration, as described above with reference to the support system 300 of FIG. 3.

[1041] FIG. 6 is a schematic illustration of a portion of a support system 500 according to another embodiment. In some embodiments, the portion of the support system 500 can be substantially similar, at least in part, to the support systems described above (e.g., the support system 400 described above with reference to FIGS. 4 and 5). The portion of the support system 500 includes a support track 520, a power rail 530, and a switch 540. Although not shown in FIG. 6, in some embodiments, the support track 520 can be configured to support a trolley or the like included in the support system 500. Similarly, the power rail 530 can be configured to provide a flow of electrical current to a portion of the trolley (not shown in FIG. 6). Thus, the portion of the support system 500 can be used to, for example, support a trolley, which in turn, can support at least a portion of a patient's weight during gait therapy and/or the like. In some embodiments, the trolley can be similar to and/or substantially the same as the trolleys described in detail in the '927 publication incorporated by reference hereinabove.

[1042] In the embodiment shown in FIG. 6, the support track 520 includes a first portion 521, a second portion 522, a third portion 523, and a fourth portion 524. Likewise, the power rail 530 includes a first portion 531 having at least one flared end 535, a second portion 532 having at least one flared end 535, a third portion 533 having at least one flared end 535, and

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a fourth portion 534 having at least one flared end 535. The switch 540 includes a support track portion 541 and a power rail portion 543 forming a flare 545 at each end thereof. The switch 540 may also contain a mounting frame and/or plate (not shown) that supports all elements of the switch 540 and enables the elements to move together when performing one or more switching actions. As described above with reference to FIG. 2, the flared ends 535 of the power rail portions 531, 532, 533, and 534 and the flared ends 545 of the power rail portion 543 of the switch 540 can facilitate a movement of one or more electrical collectors of a trolley between the power rail portions 531, 532, 533, and/or 534 and the power rail portion 543 of the switch 540. As shown, each power rail portion 531, 532, 533, and 534 of the power rail 530 and the power rail portion 543 of the switch 540 includes and/or is electrically coupled to an electrical line feed 536. Thus, each power rail portion 531, 532, 533, 534, and/or 543 can be independently connected (i.e., electrically) to a power source (not shown in FIG. 6). As described above with reference to the trolley 210 illustrated in FIG. 2, in some embodiments, a trolley can include, for example, a first collector and a second collector. In this manner, as the trolley is advanced onto the switch, a first collector can remain in electrical contact with a power rail portion (e.g., the first portion 531) while the second collector can transition onto the power rail portion 543 of the switch 540. Thus, continuous electric power can be supplied to the trolley as the trolley moves onto the switch. In some instances, power can be withheld from the power rail portion 543 of the switch 540 as the trolley is being advanced onto the switch 540 (advanced along the support track 520 and power rail 530 such that the trolley is suspended from the switch 540). Moreover, electrical power can be withheld from the power rail portion 543 of the switch 540 while the trolley is suspended therefrom until the switch 540 is placed in a desired position relative to the support track 520 and power rail 530, which in turn, can ensure that the trolley is not advanced beyond the support track portion 541 of the switch 540 when the support track portion 541 of the switch 540 is unaligned with other portions of the support track 520.

[1043] As described above with reference to the support system 100 of FIG. 1, the switch 540 is configured to be moved relative to the support track 520 and the power rail 530 to transition the portion of the support system 500 between one or more configurations. For example, as described above with reference to the support system 100, a user can manipulate a control device such as a personal computer, laptop, tablet, smartphone, and/or any other remote control device to send a control signal to the switch 540. In response to the control signal, the switch 540 can be moved (e.g., via an electromechanical device such as a motor)

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relative to the support track 520 and the power rail 530 between a first linear position (e.g., a first configuration), in which the support track portion 541 and power rail portion 543 of the switch 540 are aligned with the first portion 521 and second portion 522 of the support track 520 and the first portion 531 and the second portion 532 of the power rail 530, respectively, and a second linear position (e.g., a second configuration), in which the support track portion 541 and power rail portion 543 of the switch 540 are aligned with the third portion 523 and fourth portion 524 of the support track 520 and the third portion 533 and the fourth portion 534 of the power rail 530, respectively.

[1044] The arrangement described above is such that a trolley (not shown in FIG. 6) can be moved along the first portion 521 of the support track 520 and the first support track portion 541 of the switch 540 to the second portion 522 of the support track 520. Similarly, one or more electrical collectors of the trolley can be moved along the first portion 531 of the power rail 530 and the first power rail portion 543 of the switch 540 to the second portion 532 of the power rail 530. In other instances, the switch 540 can be moved in a translational motion and placed in a second linear position such that the trolley can be moved along the third portion 523 of the support track 520 and the support track portion 541 of the switch 540 to the fourth portion 524 of the support track 520 while the one or more electrical collectors is moved along the third portion 533 of the power rail 530 and the power rail portion 543 of the switch 540 to the fourth portion 534 of the power rail 530. In still other instances, the switch 540 can be in the first linear position to allow the trolley to move along the first portion 521 or the second portion 522 of the support track 520 and the one or more collectors to move along the first portion 531 or second portion 532 of the power rail 530 and onto the support track portion 541 and power rail portion 543 of the switch 540, respectively. Once the trolley is suspended from the switch 540, the switch 540 can be moved to the second linear position to allow the trolley to move along the support track portion 541 of the switch 540 and onto the third portion 523 or fourth portion 524 of the support track 520 and the one or more collectors onto the third portion 533 or fourth portion 534 of the power rail 530. In other words, the switch 540 can be configured to transition between the first linear position and the second linear position to "switch" and/or operably couple any suitable portion of the support track and any suitable portion of the power rail to allow the trolley to be moved therebetween.

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[1045] While the switch 540 is described above as being moved between a first position and a second position, in some embodiments, the switch 540 can be moved, for example, to a third position, fourth position, fifth position, etc. Similarly stated, a support system can include any suitable number of support track portions and power rail portions and can include a switch configured to move through any suitable number of positions to operably couple the portions of the support track and the portions of the power rail, respectively, in any suitable manner.

[1046] While the portion of a support system 500 described above with reference to FIG. 6 as having the switch 540 with one support track portion 541 and one power rail portion 543, in other embodiments, a switch can include any number of support track portions and power rail portions. For example, FIG. 7 is a schematic illustration of a portion of a support system 600 according to another embodiment. In some embodiments, the portion of the support system 600 can be substantially similar, at least in part, to the support systems described above (e.g., the portion of the support system 400 described above with reference to FIGS. 4 and 5 and/or the portion of the support system 500 described above with reference to FIG. 6).

[1047] The portion of the support system 600 includes a support track 620, a power rail 630, and a switch 640. Although not shown in FIG. 7, in some embodiments, the support track 620 can be configured to support a trolley or the like included in the support system 600. Similarly, the power rail 630 can be configured to provide a flow of electrical current to a portion of the trolley (not shown in FIG. 7). Thus, the portion of the support system 600 can be used to, for example, support a trolley, which in turn, can support at least a portion of a patient's weight during gait therapy and/or the like. In some embodiments, the trolley can be similar to and/or substantially the same as the trolleys described in detail in the '927 publication incorporated by reference hereinabove.

[1048] The support track 620 includes a first portion 621, a second portion 622, a third portion 623, and a fourth portion 624. Likewise, the power rail 630 includes a first portion 631 having at least one flared end 635, a second portion 632 having at least one flared end 635, a third portion 633 having at least one flared end 635, and a fourth portion 634 having at least one flared end 635. In this manner, the portion of the support system 600 can be similar to and/or substantially the same as the portion of the support system 500 described above with reference to FIG. 6. The portion of the support system 600 can differ from the portion of the support system 500, however, in the arrangement of the switch 640. For example, as

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shown in FIG. 7, the switch 640 includes a first support track portion 641 and a second support track portion 651, and a first power rail portion 643 and a second power rail portion 653.

[1049] Each end of the power rail portions 643 and 653 of the switch 640 forms a flare 645 and 655, respectively. Although not shown in FIG. 7, the switch 640 may also include a mounting frame and/or plate that supports all elements of the switch 640 and enables the elements to move together when performing one or more switching actions. As described above with reference to FIG. 2, the flared ends 635 of the power rail portions 631, 632, 633, and 634 and the flared ends 645 and 655 of the power rail portions 643 and 653, respectively, of the switch 640 can facilitate a movement of one or more electrical collectors of a trolley between the power rail portions 631, 632, 633, and/or 634 and the power rail portions 643 and 653 of the switch 640. As shown, each power rail portion 631, 632, 633, and 634 of the power rail 630 and the power rail portion 643 of the switch 640 includes and/or is electrically coupled to an electrical line feed 636. Thus, each power rail portion 631, 632, 633, 634, and/or 643 can be independently connected (i.e., electrically) to a power source (not shown in FIG. 7). As described above with reference to the trolley 210 illustrated in FIG. 2, in some embodiments, a trolley can include, for example, a first collector and a second collector. In this manner, as the trolley is advanced onto the switch, a first collector can remain in electrical contact with a power rail portion (e.g., the first portion 631) while the second collector can transition onto the power rail portion 643 of the switch 640. Thus, electric power can be supplied (e.g., selectively or continuously) to the trolley as the trolley moves onto the switch 640, as described above with reference to the portion of the support system 500.

[1050] As described above with reference to the support systems 100, 200, 300, 400, and/or 500, the switch 640 is configured to be moved relative to the support track 620 and the power rail 630 to transition the portion of the support system 600 between one or more configurations. For example, as described above, a user can manipulate a control device to send a control signal to the switch 640 and in response, the switch 640 can be moved (e.g., via an electromechanical device such as a motor) relative to the support track 620 and the power rail 630 between any number of linear positions. As shown, for example, in FIG. 7, the switch 640 can be in a first linear position (e.g., a first configuration), in which the first support track portion 641 and first power rail portion 643 of the switch 640 are aligned with

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the first portion 621 and second portion 622 of the support track 620 and the first portion 631 and the second portion 632 of the power rail 630, respectively, while the second support track portion 651 and second power rail portion 653 of the switch 640 are aligned with the third portion 623 and fourth portion 624 of the support track 620 and the third portion 633 and the fourth portion 634 of the power rail 630, respectively. In some instances, the switch 640 can be moved, for example, to a second linear position (e.g., a second configuration), in which the first support track portion 641 and the first power rail portion 643 of the switch 640 are aligned with the third portion 623 and the fourth portion 624 of the support track 620 and the third portion 633 and the fourth portion 634 of the power rail 630, respectively, while the second track portion 651 and the second power rail portion 653 of the switch 640 are not aligned with a portion of the support track 620 and power rail 630, respectively. Conversely, in other instances, the switch 640 can be moved, for example, to a third linear position (e.g., a third configuration), in which the second support track portion 651 and the second power rail portion 653 of the switch 640 are aligned with the first portion 621 and the second portion 622 of the support track 620 and the first portion 631 and the second portion 632 of the power rail 630, respectively, while the first track portion 641 and the first power rail portion 643 of the switch 640 are not aligned with a portion of the support track 620 and power rail 630, respectively.

[1051] Thus, as described above with reference to the support systems 400 and/or 500, the switch 640 can be configured to transition between the first linear position, the second linear position, and the third linear position to "switch" and/or operably couple any suitable portion of the support track and any suitable portion of the power rail to allow the trolley to be moved therebetween. While the switch 640 is described above as being moved between the first linear position, the second linear position, and the third linear position, in some embodiments, the switch 640 can be moved, for example, to a fourth linear position, a fifth linear position, etc. Similarly stated, a support system can include any suitable number of support track portions and power rail portions and can include a switch configured to move through any suitable number of positions to operably couple the portions of the support track and the portions of the power rail, respectively, in any suitable manner.

[1052] FIG. 8 is a schematic illustration of a switch 740 configured for use within a portion of a support system according to an embodiment. In some embodiments, the switch 740 can be substantially similar, at least in part, to the switch 640 described above with

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reference to FIG. 7. In other embodiments, the switch 740 can be similar to or substantially the same as any of the switches described herein (e.g., the switches 140, 240, 340, 440, and/or 540). In this manner, the switch 740 can be configured to at least temporarily support and/or suspend a trolley or the like (e.g., the trolley described in the '927 publication incorporated by reference hereinabove) and can provide a means and/or ability to "switch" between multiple support track portions of the support system (e.g., as described in detail above with reference to the switch 640 of FIG. 7).

[1053] The switch 740 includes a first support track portion 741 and a second support track portion 751, and a first power rail portion 743 and a second power rail portion 753, as described above with reference to the switch 640 of FIG. 7. In the embodiment shown in FIG. 8, the support track portions 741 and 751 are each arranged and/or configured as an "I" beam from which a trolley can be suspended (e.g., as described in detail in the '927 publication). The power rail portions 743 and 753 are each arranged and/or configured as a substantially hollow tube having at least one electrically conductive surface. In some embodiments, for example, the power rail portions 743 and 753 can be similar to and/or substantially the same as the power rail described in detail in the '927 publication. The first power rail portion 743 is coupled to the first support track portion 741 of the switch 740 and arranged such that the first power rail portion 743 is substantially parallel to the first support track portion 741. Likewise, the second power rail portion 753 is coupled to the second support track portion 751 of the switch 740 and arranged such that the second power rail portion 753 is substantially parallel to the second support track portion 751. Moreover, as shown in FIG. 8, the first power rail portion 743 and the second power rail portion 753 each include and/or are electrically connected to an electrical line feed 746 and 756, respectively. Accordingly, electrical power can be provided to the first power rail portion 743 and/or the second power rail portion 753 independently.

[1054] The switch 740 also includes a guide structure 747, a mounting structure 748, and a drive system (not shown in FIG 8) configured to move the mounting structure 748 relative to and/or along a path defined by the guide structure 747. The guide structure 747 can be any suitable shape, size, and/or configuration. For example, in some embodiments, the guide structure 747 can be coupled, for example, to a ceiling, building structure, frame, etc. and can be configured to define a path along which the mounting structure 748 can be moved. Although not shown in FIG. 8, the guide structure 747 can include and/or can be coupled to

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one or more motors, tracks, wheels, drive assemblies, pulleys, etc. configured to move the mounting structure 748 relative to the guide structure 747 (e.g., along one or more surfaces).

[1055] The mounting structure 748 can be any suitable shape, size, and/or configuration. For example, in some embodiments, the mounting structure 748 can be a frame or the like movably coupled to, movably disposed on, and/or otherwise selectively engaged with the guide structure 747. For example, although not shown in FIG. 8, in some embodiments, the guide structure 747 can include a track and/or surface in contact with and/or supporting a portion of the mounting structure 748 and along which the mounting structure 748 can be moved in response to an activation of a motor, pulley system, drive assembly, linkage, movement mechanism, and/or the like. In such embodiments, the motor, drive assembly, etc. can receive a signal from a controller (e.g., a controller included in the trolley, a remote controller manipulated by a user, and/or the like) and based on receiving an electronic signal and/or a flow of electric current can move the mounting structure 748 along a path defined by the guide structure 747. In some embodiments, the arrangement of the guide structure 747 and the mounting structure 748 can allow for movement of the mounting structure 748 in one-dimension, two-dimensions, and/or three-dimensions. In other words, the mounting structure 748 can be moved in a direction along one axis, along two axes, and/or along three axes.

[1056] As shown in FIG. 8, the support track portions 741 and 751 are each coupled to and/or suspended from a mounting structure 748. More specifically, in the embodiment shown in FIG. 8, the mounting structure 748 can include a first coupling member 749A configured to couple to and/or to suspend the first support track portion 741 and a second coupling member 749B configured to couple to and/or to suspend the second support track portion 742. Accordingly, with the power rail portions 743 and 753 coupled to the support track portions 741 and 751, respectively, and with the support track portions 741 and 751 coupled to and/or suspended from the coupling members 749A and 749B, respectively, movement of the mounting structure 748 results in a similar movement of the support track portions 741 and 751 and the power rail portions 743 and 753.

[1057] As described above with reference to the portion of the support system 600, the switch 740 can be included in a support system including any suitable number of support track portions and power rail portions. In this manner, the switch 740 can be disposed in such a support system to operably couple multiple track portions and/or multiple power rail

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portions (as described above with reference to the support system 600). More specifically, the switch 740 can be configured to move (e.g., linearly) between any suitable number of positions to "switch" and/or operably couple any suitable portion of the support track and any suitable portion of the power rail to allow the trolley to be moved therebetween. Thus, the switch 740 can be configured to allow one or more trolleys to be switched from, for example, one tack or path to a different track or path.

[1058] While the switches 440,540, 640, and 740 are shown and described above as being translated or slid relative to the support tracks (420, 520, 620, and 720) and the power rails (430, 530, 630, and 730), respectively, in other embodiments, a switch can be moved in a rotational motion relative to a support track and/or power rail. For example, FIG. 9 is a schematic illustration of a portion of a support system 800 according to another embodiment. In some embodiments, the portion of the support system 800 can be substantially similar, at least in part, to the support system 100 described above with reference to FIG. 1. For example, the portion of the support system 800 includes a support track 820, a power rail 830, and a switch 840. Although not shown in FIG. 9, in some embodiments, the support track 820 can be configured to support a trolley or the like included in the support system 800. Similarly, the power rail 830 can be configured to provide a flow of electrical current to a portion of the trolley (not shown in FIG. 9). Thus, the portion of the support system 800 can be used to, for example, support a trolley, which in turn, can support at least a portion of a patient's weight during gait therapy and/or the like.

[1059] As shown in FIG. 9, the support track 820 includes a first portion 821, a second portion 822, a third portion 823, and a fourth portion 824. The power rail 830 includes a first portion 831 having at least one flared end 835, a second portion 832 having at least one flared end 835, a third portion 833 having at least one flared end 835, and a fourth portion 834 having at least one flared end 835. The switch 840 includes a support track portion 841 and a power rail portion 843. Each end of the power rail portion 843 includes and/or forms a flare 845. As described above with reference to FIG. 2, the flared ends 835 of the first portion 831 and second portion 832 of the power rail 830 and the flared ends 845 of the power rail portion 843 of the switch 840 can facilitate a movement of one or more electrical collectors of the trolley between the first portion 831 and/or second portion 832 of the power rail 830 and the power rail portion 843 of the switch 840. Moreover, as shown in FIG. 9, each portion 831, 832, 833, and 834 of the power rail 830 includes an electrical line feed 836. That is to say,

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each portion 831, 832, 833, and 834 of the power rail 830 can be independently connected (i.e., electrically) to a power source (not shown in FIG. 9). Similarly, the power rail portion 843 of the switch 840 includes an electrical line feed 846 configured to electrically connect the power rail portion 843 of the switch 840 to the power source.

[1060] As described above with reference to the support system 100 of FIG. 1, the switch 840 is configured to be moved relative to the support track 820 and the power rail 830 to transition the portion of the support system 800 between a first configuration and a second configuration. For example, as described above with reference to the support system 100, a user can manipulate a control device such as a personal computer, laptop, tablet, smartphone, and/or any other remote control device to send a control signal to the switch 840. In response to the control signal, the switch 840 can be rotated (e.g., via an electromechanical device such as a motor) relative to the support track 820 and the power rail 830 between a first angular (rotational) position and/or orientation and a second angular position and/or orientation. More specifically, in this embodiment, the control signal can result in the support track portion 841 being rotated about a central axis (not shown in FIG. 9). In other words, the switch 840 can be arranged, for example, as a turntable or the like.

[1061] For example, as shown in FIG. 9, the switch 840 can be placed in a first angular position and/or orientation (e.g., in response to receiving a control signal) such that the support track portion 841 of the switch 840 operatively couples the first portion 821 of the support track 820 to the second portion 822 of the support track 820 and the power rail portion 843 operatively couples the first portion 831 of the power rail 830 to the second portion 832 of the power rail 830. Thus, a trolley (not shown in FIG. 9) can be moved along the first portion 821 of the support track 820 and the support track portion 841 of the switch 840 to the second portion 822 of the support track 820. Similarly, one or more electrical collectors of the trolley can be moved along the first portion 831 of the power rail 830 and the power rail portion 843 of the switch 840 to the second portion 832 of the power rail 830. In other instances, the switch 840 can be placed in a second angular position and/or orientation (not shown in FIG. 9) such that the trolley can be moved along the third portion 823 of the support track 820 and the support track portion 841 of the switch 840 to the fourth portion 824 of the support track 820 while the one or more electrical collectors is moved along the third portion 833 of the power rail 830 and the power rail portion 843 of the switch 840 to the fourth portion 834 of the power rail 830.

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[1062] While the switch 840 is described above as being moved between a first angular position and a second angular position, in some embodiments, the switch 840 can be moved, for example, to a third angular position. For example, in some embodiments, the support track 820 and the power rail 830 can each include a fifth portion and sixth portion, respectively. In this manner, the switch 840 can be configured to transition the support system between a first configuration corresponding to a first path along which the trolley can move, a second configuration corresponding to a second path along which the trolley can move, and a third configuration corresponding to a third path along which the trolley can move. In this manner, the switch 840 can be placed in the third angular position to transition the support system 800 to, for example, the third configuration, as described above with reference to the support system 300 of FIG. 3.

[1063] While the switch 840 is shown and described above with reference to FIG. 9 as being rotated between a first position and a second position to couple parallel track portions and rail portions (e.g., the track portion 821 and rail portion 831 to track portion 822 and rail portion 832, respectively, or the track portion 823 and rail portion 833 to track portion 824 and rail portion 834, respectively), in other embodiments, a switch can be moved in a rotational motion to coupling any number of support track and/or power rail portions or segments in any suitable arrangement. relative to a support track and/or power rail. For example, FIG. 10 is a schematic illustration of a portion of a support system 900 according to another embodiment. In some embodiments, the portion of the support system 900 can be substantially similar, at least in part, to the support system 800 described above with reference to FIG. 9. For example, the portion of the support system 900 includes a support track 920, a power rail 930, and a switch 940. Although not shown in FIG. 10, in some embodiments, the support track 920 can be configured to support a trolley or the like included in the support system 900. Similarly, the power rail 930 can be configured to provide a flow of electrical current to a portion of the trolley (not shown in FIG. 10). Thus, the portion of the support system 900 can be used to, for example, support a trolley, which in turn, can support at least a portion of a patient's weight during gait therapy and/or the like, as described in detail in the '927 publication incorporated by reference hereinabove.

[1064] As shown in FIG. 10, the support track 920 includes a first portion 921, a second portion 922, and a third portion 923. The power rail 930 includes a first portion 931 having at least one flared end 935, a second portion 932 having at least one flared end 935, and a

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third portion 933 having at least one flared end 935. The switch 940 includes a support track portion 941 and a power rail portion 943. Each end of the power rail portion 943 includes and/or forms a flare 945. As described above with reference to FIG. 2, the flared ends 935 of the portions 931, 932, and 933 of the power rail 930 and the flared ends 945 of the power rail portion 943 of the switch 940 can facilitate a movement of one or more electrical collectors of the trolley between the portions 931, 932, and/or 933 of the power rail 930 and the power rail portion 943 of the switch 940. Moreover, as shown in FIG. 10, each portion 931, 932, and 933 of the power rail 930 includes an electrical line feed 936. That is to say, each portion 931, 932, and 933 of the power rail 930 can be independently connected (i.e., electrically) to a power source (not shown in FIG. 10). Similarly, the power rail portion 943 of the switch 940 includes an electrical line feed 946 configured to electrically connect the power rail portion 943 of the switch 940 to the power source.

[1065] As described above with reference to the support system 100 of FIG. 1, the switch 940 is configured to be moved relative to the support track 920 and the power rail 930 to transition the portion of the support system 900 between a one or more configuration. For example, as described above with reference to the support system 100, a user can manipulate a control device such as a personal computer, laptop, tablet, smartphone, and/or any other remote control device to send a control signal to the switch 940. In response to the control signal, the switch 940 can be rotated (e.g., via an electromechanical device such as a motor) relative to the support track 920 and the power rail 930 between a first angular (rotational) position and/or orientation and a second angular position and/or orientation. More specifically, in this embodiment, the control signal can result in the support track portion 941 and the power rail portion 943 of the switch being rotated about a central axis (not shown in FIG. 10). In other words, the switch 940 can be arranged, for example, as a turntable or the like. In other instances, the switch can be manually rotated via a force exerted on a portion of the switch.

[1066] For example, as shown in FIG. 10, the switch 940 can be placed in a first angular position and/or orientation (e.g., in response to receiving a control signal) such that the support track portion 941 of the switch 940 is aligned with the first portion 921 of the support track 920 and the power rail portion 943 of the switch 940 is aligned with the first portion 931 of the power rail 930. Thus, a trolley (not shown in FIG. 10) can move along the first portion 921 of the support track 920 and one or more electrical collectors of the trolley can

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move along the first portion 931 of the power rail 930 and after reaching the ends thereof, the trolley can move onto and/or along the support track portion 941 and the power rail portion 943 of the switch 940. With the trolley suspended from and in electrical contact with the switch 940, the user can provide an input (e.g., an electrical and/or electronic input, a mechanical input, etc.) to move the switch 940 to a second angular position and/or orientation such that the support track portion 941 and the power rail portion 943 of the switch 940 are substantially aligned with, for example, the second portion 922 of the support track 920 and the second portion 932 of the power rail 930, respectively. In other instances, the switch 940 can be placed in a third angular position such that the support track portion 941 and the power rail portion 943 of the switch 940 are substantially aligned with, for example, the third portion 923 of the support track 920 and the third portion 933 of the power rail 930, respectively.

[1067] While the switch 940 is described above as being moved between the first angular position, the second angular position, and the third angular position, in other embodiments, the switch 940 can be moved to and/or between any suitable number of angular positions and/or orientations to align the support track portion 941 and the power rail portion 943 of the switch 940 with any suitable number of track portions and power rail portions, respectively. For example, in some embodiments, a support system can include two, three, four, five, six, seven, eight, nine, ten, or more track and power rail portions. Moreover, in such instances, the switch can include any suitable device and/or mechanism configured to rotate the switch 940 with sufficient precision to rotate the switch 940 through relatively small angular position changes (e.g., five degrees, 10 degrees, 15 degrees, 30 degrees, 45 degrees, etc.). Thus, in such embodiments, a trolley and one or more collector(s) thereof can be moved along any suitable portion of a support track and a power rail, respectively, and onto the support track portion 941 and power rail portion 943 of the switch 940, which in turn, can be placed in any suitable angular position to align the support track portion 941 and the power rail portion 943 of the switch 940 with any suitable portion of the support track and power rail, respectively.

[1068] FIG. 11 is a schematic illustration of a switch 1040 configured for use within a portion of a support system according to an embodiment. In some embodiments, the switch 1040 can be substantially similar, at least in part, to the switch 840 described above with reference to FIG. 9 and/or the switch 940 described above with reference to FIG. 10. In other

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embodiments, the switch 1040 can be similar to or substantially the same as any of the switches described herein. In this manner, the switch 1040 can be configured to at least temporarily support and/or suspend a trolley or the like (e.g., the trolley described in the '927 publication incorporated by reference hereinabove) and can provide a means and/or ability to "switch" between multiple support track portions of the support system (e.g., as described in detail above with reference to the switches 840 and/or 940).

[1069] The switch 1040 includes a support track portion 1041 and a power rail portion 1043, as described above with reference to the switches 840 and 940. In some embodiments, the switch 1040 can be substantially similar in form and/or function to the switch 740. For example, the support track portion 1041 of the switch 1040 is arranged and/or configured as an "I" beam from which a trolley can be suspended (e.g., as described in detail in the '927 publication) and the power rail portion 1043 is arranged and/or configured as a substantially hollow tube having at least one electrically conductive surface. The power rail portion 1043 is coupled to the support track portion 1041 and arranged such that the power rail portion 1043 is substantially parallel to the support track portion 1041. Moreover, as shown in FIG. 11, the power rail portion 1043 includes and/or is electrically connected to an electrical line feed 1046 configured to supply a flow of electric power to the power rail portion 1043.

[1070] As described above with reference to the switch 740, the switch 1040 also includes a guide structure 1047, a mounting structure 1048, and a drive system (not shown in FIG 11) configured to move the mounting structure 1048 relative to and/or along a path defined by the guide structure 1047. The guide structure 1047 and the mounting structure 1048 each can be any suitable shape, size, and/or configuration. In some embodiments, the guide structure 1047 and the mounting structure 1048 can be substantially similar in at least form and/or function to the guide structure 747 and mounting structure 748, respectively, described above with reference to FIG. 8. In the embodiment shown in FIG. 11, however, the guide structure 1047 and mounting structure 1048 can differ from the guide structure 747 and mounting structure 748, respectively, by being configured for rotational movement rather than translational movement. That is to say, the mounting structure 1048 can be a frame or the like rotatably coupled to and/or rotatably disposed on the guide structure 1047. As such, a motor, drive assembly, etc. can receive a signal from a controller (e.g., a controller included in the trolley, a remote controller manipulated by a user, and/or the like) and based on

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receiving an electronic signal and/or a flow of electric current can rotate the mounting structure 1048 along a rotational path defined by the guide structure 1047.

[1071] As described above with reference to the switch 740, the support track portion 1041 is coupled to and/or suspended from a coupling member 1049 of the mounting portion 1048. Accordingly, with the power rail portion 1043 coupled to the support track portion 1041 and with the support track portion 1041 coupled to and/or suspended from the coupling member 1049 movement of the mounting structure 1048 results in a similar movement of the support track portion 1041 and the power rail portion 1043.

[1072] As described above with reference to the portion of the support systems 800 and/or 900, the switch 1040 can be included in a support system including any suitable number of support track portions and power rail portions. In this manner, the switch 1040 can be disposed in such a support system to operably couple multiple track portions and/or multiple power rail portions. More specifically, the switch 1040 can be configured to move between any suitable number of angular (e.g., rotational) positions to "switch" and/or operably couple any suitable portion of the support track and any suitable portion of the power rail to allow the trolley to be moved therebetween. Thus, the switch 1040 can be configured to allow one or more trolleys to be switched from, for example, one tack or path to a different track or path.

[1073] Referring now to FIG. 12, a flowchart is shown illustrating a method 10 of using a body weight support system according to an embodiment. The body weight support system can be substantially similar to any of those described herein. For example, the body weight support system (also referred to herein as "support system") can be substantially similar to the support system 100, 200, 300, 400, 500, 600, 800, and/or 900 described herein. The support system can include a support track having at least a first support track portion and a second support track portion, a power rail having at least a first power rail portion and a second power rail portion, and a switch. The support track portions and the power rail portions can be substantially similar to any of those described herein. The switch can include at least one support track portion and at least one power rail portion. In some embodiments, the switch can be substantially similar to any of the switches 140, 340, 440, 540, 640, 740, 840, 940, and/or 1040 described herein. In this manner, the support system can be used to support and/or suspend a trolley, configured to support at least a portion of a body weight of a patient, and the switch can be transitioned between any suitable number of configurations

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and/or positions to operably couple one or more discontinuous portions of the support track and power rail, as described in further detail herein.

[1074] The method 10 includes moving a trolley from a first position, in which the trolley is movably suspended from the first support track portion and is in electrical contact with the first power rail portion, to a second position, in which the trolley is movably suspended from the support track portion of the switch and is in electrical contact with a power rail portion of the switch, at 11. For example, in some embodiments, the support track portion and the power rail portion of the switch can be substantially aligned with, for example the first support track portion and the first power rail portion, respectively, when the switch is in the first configuration. Accordingly, trolley can receive a flow of electrical power from at least one of the first power rail portion or the power rail portion of the switch and in response, the trolley can be advanced from the first position to the second position. In some embodiments, the arrangement of the trolley, the first power rail portion, and the power rail portion of the switch can be such that the trolley receives a substantially uninterrupted flow of electric power. For example, in some embodiments, the trolley can include two or more electric collectors or the like, as described above with reference to the trolley 210 in FIG. 2. In addition, the arrangement of the trolley, the first support track portion, and the support track portion of the switch can be such that a drive assembly or the like of the trolley is advanced along the first support track portion and onto or along the support track portion of the switch as the trolley is moved from the first position to the second position.

[1075] The switch is transitioned from a first configuration to a second configuration, at 12. In some embodiments, for example, the support track portion of the switch and the power rail portion of the switch can each be aligned with the first support track portion and the first power rail portion, respectively. Thus, as described above, the trolley can be advanced from the first position to the second position. After the trolley is suspended from the switch, the switch can be transitioned from the first configuration to the second configuration. As described above with reference to the support systems and/or switches above, the support track portion of the switch and the power rail portion of the switch can each be aligned with the second support track portion and the second power rail portion, respectively. In some embodiments, transitioning the switch can include moving the switch in a translational motion or a rotational motion from the first configuration to the second configuration. In

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other embodiments, transitioning the switch from the first configuration to the second configuration can include reconfiguring and/or rearranging the switch in any suitable manner.

[1076] The trolley is then moved from the second position to a third position such that the trolley is movably suspended from the second support track portion and is in electrical contact with the second power rail portion, at 13. As described above with reference to the support systems and/or switches herein, transitioning the switch from the first configuration to the second configuration can include transitioning the switch in any suitable manner to align the support track portion of the switch and the power rail portion of the switch with any suitable portion of the support track and/or power rail, respectively. For example, in some embodiments, a support system can include two support track portions and power rail portions, three support track portions and power rail portions, four support track portions and power rail portions, five support track portions and power rail portions, etc.

[1077] Although not specifically shown or described herein, the support systems 100, 200, 300, 400, 500, 600, 800, and/or 900 can include any suitable support track and/or power rail. For example, in some embodiments, any of the support systems and/or portions thereof described herein can include one or more support track portions and one or more power rail portions that are substantially similar to the support track portions 741, 751, and/or 1041 (e.g., an "I" beam configuration) and the power rail portions 743, 753, and/or 1043 (e.g., a hollow tube having one or more conductive surfaces), respectively.

[1078] In some embodiments, the power rails and/or power rail portions can be coupled to one or more power sources configured to provide a flow of electrical current (e.g., electrical power) to the power rails. In some embodiments, the power rails can include any suitable transformer, converter, conditioner, capacitor, resistor, insulator, and/or the like such that the power rail can receive the flow of electrical current from the power source and transfer at least a portion of the flow of electrical current to the trolley. The power rails can include one or more electrical conductors to deliver, for example, single or multiphase electrical power to one or more trolleys. For example, in some embodiments, a power rail can be a substantially tubular rail configured to receive a conductive portion of an electronic system of the trolley. More specifically, the power rail can include one or more conductive surfaces disposed within an inner portion of the tubular rail along which a conductive member of the electronic system (e.g., an electrical collector) moves. In this manner, the power rails can transmit a flow of electrical current from the power source to the electronic

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system of the trolley, as described above. Furthermore, the arrangement of the support track portions, power rail portions, and trolleys is such that movement of a trolley along the length of the support track portion is not hindered or limited by a bundle of cables and/or other restrictions associated with providing electrical power to the trolley, as described above with reference to known support systems.

[1079] Any of the embodiments described herein can be configured to move a switch between positions via a motor, actuator, and/or any other electromechanical device. The motor, actuator, or other electromechanical device may be activated by a user via a wired or a wireless switch and/or control device. Any of the embodiments described herein can include one or more safety mechanism to prevent switching when a trolley is passing over a switch. For example, in some embodiments, a location of the trolley(s) on the track can be determined and the switching mechanism can be blocked if the trolley approaches the switch. Alternatively, the switch can have optic, magnetic, or electrical sensors to sense that the trolley is approaching the switch and to block the switching operation. Similarly, the embodiments described herein can prevent a trolley from traveling to the switch while the switch is in an undesirable position such that a portion of the support track is open or the like. In some embodiments, for example, a switch can include a mechanical barrier, which can move against the open track, or by an electro-mechanical operation, which is configured to set a barrier once the track is open, or when the switch is moving. Moreover, any of the embodiments described herein can be configured to send and/or provide feedback to a user, an operator, a patient, and/or the like that a switch operation is completed, and it is safe to move. The feedback can be given via an optical, audio, tactile, and/or other indication.

[1080] While various embodiments have been described above, it should be understood that they have been presented by way of example only, and not limitation. Where schematics and/or embodiments described above indicate certain components arranged in certain orientations or positions, the arrangement of components may be modified. While the embodiments have been particularly shown and described, it will be understood that various changes in form and details may be made. Although various embodiments have been described as having particular features and/or combinations of components, other embodiments are possible having a combination of any features and/or components from any of embodiments as discussed above.

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[1081] Where methods and/or events described above indicate certain events and/or procedures occurring in certain order, the ordering of certain events and/or procedures may be modified. Additionally, certain events and/or procedures may be performed concurrently in a parallel process when possible, as well as performed sequentially as described above.

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What is claimed:

1. A body weight support system, comprising:

a support track configured to movably suspend a trolley therefrom, the trolley configured to support at least a portion of a body weight of a patient;

a power rail coupled to the support track, at least a portion of the power rail in electrical contact with the trolley; and

a switch having a support track portion and a power rail portion, the switch configured to transition between a first configuration, in which a first portion of the support track and the support track portion of the switch define a first path, and a second configuration, in which a second portion of the support track and the support track portion of the switch define a second path, the trolley configured to receive a flow of electric power from at least one of the power rail or the power rail portion of the switch operable to move the trolley along the first path when the switch is in the first configuration and along the second path when the switch is in the second configuration.

2. The body weight support system of claim 1, wherein the first portion of the support track is discontinuous from the second portion of the support track.

3. The body weight support system of claim 1, wherein transitioning the switch from the first configuration to the second configuration includes moving the switch in a translational motion from a first position to a second position.

4. The body weight support system of claim 1, wherein transitioning the switch from the first configuration to the second configuration includes moving the switch in a rotational motion from a first position to a second position.

5. The body weight support system of claim 1, wherein the switch is configured to transition between the first configuration and the second configuration while the trolley is movably suspended from the support track.

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6. The body weight support system of claim 1, wherein the switch is configured to transition between the first configuration and the second configuration while the trolley is movably suspended from the support track portion of the switch.

7. The body weight support system of claim 1, wherein the trolley includes a first electrical collector and a second electrical collector, at least one of the first electrical collector or the second electrical collector being maintained in electrical contact with at least one of the power rail or the power rail portion of the switch.

8. A body weight support system, comprising:

a support track having a first track portion and a second track portion discontinuous from the first track portion;

a power rail having a first power rail portion and a second power rail portion discontinuous from the first power rail portion, the first power rail portion coupled to the first track portion, the second power rail portion coupled to the second track portion;

a switch having a support track portion and a power rail portion, the switch configured to transition between a first configuration, in which the support track portion of the switch is aligned with the first track portion and the power rail portion of the switch is aligned with the first power rail portion, and a second configuration, in which the support track portion of the switch is aligned with the second track portion and the power rail portion of the switch is aligned with the second power rail portion; and

a trolley configured to support at least a portion of a body weight of a patient, the trolley configured to be moved from a first position to a second position while the switch is in the first configuration, the trolley being movably suspended from the first track portion and in electrical contact with the first power rail portion when in the first position, the trolley being movably suspended from the support track portion of the switch and in electrical contact with the power rail portion of the switch when in the second position,

the trolley configured to be moved from the second position to a third position after the switch is transitioned from the first configuration to the second configuration, the trolley being movably suspended from the second track portion and in electrical contact with the second power rail portion when in the third position.

9. The body weight support system of claim 8, wherein the trolley includes a first electrical collector and a second electrical collector, at least one of the first electrical collector

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or the second electrical collector is in electrical contact with at least one of the first power rail portion, the second power rail portion, or the power rail portion of the switch as the trolley is moved between the first position, the second position, and the third position.

10. The body weight support system of claim 8, wherein the switch is in a first switch position relative to the support track when in the first configuration and is in a second switch position relative to the support track when in the second configuration.

11. The body weight support system of claim 10, wherein the first switch position is a first translational position and the second switch position is a second translational position.

12. The body weight support system of claim 10, wherein the first switch position is a first rotational position and the second switch position is a second rotational position.

13. The body weight support system of claim 8, wherein the support track includes a third track portion discontinuous from the first track portion and the second track portion, the power rail includes a third power rail portion coupled to the third track portion,

the switch has a third configuration, in which the support track portion of the switch is aligned with the third track portion and the power rail portion of the switch is aligned with the third power rail portion,

the trolley configured to be moved from the second position to a fourth position after the switch is placed in the third configuration, the trolley being movably suspended from the third track portion and in electrical contact with the third power rail portion when in the fourth position.

14. The body weight support system of claim 8, wherein the support track portion of the switch is a first support track portion of the switch and the power rail portion of the switch is a first power rail portion of the switch, the switch including a second support track portion and a second power rail portion,

the first support track portion of the switch and the first power rail portion of the switch are aligned with the first track portion and the first power rail portion, respectively, when the switch is in the first configuration,

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the second support track portion of the switch and the second power rail portion of the switch are aligned with the second track portion and the second power rail portion, respectively, when the switch is in the first configuration.

15. The body weight support system of claim 14, wherein the switch has a third configuration, the second support track portion of the switch and the second power rail portion of the switch are aligned with the first track portion and the first power rail portion, respectively, when the switch is in the third configuration.

16. A method, comprising:

moving, from a first position to a second position, a trolley configured to support at least a portion of a body weight of a patient, the trolley being movably suspended from a first support track portion and being in electrical contact with a first power rail portion when in the first position, the trolley being movably suspended from a support track portion of a switch and being in electrical contact with a power rail portion of the switch when in the second position;

transitioning the switch from a first configuration to a second configuration, the support track portion and the power rail portion of the switch being aligned with the first support track portion and the first power rail portion, respectively, when the switch is in the first configuration, the support track portion of the switch being aligned with a second support track portion discontinuous from the first support track portion and the power rail portion of the switch being aligned with a second power rail portion discontinuous from the first power rail portion when the switch is in the second configuration; and

moving the trolley from the second position to a third position, the trolley being movably suspended from the second support track portion and being in electrical contact with the second power rail portion when in the third position.

17. The method of claim 16, wherein the trolley includes first electrical collector and a second electrical collector,

the moving of the trolley from the first position to the second position being such that at least one of the first electrical collector or the second electrical collector is in electrical contact with at least one of the first power rail portion or the power rail portion of the switch as the trolley is moved from the first position to the second position.

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18. The method of claim 16, further comprising:

withholding electrical power from the trolley when the switch is transitioned between the first configuration and the second configuration.

19. The method of claim 16, wherein the transitioning the switch from the first configuration to the second configuration is prior to moving the trolley from the first position to the second position.

20. The method of claim 16, wherein the transitioning the switch from the first configuration to the second configuration is after moving the trolley from the first position to the second position.

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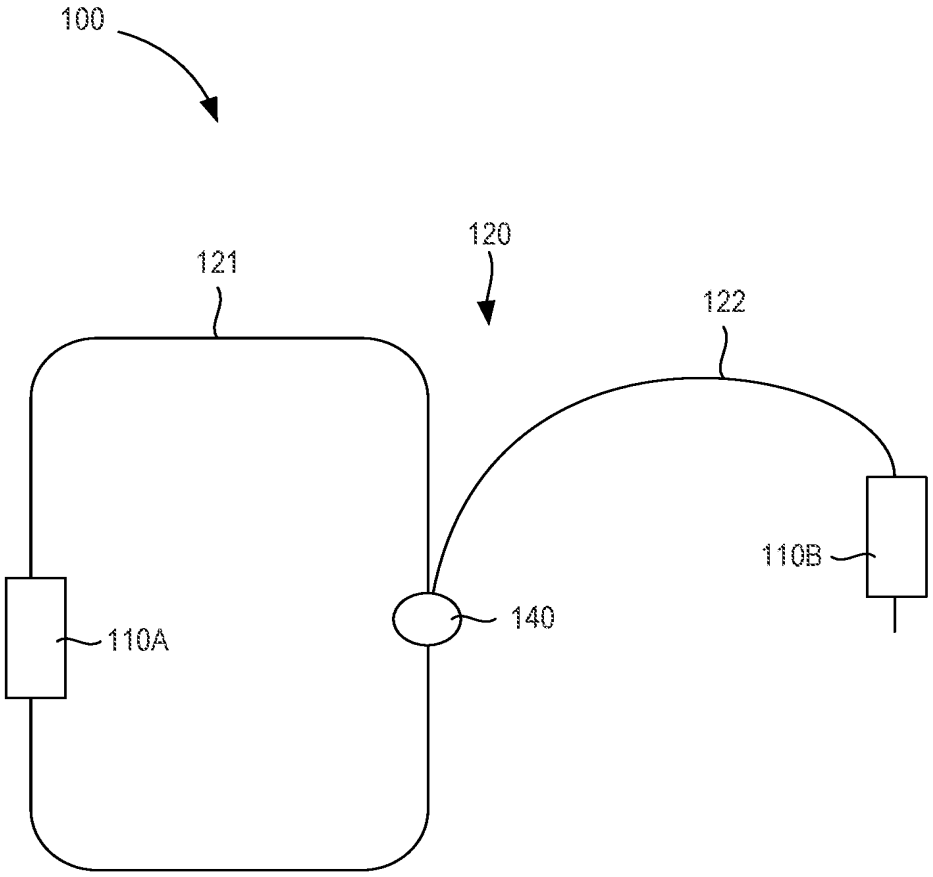


FIG. 1

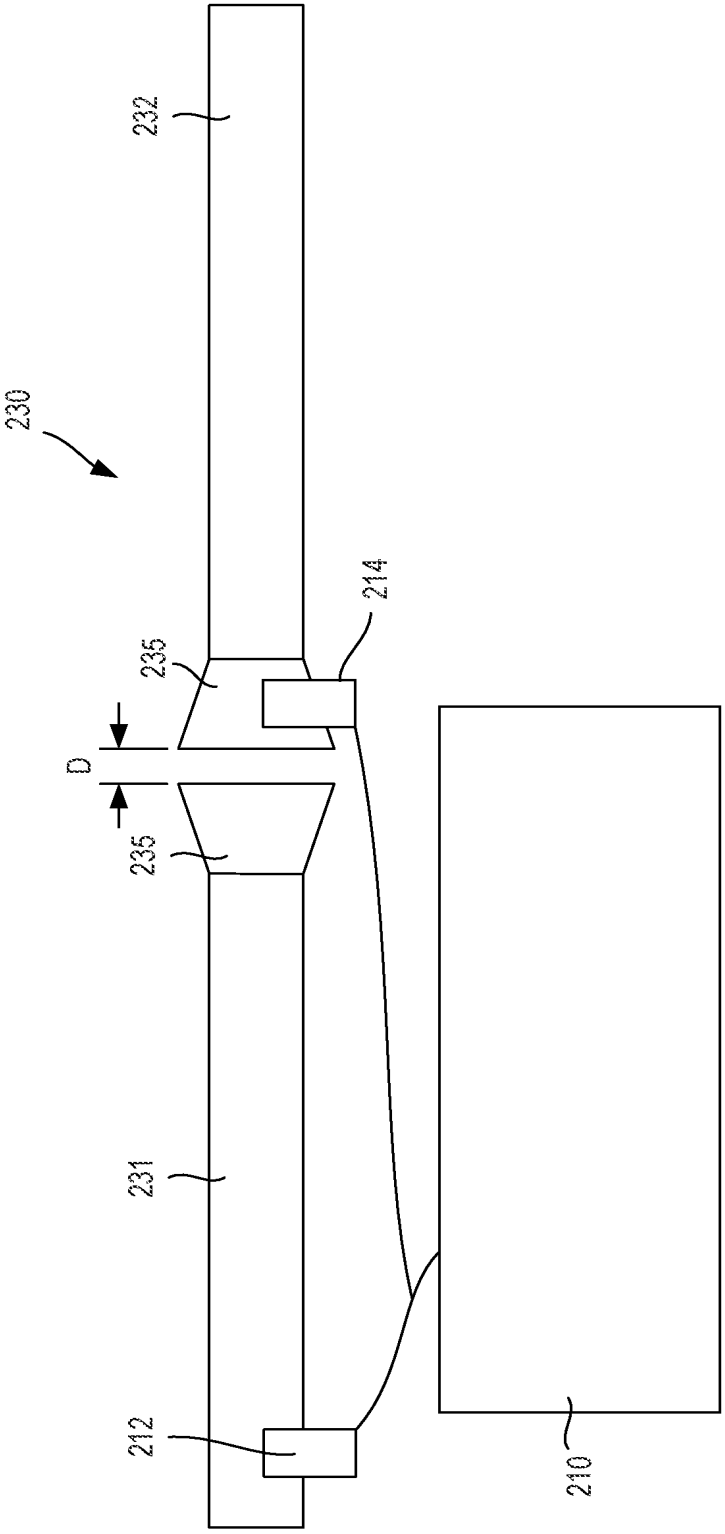


FIG. 2

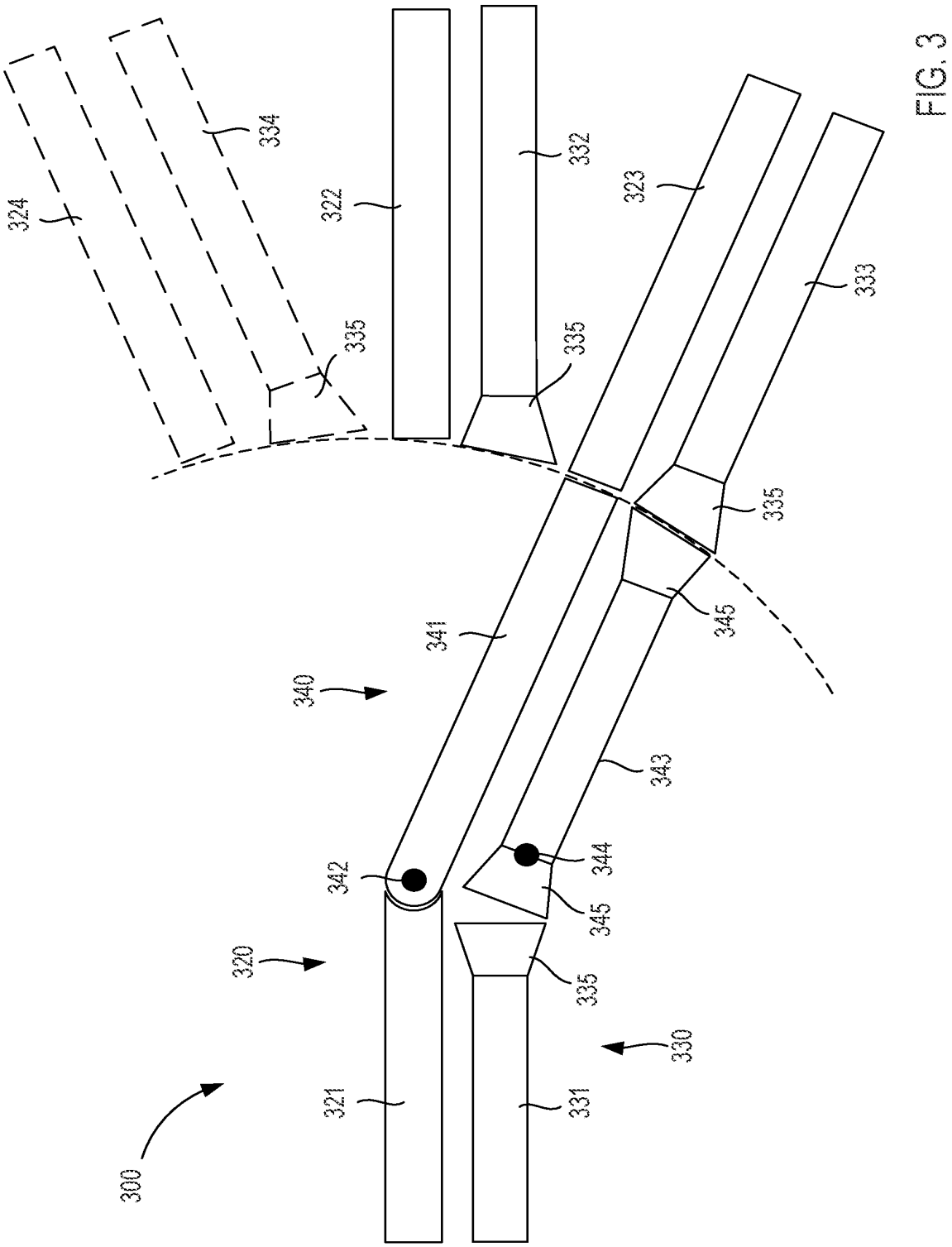

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FIG. 3

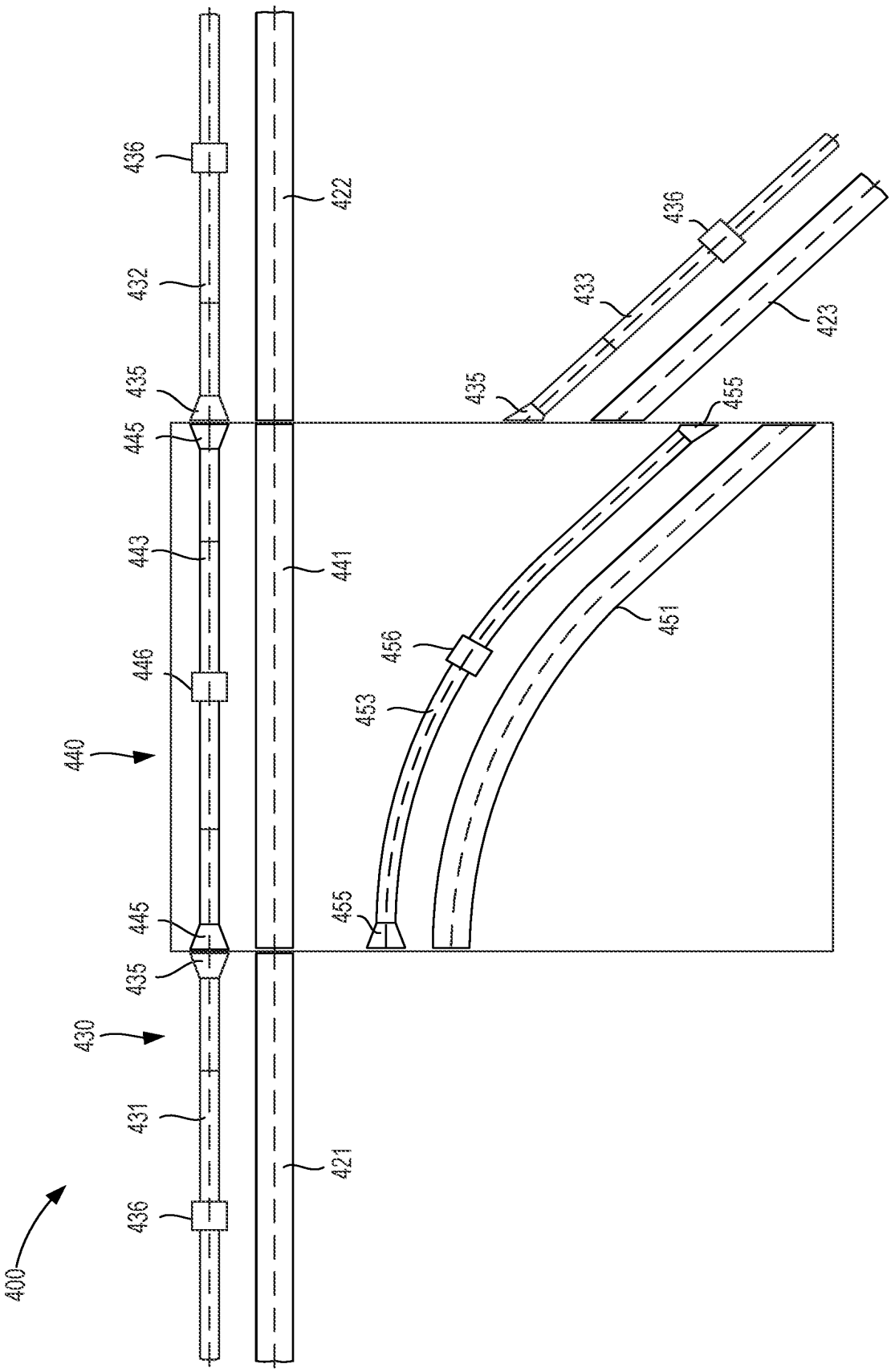

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FIG. 4

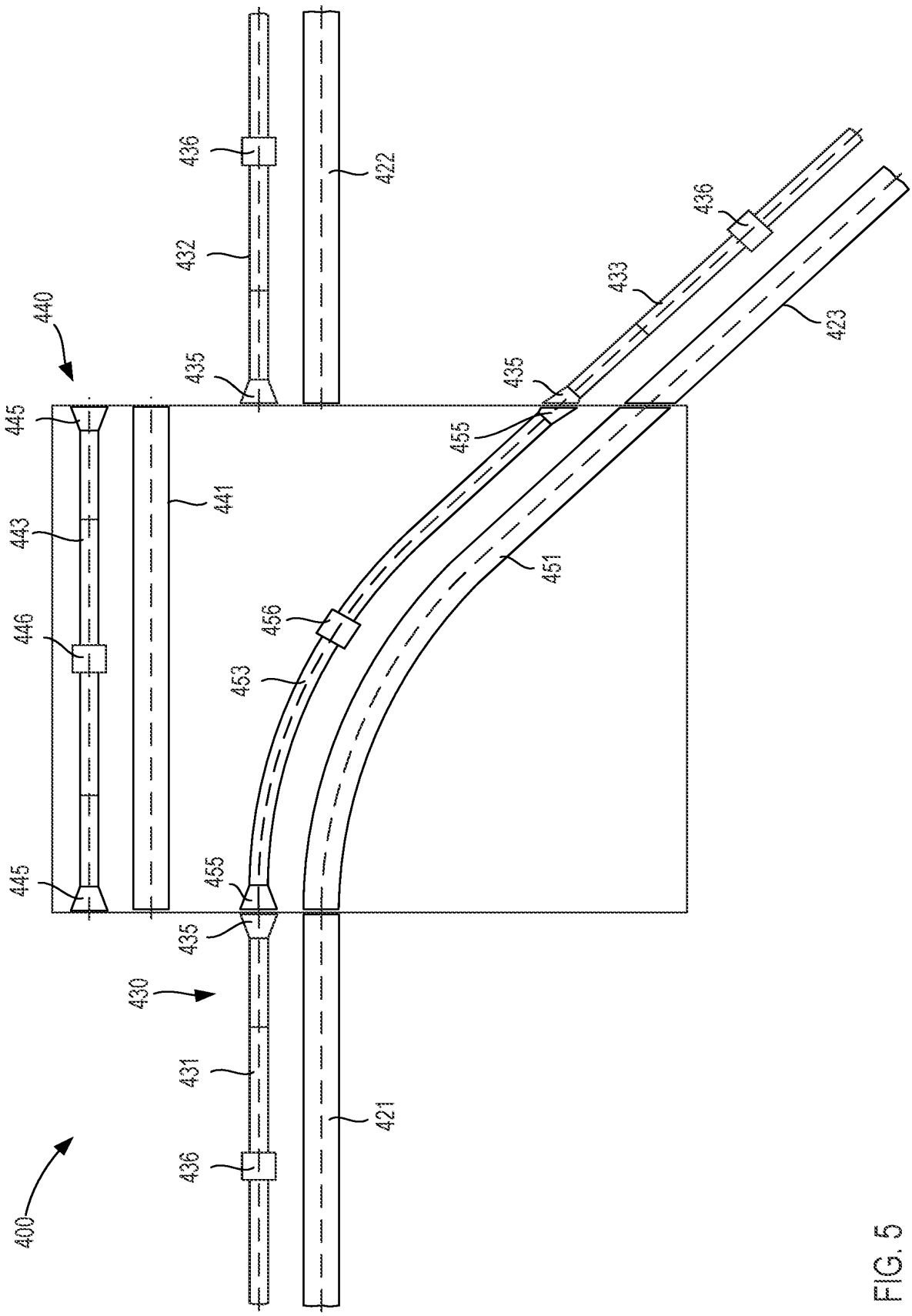

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FIG. 5

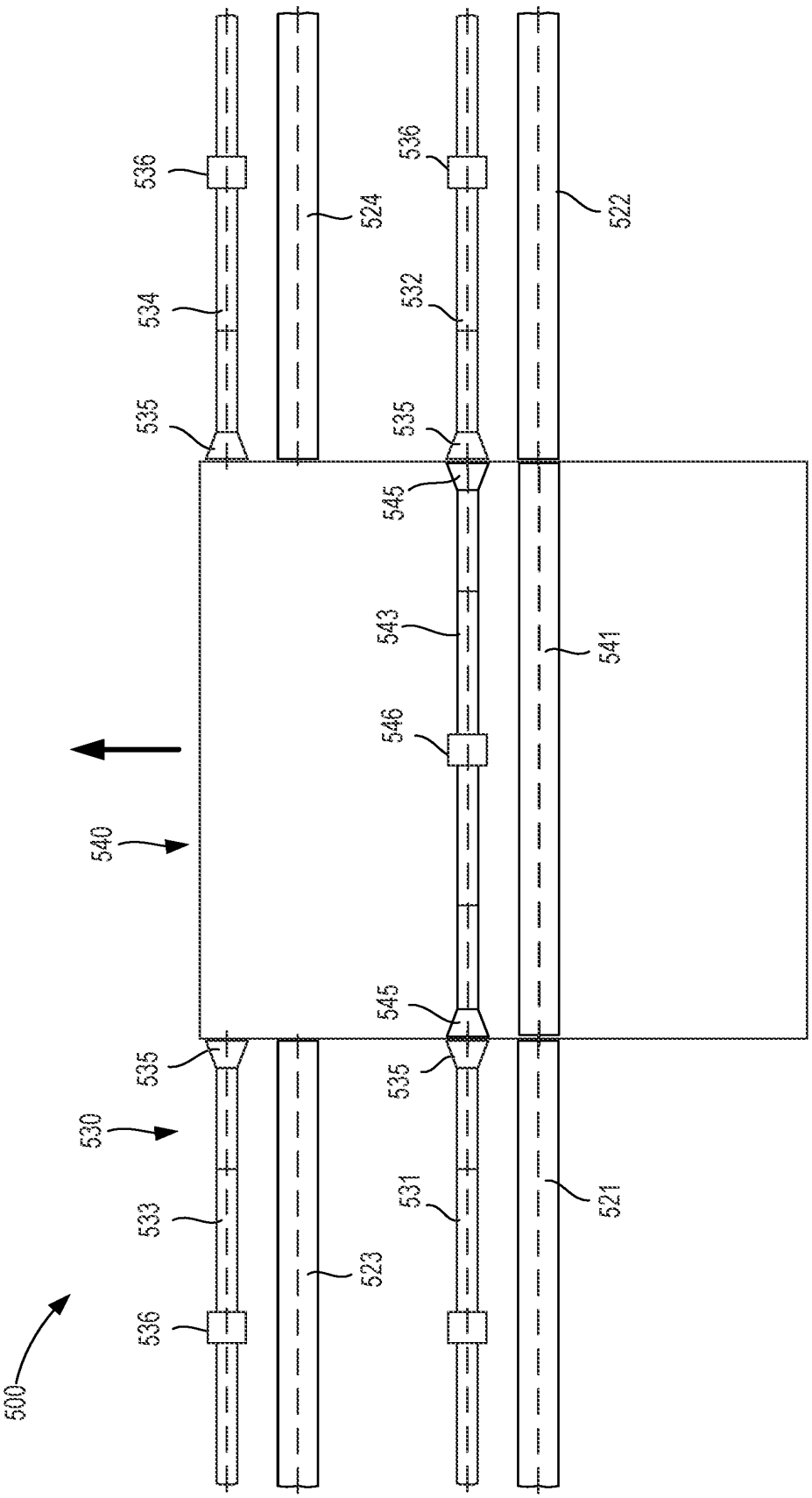

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FIG. 6

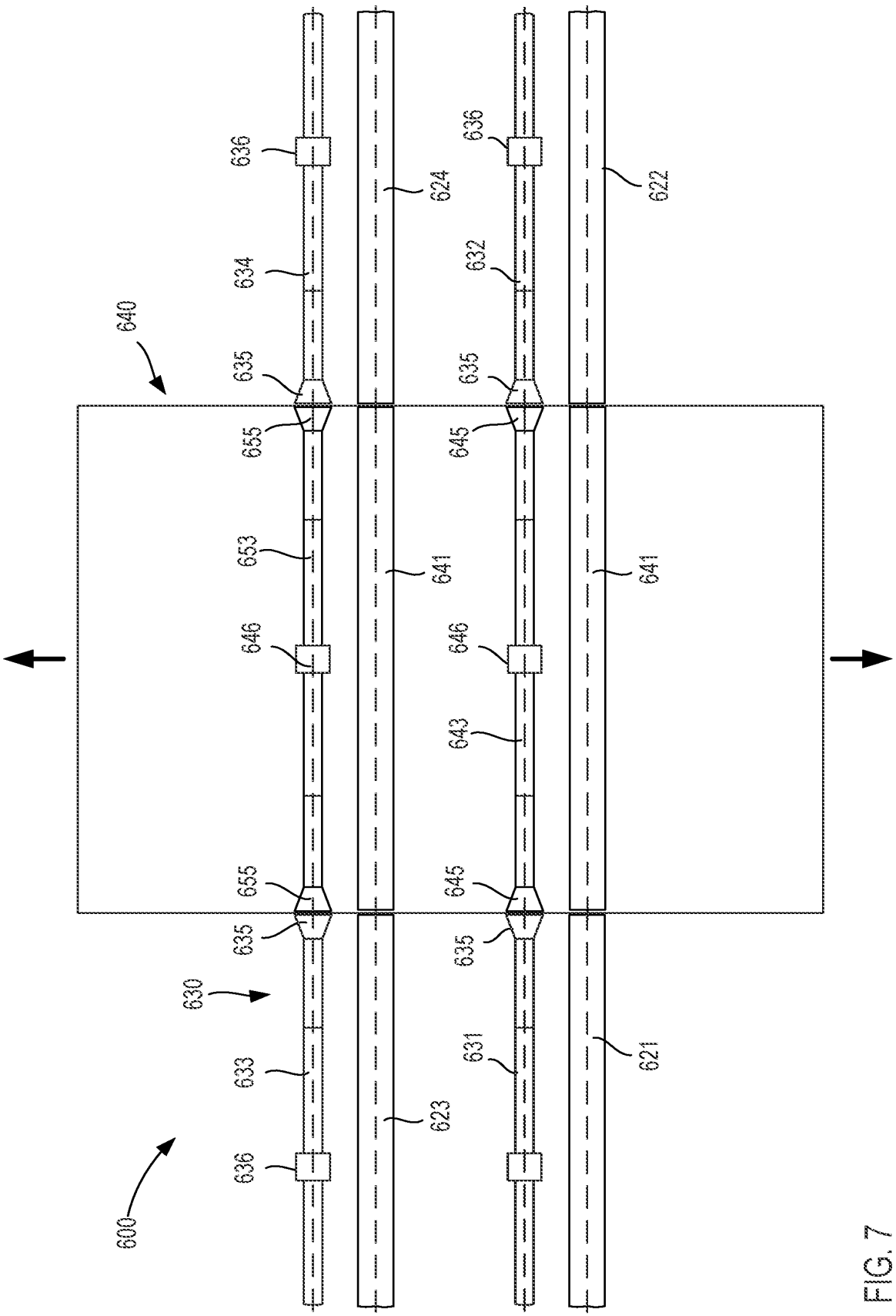

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FIG. 7

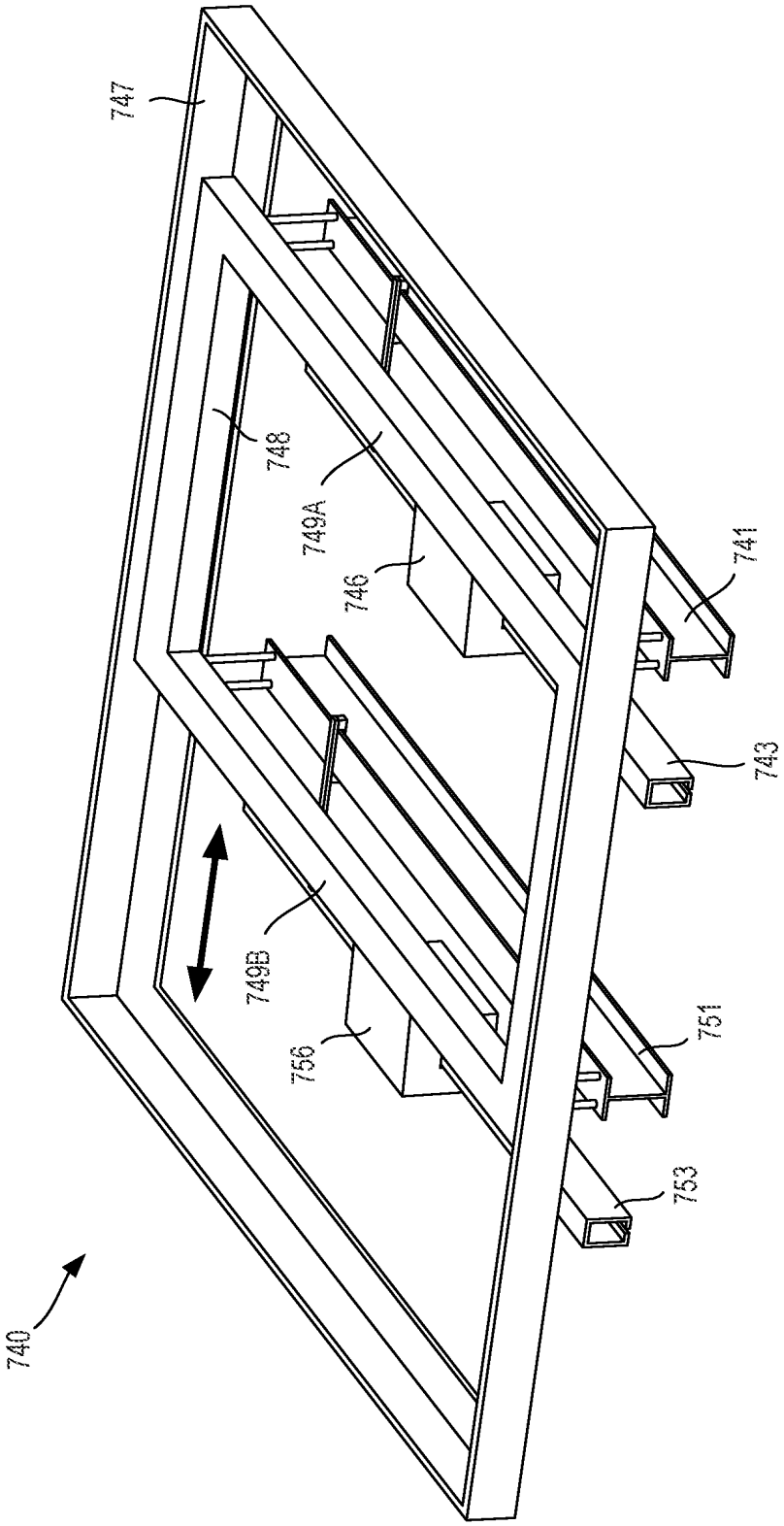


FIG. 8

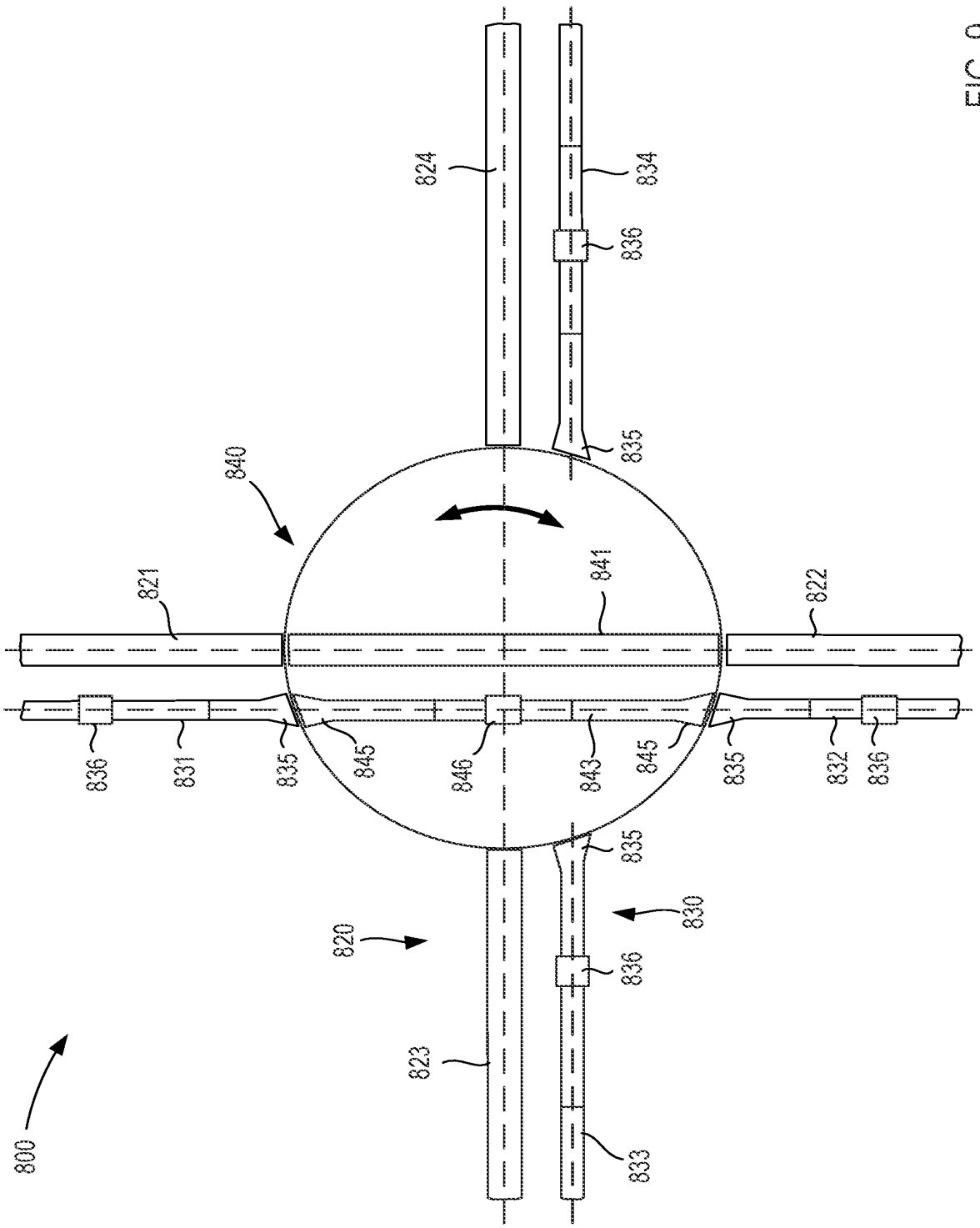
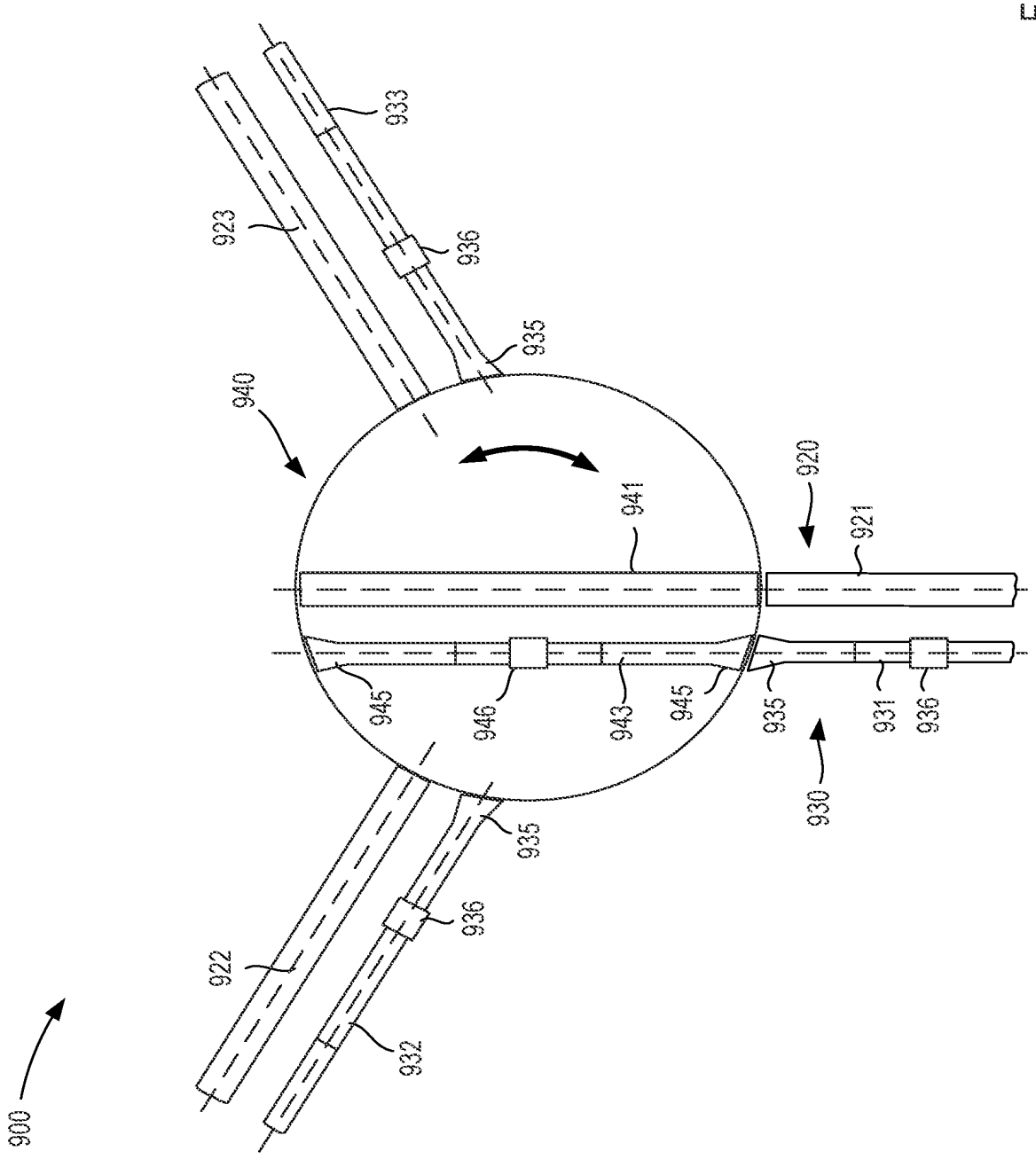

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FIG. 9

FIG. 10



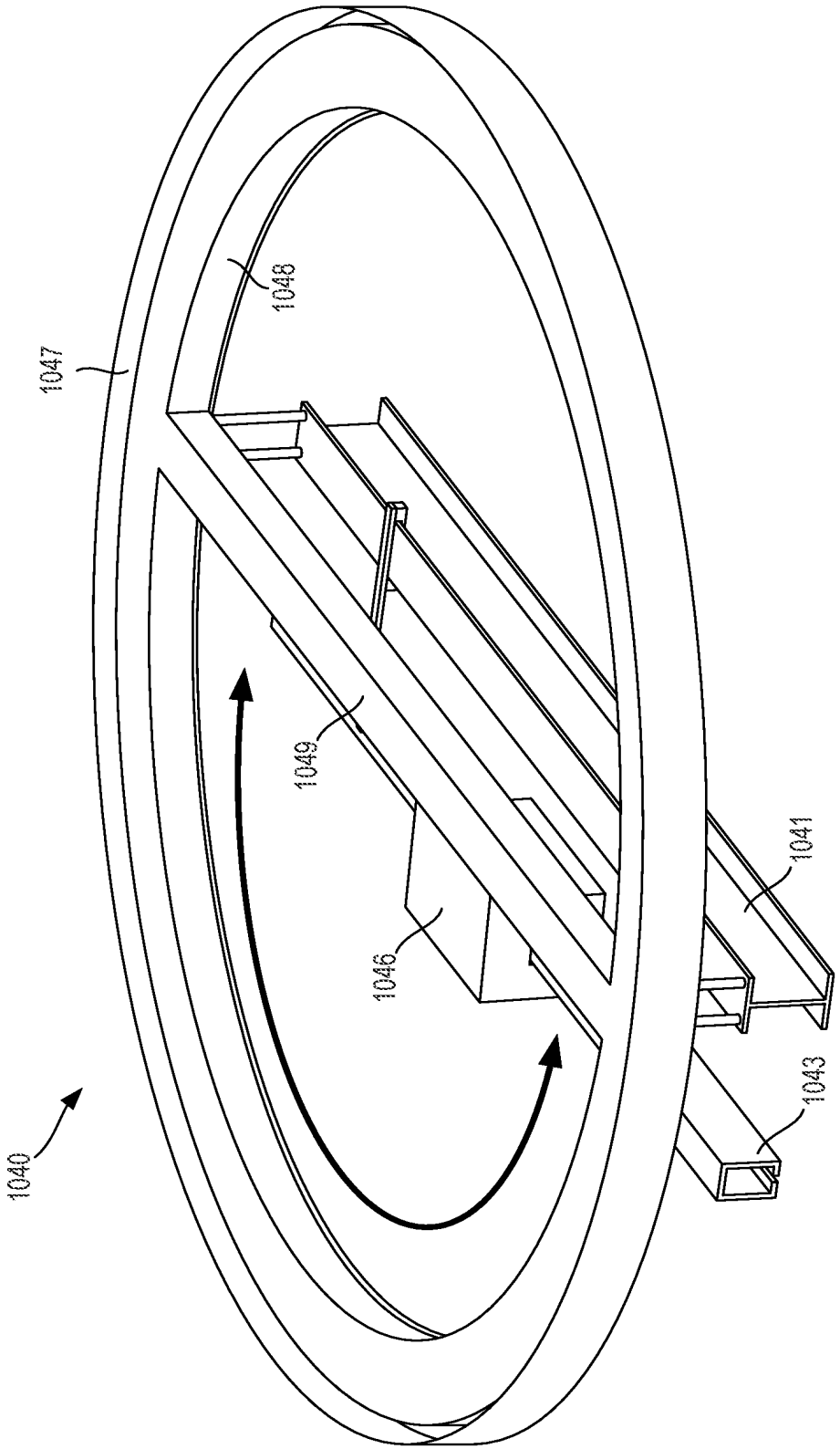


FIG. 11

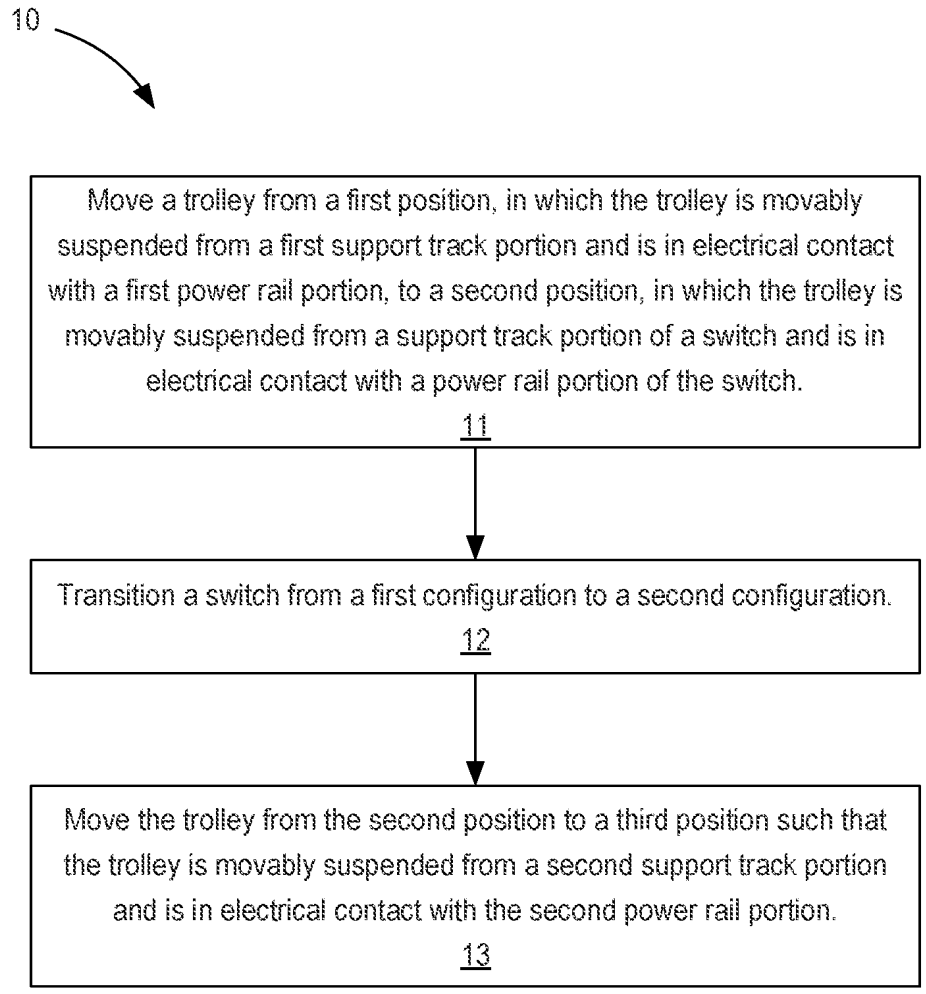

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Move a trolley from a first position, in which the trolley is movably suspended from a first support track portion and is in electrical contact with a first power rail portion, to a second position, in which the trolley is movably suspended from a support track portion of a switch and is in electrical contact with a power rail portion of the switch.
11
Transition a switch from a first configuration to a second configuration.
12
Move the trolley from the second position to a third position such that the trolley is movably suspended from a second support track portion and is in electrical contact with the second power rail portion.
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FIG. 12

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/61552

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61G 7/10; A61H 1/00, 1/02, 3/00; B61J 1/06 (2017.01)
CPC - A61G 7/1042; A61H 1/0262, 3/008; B61J 1/06; B65G 9/008
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) Classifications: A61G 7/053, 7/10, 7/14; A61H 1/00, 1/02, 3/00; A63B 23/04; B61J 1/00, 1/02, 1/04, 1/06; B65G 9/00 (2016.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC Classifications: A61G 7/053, 7/10, 7/1042; A61H 1/02, 1/0237, 1/0262, 3/00, 3/008; A63B 23/04; B61J 1/00, 1/02, 1/04, 1/06; B65G 9/00, 9/008

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); patient, body weight, lift, support, transport, rail, track, trolley, suspend, overhead, ceiling, switch, change, select, different, modify, path, track, turntable, shift, translate, slide, rotate, electric, current, power, conduct, collector, contact

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2015/0283921 A1 (JOY MM DELAWARE, INC) October 8, 2015; figures 3A, 3B, 10A-10D; paragraphs [0035]-[0037], [0042]	1-7 --- 8-13, 16-20
Y	CN 104308861 A (JIANG K. et al.) January 28, 2015; abstract; figures 1, 2; paragraph [0058]	8-13, 16-20
A	US 6,315,138 B1 (DYSON D. J.) November 13, 2001; entire document	1-20
A	US 2,360,505 A (MEDENWALD A. L. et al.) October 17, 1944; entire document	1-20
A	US 2,211,220 A (VERPLANCK P.) August 13, 1940; entire document	1-20
A	US 764,781 A (SUMNER W. J.) July 12, 1904; entire document	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 January 2017 (08.01.2017)	31 JAN 2017
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/745,830	01/20/2013	Arkady Glukhovsky	BION-051/00US 307799-2244	6272

58249 7590 06/15/2015

COOLEY LLP
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EXAMINER	
KURILLA, ERIC J	

ART UNIT	PAPER NUMBER
3673	

NOTIFICATION DATE	DELIVERY MODE
06/15/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zpatdcdocketing@cooley.com

Office Action Summary	Application No. 13/745,830	Applicant(s) GLUKHOVSKY ET AL.	
	Examiner ERIC KURILLA	Art Unit 3673	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03/27/2015*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-21* is/are pending in the application.

5a) Of the above claim(s) *9-16* is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-8 and 17-21* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on _____ is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Election/Restrictions

2. Applicant's election without traverse of Species I (Figs. 2-34), Claims 1-8 and 17-21 in the reply filed on 03/27/2015 is acknowledged. The restriction is deemed proper, and is therefore made FINAL.

Claim Objections

3. Claim 5 is objected to because of the following informalities: "the drive assembly" lacks proper antecedent bases. Examiner is assuming that claim 5 is to depend from claim 4. Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claim 7 is rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 7 recites the limitation the trolley is configured to be powered **only** from the powered conductor. Applicant's specification shows that the trolley is also powered from power source 1610 in para. [1066]. The trolley cannot be **only** powered from the power rail when the trolley is also powered from the power source. Appropriate correction is required.

6. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

> The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claim 2 is rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

8. Claim 2 recites the limitation "passive coupling" and “active coupling”. It is unclear what these limitations are referring to. The drawings and specification describe many couplings for the patient attachment. Examiner is assuming that couplings 2842 and 2812 are the couplings being described in the claim. What constitutes an "active coupling" and what constitutes a "passive coupling"? Both of these couplings can reasonably be considered active since they both allow for pivoting movement (2812 pivots via 2841). Appropriate correction is required.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

10. Claims 1-8, 17, and 20-21 are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Hidler (US PG-Pub 2008/0287268).

Regarding claim 1, Hidler discloses an apparatus (see Fig. 1), comprising: a trolley (30) configured to be movably suspended from a track (40), a powered conductor (326) operatively coupled to the track (via 36 and 38), the trolley configured to be electrically coupled to the powered conductor; at least one patient attachment (66, 220, 304, 306) coupled to the trolley, the patient support assembly configured to support a single patient; and a control system coupled to at least one of the trolley or the powered conductor.

Regarding claim 2, as best understood, Hidler discloses wherein the patient attachment includes one of a passive coupling (302) and an active coupling (306) configured to be coupled to a patient harness.

Regarding claim 3, Hidler discloses wherein the trolley includes a patient support system, the patient support system configured to actively support a patient (see Fig. 3).

Regarding claim 4, Hidler discloses wherein the trolley includes a drive assembly (50) and a torque transfer assembly (52), the drive assembly and the torque transfer assembly being driven simultaneously.

Regarding claim 5, Hidler discloses the trolley including a plurality of wheels (32 and 34), the wheels disposed above the drive assembly when in an operative configuration.

Regarding claim 6, Hidler discloses the trolley including a plurality of wheels (32 and 34), the wheels disposed above at least a portion of the track (see Fig. 12).

Regarding claim 7, Hidler discloses wherein the trolley is configured to be powered only from the powered conductor (see wires in Fig. 4).

Regarding claim 8, Hidler discloses wherein the trolley is configured to be moved from a first position at an end of the track and a second position spaced apart from the end of the track (see Fig. 3).

Regarding claim 17, Hidler discloses An apparatus, comprising: a housing (3500); a drive element (3334) disposed at least partially within the housing; a wheel

assembly (3400) coupled to the drive element and disposed at least partially within the housing; and a patient support assembly (66, 220, 304, 306) coupled to the housing, the patient support assembly configured to dynamically support a body weight of a patient.

Regarding claim 20, Hidler discloses further comprising at least one of a clutch or a brake associated with the drive element configured to inhibit movement of the drive element (see [0045]).

Regarding claim 21, Hidler discloses further comprising a second drive element coupled to the patient support assembly, the second drive element configured to dynamically support the patient (see [0071], "winch motor").

Claim Rejections - 35 USC § 103

11. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

12. Claims 18 and 19 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Hidler (US PG-Pub 2008/0287268) in view of Maurer (US Patent No. 7,137,771).

Regarding claim 18, Hidler does not disclose a light source coupled to the housing, the light source configured to project a light path on a surface opposite the

housing. Maurer teaches a light source (16) coupled to a housing (see Fig. 5), the light source configured to project a light path on a surface opposite the housing (see abstract). Hidler and Maurer are analogous art because they are from the same field of endeavor, i.e. trolleys. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the housing of Hidler with the light source of Maurer. The motivation would have been to enhance the operating safety especially under conditions of poor visibility as taught by Maurer.

Regarding claim 19, Maurer teaches that the light source is configured to illuminate a target location on a surface opposite the housing (see Fig. 5).

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ERIC KURILLA whose telephone number is (571)270-7294. The examiner can normally be reached on Monday-Thursday 7:30AM-6:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pete Cuomo can be reached on 571-272-6856. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/E. K./
Examiner, Art Unit 3673

/Nicholas Polito/
Primary Examiner, Art Unit 3673

6/1/2015

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/745,830	01/20/2013	Arkady Glukhovsky	BION-051/00US 307799-2244	6272

58249 7590 12/17/2015

COOLEY LLP
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1299 Pennsylvania Avenue, NW
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Washington, DC 20004

EXAMINER	
KURILLA, ERIC J	

ART UNIT	PAPER NUMBER
3673	

NOTIFICATION DATE	DELIVERY MODE
12/17/2015	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zpatdcdocketing@cooley.com

Office Action Summary	Application No. 13/745,830	Applicant(s) GLUKHOVSKY ET AL.	
	Examiner ERIC KURILLA	Art Unit 3673	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09/11/2015*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-8 and 17-21* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-8 and 17-21* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

In response to remarks filed 09/11/2015

Status of Claims

- ***Claims 1-8 and 17-21 are pending;***
- ***Claims 1, 2, 5, 8, and 17 are currently amended; claims 3, 4, 6, 7, and 18-21 were previously presented;***
- ***Claims 1-8 and 17-21 are rejected herein.***

Response to Arguments

1. Applicant's arguments with respect to claims 1 and 17 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 1-3 and 6-8 are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Bergenstrale et al (US PG-Pub 2012/0000876), hereinafter "Bergenstrale." Regarding claim 1, Bergenstrale discloses an apparatus (100), comprising:

a trolley (104 and 106) configured to be movably suspended from a track (102), a powered conductor (114) operatively coupled to the track (see Fig. 6), the powered conductor being substantially parallel to the track (see Fig. 6), the powered conductor including at least one conductive surface (see Fig. 6), a portion of the trolley (106) being in contact with the at least one conductive surface to electrically couple the trolley to the powered conductor (see para. [0023] and para. [0028]), the portion of the trolley configured to move along the at least one conductive surface when the trolley is moved along the track;

at least one patient attachment (110, see para. [0024]) coupled to the trolley, the at least one patient attachment support assembly configured to support a single patient; and

a control system (112) coupled to the trolley and at least operably coupled to the powered conductor.

Regarding claim 2, Bergenstrale discloses wherein the patient attachment includes one of a passive coupling (connection between 104 and 108) and an active coupling (connection between 110 and 108), the passive coupling configured to be coupled to a tether to couple the patient attachment to the trolley, the active coupling configured to be coupled to a patient harness.

Regarding claim 3, Bergenstrale discloses wherein the trolley includes a patient support system, the patient support system configured to actively support a patient (see Fig. 1 and para. [0024]).

Regarding claim 6, Bergenstrale discloses the trolley including a plurality of wheels (144a and 144b), at least a portion of the plurality of wheels disposed above at least a portion of the track (see Fig. 2).

Regarding claim 7, Bergenstrale discloses wherein the trolley is configured to be powered only from the powered conductor (see at least para. [0023]).

Regarding claim 8, Bergenstrale discloses wherein the trolley is configured to be moved from a first position at an end of the track to a second position spaced apart from the end of the track (see all Figs.).

Claim Rejections - 35 USC § 103

4. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 4, 5, 17, 20, and 21 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Bergenstrale et al. (US PG-Pub 2012/0000876) hereinafter "Bergenstrale" in view of Hidler (US PG-Pub 2008/0287268).

Regarding claim 4, Bergenstrale discloses wherein the trolley includes a drive assembly (see “motor” in para. [0027]). Bergenstrale does not show a torque transfer assembly, the drive assembly and the torque transfer assembly being driven

simultaneously. Hidler teaches a torque transfer assembly (52), a drive assembly (50) and the torque transfer assembly being driven simultaneously. Bergenstrale broadly points to a "motor" powering the trolley system in order to move along the rail. Hidler shows that it is well known in the art to provide a torque transfer assembly with a motor in order to transfer the energy of the motor into linear movement. Hidler and Bergenstrale are considered to be analogous art since they are both from the same field of endeavor, i.e. trolleys. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Bergenstrale with the torque transfer assembly of Hidler.

Regarding claim 5, Bergenstrale discloses the trolley including a plurality of wheels (144a-d), at least a portion of the plurality of wheels disposed above the drive assembly when in an operative configuration (see Fig. 5).

Regarding claim 17, Bergenstrale discloses an apparatus (100), comprising: a drive element (see para. [0027]); a wheel assembly (144a-d) coupled to the drive element (see para. [0027]); and a patient support assembly (108 and 110) coupled to the housing, the patient support assembly configured to dynamically support a body weight of a patient, the patient support assembly including a cam (see connection between 110 and 108) configured to pivot relative to the housing in response to a force associated with the body weight of the patient, the cam exerting a reaction force when the cam pivots. Bergenstrale does not disclose a housing. Hidler discloses a housing (3500) for the purpose of protecting components within the housing. It is old and well known to

place objects inside or partially inside a housing to provide some sort of protection for the objects. Therefore, it would have been obvious to modify Bergenstrale with a housing.

Regarding claim 20, Bergenstrale does not disclose further comprising at least one of a clutch or a brake associated with the drive element configured to inhibit movement of the drive element. Hidler teaches at least one of a clutch or a brake associated with the drive element configured to inhibit movement of the drive element (see [0045]) so that in the event of power loss, the brakes lock and the subject cannot fall. Therefore, it would have been obvious to modify Bergenstrale with the brakes of Hidler.

Regarding claim 21, Bergenstrale discloses further comprising a second drive (133) element coupled to the patient support assembly, the second drive element configured to dynamically support the patient.

6. Claims 18 and 19 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Bergenstrale et al. (US PG-Pub 2012/0000876) hereinafter "Bergenstrale" and Hidler (US PG-Pub 2008/0287268) in view of Maurer (US Patent No. 7,137,771).

Regarding claim 18, Bergenstrale does not disclose a light source coupled to the housing, the light source configured to project a light path on a surface opposite the housing. Maurer teaches a light source (16) coupled to a housing (see Fig. 5), the light source configured to project a light path on a surface opposite the housing (see abstract). Bergenstrale and Maurer are analogous art because they are from the same

field of endeavor, i.e. trolleys. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the housing of Hidler with the light source of Maurer. The motivation would have been to enhance the operating safety especially under conditions of poor visibility as taught by Maurer.

Regarding claim 19, Maurer teaches that the light source is configured to illuminate a target location on a surface opposite the housing (see Fig. 5).

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ERIC KURILLA whose telephone number is (571)270-7294. The examiner can normally be reached on Monday-Thursday 7:30AM-6:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pete Cuomo can be reached on 571-272-6856. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/E. K./
Examiner, Art Unit 3673

/Nicholas Polito/
Primary Examiner, Art Unit 3673

12/11/2015

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13/745,830	01/20/2013	Arkady Glukhovsky	BION-051/00US 307799-2244	6272

58249 7590 06/02/2016

COOLEY LLP
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1299 Pennsylvania Avenue, NW
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Washington, DC 20004

EXAMINER	
KURILLA, ERIC J	

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06/02/2016	ELECTRONIC

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zpatdcdocketing@cooley.com

Office Action Summary	Application No. 13/745,830	Applicant(s) GLUKHOVSKY ET AL.	
	Examiner ERIC KURILLA	Art Unit 3673	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04/13/2016*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-4,6-8 and 17-29* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☒ Claim(s) *1-4 and 6-8* is/are allowed.

7)☒ Claim(s) *17-29* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

In response to remarks filed 09/11/2015

Status of Claims

- ***Claims 1-4, 6-8, and 17-29 are pending;***
- ***Claims 1, 4, 6, and 17 are currently amended; claims 2, 3, 7, 8, and 18-21 were previously presented; claims 22-29 are new;***
- ***Claims 17-29 are rejected herein.***

Response to Arguments

1. Applicant's arguments filed 03/15/2016, see page 8, with respect to claim 1 have been considered and are persuasive. Therefore, the rejection(s) of claim 1 have been withdrawn.

Applicant's arguments with respect to claim 17 have been considered and are not persuasive. Applicant argues that *Bergenstrale alone or in combination with Hidler fails to disclose or suggest a cam pivoting relative to a housing and about a vertical axis in response to a force exerted on a tether* — Examiner disagrees. The connection between 108 and 110 acts as a cam. The combination of Bergenstrale and Hidler yields the cam pivoting relative to a housing and about a vertical axis in response to a force exerted on tether 108. If one were to spin 110 clockwise, tether 108 the connection between 108 and 110 would also spin clockwise. This spinning motion would be a result of a force exerted on tether 108.

Claim Rejections - 35 USC § 112

2. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 22-29 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

4. Claim 22 recites the limitation "the track" in line 3 of the claim. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. Claims 22-24 and 28 are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Bergenstrale et al. (US PG-Pub 2012/0000876), hereinafter referred to as “Bergenstrale”.

Regarding Claim 22, Bergenstrale discloses an apparatus (100), comprising: a trolley (104 and 106) having a drive assembly (see para. [0027]), the drive assembly including a plurality of wheels (144a-144d) configured to move along at least one surface of the track (102) to move the trolley relative to the track;
a powered conductor (114) operatively coupled and substantially parallel to the track (see Fig. 6), the powered conductor including at least one conductive surface in contact with a portion of the trolley (156) to electrically couple the trolley to the powered conductor, the portion of the trolley configured to move along the at least one conductive surface when the trolley is moved along the track, a portion of the track disposed between at least one wheel from the plurality of wheels and the powered conductor (see portion of either 134a or 134b between wheels 144b/144a and conductors 114a/114b in Fig. 8); at least one patient attachment (110, see para. [0024]) coupled to the trolley, the at least one patient attachment configured to support a single patient; and a control system (112) coupled to the trolley and at least operably coupled to the powered conductor.

Regarding Claim 23, Bergenstrale discloses wherein the trolley is configured to be powered only from the powered conductor (see at least para. [0023]).

Regarding Claim 24, Bergenstrale discloses wherein the trolley includes a patient support system (110 and Fig. 5), the patient support system configured to actively support a patient.

Regarding Claim 28, Bergenstrale discloses wherein the conductive surface of the powered conductor defines a first plane (see Fig. 8 @114a or @114b), and the drive

assembly includes a first wheel (144b) from the plurality of wheels and a second wheel (144a) from the plurality of wheels, the first wheel from the plurality of wheels and the second wheel from the plurality of wheels being configured to move along at least one surface of the track (see inside of 134a and 134b) to movably suspend the trolley from the track, the at least one surface of the track defining a second plane nonparallel to the first plane (inside plane of 134a and 134b are perpendicular to plane of 114a and 114b).

Claim Rejections - 35 USC § 103

7. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 17, 20, and 21 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Bergenstrale et al. (US PG-Pub 2012/0000876) hereinafter "Bergenstrale" in view of Hidler (US PG-Pub 2008/0287268).

Regarding claim 17, Bergenstrale discloses an apparatus (100), comprising: a drive element (see para. [0027], specifically “motor”); a wheel assembly (144a-d) coupled to the drive element (see para. [0027]) ; and a patient support assembly (108 and 110),

the patient support assembly including a tether (108) configured to dynamically support a body weight of a patient, the patient support assembly including a cam (see connection between 110 and 108) configured to pivot and about a vertical axis in response to a force associated with the body weight of the patient exerted on the tether (e.g. if one were to spin sling bar 110), the cam exerting a reaction force when the cam pivots (inherent). Bergenstrale does not disclose a housing or the cam operably coupled to a sensor configured to detect pivoting of the cam. Hidler discloses a housing 3500 for the purpose of protecting components within the housing and a pivoting arm 66 operably coupled to a sensor configured to detect pivoting of the arm for the purpose of driving a trolley forward until the rope 220 is vertical (see para. [0058]) so that the trolley is not dragging a patient. Hidler and Bergenstrale are considered to be analogous art since they are both from the same field of endeavor, i.e. trolleys. Therefore, it would have been obvious to modify Bergenstrale with the housing and sensor as taught by Hidler.

Regarding claim 20, Bergenstrale does not disclose further comprising at least one of a clutch or a brake associated with the drive element configured to inhibit movement of the drive element. Hidler teaches at least one of a clutch or a brake associated with a drive element configured to inhibit movement of the drive element (see [0045]) so that in the event of power loss, the brakes lock and the subject cannot fall. Therefore, it would have been obvious to modify Bergenstrale with the brakes of Hidler.

Regarding claim 21, Bergenstrale discloses further comprising a second drive (133) element coupled to the patient support assembly, the second drive element configured to dynamically support the patient.

9. Claims 18 and 19 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Bergenstrale et al. (US PG-Pub 2012/0000876) hereinafter "Bergenstrale" and Hidler (US PG-Pub 2008/0287268) in view of Maurer (US Patent No. 7,137,771).

Regarding claim 18, Bergenstrale does not disclose a light source coupled to the housing, the light source configured to project a light path on a surface opposite the housing. Maurer teaches a light source (16) coupled to a housing (see Fig. 5), the light source configured to project a light path on a surface opposite the housing (see abstract). Bergenstrale and Maurer are analogous art because they are from the same field of endeavor, i.e. trolleys. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the housing of Hidler with the light source of Maurer. The motivation would have been to enhance the operating safety especially under conditions of poor visibility as taught by Maurer.

Regarding claim 19, Maurer teaches that the light source is configured to illuminate a target location on a surface opposite the housing (see Fig. 5).

Allowable Subject Matter

10. Claims 1-4 and 6-8 are allowed.

11. The following is an examiner's statement of reasons for allowance: The prior art of record does not teach nor disclose "a portion of the trolley being disposed within the powered conductor" in combination with the other structure contained in claim 1. Bergenstrale's powered conductor does not contain any portion of the trolley **within** it. Furthermore, the prior art of record does not suggest a powered conductor with a portion of a trolley within it.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

12. Claims 25-27 and 29 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

13. The following is a statement of reasons for the indication of allowable subject matter:

Regarding Claim 25, Bergenstrale does not disclose "the first wheel from the plurality of wheels being in contact with a first surface of the track and the second wheel from the plurality of wheels being in contact with a second surface of the track such that the portion of the track is disposed between the first wheel from the plurality of wheels and the second wheel from the plurality of wheels." The portion of track of Bergenstrale, as required by claim 22, was considered to be the portion of either 134a or 134b

between wheels 144b/144a and conductors 114a/114b in Fig. 8. This portion cannot reasonably be considered to be disposed between the first wheel 144b from the plurality of wheels and the second wheel 144a from the plurality of wheels.

Regarding Claim 29, Bergenstrale does not disclose "the third wheel from the plurality of wheels being configured to move along a surface of the portion of the track, the surface of the portion of the track defines a third plane parallel to the first plane." If either wheels 144c or 144 d were to taken to be a third wheel, the surface of the portion of either 134a or 134b between wheels 144b/144a and conductors 114a/114b in Fig. 8 cannot reasonably be considered to be parallel to the first plane that is defined by the surface of 114. This third plane would be perpendicular to the first plane.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ERIC KURILLA whose telephone number is (571)270-7294. The examiner can normally be reached on Monday-Thursday 7:30AM-6:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pete Cuomo can be reached on 571-272-6856. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ERIC KURILLA/
Examiner, Art Unit 3673

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/226,021	03/26/2014	Erol Erturk	BION-051/01US 307799-2266	9036

58249 7590 09/14/2016

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EXAMINER
KURILLA, ERIC J

ART UNIT	PAPER NUMBER
3673	

NOTIFICATION DATE	DELIVERY MODE
09/14/2016	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zpatdcdocketing@cooley.com

Office Action Summary	Application No. 14/226,021	Applicant(s) ERTURK ET AL.	
	Examiner ERIC KURILLA	Art Unit 3673	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *08/05/2016*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-14 and 21-26* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-4,7-14 and 21-26* is/are rejected.

8)☐ Claim(s) *5-6* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *03/26/2014* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Election/Restrictions

2. Applicant's election with traverse of Species IV (Figs. 38-40) in the reply filed on 08/05/2016 is acknowledged. The traversal is on the ground(s) that Species VI (Figs. 43-44) should also be included in Species IV since they are a similar structure. This is found persuasive because Figs. 38-40 and Figs. 43-44 can be substantially similar in form and/or function. As such, Species VI is deleted and Figs. 43-44 are included into Species IV.

The requirement is deemed proper and is therefore made FINAL.

Information Disclosure Statement

3. The information disclosure statement filed 03/31/2015 fails to comply with 37 CFR 1.98(a)(2), which requires a legible copy of each cited foreign patent document; each non-patent literature publication or that portion which caused it to be listed; and all other information or that portion which caused it to be listed. It has been placed in the application file, but the information referred to therein has not been considered. A copy of Cite No. C1 was not filed.

Drawings

4. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference character(s) not mentioned in the description: 7068 in Fig. 43. Corrected drawing sheets in compliance with 37 CFR 1.121(d), or amendment to the specification to add the reference character(s) in the description in compliance with 37 CFR 1.121(b) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

5. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 10-14 and 21-26 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly

point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

7. Claim 10 recites the limitation "the end portion" in line 11 of the claim. It is unclear to the Examiner which "end portion" is being claimed. Is this "an end portion of a support track" or "an end portion of the first member"?

8. Claim 11 recites the limitation "an open-ended track" in line 1 of the claim. It is unclear to the Examiner what this limitation is claiming. Is "open-ended" intended to mean not a closed-loop type track? If so, Examiner suggests Applicant reword the claim to better reflect this meaning. “Open-ended” directly contradicts having an “end portion.” Claim 11 also recites the limitation "the end portion" in line 4 of the claim. It is unclear to the Examiner which "end portion" is being claimed. Is this "an end portion of a support track" or "an end portion of the first member”? Lastly Claim 11 recites the limitation “a portion" in line 3 of the claim. It is unclear to the Examiner if this "portion" is in addition to "a portion of a patient support assembly" as specified by parent Claim 10 in line 9.

9. Claim 21 recites the limitation “a first portion of the track stop” in line 15 of the claim. Is this the same as, or in addition to "a first portion" in lines 13-14 of the claim?

10. Claim 24 recites the limitation "a first portion and a second portion" and “the first portion" and "the second portion". Parent claim 21 identifies the collision management system already including a first portion and a second portion with the track stop. If these portions are in addition to the portions identified in Claim

21, Applicant is required to change the terminology to make it clear that there are four distinct structures being claimed.

11. Claim 25 recites the limitation "the second portion" in line 1 of the claim. There is insufficient antecedent basis for this limitation in the claim. It is unclear which “second portion” is being claimed. Is this the second portion identified in Claim 24 or the second portion identified in Claim 21.

12. All claims that are not rejected under prior art, but are rejected under 35 USC 112 are not considered to be allowable. “Where there is a great deal of confusion and uncertainty as to the proper interpretation of the limitations of a claim, it would not be proper to reject such a claim on the basis of prior art. As stated in In re Steele, 305 F.2d 859, 134 USPQ 292 (CCPA 1962), a rejection under 35 U.S.C. 103 should not be based on considerable speculation about the meaning of terms employed in a claim or assumptions that must be made as to the scope of the claims.” See MPEP 2173.06

Claim Rejections - 35 USC § 103

13. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

14. Claim 1-4 and 7-9 is/are rejected under 35 U.S.C. 103 as being unpatentable over Bergenstrale (US PG-Pub 2012/0000876).

Regarding Claim 1, Bergenstrale discloses a system (100), comprising:

a support track (102);

a first trolley (104) configured to be movably suspended from the support track (via carriage 106), the first trolley including a patient attachment mechanism (108) configured to support a first patient, the first trolley configured to move relative to the support track; and

a collision management assembly (106) configured to be coupled to one of the first trolley and the second trolley, the collision management assembly including a bumper (131) configured to prevent the first trolley from directly contacting a second trolley.

Bergenstrale does not disclose a second trolley configured to be movably suspended from the support track, the second trolley including a patient attachment mechanism configured to support a second patient, the second trolley configured to move relative to the support track, the movement of the second trolley being independent of the movement of the first trolley. It would have been obvious to one having ordinary skill in the art at the time the invention was made to duplicate the first trolley, since it has been held that mere duplication of essential working parts of a device involve only routine skill in the art. In re Regis Paper Co. v. Bemis Co., 193 USPQ 8. Providing a second trolley identical to the first trolley of Bergenstrale would be a cost effective way of

supporting two patients. The two trolleys could share the same track, thus eliminating the need for a second track in order to support two patients.

Regarding Claim 2, Bergenstrale discloses wherein the bumper is formed from an elastomeric material (see para. [0033], specifically "rubber") configured to elastically deform under pressure.

Regarding Claim 3, Bergenstrale does not explicitly disclose wherein a minimum distance threshold between the first trolley and the second trolley is set to define a dimension of the bumper. However, it would have been an obvious matter of design to provide a bumper that is the allowable minimum distance between the two trolleys.

Regarding Claim 4, Bergenstrale discloses wherein the collision management assembly includes a trolley portion (140) and a coupling portion (142), the trolley portion being movably suspended from the support track (via wheels 144), the trolley portion including the bumper (see para. [0033]), the coupling portion configured to couple the trolley portion to the first trolley (see para. [0025]).

Regarding Claim 7, Bergenstrale discloses wherein at least the first trolley includes a patient support system (110) configured to actively support the first patient.

Regarding Claim 8, Bergenstrale discloses wherein the first trolley includes at least an electronic system (see para. [0024] and [0027] and 112) and a drive mechanism (see para. [0027], specifically "motor"), the electronic system

configured to control the drive mechanism to move the first trolley along the support track.

Regarding Claim 9, Bergenstrale discloses, wherein the collision management assembly includes a plate having an edge portion coupled to the bumper (see plate coupled to bumper 131 in Figs. 2 and 4).

15. Claims 21-23 and 26 is/are rejected under 35 U.S.C. 103 as being unpatentable over Bergenstrale (US PG-Pub 2012/0000876) in view of Love (US Patent No. 5,638,755).

Regarding Claim 21, as discussed in the rejection of Claim 1 above, Bergenstrale as modified teaches a system (100), comprising:

a support track (102), the support track including an end portion;

a first trolley (104) configured to be movably suspended from the support track (via carriage 106), the first trolley including a patient attachment mechanism (108) configured to support a first patient, the first trolley configured to move along a length of the support track;

a second trolley (see claim 1 rejection) configured to be movably suspended from the support track (via another carriage 106), the second trolley including a patient attachment mechanism (another 108) configured to support a second patient, the second trolley configured to move along a length of the support track; and

a collision management system (106) including a collision management assembly configured to be movably suspended from the support track and coupled to one of the first trolley and the second trolley, the collision

management assembly including a bumper (131) configured to prevent the first trolley from directly contacting a second trolley.

Bergenstrale does not suggest the collision management system including a track stop, the track stop having a first portion movably suspended from the support track and a second portion fixedly coupled to the end portion of the support track, a first portion of the track stop including a bumper configured to prevent at least one of the first trolley and the second trolley from moving beyond the end portion of the support track. Love teaches a track stop (Fig. 6), the track stop having a first portion (70) movably suspended from a support track (14) and a second portion (64) fixedly coupled to an end portion (62) of the support track, the first portion of the track stop including a bumper configured to prevent at least one of a first trolley (18) and a second trolley from moving beyond the end portion of the support track (see Col. 4, Lines 5-20). Bergenstrale and Love are analogous art because they are from the same field of endeavor, i.e. track systems. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Bergenstrale with the track stop of Love for the purpose of preventing damage to the trolley of Bergenstrale.

Regarding Claim 22, Love teaches wherein the first portion of the track stop is configured to move relative the second portion of the track stop in response to a force exerted on the bumper of the track stop by at least one of the first trolley and the second trolley, the first portion of the track stop configured to move relative to the second portion of the track stop in an axial direction

substantially parallel to a length of the support track (see Col. 4, Lines 5-20 and Fig. 6).

Regarding Claim 23, Love teaches wherein the second portion of the track stop includes an energy storage member (68), the first portion of the track stop is in contact with the energy storage member and is configured to transition the energy storage member from a first energy state (uncompressed) to a second energy state (compressed) when the first portion is moved relative to the second portion, the second energy state resulting from a portion of a kinetic energy associated with the force exerted on the bumper of the track stop being converted into a potential energy stored by the energy storage member (see Col. 4, Lines 5-20 and Fig. 6).

Regarding Claim 26, Bergenstrale discloses wherein the first trolley includes an electronic system (see para. [0024] and [0027] and 112) and a drive mechanism (see para. [0027], specifically "motor"), the electronic system of the first trolley configured to control the drive mechanism to move the first trolley along the support track. Bergenstrale does not disclose the second trolley includes at least an electronic system and a drive mechanism, the electronic system of the second trolley configured to control the drive mechanism of the second trolley to move the second trolley along the support track, the movement of the second trolley being independent of the movement of the first trolley. However, as mentioned with regards to the rejection of Claim 1, it would have been obvious to duplicate the parts of the first trolley system. it has been held

that mere duplication of essential working parts of a device involve only routine skill in the art. In re Regis Paper Co. v. Bemis Co., 193 USPQ 8.

Allowable Subject Matter

16. Claims 5 and 6 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

17. The following is a statement of reasons for the indication of allowable subject matter: Bergenstrale does not disclose wherein the collision management assembly includes a trolley portion and a coupling portion, the trolley portion including the bumper, the coupling portion including a first member coupled to the trolley portion, and a second member coupled to the first trolley, the first member configured to move relative to the second member when the bumper contacts the second trolley. Furthermore, no prior art could be found to modify Bergenstrale as specified by Claim 5. Therefore, a case for obviousness could not be made.

Conclusion

18. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See attached *Notice of References Cited* form.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ERIC KURILLA whose telephone number is

(571)270-7294. The examiner can normally be reached on Monday-Thursday 7:30AM-6:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pete Cuomo can be reached on 571-272-6856. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ERIC KURILLA/
Examiner, Art Unit 3673

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/226,021	03/26/2014	Erol Erturk	BION-051/01US 307799-2266	9036

58249 7590 02/22/2017

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EXAMINER
KURILLA, ERIC J

ART UNIT	PAPER NUMBER
3673	

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02/22/2017	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zpatdcdocketing@cooley.com

Office Action Summary	Application No. 14/226,021	Applicant(s) ERTURK ET AL.	
	Examiner ERIC KURILLA	Art Unit 3673	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12/14/2016*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *1-4,6-14 and 21-26* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1-4,6-9 and 21-26* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "second trolley portion" in Claim 21 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered. It appears that Claim 21 is a combination of Figs. 43 and 38.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner,

the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 112

3. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 21-26 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention. Applicant has not shown in their originally filed disclosure support for a collision management assembly containing two trolley portions. This subject matter appears to be a combination of Figs. 38 and 43. The originally filed specification does not state that these two features are usable together.

3. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 4 and 21-26 is rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

5. Claim 4 recites the limitation "a trolley portion" and "a coupling portion" in line 2 of the claim. It is unclear to the Examiner if these are new limitations, or the same limitations being claims in parent claim 1. For examination purposes, Examiner is interpreting Claim 4 as containing the same subject matter as Claim 1.

6. Claim 21 recites "a bumper" in lines 13 and 19. It is unclear if these are two separate bumpers or the same bumper.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having

> ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

8. Claim 1-4 and 6-9 is/are rejected under 35 U.S.C. 103 as being unpatentable over Bergenstrale (US PG-Pub 2012/0000876) in view of Dehne (US Patent 3,720,172).

Regarding Claim 1, Bergenstrale discloses a system (100), comprising:

a support track (102);

a first trolley (104) configured to be movably suspended from the support track (via carriage 106), the first trolley including a patient attachment mechanism (108) configured to support a first patient, the first trolley configured to move relative to the support track.

a collision management assembly comprising a trolley portion that includes a bumper (129) configured to prevent the first trolley from directly contacting the second trolley.

Bergenstrale does not disclose a second trolley configured to be movably suspended from the support track, the second trolley including a patient attachment mechanism configured to support a second patient, the second trolley configured to move relative to the support track, the movement of the second trolley being independent of the movement of the first trolley. It would have been obvious to one having ordinary skill in the art at the time the invention was made to duplicate the first trolley, since it has been held that mere duplication of essential working parts of a device involve only routine skill in the art. In re Regis Paper Co. v. Bemis Co., 193 USPQ 8. Providing a second trolley identical to the first trolley of Bergenstrale would be a cost effective way of supporting two patients. The two trolleys could share the same

track, thus eliminating the need for a second track in order to support two patients. Bergenstrale also does not disclose a collision management assembly configured to be coupled to one of the first trolley and the second trolley, the collision management assembly including a trolley portion and a coupling portion, the trolley portion including a bumper configured to prevent the first trolley from directly contacting the second trolley, the coupling portion including a first member coupled to the trolley portion and a second member coupled to the first trolley, the first member configured to move relative to the second member when the bumper contacts the second trolley. Dehne teaches a collision management assembly (40) configured to be coupled to one of a first trolley (24) and a second trolley, the collision management assembly including a trolley portion (22) and a coupling portion (50 and 52), the coupling portion including a first member (50) coupled to the trolley portion and a second member (52) coupled to the first trolley, the first member configured to move relative to the second member when it contacts the second trolley (see Fig. 2). It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Bergenstrale with the collision management assembly of Dehne. This would be an obvious modification to Bergenstrale since Dehne is reasonably pertinent to the problem Applicant is trying to solve, i.e. to dampen the impact between two suspended trolleys. This type of collision management assembly is commonly referred to in the railway art as “tow bars". The combination of Bergenstrale and Dehne would yield the trolley portion including a bumper (129 of Bergenstrale) configured to prevent the first trolley from directly contacting the second trolley.

Regarding Claim 2, Bergenstrale discloses wherein the bumper is formed from an elastomeric material (see para. [0033], specifically "rubber") configured to elastically deform under pressure.

Regarding Claim 3, Bergenstrale does not explicitly disclose wherein a minimum distance threshold between the first trolley and the second trolley is set to define a dimension of the bumper. However, it would have been an obvious matter of design to provide a bumper that is the allowable minimum distance between the two trolleys.

Regarding Claim 4, Bergenstrale as modified teaches wherein the collision management assembly includes a trolley portion (Dehne: 22) and a coupling portion (Dehne: 50 and 52), the trolley portion being movably suspended from the support track (Dehne: via wheels shown in Fig.1), the trolley portion including the bumper (Bergenstrale: see para. [0033]), the coupling portion configured to couple the trolley portion to the first trolley (Dehne: see Fig. 1).

Regarding Claim 6, Dehne teaches wherein the coupling portion includes an energy absorption member (72) disposed between a portion of the first member and a portion of the second member such that when the first member is moved relative to the second member, the energy absorption member is transitioned from a first configuration having a first potential energy to a second configuration having a second potential energy, the second potential energy being greater than the first potential energy (see Col. 3, Lines 56-68).

Regarding Claim 7, Bergenstrale discloses wherein at least the first trolley includes a patient support system (110) configured to actively support the first patient.

Regarding Claim 8, Bergenstrale discloses wherein the first trolley includes at least an electronic system (see para. [0024] and [0027] and 112) and a drive mechanism (see para. [0027], specifically "motor"), the electronic system configured to control the drive mechanism to move the first trolley along the support track.

Regarding Claim 9, Bergenstrale discloses, wherein the collision management assembly includes a plate having an edge portion coupled to the bumper (see plate coupled to bumper 131 in Figs. 2 and 4).

Allowable Subject Matter

9. Claims 10-14 are allowed.

10. The following is an examiner's statement of reasons for allowance: Bergenstrale as modified by Dehne does not teach "a coupling portion configured to be coupled to an end portion of a support track, the coupling portion including a first member and a second member, the second member configured to be maintained in a **fixed position** relative to the support track, the first member configured to move relative to the support track to transition the coupling portion between a first configuration and a second configuration." Dehne has two members 50 and 52 that make up a coupling portion. Both of these members move relative to the support track.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably

accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See attached PTO-892 form.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ERIC KURILLA whose telephone number is (571)270-7294. The examiner can normally be reached on Monday-Thursday 7:30AM-6:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Pete Cuomo can be reached on 571-272-6856. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/ERIC KURILLA/
Examiner, Art Unit 3673

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/613,140	02/03/2015	Keith McBride	BION-051/02US 307799-2272	7107

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EXAMINER
ANDERSON, MEGAN M

ART UNIT	PAPER NUMBER
3764	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zpatdcdocketing@cooley.com

Office Action Summary	Application No. 14/613,140	Applicant(s) MCBRIDE, KEITH	
	Examiner MEGAN ANDERSON	Art Unit 3764	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01/23/2017*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *8-27* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *8-27* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *02/03/2015* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *see attached*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

This is the First Office Action on the Merits based on the 14/613,140 application filed on 02/03/2015 and which claims as originally filed have been considered in the ensuing action.

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Election/Restrictions

Applicant's election without traverse of Invention II and Species I in the reply filed on 01/23/2017 is acknowledged.

Priority

Application 14/613,140 is a Continuation-In-Part (CIP) of application 14/226,021 filed 03/26/2014, which is a CIP of application 13/745,830 filed 01/20/2013 which is now US Patent 9,682,000.

However, the limitations discloses in the independent claims, specifically "a first operating condition" are not found in applications 14/226,021 and 13/745,830. For purposes of examination the claims of application 14/613,140 will be given the priority date of 02/03/2015.

Information Disclosure Statement

The information disclosure statements (IDS) submitted on 03/31/2015 and 01/23/2017 were filed. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Specification

The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Objections

1. Claim 8 is objected to because of the following informalities:

   a. On line 5, "the trolley" should be corrected to ---the active trolley---

   b. On line 10, "the determining" should be corrected to ---the difference between the first operating condition and the second operating condition---

2. Claim 9 is objected to because of the following informality:

   c. On line 7, "a second operating condition" should be corrected to ---the second operating condition---

3. Claim 15 is objected to because of the following informality:

d. On line 1, "drive mechanism" should be corrected to ---the drive mechanism---

Appropriate correction is required.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

The claimed invention is a method for using an apparatus for body weight support. The claimed invention falls within the four statutory categories of invention, specifically, the claimed invention is a process.

Claims 8-13 are directed towards an abstract idea. Independent claim 8 is a method of receiving a signal associated with a first operating condition, receiving a signal associated with a second operating condition, determining the difference between the first operating condition and the second operating condition and defining a gait characteristic based on the difference between the first and second operating condition. This is method is simply acquiring data. While claim 8 does have some structure, such as a patient support mechanism and a drive mechanism, these structures are not responsible for receiving and analyzing a signal. The method steps of acquiring and analyzing the data could be performed by a person or could be preprogramed into a computer. Further, dependent claims 9-10 and 12-13 do not add sufficient structure to

overcome the abstract idea. The claims as a whole do not amount to significantly more than the abstract idea, as there are no other elements in the clams in addition to the exception. Claim 11 claims a sensor, however, the sensor is generic and does not amount to significantly more than the abstract idea.

Claims 14, and 16- 20 are directed towards an abstract idea, specifically, the method of receiving a first signal, receiving a second signal, determining a gait characteristic from the first and second signal and sending a third signal to an output device. While claim 8 does have some structure, such as a patient support mechanism and a drive mechanism, these structures are not responsible for receiving and analyzing a signal. Additionally, claim 14 claims a first sensor, a second sensor and an output device. The identified elements of the first sensor, the second sensor and the output device do not, individually or in combination, amount to significantly more than the exception of an abstract idea, as the sensors and the output device are generic components and do not add meaningful limitations to the abstract idea. . Further, dependent claims **16-20** do not add sufficient structure to overcome the abstract idea, as the claims as a whole do not amount to significantly more than the abstract idea, as there are no other elements in the clams in addition to the exception.

However, **claim 15** has limitations that do amount to significantly more than the abstract idea. Specifically, the limitations of the drive mechanism including a set of wheels in contact with a portion of the support track and a motor operably coupled to the set of wheels, the motor configured to rotate the set of wheels to move the drive mechanism along the support track, the operating condition of the drive mechanism

being associated with a rotational velocity or a rotational acceleration of the set of wheels, the receiving of the second signal from the second sensor includes receiving data associated with at least one of the rotational velocity of the set of wheels or the acceleration of the set of wheels amount to significantly more than the abstract idea.

Claims 21-27 are directed towards an abstract idea, specifically, the method of receiving a first signal, receiving a second signal, determining a gait characteristic from the first and second signal and sending a third signal to an output device. While claim 8 does have some structure, such as a patient support mechanism and a drive mechanism, these structures are not responsible for receiving and analyzing a signal. Additionally, claim 21 claims a processor and an electronic device. The identified elements of the processor and the electronic device do not, individually or in combination, amount to significantly more than the exception of an abstract idea, as the sensors and the output device are generic components and do not add meaningful limitations to the abstract idea. Further **claims 22-27** do not add sufficient structure to overcome the abstract idea. The claims as a whole do not amount to significantly more than the abstract idea, as there are no other elements in the clams in addition to the exception.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –

> (a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

Claims 8-17, 19-23, 25, and 26 are rejected under 35 U.S.C. 102(a)(2) as being anticipated by Hidler (US 7,883,450).

Regarding claim 8:

Hidler discloses receiving a signal associated with a first operating condition of at least one of a drive mechanism or a patient support mechanism (The device of Hidler has an operating system that receives data from instrumentation that tracks the distance walked, walking speed and unloading forces within and across sessions, see column 4 lines 46-49) , the patient support mechanism (300, 66) coupled to an active trolley (30) and configured to support a patient (see Figure 3), the drive mechanism (motor 50, and wheels 32, 34) coupled to the active trolley and configured to move the trolley along a support track in response to a movement of the patient (the trolley automatically moves with response to the patient moving, see column 4 lines 22-25); receiving a signal associated with a second operating condition of at least one of the drive mechanism or the patient support mechanism (as discussed above the Hidler device constantly receives data across a single or multiple exercise routines); determining a difference between the first operating condition and the second operating condition (see Figure 6; Figure 6 is an example of a graphical user interface that displays data related to walking speed, body weight, distance walked, number of breaks taken. For each session, the walking speed is shown with a maximum, minimum and an

average); and defining, based at least in part on the determining, a gait characteristic of the patient supported by the patient support mechanism (this is shown in Figure 6).

Regarding claim 9:

Hidler discloses that wherein the first operating condition is a first operating condition of the patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20. As discussed above, the pivoting arm 66 is part of the patient support mechanism), the method further comprising: receiving a first operating condition associated with the drive mechanism; receiving a second operating condition associated with the drive mechanism; and determining a difference between the first operating condition of the drive mechanism and a second operating condition of the drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44), the defining of the gait characteristic includes defining the gait characteristic based at least in part of the difference between the first operating condition of the patient support mechanism and

the second operating condition of the patient support mechanism and the difference between the first operating condition of the drive mechanism and the second operating condition of the drive mechanism (see Figure 6).

Regarding claim 10:

Hidler discloses that the at least one of the drive mechanism or the patient support mechanism is in the first operating condition when the patient is in a first position relative to the support track, the at least one of the drive mechanism or the patient support mechanism is in the second operating condition when the patient moves to a second position relative to the support track, the second position being different from the first position (as discussed above, many metrics are measured during use of the Hidler device, including the distance walked which would include a first operating condition at the beginning and a second operating condition at the end, where the beginning and end are two different locations).

Regarding claim 11:

Hidler discloses that the first operating condition is a first operating condition of the patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism, the receiving of the signal associated with the first operating condition includes receiving the signal associated with the first operating condition from a sensor included in the patient support mechanism, the receiving of the signal associated with the second operating condition

includes receiving the signal associated with the second operating condition from the sensor included in the patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20. As discussed above, the pivoting arm 66 is part of the patient support mechanism).

Regarding claim 12:

Hidler discloses that the first operating condition is a first operating condition of the drive mechanism and the second operating condition is a second operating condition of the drive mechanism, the receiving of the signal associated with the first operating condition includes receiving the signal associated with the first operating condition from a sensor included in the drive mechanism, the receiving of the signal associated with the second operating condition includes receiving the signal associated with the second operating condition from the sensor included in the drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44).

Regarding claim 13:

Hidler discloses that sending a signal to an output device, the signal indicative of an instruction to output data associated with the gait characteristic via the output device (Hidler discloses that the device sends information to a pocketPC, see column 6 lines 4-9).

Regarding claim 14:

Hidler discloses receiving a first signal from a first sensor, the first signal being associated with an operating condition of a patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20.) included in a patient support system (66, 300), the patient support mechanism including a tether (220) configured to tether a patient to the patient support mechanism (see Figures 2-3), the patient support system supporting at least a portion of a weight of the patient when the patient is tethered to the patient support mechanism (the patient support mechanism can support the full weight of the user or only a partial weight of the user, see column 4, lines 22-35); receiving a second signal from a second sensor, the second signal being associated with an operating condition of a drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34*

measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed." See column 7 lines 40-44, where the drive mechanism includes the motor 50 and the wheels 32,34) included in the patient support system, the drive mechanism configured to (1) suspend the patient support system from a support track (see Figure 3) and (2) move along the support track in response to a movement of the patient ("*As the subject 15 ambulates, the trolley 30 automatically moves forward or back, staying above the subject 15 so that the subject 15 only feels a vertical unloading force and does not have to drag the mass of the trolley 30."* See column 4 lines 22-25); determining at least one gait characteristic associated with the movement of the patient based at least in part on the operating condition of the patient support mechanism and the operating condition of the drive mechanism (see Figure 6, the device complies and displays data associated with the patients walking routine, including walking speed, body weight support and distance walked, which includes information taken from the first and second sensors, see above); and sending, to an output device, a third signal, the third signal indicative of an instruction to output data associated with the at least one gait characteristic via the output device ("*In addition to a touch-screen user interface, the system can also be controlled wirelessly through a pocketPC. This feature allows the therapist to maintain full control over the unloading system at any point along the rail system is a wireless pocketPC interface computer*." Column 6 lines 4-8).

Regarding claim 15:

Hidler discloses that the drive mechanism includes a set of wheels (32, 34) in contact with a portion of the support track (40) and a motor (50) operably coupled to the set of wheels, the motor configured to rotate the set of wheels to move the drive mechanism along the support track ("I*n the embodiment illustrated in FIG. 12, a direct current (DC) motor 50 is mounted between the front and back trolley wheels or wheel assemblies 32 and 34. In another embodiment, a DC motor is mounted to one of the pivoting wheel assembles 32 or 34. The motor 50, including a gearhead, is utilized to drive the system via a motor drive wheel 52*." See columns 6-7, lines 67, and 1-4), the operating condition of the drive mechanism being associated with a rotational velocity or a rotational acceleration of the set of wheels, the receiving of the second signal from the second sensor includes receiving data associated with at least one of the rotational velocity of the set of wheels or the acceleration of the set of wheels (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44).

Regarding claim 16:

Hidler discloses that the operating condition of the patient support mechanism is associated with at least one of a length of a portion of the tether, an angle of the portion of the tether relative to the support track, a tension within a portion of the tether, or a feed rate of the tether ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a*

sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm." See column 7 lines 14-20.).

Regarding claim 17:

Hidler discloses that the movement of the patient is associated with the patient walking, the drive mechanism configured to move along the support track in response to the patient walking ("*As the subject 15 ambulates, the trolley 30 automatically moves forward or back, staying above the subject 15 so that the subject 15 only feels a vertical unloading force and does not have to drag the mass of the trolley 30."* See column 4 lines 22-25).

Regarding claim 19:

Hidler discloses that the output device includes a display, the sending of the third signal includes sending the third signal to cause at least one of a graphical representation, a numeric representation, or an alpha-numeric representation of data associated with the gait characteristic to be presented on the display of the output device ("*In addition to a touch-screen user interface, the system can also be controlled wirelessly through a pocketPC. This feature allows the therapist to maintain full control over the unloading system at any point along the rail system is a wireless pocketPC interface computer*." Column 6 lines 4-8; please also see Figure 6)

Regarding claim 20:

Hidler discloses that the operating condition of the patient support mechanism is a first operating condition of the patient support mechanism, and the operating condition of the drive mechanism is a first operating condition of the drive mechanism (see rejection above), the method further comprising: defining, based at least in part on the determining of the at least one gait characteristic, a second operating condition associated with the patient support mechanism and a second operating condition associated with the drive mechanism (the patient support mechanism and the drive mechanism are continually sending information to the processor, see Figure 6 for graphical representation of data); sending, to the patient support mechanism, a fourth signal, the fourth signal indicative of an instruction to place the patient support mechanism in its second operating condition (the fourth signal is the vertical height measurement changes, indicative of a fall); and sending, to the drive mechanism, a fifth signal, the fifth signal indicative of an instruction to place the drive mechanism in its second operating condition ("*In one embodiment, the system has extensive safety features that constantly monitor the status of the patient during training sessions and provide a high level of security to the subject being trained. The subject's vertical height is monitore3d using the system's instrumentation. In one embodiment, if at any time a fall is detected, the system automatically adjusts the unloading force so that the subject will descend a minimal distance, which in one implementation is not more than four*

inches." See column 4 lines 50-58; wherein the fifth signal is the signal changing the unloading force of the device).

Regarding claim 21:

Hidler discloses receiving, at a processor (the pocketPC, see column 6 lines 4-8) of a patient support system, a first signal, the first signal associated with a first operating condition of the patient support system at a first time ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20.), the patient support system including a tether (220) configured to tether a patient to the patient support system (see Figure 3), the patient support system supporting at least a portion of a weight of the patient when the patient is tethered to the patient support system (the patient support mechanism can support the full weight of the user or only a partial weight of the user, see column 4, lines 22-35); receiving, at the processor, a second signal, the second signal associated with a second operating condition of the patient support system at a second time after the first time, the patient support system configured to transition from the first operating condition to the second operating condition in response to a change in force exerted by the patient on the tether ("*In one embodiment, the system has extensive safety features that constantly monitor the status of the patient during training*

sessions and provide a high level of security to the subject being trained. The subject's vertical height is monitore3d using the system's instrumentation. In one embodiment, if at any time a fall is detected, the system automatically adjusts the unloading force so that the subject will descend a minimal distance, which in one implementation is not more than four inches." See column 4 lines 50-58); determining at least one gait characteristic of the patient based at least in part a difference between the first operating condition and the second operating condition (see Figure 6); and displaying data associated with the at least one gait characteristic of the patient on a display of an electronic device in communication with the processor (the graphical user interface displays gait characteristics associated with the workout routine of the patient, see column 6 lines 4-35).

Regarding claim 22:

Hidler discloses that the patient support system includes a drive mechanism (32, 34 and 50), a patient support mechanism (66, 300), and an electronic system (the pocketPC, sensors and graphical user interface, see column 4 lines 36- 54, and 6 lines 4-35), the drive mechanism is configured to movably suspend the patient support system from a support track (the wheels 32, 34 suspend the patient support system from a support track 40, see Figure 3), the patient support mechanism includes the tether (220) and is configured to operably couple the patient to the patient support system (see Figure 3), the electronic system includes the processor (pocketPC) and at least one sensor (sensors associated with the wheels and the tether, see rejection

above), the at least one sensor configured to send the first signal and the second signal to the processor (the information collected from the first signal and the second signal are sent to the computer to been shown in the graphical user interface, see also Figure 6).

Regarding claim 23:

Hidler disclose that the change in force exerted by the patient on the tether is associated with a change in a portion of the weight of the patient supported by the patient support system (the tether supports the user's weight, see rejection above, a change in force is directly related to the change in a portion of the weight).

Regarding claim 25:

Hidler discloses that the first operating condition is a first operating condition of a drive mechanism included in the patient support system and the second operating condition is a second operating condition of the drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44; the wheels are continuously monitored), the drive mechanism configured to movably suspend the patient support system from a support track (the wheels 32, 34 of the drive mechanism suspend the patient support system from a support track 40), the difference between the first operating condition and the second operating condition of the drive mechanism

is associated with difference between at least one of a position of the drive mechanism along the support track, a velocity of at least one wheel included in the drive mechanism, or an acceleration of the at least one wheel included in the drive mechanism (the difference between a first operating condition and a second operating condition shows the difference in position as well as the rotation of the wheels).

Regarding claim 26:

Hidler discloses that the first operating condition is a first operating condition of a patient support mechanism included in the patient support system and the second operating condition is a second operating condition of the patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm.*" See column 7 lines 14-20.), the patient support mechanism including the tether (220), the difference between the first operating condition and the second operating condition of the patient support mechanism is associated with a difference between at least one of a length of a portion of the tether, an angle of a guide member included in the patient support mechanism and engaged with the tether, a tension within a portion of the tether, or a feed rate of the tether.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 18 and 24 are rejected under 35 U.S.C. 103 as being unpatentable over Hidler (US 7,883,450) in view of Martin (US 6,645,126).

Hidler discloses the method as substantially claimed above.

Regarding claim 18:

Hidler fails to distinctly disclose that the determining of the at least one gait characteristic associated with the patient includes determining at least one of a step duration, a swing to stance duration, a swing to stance ratio, a cadence, a stride length of height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

Martin teaches that the gait characteristic of the patient is at least one *of* a step duration, a swing to stance duration, a swing to stance ratio, a cadence (sensed gait parameters can be used to evaluate cadence; claim 2), a stride length (stride length; claim 2), a stride height, a range of motion in an anterior and posterior direction, a range

of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

In order to provide feedback for gait therapy/training to the patient, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Hidler's method of feedback to include Martin's feedback in the form of evaluation of gait characteristics such as cadence arid gait patterns because, as Martin discloses, the gait training device evaluates the patient's stride length, cadence, gait velocity, and gait pattern and provides a quantified documentation to help patients (Martin, column 4, lines 5-15); furthermore, one of ordinary skill in the art would recognize that Hidler's plurality of sensors and encoders associated with the tether and drive system coupled with the processor would be configured to determine gait characteristics such as cadence, lateral motion, stride direction, or stride length.

Regarding claim 24:

Hidler fails to distinctly disclose that the determining of the at least one gait characteristic associated with the patient includes determining at least one of a step duration, a swing to stance duration, a swing to stance ratio, a cadence, a stride length of height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

Martin teaches that the gait characteristic of the patient is at least one *of* a step duration, a swing to stance duration, a swing to stance ratio, a cadence (sensed gait

parameters can be used to evaluate cadence; claim 2), a stride length (stride length; claim 2), a stride height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

In order to provide feedback for gait therapy/training to the patient, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Hidler's method of feedback to include Martin's feedback in the form of evaluation of gait characteristics such as cadence arid gait patterns because, as Martin discloses, the gait training device evaluates the patient's stride length, cadence, gait velocity, and gait pattern and provides a quantified documentation to help patients (Martin, column 4, lines 5-15); furthermore, one of ordinary skill in the art would recognize that Hidler's plurality of sensors and encoders associated with the tether and drive system coupled with the processor would be configured to determine gait characteristics such as cadence, lateral motion, stride direction, or stride length.

Examiner's Note

Claim 27 has not been rejected with art, however, a 35 USC 101 rejection has been issued for claim 27.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MEGAN ANDERSON whose telephone number is (313)446-6531. The examiner can normally be reached on M-Th 9:00-7:30 EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, LoAn Thanh can be reached on 571-272-4966. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MEGAN ANDERSON/
Examiner, Art Unit 3764

/LOAN H THANH/
Supervisory Patent Examiner, Art Unit 3764

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EXAMINER
ANDERSON, MEGAN M

ART UNIT	PAPER NUMBER
3764	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zpatdcdocketing@cooley.com

Office Action Summary	Application No. 14/613,140	Applicant(s) MCBRIDE, KEITH	
	Examiner MEGAN ANDERSON	Art Unit 3764	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01/29/2018*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *8-27* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *8-27* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *see attached*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

DETAILED ACTION

This is the Final Rejection based on the 14/613,140 application filed on 02/03/2015 and which claims as amended on 01/29/2018 have been considered in the ensuing action.

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 01/29/2018 was filed. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Response to Amendments

The amendments have been sufficient to overcome the claim objections. The amendments have not been sufficient to overcome the 35 USC 101 rejections or the art rejections. Please see below

Claim Objections

1. Claim 8 is objected to because of the following informalities:

   a. On line 4, “tether” should be corrected to ---a tether---

   b. On line 5, “a patient” should be corrected to ---the patient---

Appropriate correction is required.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

The claimed invention is a method for using an apparatus for body weight support. The claimed invention falls within the four statutory categories of invention, specifically, the claimed invention is a process.

Claims 8-13 are directed towards an abstract idea. Independent claim 8 is a method of receiving a signal associated with a first operating condition, receiving a signal associated with a second operating condition, determining the difference between the first operating condition and the second operating condition and defining a gait characteristic based on the difference between the first and second operating condition. This is method is simply acquiring data. While claim 8 does have some structure, such as a tether with an attachment device, a patient support mechanism and a drive mechanism, these structures are not responsible for receiving and analyzing a signal. The method steps of acquiring and analyzing the data could be performed by a person or could be preprogramed into a computer. Further, dependent claims 9-10 and 12-13 do not add sufficient structure to overcome the abstract idea. The claims as a whole do not amount to significantly more than the abstract idea, as there are no other elements in the clams in addition to the exception. Claim 11 claims a sensor, however, the sensor is generic and does not amount to significantly more than the abstract idea.

Claims 14, and 16- 20 are directed towards an abstract idea, specifically, the method of receiving a first signal, receiving a second signal, determining a gait characteristic from the first and second signal and sending a third signal to an output device. While claim 8 does have some structure, such as a tether with an attachment device, a patient support mechanism and a drive mechanism, these structures are not responsible for receiving and analyzing a signal. Additionally, claim 14 claims a first sensor, a second sensor and an output device. The identified elements of the first sensor, the second sensor and the output device do not, individually or in combination, amount to significantly more than the exception of an abstract idea, as the sensors and the output device are generic components and do not add meaningful limitations to the abstract idea. . Further, dependent claims **16-20** do not add sufficient structure to overcome the abstract idea, as the claims as a whole do not amount to significantly more than the abstract idea, as there are no other elements in the clams in addition to the exception.

However, **claim 15** has limitations that do amount to significantly more than the abstract idea. Specifically, the limitations of the drive mechanism including a set of wheels in contact with a portion of the support track and a motor operably coupled to the set of wheels, the motor configured to rotate the set of wheels to move the drive mechanism along the support track, the operating condition of the drive mechanism being associated with a rotational velocity or a rotational acceleration of the set of wheels, the receiving of the second signal from the second sensor includes receiving

data associated with at least one of the rotational velocity of the set of wheels or the acceleration of the set of wheels amount to significantly more than the abstract idea.

Claims 21-27 are directed towards an abstract idea, specifically, the method of receiving a first signal, receiving a second signal, determining a gait characteristic from the first and second signal and sending a third signal to an output device. While claim 8 does have some structure, such as a patient support mechanism and a drive mechanism, these structures are not responsible for receiving and analyzing a signal. Additionally, claim 21 claims a processor and an electronic device. The identified elements of the processor and the electronic device do not, individually or in combination, amount to significantly more than the exception of an abstract idea, as the sensors and the output device are generic components and do not add meaningful limitations to the abstract idea. Further **claims 22-27** do not add sufficient structure to overcome the abstract idea. The claims as a whole do not amount to significantly more than the abstract idea, as there are no other elements in the clams in addition to the exception.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 8-27 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention.

Regarding claim 8, the limitation of “providing electric power to at least one of the drive mechanism or the patient support mechanism operable to transition at least one of the drive mechanism or the patient support mechanism, respectively, from the first operating condition to a second operating condition in response to movement of the patient” on lines 8-11 is considered new matter. The specification does not contain reference to “electric power” nor how it could be used.

Regarding claim 14, the limitations of “providing a first flow of electric power” on line 3, “the first flow of electric power being sent to the patient support mechanism in response to movement of the patient" on lines 7-8, "providing a second flow of electric power" on line 10, "the second flow of electric power" on line 13, " the first signal being associated with an operating condition of the patient support mechanism after being sent the first flow of electric power” on lines 15-17, and “the second signal being associated with an operating condition of the drive mechanism after being sent the

second flow of electric power" on lines 18-19 are considered new matter. The specification does not contain reference to "electric power", either a first or second flow, nor how it could be used.

Regarding claim 15, the limitation of "in response to the second flow of electric power" on line 4 is considered new matter. The specification does not contain reference to "a second flow of electric power" nor how it could be used.

Regarding claim 20, the limitations of "providing a third flow of electric power" on line 8, "the third flow of electric power operable" on lines 9-10, "providing a fourth flow of electric power" on line 11, and "the fourth flow of electric power operable" on line 12 is considered new matter. The specification does not contain reference to "a third flow of electric power" or "a fourth flow of electric power" nor how the electric power could be used.

Regarding claim 21, the limitation of "providing a flow of electric power to at least one of the drive mechanism or the patient support mechanism" on lines 10-11 is considered new matter. The specification does not contain reference to "electric power" nor how it could be used.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the

patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

Claims 8-17, 19-23, 25, and 26 are rejected under 35 U.S.C. 102(a)(2) as being anticipated by Hidler (US 7,883,450).

Regarding claim 8:

Hidler discloses receiving a signal associated with a first operating condition of at least one of a drive mechanism or a patient support mechanism (The device of Hidler has an operating system that receives data from instrumentation that tracks the distance walked, walking speed and unloading forces within and across sessions, see column 4 lines 46-49; the first operating condition is the static state before the user walks) , the patient support mechanism (300, 66) coupled to an active trolley (30) and including a tether (220) having an end portion (306) configured to couple to a patient via an attachment device (see Figure 3), the patient support mechanism configured to support a patient (see Figure 3), the drive mechanism (motor 50, and wheels 32, 34) coupled to the active trolley and configured to move the active trolley along a support track in response to a movement of the patient (the trolley automatically moves with response to the patient moving, see column 4 lines 22-25); providing electric power to at least one of the drive mechanism or the patient support mechanism operable to transition at least one of the drive mechanism or the patient support mechanism, respectively, from the first operating condition to a second operating condition in response to movement of the patient (As discussed above, the device of Hidler has an operating system that receives data from instrumentation that tracks the distance

walked, walking speed and unloading forces within and across session and the device automatically moved with the patient is moving, the second operating condition is when the user starts to move); receiving a signal associated with the second operating condition of at least one of the drive mechanism or the patient support mechanism (as discussed above the Hidler device constantly receives data across a single or multiple exercise routines); determining a difference between the first operating condition and the second operating condition (see Figure 6; Figure 6 is an example of a graphical user interface that displays data related to walking speed, body weight, distance walked, number of breaks taken. For each session, the walking speed is shown with a maximum, minimum and an average); determining, based at least in part on the difference between the first operating condition and the second operating condition, a change in position associated with the attachment device ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" are used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm."* see column 7 lines 14-20); and defining, based at least in part on the change in the position of the attachment device a gait characteristic of the patient supported by the patient support mechanism (this is shown in Figure 6).

Regarding claim 9:

Hidler discloses that wherein the first operating condition is a first operating condition of the patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20. As discussed above, the pivoting arm 66 is part of the patient support mechanism), the method further comprising: receiving a first operating condition associated with the drive mechanism; receiving a second operating condition associated with the drive mechanism; and determining a difference between the first operating condition of the drive mechanism and a second operating condition of the drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44), the determining of the change in the position of the attachment device includes determining the change in the position of the attachment device based at least in part of the difference between the first operating condition of the patient support mechanism and the second operating condition of the patient support mechanism and the difference between the first operating condition of the drive mechanism and the second operating condition of the drive mechanism (see Figure 6; when the user begins to walk, i.e. the first operating

condition moving to the second operating condition, the angle of the unloading system will change and cause the patient support mechanism to move).

Regarding claim 10:

Hidler discloses that the at least one of the drive mechanism or the patient support mechanism is in the first operating condition when the patient is in a first position relative to the support track, the at least one of the drive mechanism or the patient support mechanism is in the second operating condition when the patient moves to a second position relative to the support track, the second position being different from the first position (as discussed above, many metrics are measured during use of the Hidler device, including the distance walked which would include a first operating condition at the beginning and a second operating condition at the end, where the beginning and end are two different locations).

Regarding claim 11:

Hidler discloses that the first operating condition is a first operating condition of the patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism, the receiving of the signal associated with the first operating condition includes receiving the signal associated with the first operating condition from a sensor included in the patient support mechanism, the receiving of the signal associated with the second operating condition includes receiving the signal associated with the second operating condition from the

sensor included in the patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20. As discussed above, the pivoting arm 66 is part of the patient support mechanism).

Regarding claim 12:

Hidler discloses that the first operating condition is a first operating condition of the drive mechanism and the second operating condition is a second operating condition of the drive mechanism, the receiving of the signal associated with the first operating condition includes receiving the signal associated with the first operating condition from a sensor included in the drive mechanism, the receiving of the signal associated with the second operating condition includes receiving the signal associated with the second operating condition from the sensor included in the drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44).

Regarding claim 13:

Hidler discloses that sending a signal to an output device, the signal indicative of an instruction to output data associated with the gait characteristic via the output device (Hidler discloses that the device sends information to a pocketPC, see column 6 lines 4-9).

Regarding claim 14:

Hidler discloses providing a first flow of electric power to a patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20; the flow of electricity is when the sensor senses the rotation of the pivoting arm and sends the information to the patient support mechanism so that the patient support mechanism move with the user) included in a patient support system (66, 300), the patient support mechanism including a tether (220) configured to couple a patient via an attachment device (306) to tether the patient to the patient support mechanism (see Figures 2-3), the patient support system supporting at least a portion of a weight of the patient when the patient is tethered to the patient support mechanism (the patient support mechanism can support the full weight of the user or only a partial weight of the user, see column 4, lines 22-35), the first flow of electric power being sent to the patient support mechanism in response to movement of the patient (see above); providing a

second flow of electric power to a drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44, where the drive mechanism includes the motor 50 and the wheels 32,34) included in the patient support system in response to the movement of the patient, the drive mechanism configured to (1) suspend the patient support system from a support track (see Figure 3) and (2) move along the support track in response to the second flow of electric power ("*As the subject 15 ambulates, the trolley 30 automatically moves forward or back, staying above the subject 15 so that the subject 15 only feels a vertical unloading force and does not have to drag the mass of the trolley 30."* See column 4 lines 22-25); receiving a first signal from a first sensor (sensor detecting the position of the rope), the first sensor being associated with an operation condition of the patient support mechanism after being sent the first flow of electric power; receiving a second signal from a second sensor (sensor mounted on one of the wheels), the second signal being associated with an operating condition of the drive mechanism after being sent the second flow of electric power; determining a change in a position associated with the attachment device based at least in part on the operating condition of the patient support mechanism (as discussed above, the sensors in the wheels and the rope detect the operating condition of the patient support mechanism and the drive mechanism) and the operating condition of the drive mechanism; defining at least one gait characteristic associated with the movement of the patient based at least in part on change in position

of the attachment device (see Figure 6, the device complies and displays data associated with the patients walking routine, including walking speed, body weight support and distance walked, which includes information taken from the first and second sensors, see above); and sending, to an output device, a third signal, the third signal indicative of an instruction to output data associated with the at least one gait characteristic via the output device ("*In addition to a touch-screen user interface, the system can also be controlled wirelessly through a pocketPC. This feature allows the therapist to maintain full control over the unloading system at any point along the rail system is a wireless pocketPC interface computer*." Column 6 lines 4-8).

Regarding claim 15:

Hidler discloses that the drive mechanism includes a set of wheels (32, 34) in contact with a portion of the support track (40) and a motor (50) operably coupled to the set of wheels, the motor configured to rotate the set of wheels to move the drive mechanism along the support track ("I*n the embodiment illustrated in FIG. 12, a direct current (DC) motor 50 is mounted between the front and back trolley wheels or wheel assemblies 32 and 34. In another embodiment, a DC motor is mounted to one of the pivoting wheel assembles 32 or 34. The motor 50, including a gearhead, is utilized to drive the system via a motor drive wheel 52*." See columns 6-7, lines 67, and 1-4), the operating condition of the drive mechanism being associated with a rotational velocity or a rotational acceleration of the set of wheels, the receiving of the second signal from the second sensor includes receiving data associated with at least one of the rotational

velocity of the set of wheels or the acceleration of the set of wheels (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44).

Regarding claim 16:

Hidler discloses that the operating condition of the patient support mechanism is associated with at least one of a length of a portion of the tether, an angle of the portion of the tether relative to the support track, a tension within a portion of the tether, or a feed rate of the tether ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20.).

Regarding claim 17:

Hidler discloses that the movement of the patient is associated with the patient walking, the drive mechanism configured to move along the support track in response to the patient walking ("*As the subject 15 ambulates, the trolley 30 automatically moves forward or back, staying above the subject 15 so that the subject 15 only feels a vertical*

unloading force and does not have to drag the mass of the trolley 30." See column 4 lines 22-25).

Regarding claim 19:

Hidler discloses that the output device includes a display, the sending of the third signal includes sending the third signal to cause at least one of a graphical representation, a numeric representation, or an alpha-numeric representation of data associated with the gait characteristic to be presented on the display of the output device ("*In addition to a touch-screen user interface, the system can also be controlled wirelessly through a pocketPC. This feature allows the therapist to maintain full control over the unloading system at any point along the rail system is a wireless pocketPC interface computer*." Column 6 lines 4-8; please also see Figure 6).

Regarding claim 20:

Hidler discloses that the operating condition of the patient support mechanism is a first operating condition of the patient support mechanism, and the operating condition of the drive mechanism is a first operating condition of the drive mechanism (see rejection above), the method further comprising: defining, based at least in part on the determining of the at least one gait characteristic, a second operating condition associated with the patient support mechanism and a second operating condition associated with the drive mechanism (the patient support mechanism and the drive mechanism are continually sending information to the processor, see Figure 6 for

graphical representation of data); providing a third flow of electric power to the patient support mechanism, the third flow of electric power operable to place the patient support mechanism in its second operating condition (the fourth signal is the vertical height measurement changes, indicative of a fall); and providing a fourth flow of electric power, to the drive mechanism, the fourth flow of electric power operable to place the drive mechanism in its second operating condition ("*In one embodiment, the system has extensive safety features that constantly monitor the status of the patient during training sessions and provide a high level of security to the subject being trained. The subject's vertical height is monitore3d using the system's instrumentation. In one embodiment, if at any time a fall is detected, the system automatically adjusts the unloading force so that the subject will descend a minimal distance, which in one implementation is not more than four inches.*" See column 4 lines 50-58; wherein the fifth signal is the signal changing the unloading force of the device).

Regarding claim 21:

Hidler discloses receiving, at a processor (the pocketPC, see column 6 lines 4-8) of a patient support system, a signal, the signal associated with a first operating condition of the patient support system ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the*

pivoting arm." See column 7 lines 14-20.), the patient support system including a drive mechanism (32, 34, 50) configured to movably suspend the patient support system from a supporting track (see Figures 2-3) and a patient support mechanism having a tether (220) configured couple to a patient via an attachment device to tether a patient to the patient support system (see Figure 3), the patient support system supporting at least a portion of a weight of the patient when the patient is tethered to the patient support system (the patient support mechanism can support the full weight of the user or only a partial weight of the user, see column 4, lines 22-35) providing a flow of electric power to at least one of the drive mechanism or the patient support mechanism to transition the patient support mechanism from the first operating condition to the second operating condition in response to a change in force exerted by the patient on the tether ("*In one embodiment, the system has extensive safety features that constantly monitor the status of the patient during training sessions and provide a high level of security to the subject being trained. The subject's vertical height is monitore3d using the system's instrumentation. In one embodiment, if at any time a fall is detected, the system automatically adjusts the unloading force so that the subject will descend a minimal distance, which in one implementation is not more than four inches."* See column 4 lines 50-58); determining, at the processor, a change in a position associated with the attachment device based at least in part on a change in the force exerted by the patient on the tether ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be*

used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm." See column 7 lines 14-20.), defining at the processor at least one gait characteristic of the patient based at least in part on the change in the position of the attachment device (see Figure 6); and displaying data associated with the at least one gait characteristic of the patient on a display of an electronic device in communication with the processor (the graphical user interface displays gait characteristics associated with the workout routine of the patient, see column 6 lines 4-35).

Regarding claim 22:

Hidler discloses that the patient support system includes an electronic system (the pocketPC, sensors and graphical user interface, see column 4 lines 36- 54, and 6 lines 4-35), the electronic system includes the processor (pocketPC) and at least one sensor (sensors associated with the wheels and the tether, see rejection above), the at least one sensor configured to send the signal to the processor (the information collected from the first signal and the second signal are sent to the computer to been shown in the graphical user interface, see also Figure 6).

Regarding claim 23:

Hidler disclose that the change in force exerted by the patient on the tether is associated with a change in a portion of the weight of the patient supported by the

patient support system (the tether supports the user's weight, see rejection above, a change in force is directly related to the change in a portion of the weight).

Regarding claim 25:

Hidler discloses that the first operating condition is a first operating condition of a drive mechanism and the second operating condition is a second operating condition of the drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44; the wheels are continuously monitored), the drive mechanism configured to movably suspend the patient support system from a support track (the wheels 32, 34 of the drive mechanism suspend the patient support system from a support track 40), the difference between the first operating condition and the second operating condition of the drive mechanism.

Regarding claim 26:

Hidler discloses that the first operating condition is a first operating condition of a patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps*

forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm." See column 7 lines 14-20.), the difference between the first operating condition and the second operating condition of the patient support mechanism is associated with a difference between at least one of a length of a portion of the tether, an angle of a guide member included in the patient support mechanism and engaged with the tether, a tension within a portion of the tether, or a feed rate of the tether.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 18 and 24 are rejected under 35 U.S.C. 103 as being unpatentable over Hidler (US 7,883,450) in view of Martin (US 6,645,126).

Hidler discloses the method as substantially claimed above.

Regarding claim 18:

Hidler fails to distinctly disclose that the determining of the at least one gait characteristic associated with the patient includes determining at least one of a step duration, a swing to stance duration, a swing to stance ratio, a cadence, a stride length of height, a range of motion in an anterior and posterior direction, a range of motion in a

lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

Martin teaches that the gait characteristic of the patient is at least one *of* a step duration, a swing to stance duration, a swing to stance ratio, a cadence (sensed gait parameters can be used to evaluate cadence; claim 2), a stride length (stride length; claim 2), a stride height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

In order to provide feedback for gait therapy/training to the patient, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Hidler's method of feedback to include Martin's feedback in the form of evaluation of gait characteristics such as cadence arid gait patterns because, as Martin discloses, the gait training device evaluates the patient's stride length, cadence, gait velocity, and gait pattern and provides a quantified documentation to help patients (Martin, column 4, lines 5-15); furthermore, one of ordinary skill in the art would recognize that Hidler's plurality of sensors and encoders associated with the tether and drive system coupled with the processor would be configured to determine gait characteristics such as cadence, lateral motion, stride direction, or stride length.

Regarding claim 24:

Hidler fails to distinctly disclose that the determining of the at least one gait characteristic associated with the patient includes determining at least one of a step

duration, a swing to stance duration, a swing to stance ratio, a cadence, a stride length of height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

Martin teaches that the gait characteristic of the patient is at least one *of* a step duration, a swing to stance duration, a swing to stance ratio, a cadence (sensed gait parameters can be used to evaluate cadence; claim 2), a stride length (stride length; claim 2), a stride height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

In order to provide feedback for gait therapy/training to the patient, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Hidler's method of feedback to include Martin's feedback in the form of evaluation of gait characteristics such as cadence arid gait patterns because, as Martin discloses, the gait training device evaluates the patient's stride length, cadence, gait velocity, and gait pattern and provides a quantified documentation to help patients (Martin, column 4, lines 5-15); furthermore, one of ordinary skill in the art would recognize that Hidler's plurality of sensors and encoders associated with the tether and drive system coupled with the processor would be configured to determine gait characteristics such as cadence, lateral motion, stride direction, or stride length.

Examiner's Note

Claim 27 has not been rejected with art, however, a 35 USC 101 rejection has been issued for claim 27.

Response to Arguments

Applicant's arguments filed 01/29/2018 have been fully considered but they are not persuasive.

With regards to the arguments addressing the 35 USC 101 rejection, the Applicant states that the 101 rejections have been overcome but does not state how. Please see 35 USC 101 rejections above.

With regards to the arguments addressing the art rejections of claims 8, 14 and 21, the Applicant is arguing a more narrow scope of the claimed invention. The claims do not have a limitation directed to the "method of calculating change in the center of mass of the patient and then determining gait characteristics". The method claims state using a first operating condition and a second operating condition, but not that the operating conditions being dependent upon a center of mass of the patient.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MEGAN ANDERSON whose telephone number is (313)446-6531. The examiner can normally be reached on M-Th 9:00-7:30 EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, LoAn Thanh can be reached on 571-272-4966. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/MEGAN ANDERSON/
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14/613,140	02/03/2015	Keith McBride	BION-051/02US 307799-2272	7107

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EXAMINER	
ANDERSON, MEGAN M	

ART UNIT	PAPER NUMBER
3784	

NOTIFICATION DATE	DELIVERY MODE
10/30/2018	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zIPPatentDocketingMailboxUS@cooley.com

Office Action Summary	Application No. 14/613,140	Applicant(s) McBride, Keith	
	Examiner MEGAN M ANDERSON	Art Unit 3784	AIA Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 09/25/2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 8-27 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 8-26 is/are rejected.

8) ☑ Claim(s) 27 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date see attached.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

This is the First Action for the Request for Continued Examination based on the 14/613,140 application filed on 02/03/2015 and which claims as amended on 09/25/2018 have been considered in the ensuing action. The present application is being examined under the pre-AIA first to invent provisions.

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 09/25/2018 was filed. The submission is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement is being considered by the examiner.

Response to Amendment

The amendment submitted on 09/25/2018 was sufficient to overcome the claim objections and the 35 USC 112(a) rejections. The claim amendments have been sufficient to overcome the 101 rejections.

Claim Objections

1. Claim 25 objected to because of the following informalities:

   a. On line 6, "difference" should be corrected to ---a difference---

Appropriate correction is required.

Claim Interpretation

The following is a quotation of 35 U.S.C. 112(f):

(f) Element in Claim for a Combination. – An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The following is a quotation of pre-AIA 35 U.S.C. 112, sixth paragraph:

An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

This application includes one or more claim limitations that do not use the word "means," but are nonetheless being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, because the claim limitation(s) uses a generic placeholder that is coupled with functional language without reciting sufficient structure to perform the recited function and the generic placeholder is not preceded by a structural modifier. Such claim limitation(s) is/are:

b. A drive mechanism (at least claims 1, 14, 21): 2300 shown in Figure 12 and including a motor, a support structure, a set of guide wheels assemblies, a secondary wheel assembly (see paragraph [1107])

c. A patient support mechanism (at least claim 1, 14, 21): 2500 shown in Figures 27-33 and including a tether, a winch assembly, a guide mechanism, a first pulley, a second pulley and a cam mechanism (see paragraph [1134])

d. An attachment device (at least claims 1, 21): 1800 shown in Figure 34 including a patient coupling portion see paragraph [1080]

e. A patient support system (at least claims 14, 21): 2000, including a tether, the trolley and the support rail (see paragraph [1159])

f. Output device (at least claim 14): a monitor, laptop, personal computer, hand held controller, smartphone or the like, see paragraph [1214]

Because this/these claim limitation(s) is/are being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, it/they is/are being interpreted to cover the corresponding structure described in the specification as performing the claimed function, and equivalents thereof.

If applicant does not intend to have this/these limitation(s) interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, applicant may: (1) amend the claim limitation(s) to avoid it/them being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph (e.g., by reciting sufficient structure to perform the claimed function); or (2) present a sufficient showing that the claim limitation(s) recite(s) sufficient structure to perform the claimed function so as to avoid it/them being interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention

> and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 8-17, 19-23, 25 and 26 are rejected under 35 U.S.C. 103 as being unpatentable over Hidler (US 7,883,450) in view of Gordon et al (US 2003/0153438).

Regarding claim 8:

Hidler discloses receiving a signal associated with a first operating condition of at least one of a drive mechanism or a patient support mechanism (The device of Hidler has an operating system that receives data from instrumentation that tracks the distance walked, walking speed and unloading forces within and across sessions, see column 4 lines 46-49; the first operating condition is the static state before the user walks) , the patient support mechanism (300, 66) coupled to an active trolley (30) and including a tether (220) having an end portion (306) configured to couple to a patient via an attachment device (see Figure 3), the patient support mechanism configured to support a patient (see Figure 3), the drive mechanism (motor 50, and wheels 32, 34) coupled to the active trolley and including a set of wheels (wheels 32, 34) and configured to move the active trolley along a support track in response to a movement of the patient (the trolley automatically moves with response to the patient moving, see column 4 lines 22-25); providing electric current to at least one of the drive mechanism or the patient support mechanism operable to transition at least one of the drive mechanism or the patient support mechanism, respectively, from the first operating condition to a second operating condition in response to movement of the patient (As discussed above, the device of Hidler has an operating system that receives data from instrumentation that tracks the distance

walked, walking speed and unloading forces within and across session and the device automatically moved with the patient is moving, the second operating condition is when the user starts to move) such that (1) a motor of the drive mechanism rotates the set of wheels to move the active trolley along the support track ("*The trolley motor 50 is turned on, driving the trolley forward or backward, until the rope is vertical (e.g. the patient is directly below the trolley). In this setting, the subject does not have to drag the trolley along but instead the trolley automatically tracks the subject (e.g. stays directly above them) using the motor.* " see column 7 lines 20-25; Hidler discusses that the motor drives the wheels in column 7 lines 1-13) or (2) a motor of the patient support mechanism moves the tether relative to the active trolley, respectively; receiving a signal associated with the second operating condition of at least one of the drive mechanism or the patient support mechanism (as discussed above the Hidler device constantly receives data across a single or multiple exercise routines) ; determining a difference between the first operating condition and the second operating condition (see Figure 6; Figure 6 is an example of a graphical user interface that displays data related to walking speed, body weight, distance walked, number of breaks taken. For each session, the walking speed is shown with a maximum, minimum and an average); determining, based at least in part on the difference between the first operating condition and the second operating condition, a change in position associated with the attachment device ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" are used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines

14-20); and defining, based at least in part on the change in the position of the attachment device a gait characteristic of the patient supported by the patient support mechanism (this is shown in Figure 6).

Hidler fails to disclose that the change in the center of mass of the patient is determined and is used to help define a gait characteristic of the patient supported by the patient support mechanism. However, Hidler discusses various metrics such as fall distance and angle of the tether relative to the vertical. These metrics are related to the center of mass of the patient. Further, Hidler discloses that "other types and units of data may be tracked by the system and displayed." See column 17, lines 53-54.

Gordon et al discloses a body weight support system and states that the center of mass of the user changes during locomotion see paragraph [0014]. Gordon et al further discloses monitoring the center of mass of the user to maintain a proper level of support to the user during locomotion (see paragraph [0022 and 0048-0052]) and that the center of mass helps determine walking characteristics such as what part of walking phase the user is in (see paragraph [0014]).

It would have been obvious to a person having ordinary skill in the art before the effective filing date of the claimed invention to modify the method of Hidler such that the center of mass is monitored and used to help determine a gait characteristic of the user, as disclosed by Gordon et al, as the center of mass is an important locomotion metric (as disclosed by Gordon et al).

Regarding claim 9:

Hidler discloses that wherein the first operating condition is a first operating condition of the patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism *(" In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20. As discussed above, the pivoting arm 66 is part of the patient support mechanism), the method further comprising: receiving a first operating condition associated with the drive mechanism; receiving a second operating condition associated with the drive mechanism; and determining a difference between the first operating condition of the drive mechanism and a second operating condition of the drive mechanism ("A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed." See column 7 lines 40-44), the determining of the change in the center of mass device includes determining the change in the center of mass device based at least in part of the difference between the first operating condition of the patient support mechanism and the second operating condition of the patient support mechanism and the difference between the first operating condition of the drive mechanism and the second operating condition of the drive mechanism (see Figure 6; when the user begins to walk, i.e. the first operating condition moving to the second operating condition, the center of mass of the user changes, as discussed above).

Regarding claim 10:

Hidler discloses that the at least one of the drive mechanism or the patient support mechanism is in the first operating condition when the patient is in a first position relative to the support track, the at least one of the drive mechanism or the patient support mechanism is in the second operating condition when the patient moves to a second position relative to the support track, the second position being different from the first position (as discussed above, many metrics are measured during use of the Hidler device, including the distance walked which would include a first operating condition at the beginning and a second operating condition at the end, where the beginning and end are two different locations).

Regarding claim 11:

Hidler discloses that the first operating condition is a first operating condition of the patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism, the receiving of the signal associated with the first operating condition includes receiving the signal associated with the first operating condition from a sensor included in the patient support mechanism, the receiving of the signal associated with the second operating condition includes receiving the signal associated with the second operating condition from the sensor included in the patient support mechanism (“ In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the

pivoting arm." See column 7, lines 14-20. As discussed above, the pivoting arm 66 is part of the patient support mechanism).

Regarding claim 12:

Hidler discloses that the first operating condition is a first operating condition of the drive mechanism and the second operating condition is a second operating condition of the drive mechanism, the receiving of the signal associated with the first operating condition includes receiving the signal associated with the first operating condition from a sensor included in the drive mechanism, the receiving of the signal associated with the second operating condition includes receiving the signal associated with the second operating condition from the sensor included in the drive mechanism ("A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed." See column 7 lines 40-44).

Regarding claim 13:

Hidler discloses that sending a signal to an output device, the signal indicative of an instruction to output data associated with the gait characteristic via the output device (Hidler discloses that the device sends information to a pocketPC, see column 6 lines 4-9).

Regarding claim 14:

Hidler discloses providing a first flow of electric current to a patient support mechanism ("In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm." See column 7 lines 14-20; the flow of electricity is when the sensor senses the rotation of the pivoting arm and sends the information to the patient support mechanism so that the patient support mechanism move with the user) included in a patient support system (66, 300), the patient support mechanism including a tether (220) configured to couple a patient via an attachment device (306) to tether the patient to the patient support mechanism (see Figures 2-3), the patient support system supporting at least a portion of a weight of the patient when the patient is tethered to the patient support mechanism (the patient support mechanism can support the full weight of the user or only a partial weight of the user, see column 4, lines 22-35), the first flow of electric current being sent to the patient support mechanism in response to movement of the patient (see above) such that a motor of the patient support mechanism moves a portion of the tether relative to the patient ("*A function of the winch is to raise and lower the subject into or out of a sitting position, or in some cases, bring a person up from or lower a person to the floor. The winch sub-assembly consists of a DC brushless motor, a harmonic drive gear head, and a winch drum spooled with approximately twelve feet of rope."* See column 9 lines 59-65; the position of the user is controlled by the user interface); providing a second flow of electric current to a drive mechanism ("A high-resolution sensor that is mounted to one of the wheels on the pivoting

wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed." drive mechanism includes the motor 50 and the wheels 32,34) included in the patient support system in response to the movement of the patient, the drive mechanism configured to (1) suspend the patient support system from a support track (see Figure 3) and (2) rotate a set of wheels (32 and 34) to move the patient support system along the support track in response to the second flow of electric current (" As the subject ambulates, the trolley 30 automatically moves forward or back, staying above the subject 15 so that the subject 15 only feels a vertical unloading force and does not have to drag the mass of the trolley 30." See column 7 lines 40-44, where the As the subject 15 ambulates, the trolley See column 4 lines 22-25); receiving a first signal from a first sensor (sensor detecting the position of the rope), the first sensor being associated with an operation condition of the patient support mechanism after being sent the first flow of electric current; receiving a second signal from a second sensor (sensor mounted on one of the wheels), the second signal being associated with an operating condition of the drive mechanism after being sent the second flow of electric current; determining a change in a position associated with the attachment device based at least in part on the operating condition of the patient support mechanism (as discussed above, the sensors in the wheels and the rope detect the operating condition of the patient support mechanism and the drive mechanism) and the operating condition of the drive mechanism; defining at least one gait characteristic associated with the movement of the patient based at least in part on change in position of the attachment device (see Figure 6, the device complies and displays data associated with the patients walking routine, including walking speed, body weight support and distance walked, which includes

information taken from the first and second sensors, see above); and sending, to an output device, a third signal, the third signal indicative of an instruction to output data associated with the at least one gait characteristic via the output device ("In addition to a touch-screen user interface, the system can also be controlled wirelessly through a pocketPC. This feature allows the therapist to maintain full control over the unloading system at any point along the rail system is a wireless pocketPC interface computer." Column 6 lines 4-8).

Hidler fails to disclose that the change in the center of mass of the patient is determined and is used to help define a gait characteristic of the patient supported by the patient support mechanism. However, Hidler discusses various metrics such as fall distance and angle of the tether relative to the vertical. These metrics are related to the center of mass of the patient. Further, Hidler discloses that "other types and units of data may be tracked by the system and displayed." See column 17, lines 53-54.

Gordon et al discloses a body weight support system and states that the center of mass of the user changes during locomotion see paragraph [0014]. Gordon et al further discloses monitoring the center of mass of the user to maintain a proper level of support to the user during locomotion (see paragraph [0022 and 0048-0052]) and that the center of mass helps determine walking characteristics such as what part of walking phase the user is in (see paragraph [0014]).

It would have been obvious to a person having ordinary skill in the art before the effective filing date of the claimed invention to modify the method of Hidler such that the center of mass is monitored and used to help determine a gait characteristic of the user, as

disclosed by Gordon et al, as the center of mass is an important locomotion metric (as disclosed by Gordon et al).

Regarding claim 15:

Hidler discloses that the drive mechanism includes a motor (50) operably coupled to the set of wheels, the motor configured to rotate the set of wheels to move the drive mechanism along the support track in response to the second flow of electric current ("*In the embodiment illustrated in FIG. 12, a direct current (DC) motor 50 is mounted between the front and back trolley wheels or wheel assemblies 32 and 34. In another embodiment, a DC motor is mounted to one of the pivoting wheel assembles 32 or 34. The motor 50, including a gearhead, is utilized to drive the system via a motor drive wheel 52*." See columns 6-7, lines 67, and 1-4), the operating condition of the drive mechanism being associated with a rotational velocity or a rotational acceleration of the set of wheels, the receiving of the second signal from the second sensor includes receiving data associated with at least one of the rotational velocity of the set of wheels or the acceleration of the set of wheels ("*A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed.*" See column 7 lines 40-44).

Regarding claim 16:

Hidler discloses that the operating condition of the patient support mechanism is associated with at least one of a length of a portion of the tether, an angle of the portion of the

tether relative to the support track, a tension within a portion of the tether, or a feed rate of the tether ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20.).

Regarding claim 17:

Hidler discloses that the movement of the patient is associated with the patient walking, the drive mechanism configured to rotate the set of wheels to move the patient support system along the support track in response to the patient walking ("*As the subject 15 ambulates, the trolley 30 automatically moves forward or back, staying above the subject 15 so that the subject 15 only feels a vertical unloading force and does not have to drag the mass of the trolley 30.*" See column 4 lines 22-25).

Regarding claim 19:

Hidler discloses that the output device includes a display, the sending of the third signal includes sending the third signal to cause at least one of a graphical representation, a numeric representation, or an alpha-numeric representation of data associated with the gait characteristic to be presented on the display of the output device ("*In addition to a touch-screen user interface, the system can also be controlled wirelessly through a pocketPC. This feature allows the therapist to maintain full control over the unloading system at any point*

along the rail system is a wireless pocketPC interface computer." See column 6 lines 4-8; please also see Figure 6).

Regarding claim 20:

Hidler discloses that the operating condition of the patient support mechanism is a first operating condition of the patient support mechanism, and the operating condition of the drive mechanism is a first operating condition of the drive mechanism (see rejection above), the method further comprising: defining, based at least in part on the determining of the at least one gait characteristic, a second operating condition associated with the patient support mechanism and a second operating condition associated with the drive mechanism (the patient support mechanism and the drive mechanism are continually sending information to the processor, see Figure 6 for graphical representation of data); providing a third flow of electric current to the patient support mechanism, the third flow of electric current operable to move at the portion of the tether relative to the patient to place the patient support mechanism in its second operating condition (the fourth signal is the vertical height measurement changes, indicative of a fall); and providing a fourth flow of electric current to the drive mechanism, the fourth flow of electric current operable to rotate the set of wheels of the drive mechanism to place the drive mechanism in its second operating condition ("*In one embodiment, the system has extensive safety features that constantly monitor the status of the patient during training sessions and provide a high level of security to the subject being trained. The subject's vertical height is monitored using the system's instrumentation. In one embodiment, if at any time a fall is detected, the system automatically adjusts the unloading force so that the subject will*

descend a minimal distance, which in one implementation is not more than four inches." See column 4 lines 50-58; wherein the fifth signal is the signal changing the unloading force of the device).

Regarding claim 21:

Hidler discloses receiving, at a processor (the pocketPC, see column 6 lines 4-8) of a patient support system, a signal, the signal associated with a first operating condition of the patient support system ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20.), the patient support system including a drive mechanism (32, 34, 50) having a set of wheels (32, 34) configured to movably suspend the patient support system from a supporting track (see Figures 2-3) and a patient support mechanism having a tether (220) configured couple to a patient via an attachment device to tether a patient to the patient support system (see Figure 3), the patient support system supporting at least a portion of a weight of the patient when the patient is tethered to the patient support system (the patient support mechanism can support the full weight of the user or only a partial weight of the user, see column 4, lines 22-35) providing a flow of electric current to at least one of the drive mechanism or the patient support mechanism to transition the patient support mechanism from the first operating condition to the second operating condition in response to a change in force exerted by the patient on the

tether such that (1) a motor (50) of the drive mechanism rotates the set of wheels to move the patient support system along the track or (2) a motor of the patient support mechanism moves a portion of the tether relative to the patient, respectively; ("*In one embodiment, the system has extensive safety features that constantly monitor the status of the patient during training sessions and provide a high level of security to the subject being trained. The subject's vertical height is monitore3d using the system's instrumentation. In one embodiment, if at any time a fall is detected, the system automatically adjusts the unloading force so that the subject will descend a minimal distance, which in one implementation is not more than four inches.*" See column 4 lines 50-58); determining, at the processor, a change in a position associated with the attachment device based at least in part on a change in the force exerted by the patient on the tether ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20.), defining at the processor at least one gait characteristic of the patient based at least in part on the change in the position of the attachment device (see Figure 6); and displaying data associated with the at least one gait characteristic of the patient on a display of an electronic device in communication with the processor (the graphical user interface displays gait characteristics associated with the workout routine of the patient, see column 6 lines 4-35).

Hidler fails to disclose that the change in the center of mass of the patient is determined and is used to help define a gait characteristic of the patient supported by the patient support

mechanism. However, Hidler discusses various metrics such as fall distance and angle of the tether relative to the vertical. These metrics are related to the center of mass of the patient. Further, Hidler discloses that "other types and units of data may be tracked by the system and displayed." See column 17, lines 53-54.

Gordon et al discloses a body weight support system and states that the center of mass of the user changes during locomotion see paragraph [0014]. Gordon et al further discloses monitoring the center of mass of the user to maintain a proper level of support to the user during locomotion (see paragraph [0022 and 0048-0052]) and that the center of mass helps determine walking characteristics such as what part of walking phase the user is in (see paragraph [0014]).

It would have been obvious to a person having ordinary skill in the art before the effective filing date of the claimed invention to modify the method of Hidler such that the center of mass is monitored and used to help determine a gait characteristic of the user, as disclosed by Gordon et al, as the center of mass is an important locomotion metric (as disclosed by Gordon et al).

Regarding claim 22:

Hidler discloses that the patient support system includes an electronic system (the pocketPC, sensors and graphical user interface, see column 4 lines 36- 54, and 6 lines 4-35), the electronic system includes the processor (pocketPC) and at least one sensor (sensors associated with the wheels and the tether, see rejection above), the at least one sensor configured to send

the signal to the processor (the information collected from the first signal and the second signal are sent to the computer to been shown in the graphical user interface, see also Figure 6).

Regarding claim 23:

Hidler disclose that the change in force exerted by the patient on the tether is associated with a change in a portion of the weight of the patient supported by the patient support system (the tether supports the user's weight, see rejection above, a change in force is directly related to the change in a portion of the weight).

Regarding claim 25:

Hidler discloses that the first operating condition is a first operating condition of a drive mechanism and the second operating condition is a second operating condition of the drive mechanism (*"A high-resolution sensor that is mounted to one of the wheels on the pivoting wheel assemblies 32 and 34 measures the rotation of the wheel in order to monitor how far the subject has walked and also their walking speed."* See column 7 lines 40-44; the wheels are continuously monitored), the difference between the first operating condition and the second operating condition of the drive mechanism is associated with a difference between at least one of a position of at least one wheel from the set of wheels relative to the support track, or a velocity of at least one wheel from the set of wheels, or an acceleration of at least one wheel from the set of wheels.

Regarding claim 26:

Hidler discloses that the first operating condition is a first operating condition of a patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism ("*In this setting, the rope of the unloading system hangs down through a pivoting arm and connects to the patient's harness. On the pivoting arm is a sensor or detector that measures the angle of the rope. The terms "sensor" and "detector" can be used interchangeably herein. As the subject steps forward, this causes the pivoting arm to rotate, which is detected by the sensor on the pivoting arm*." See column 7 lines 14-20.), the difference between the first operating condition and the second operating condition of the patient support mechanism is associated with a difference between at least one of a length of a portion of the tether, an angle of a guide member included in the patient support mechanism and engaged with the tether, a tension within a portion of the tether, or a feed rate of the tether.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 18 and 24 are rejected under 35 U.S.C. 103 as being unpatentable over Hidler (US 7,883,450) and Gordon et al (US 2003/0153438) in view of Martin (US 6,645,126).

Hidler as modified discloses the method as substantially claimed above.

Regarding claim 18:

Hidler fails to distinctly disclose that the determining of the at least one gait characteristic associated with the patient includes determining at least one of a step duration, a swing to stance duration, a swing to stance ratio, a cadence, a stride length of height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

Martin teaches that the gait characteristic of the patient is at least one *of* a step duration, a swing to stance duration, a swing to stance ratio, a cadence (sensed gait parameters can be used to evaluate cadence; claim 2), a stride length (stride length; claim 2), a stride height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

In order to provide feedback for gait therapy/training to the patient, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Hidler's method of feedback to include Martin's feedback in the form of evaluation of gait characteristics such as cadence arid gait patterns because, as Martin discloses, the gait training device evaluates the patient's stride length, cadence, gait velocity, and gait pattern and provides a quantified documentation to help patients (Martin, column 4, lines 5-15); furthermore, one of ordinary

skill in the art would recognize that Hidler's plurality of sensors and encoders associated with the tether and drive system coupled with the processor would be configured to determine gait characteristics such as cadence, lateral motion, stride direction, or stride length.

Regarding claim 24:

Hidler fails to distinctly disclose that the determining of the at least one gait characteristic associated with the patient includes determining at least one of a step duration, a swing to stance duration, a swing to stance ratio, a cadence, a stride length of height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

Martin teaches that the gait characteristic of the patient is at least one *of* a step duration, a swing to stance duration, a swing to stance ratio, a cadence (sensed gait parameters can be used to evaluate cadence; claim 2), a stride length (stride length; claim 2), a stride height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction.

In order to provide feedback for gait therapy/training to the patient, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Hidler's method of feedback to include Martin's feedback in the form of evaluation of gait characteristics such as cadence arid gait patterns because, as Martin discloses, the gait training device evaluates the

patient's stride length, cadence, gait velocity, and gait pattern and provides a quantified documentation to help patients (Martin, column 4, lines 5-15); furthermore, one of ordinary skill in the art would recognize that Hidler's plurality of sensors and encoders associated with the tether and drive system coupled with the processor would be configured to determine gait characteristics such as cadence, lateral motion, stride direction, or stride length.

Allowable Subject Matter

Claim 27 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

Applicant's arguments with respect to claims 8, 14, and 21 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection. Hidler does not discuss a center of mass. Please see rejection of above.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of

the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MEGAN M ANDERSON whose telephone number is (313)446-6531. The examiner can normally be reached on M-TH 6 a.m. -4 p.m (Arizona).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, LoAn Thanh can be reached on 571-272-4966. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you

would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Megan Anderson/
Examiner, Art Unit 3784

Notice of References Cited	Application/Control No. 14/613,140	Applicant(s)/Patent Under Reexamination McBride, Keith	
	Examiner MEGAN M ANDERSON	Art Unit 3784	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20030153438-A1	08-2003	Gordon, Keith	A63B22/02	482/92
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/783,755	10/13/2017	Joel Behnke	BION-051/10US 307799-2323	1082

58249 7590 05/07/2018

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UNITED STATES OF AMERICA

EXAMINER	
KURILLA, ERIC J	

ART UNIT	PAPER NUMBER
3673	

NOTIFICATION DATE	DELIVERY MODE
05/07/2018	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zIPPatentDocketingMailboxUS@cooley.com

Office Action Summary	Application No. 15/783,755	Applicant(s) Behnke et al.	
	Examiner ERIC J KURILLA	Art Unit 3673	AIA Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 02/26/2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 22-51 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 22-51 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 10/13/2017 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Election/Restrictions

2. Applicant's election without traverse of Species I (Figs. 2-34) in the reply filed on 02/26/2018 is acknowledged. Applicant correctly asserted that the election requirement pertained to new claims 22-51 and not the canceled claims 1-21.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claim(s) 22 and 25-51 is/are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Hidler (US PG-Pub 2008/0287268).

Regarding Claim 22, Hidler discloses a system (Fig. 1), comprising: a trolley (30) having a drive assembly (50) configured to movably suspend the trolley from a track; an adjustable tether (220) coupled to the trolley, the adjustable tether configured to support a patient (see Fig. 3); and a powered conductor (326) fixedly coupled adjacent to the track such that each of the track and the drive assembly are disposed outside of and separated from the powered conductor, the powered conductor configured to electrically couple to the trolley, the trolley configured to supply the drive assembly with electric power received from the powered

conductor to move the trolley along the track in response to a change in a force exerted by the patient on the adjustable tether (see para. [0051] and [0052] and Fig. 5).

Regarding Claim 25, Hidler discloses wherein the change in the force exerted by the patient on the adjustable tether results in a displacement of the adjustable tether relative to a portion of the trolley (see para. [0069]).

Regarding Claim 26, Hidler discloses wherein the displacement of the adjustable tether results in a change in an angle of a portion of the adjustable tether relative to the portion of the trolley, the trolley includes a sensor configured to sense a change in angle of the portion of the adjustable tether, the trolley configured to supply electric power to the drive assembly to move the trolley along the track in response to an output received from the sensor (see para. [0069]).

Regarding Claim 27, Hidler discloses wherein the adjustable tether is included in a patient support mechanism (300) of the trolley, the trolley configured supply the patient support mechanism with electric power received from the powered conductor such that the patient support mechanism actively supports the patient (see Fig. 3).

Regarding Claim 28, Hidler discloses wherein the change in the force exerted by the patient on the adjustable tether includes a change in a horizontal force exerted by the patient on the adjustable tether, the trolley configured to supply electric power to the drive assembly to move the trolley along the track in response to the change in the horizontal force (see para. [0069]. Angle includes vertical and horizontal components).

Regarding Claim 29, Hidler discloses wherein the change in the force exerted by the patient on the adjustable tether includes a change in a vertical force exerted by the patient on the adjustable tether, the trolley configured to supply electric power to the patient support

mechanism to actively support the patient in response to the change in the vertical force (see para. [0069]. Angle includes vertical and horizontal components).

Regarding Claim 30, Hidler discloses wherein the drive assembly includes a plurality of wheels (32 and 34), at least a portion of the plurality of wheels disposed above at least a portion of the track (see Fig. 12).

Regarding Claim 31, Hidler discloses wherein the drive assembly includes a plurality of wheels (32 and 34), a portion of the track being disposed between at least one wheel from the plurality of wheels and the powered conductor such that the at least one wheel is isolated from the powered conductor (see Figs. 2 and 12).

Regarding Claim 32, Hidler discloses a trolley (30), comprising: a drive assembly (50) configured to movably suspend the trolley from a track; a patient support mechanism including an adjustable tether (220) and configured to support an amount of weight of a user; and an electronic system (see Fig. 2) electrically coupled to the drive assembly and the patient support mechanism, a portion of the electronic system in electrical contact with at least one conductive surface of a powered conductor (326) coupled adjacent to the track, the electronic system configured to supply the drive assembly with electric power received from the powered conductor in response to a first force exerted by the user on the adjustable tether such that the drive assembly moves the trolley along the track (see para. [0069]), the electronic system configured to supply the patient support mechanism with electric power received from the powered conductor in response to a second force exerted by the user on the adjustable tether such that the patient support mechanism adjusts the amount of weight supported by the

patient support mechanism, the second force being different from the first force (see Fig. 5 and 30).

Regarding Claim 33, Hidler discloses wherein the first force exerted by the user on the adjustable tether results in a change in an angle of a portion of the adjustable tether relative to a portion of the patient support mechanism, the portion of the patient support mechanism including a sensor configured to detect an angle of the portion of the adjustable tether (see para. [0069]).

Regarding Claim 34, Hidler discloses wherein the drive assembly includes a plurality of wheels (32 and 34), at least a portion of the track is disposed between at least one wheel from the plurality of wheels and the powered conductor (see Figs 2 and 12).

Regarding Claim 35, Hidler discloses wherein the drive assembly includes a plurality of wheels (32 and 34) and a first motor (50), the first motor is configured to move at least a portion of the wheels along the track in response to movement of the user supported by the adjustable tether.

Regarding Claim 36, Hidler discloses wherein the patient support mechanism includes a drum and a second motor (205), the adjustable tether includes a first end portion configured to couple to a support harness worn by the user (see Fig. 3) and a second end portion coupled to the drum (see para. [0047]), the second motor configured to rotate the drum to adjust an amount of weight supported by the patient support mechanism in response to the second force (see para. [0074]).

Regarding Claim 37, Hidler discloses wherein the electronic system is configured to supply electric power to the drive assembly and to the patient support mechanism independently (see para. [0069] and [0074]).

Regarding Claim 38, Hidler discloses wherein the electronic system is configured to supply electric power to the drive assembly and to the patient support mechanism concurrently (see para. [0069] and [0074]).

Regarding Claim 39, Hidler discloses wherein a direction of the first force is different from a direction of the second force (see para. [0069]).

Regarding Claim 40, Hidler discloses wherein the first force is a horizontal force associated with movement of the user relative to the track (see para. [0069]. Angle includes vertical and horizontal components).

Regarding Claim 41, Hidler discloses wherein the second force is a vertical force associated with movement of the user relative to the track (see para. [0069]. Angle includes vertical and horizontal components).

Regarding Claim 42, Hidler discloses a method for supporting an amount of a user's weight via a body weight support system (see Fig. 3), the body weight support system including a trolley (30) having a drive assembly (50) and a patient support mechanism (300), the drive assembly configured to movably suspend the trolley from a track, the patient support mechanism including an adjustable tether (220), the method comprising: coupling the adjustable tether to a support harness worn by the user (see Fig. 3); receiving a flow of electric power from a powered conductor (326) coupled adjacent to the track; providing a flow of

electric power to at least one of the drive assembly or the patient support mechanism to place the trolley in a first operating state (pivoting arm vertical) in response to a force exerted by the user on the adjustable tether; and providing a flow of electric power to at least one of the drive assembly or the patient support mechanism to place the trolley in a second operating state (brake on to keep trolley in a particular position) in response to a change in the force exerted by the user on the adjustable tether (see para. [0069]).

Regarding Claim 43, Hidler discloses wherein the first operating state is different from the second operating state (see para. [0069])

Regarding Claim 44, Hidler discloses receiving, from at least one sensor (65), a signal associated with the change in the force exerted by the user on the adjustable tether (see Figs. 15 and 16).

Regarding Claim 45, Hidler discloses wherein the change in the force exerted by the user on the adjustable tether includes a change in at least one of a magnitude of the force, a direction of the force, or an acceleration associated with the force (see para. [0069]).

Regarding Claim 46, Hidler discloses wherein providing the flow of electric power to at least one of the drive assembly or the patient support mechanism to place the trolley in the first operating state includes providing electric power to the drive assembly, the drive assembly including a plurality of wheels configured to move along the track to move the trolley relative to the track in response to the force exerted by the user on the adjustable tether (see para. [0069]).

Regarding Claim 47, Hidler discloses wherein providing the flow of electric power to at least one of the drive assembly or the patient support mechanism to place the trolley in the

first operating state includes providing electric power to the patient support mechanism, the patient support mechanism includes a drum and a second motor (205), the adjustable tether includes a first end portion configured to be coupled to the support harness worn by the user (see Fig. 3) and a second end portion coupled to the drum, the second motor configured to rotate the drum in response to the force exerted by the user on the adjustable tether (see para. [0074]).

Regarding Claim 48, Hidler discloses wherein providing the flow of electric power to at least one of the drive assembly or the patient support mechanism to place the trolley in the first operating state includes providing electric power to the drive assembly and the patient support mechanism (see para. [0069] and [0074]), the drive assembly including a plurality of wheels configured to move along the track to move the trolley relative to the track in response to the force exerted by the user on the adjustable tether, and the patient support mechanism includes a drum and a second motor (205), the adjustable tether includes a first end portion configured to be coupled to the support harness worn by the user (see Fig. 3) and a second end portion coupled to the drum, the second motor configured to rotate the drum in response to the force exerted by the user on the adjustable tether (see para. 0074[).

Regarding Claim 49, Hidler discloses wherein (1) providing the flow of electric power to at least one of the drive assembly or the patient support mechanism to place the trolley in the second operating state includes providing electric power to the drive assembly (see para. [0069]), (2) the change in the force exerted by the user on the adjustable tether includes a change in a horizontal force exerted by the user on the adjustable tether (see para. [0069]), and (3) the change in the horizontal force exerted by the user on the adjustable tether results in a

change in an angle of a portion of the adjustable tether relative to a portion of the trolley (see par. [0069]), the drive assembly including a plurality of wheels (32 and 34) configured to move along the track to move the trolley relative to the track in response to the change in the angle of the portion of the adjustable tether relative to the portion of the trolley (see para. [0069]).

Regarding Claim 50, Hidler discloses wherein providing the flow of electric power to at least one of the drive assembly or the patient support mechanism to place the trolley in the second operating state includes providing electric power to the patient support mechanism (keeping rope 220 under tension, see para. [0074]), and the change in the force exerted by the user on the adjustable tether includes a change in a vertical force exerted by the user on the adjustable tether, the patient support mechanism includes a drum and a second motor (205), the adjustable tether includes a first end portion (see Fig. 3) configured to be coupled to the support harness worn by the user and a second end portion coupled to the drum, the second motor configured to rotate the drum in response to the change in the vertical force exerted by the user on the adjustable tether (see para. [0047]).

Regarding Claim 51, Hidler discloses wherein providing the flow of electric power to at least one of the drive assembly or the patient support mechanism to place the trolley in the second operating state includes providing electric power to the drive assembly and the patient support mechanism (braking and keeping the rope under tension), the drive assembly including a plurality of wheels (32 and 34) configured to move along the track to move the trolley relative to the track in response to the change in the force exerted by the user on the adjustable tether, and the patient support mechanism includes a drum and a second motor (205), the adjustable tether includes a second end portion configured to be coupled to the support harness worn by

the user (see Fig. 3) and a second end portion coupled to the drum, the second motor configured to rotate the drum in response to the change in the force exerted by the user on the adjustable tether (see para. [0047]).

Claim Rejections - 35 USC § 103

5. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claim 23 and 24 is/are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Hidler (US PG-Pub 2008/0287268) in view of Bergenstrale (US PG-Pub 2012/0000876).

Regarding Claim 23, Hidler fails to disclose a battery configured to at least temporarily provide electric power to the trolley. Bergenstrale teaches a battery configured to at least temporarily provide electric power to the trolley (see para. [0003]). Hidler and Bergenstrale are analogous art because they are from the same field of endeavor, i.e. patient supports. It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the system of Hidler with the battery of Bergenstrale. The motivation would have been to provide redundancy in case of a power failure.

Regarding Claim 24, Bergenstrale teaches herein the battery is configured to receive electric power from a power source, the electric power received from the power source being operable to electrically charge the battery (see para. [0003]).

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See attached PTO-892.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ERIC J KURILLA whose telephone number is (571)270-7294. The examiner can normally be reached on 7AM-6PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Peter Cuomo can be reached on 571-272-6856. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/ERIC J KURILLA/
Primary Examiner, Art Unit 3673

Notice of References Cited	Application/Control No. 15/783,755	Applicant(s)/Patent Under Reexamination Behnke et al.	
	Examiner ERIC J KURILLA	Art Unit 3673	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9510991-B2	12-2016	Stockmaster; James G.	A61H3/008	1/1
*	B	US-20120000876-A1	01-2012	Bergenstrale; Robert	A61G7/1042	212/336
*	C	US-20080287268-A1	11-2008	Hidler; Joseph	A61H3/008	482/69
*	D	US-20150143627-A1	05-2015	McBride; Keith	A61H3/008	5/81.1R
*	E	US-20110265260-A1	11-2011	Darrow; Dewey	A61G7/1015	5/85.1
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/349,390	11/11/2016	Arkady GLUKHOVSKY	BION-054/01US 307799-2300	1086

58249 7590 01/17/2019

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

EXAMINER	
LE, MARK T	

ART UNIT	PAPER NUMBER
3617	

NOTIFICATION DATE	DELIVERY MODE
01/17/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zIPPatentDocketingMailboxUS@cooley.com

Office Action Summary	Application No. 15/349,390	Applicant(s) GLUKHOVSKY et al.	
	Examiner MARK T LE	Art Unit 3617	AIA Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 29 November 2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-3,5-11,13-15 and 21-27 is/are pending in the application.

5a) Of the above claim(s) 8-11 and 13-15 is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-3,5-7 and 21-27 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

2. Applicant's election without traverse of Group I, Species D, shown in Figs. 4-5 in the reply filed on November 29, 2018 is acknowledged. Applicant submits that all current pending claims 1-3, 5-11, 13-15 and 21-27 are readable on the elected Species D shown in Figs. 4-5. However, upon more a carefully reading independent claim 8, it is noted that claim 8 (i.e. at least the last paragraph of claim 8) is not readable on the elected Species D of Figs. 4-5, wherein the trolley on the support system of Species D cannot be moved from the second position to the third position after the switch is transitioned from the first configuration to the second configuration. Accordingly, independent claim 8 along with claims 9-11, 13-15 depending therefrom are withdrawn from further consideration for being drawn to non-elected species.

3. The abstract of the disclosure is objected to because phrases that can be implied, such as "The present invention ....", line 1 of the abstract, should be avoided. Correction is required. See MPEP § 608.01(b).

4. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claim 23 is rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention. Specifically, the storage configuration recited in claim 23 is not found in the originally filed disclosure.

6. Claims 1-3, 5-7 and 21-27 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Throughout the instant claims, the designations of the first, second, and third track and power rail portions are not consistent with the corresponding track and power rail portions described in the instant specification such that the instant claimed structure are confusing when reads in light of the specification. Note for example, the track portions 421, 422, 423 of Figs. 4-5 are described in the instant specification as first, second, and third track portions, respectively, whereas the same track portions 421, 422, 423 are implied for example in claim 27 as first, third and second track portions, respectively.

7. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have

> been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the effective filing date of the claimed invention(s) absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

8. Claims 1-3, 5-7 and 21-27 is/are rejected under 35 U.S.C. 103 as being unpatentable over Spafford (US 2,688,933) in view of Weise (US 2,519,165).

Spafford discloses a support system having features similar to that recited in the instant claims, including support track with portions 11, 12 and power rail 36, 37 comprising portions corresponding to the support track portions, wherein the support track and power rail are configured to support and providing electrical power to a trolley, and track switch 14 shown in Fig. 1 that includes a support track portion comprising first and second track portions 15, 16, and associated power rail portions.

Weise (Fig. 3) shows power rail 30, 31 coupled to the support track.

In view of Weise, it would have been obvious to one of ordinary skill in the art to construct the support system of Spafford with the power rails coupled to the support track, in a manner similar to that taught by Weise, because Spadfffford does not provide a detailed teaching of mounting power rails to the support track to achieve advantages expected from the mounting taught by Weise. The structure of Spafford, as modified, is

considered to include the combination of features recited in instant claim 1, and to be capable for operation as recited in instant claim 1.

Regarding instant claim 2, consider discontinuous first and second support track portions 11 and 12 of Spafford.

Regarding instant claim 3, consider track switch 14 of Spafford that is configured for translation between first and second configurations via driving device 43, 44, 45.

Regarding instant claims 5-6, the structure of Spafford, as modified, has the configuration that is capable for operation as recited in instant claims 5-6.

Regarding instant claim 7, consider collectors 32-35 shown in Fig. 1 of Spafford.

Regarding instant claim 21, consider the above described features of Spafford, as modified. The structure of Spafford, as modified, is considered to include the combination of features of claim 21.

Regarding instant claim 22, consider the arrangement of switch 14 shown in Fig. 1 of Spafford.

Regarding instant claims 23-27, the support system of Spafford, as modified, has the configuration and capable as recited in instant claims 23-27. See Fig. 1 of Spafford.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MARK T LE whose telephone number is (571)272-6682. The examiner can normally be reached on Mon-Tue,Thu-Fri 6am-4:30pm.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Samuel Morano can be reached on 571-272-6684. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MARK T. LE
Primary Examiner
Art Unit 3617

/MARK T LE/
Primary Examiner, Art Unit 3617

Notice of References Cited	Application/Control No. 15/349,390	Applicant(s)/Patent Under Reexamination GLUKHOVSKY et al.	
	Examiner MARK T LE	Art Unit 3617	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2688933-A	09-1954	SPAFFORD RALPH W	B61L23/005	104/130.06
*	B	US-2519165-A	08-1950	WEISE KURT R	H01R41/00	191/45A
	C					
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FOREIGN PATENT DOCUMENTS

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	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 7

Complete if Known	
Application Number	15/349,390
Filing Date	November 11, 2016
First Named Inventor	Arkady GLUKHOVSKY
Art Unit	3617
Examiner Name	Mark T. LE
Attorney Docket Number	BION-054/01US 307799-2300

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	1.	764,781	07-12-1904	Sumner	
	2.	895,055	08-04-1908	Spooner	
	3.	1,536,766	05-05-1925	Cammann	
	4.	1,648,930	11-15-1927	Zouck	
	5.	1,971,294	08-21-1934	Bunker	
	6.	2,211,220	08-13-1940	Verplanck	
	7.	2,360,505	10-17-1944	Medenwald et al.	
	8.	2,819,755	01-14-1958	Berger et al.	
	9.	3,424,458	01-28-1969	Hopps, Jr.	
	10.	3,720,172	03-13-1973	Dehne	
	11.	3,780,663	12-25-1973	Pettit	
	12.	3,985,082	10-12-1976	Barac	
	13.	4,243,147	01-06-1981	Twitchell et al.	
	14.	4,360,307	11-23-1982	Larsson	
	15.	4,372,452	02-08-1983	McCord	
	16.	4,427,398	01-24-1984	Eisbrecher et al.	
	17.	4,606,082	08-19-1986	Kuhlman	
	18.	4,627,119	12-09-1986	Hachey et al.	
	19.	4,639,955	02-03-1987	Carminati et al.	
	20.	4,706,782	11-17-1987	Spoeler et al.	
	21.	4,944,056	07-31-1990	Schroeder et al.	
	22.	5,048,822	09-17-1991	Murphy	
	23.	5,138,953	08-18-1992	Horcher et al.	
	24.	5,337,908	08-16-1994	Beck, Jr.	
	25.	5,490,293	02-13-1996	Nilsson	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 7

Complete if Known	
Application Number	15/349,390
Filing Date	November 11, 2016
First Named Inventor	Arkady GLUKHOVSKY
Art Unit	3617
Examiner Name	Mark T. LE
Attorney Docket Number	BION-054/01US 307799-2300

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	26.	5,511,486	04-30-1996	Pollard et al.	
	27.	5,632,206	05-27-1997	Summa et al.	
	28.	5,638,755	06-17-1997	Love et al.	
	29.	5,695,432	12-09-1997	Soderlund	
	30.	5,809,591	09-22-1998	Capaldi et al.	
	31.	5,850,928	12-22-1998	Kahlman et al.	
	32.	5,904,099	05-18-1999	Danneker	
	33.	6,080,087	06-27-2000	Bingham	
	34.	6,192,803	02-27-2001	Nishino	
	35.	6,315,138	11-13-2001	Dyson	
	36.	6,464,208	10-15-2002	Smith	
	37.	6,520,484	02-18-2003	Shimizu et al.	
	38.	6,645,126	11-11-2003	Martin et al.	
	39.	6,679,185	01-20-2004	Sullivan et al.	
	40.	6,890,288	05-10-2005	Bingham	
	41.	7,137,771	11-21-2006	Maurer et al.	
	42.	7,240,621	07-10-2007	Chepurny et al.	
	43.	7,303,049	12-04-2007	Greenlee	
	44.	7,377,377	05-27-2008	Christiansson	
	45.	7,462,138	12-09-2008	Shetty et al.	
	46.	7,618,223	11-17-2009	Begley	
	47.	7,883,450	02-08-2011	Hidler	
	48.	7,938,757	05-10-2011	Cockrell	
	49.	7,993,248	08-09-2011	Rasmussen	
	50.	8,397,320	03-19-2013	Capaldi	

Examiner Signature		Date Considered	

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	51.	8,584,274	11-19-2013	Hushek	
	52.	8,789,682	07-29-2014	Fisher	
	53.	8,978,905	03-17-2015	Bergenstrale et al.	
	54.	9,510,991	12-06-2016	Stockmaster et al.	
	55.	9,682,000	06-20-2017	Glukhovsky	
	56.	9,839,569	12-12-2017	Behnke et al.	
	57.	9,855,177	01-02-2018	Erturk et al.	
	58.	2001/0027149	10-04-2001	Bingham	
	59.	2003/0084508	05-08-2003	Faucher et al.	
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	61.	2003/0153438	08-14-2003	Gordon et al.	
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	65.	2004/0143198	07-22-2004	West	
	66.	2004/0200795	10-14-2004	Summa	
	67.	2005/0115914	06-02-2005	Chepurny et al.	
	68.	2006/0189453	08-24-2006	Leblond	
	69.	2006/0229167	10-12-2006	Kram et al.	
	70.	2006/0240952	10-26-2006	Schlosser	
	71.	2007/0004567	01-04-2007	Shetty et al.	
	72.	2008/0287268	11-20-2008	Hidler	
	73.	2009/0308828	12-17-2009	Hansen	
	74.	2010/0000546	01-07-2010	Park	
	75.	2010/0312152	12-09-2010	Sarkodie-Gyan et al.	

Examiner Signature		Date Considered	

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.T.L/

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Substitute for form 1449A/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 4 of 7

Complete if Known	
Application Number	15/349,390
Filing Date	November 11, 2016
First Named Inventor	Arkady GLUKHOVSKY
Art Unit	3617
Examiner Name	Mark T. LE
Attorney Docket Number	BION-054/01US 307799-2300

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	76.	2011/0000015	01-06-2011	Faucher et al.	
	77.	2011/0072580	03-31-2011	Imhoff	
	78.	2011/0265260	11-03-2011	Darrow	
	79.	2012/0018249	01-26-2012	Mehr	
	80.	2012/0000876	01-05-2012	Bergenstrale et al.	
	81.	2012/0198612	08-09-2012	Tindall	
	82.	2012/0325586	12-27-2012	Meggs et al.	
	83.	2014/0206503	07-24-2014	Stockmaster et al.	
	84.	2015/0143627	05-28-2015	McBride	
	85.	2015/0238816	08-27-2015	Naderer et al.	
	86.	2015/0283921	10-08-2015	Zimmerman et al.	
	87.	2018/0036196	02-08-2018	Behnke et al.	
	88.	2018/0071159	03-15-2018	Glukhovsky et al.	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] "Number[4] "Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	89.	CH 669780 A5	04-14-1989	Nussbaumer		✓
	90.	CN 104308861 B)	01-28-2015	Shandong Luneng Intelligence Technology Co Ltd		✓
	91.	DE 102008015879 A1	04-09-2009	Berwald et al.	English Abstract	✓
	92.	EP 008061 A2	09-07-1983	Hedstrom		

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 5 of 7

Complete if Known	
Application Number	15/349,390
Filing Date	November 11, 2016
First Named Inventor	Arkady GLUKHOVSKY
Art Unit	3617
Examiner Name	Mark T. LE
Attorney Docket Number	BION-054/01US 307799-2300

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] "Number[4] "Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
	93.	EP 1296595 B1	08-15-2007	Lifewaves International, Inc.		
	94.	JP 2000-237250 A	09-05-2000	Iwauchi		✓
	95.	JPH02-131435 U	11-01-1990	Denken Electricity Co. Ltd.	English Abstract	✓
	96.	WO 2013/117750	08-15-2013	Lutz Medical Engineering		
	97.	WO 2017/083666	05-18-2017	Bioness Inc.		

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1]Applicant's unique citation designation number (optional). [2]See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 6 of 7

Complete if Known	
Application Number	15/349,390
Filing Date	November 11, 2016
First Named Inventor	Arkady GLUKHOVSKY
Art Unit	3617
Examiner Name	Mark T. LE
Attorney Docket Number	BION-054/01US 307799-2300

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	98.	Extended European Search Report for European Application No. 14740676.3, mailed August 18, 2016, 6 pages	
	99.	Extended European Search Report for European Application No. 16747097.0, mailed July 27, 2018, 8 pages	
	100.	Final Notice of Reasons for Rejection for Japanese Application No. 2017-052240, mailed July 19, 2018, 4 pages	
	101.	International Search Report and Written Opinion for International Application No. PCT/US2014/012064, mailed May 9, 2014	
	102.	International Search Report and Written Opinion for International Application No. PCT/US2016/016131, mailed April 21, 2016, 10 pages	
	103.	International Search Report and Written Opinion for International Application No. PCT/US2016/061552, mailed January 31, 2017, 10 pages	
	104.	International Search Report and Written Opinion for International Application No. PCT/US2017/050482, mailed December 21, 2017, 9 pages	
	105.	International Search Report and Written Opinion for International Application No. PCT/US2018/018166, mailed July 2, 2018, 11 pages	
	106.	Notice of Reasons for Rejection for Japanese Application No. 2015-553851, mailed July 4, 2016, 5 pages	✓
	107.	Notice of Reasons for Rejection for Japanese Application No. 2017-052240, mailed January 15, 2018, 9 pages	✓

Examiner Signature		Date Considered	

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[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 7 of 7

Complete if Known	
Application Number	15/349,390
Filing Date	November 11, 2016
First Named Inventor	Arkady GLUKHOVSKY
Art Unit	3617
Examiner Name	Mark T. LE
Attorney Docket Number	BION-054/01US 307799-2300

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	108.	Office Action for U.S. Application No. 13/745,830, mailed December 17, 2015, 9 pages	
	109.	Office Action for U.S. Application No. 13/745,830, mailed June 15, 2015, 9 pages	
	110.	Office Action for U.S. Application No. 13/745,830, mailed June 2, 2016, 11 pages	
	111.	Office Action for U.S. Application No. 14/226,021, mailed February 22, 2017, 11 pages	
	112.	Office Action for U.S. Application No. 14/226,021, mailed September 14, 2016, 13 pages.	
	113.	Office Action for U.S. Application No. 14/613,140, mailed August 28, 2017, 25 pages	
	114.	Office Action for U.S. Application No. 14/613,140, mailed March 26, 2018, 28 pages	
	115.	Office Action for U.S. Application No. 14/613,140, mailed October 30, 2018, 28 pages	
	116.	Office Action for U.S. Application No. 15/783,755, mailed May 7, 2018, 13 pages	
	117.	VAHLE Electrification Systems, “Enclosed Conductor System KBH,” Catalogue, 2014, 28 pages	
	118.	VALLERY, H. et al., "Multidirectional Transparent Support for Overground Gait Training," 2013 IEEE International Conference on Rehabilitation Robotics, Seattle, WA (June 2013), 7 pages	

Examiner Signature	/MARK T LE/	Date Considered	01/02/2019

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Applicant’s unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

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Gill Jennings & Every LLP
The Broadgate Tower
20 Primrose Street
London EC2A 2ES
ROYAUME UNI

Date: 18.08.16

Reference	Application No./Patent No.
SAH10396EP	14740676.3 - 1651 / 2945898 PCT/US2014012064
Applicant/Proprietor: Bioness Inc.	

Communication

The extended European search report is enclosed.

The extended European search report includes, pursuant to Rule 62 EPC, the supplementary European search report (Art. 153(7) EPC) and the European search opinion.

Copies of documents cited in the European search report are attached.

☑ 0 additional set(s) of copies of such documents is (are) enclosed as well.

Refund of the search fee
If applicable under Article 9 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.

Should you wish to further prosecute this application in the examination phase, your attention is drawn to the provisions of Rule 70a EPC. An invitation to respond to the extended European search report will be issued shortly (R. 70(2) EPC).

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Aretech LLC - Exhibit 1004, Page 00735

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SUPPLEMENTARY EUROPEAN SEARCH REPORT

Application Number
EP 14 74 0676

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	CH 669 780 A5 (BENNO NUSSBAUMER) 14 April 1989 (1989-04-14) * page 2, column 2, line 8 - page 3, column 2, line 4 * * figures 1-3 * -----	1-10, 12-15 11	INV. B66C13/12 A61G7/10 ADD. A61H3/00
X	EP 0 088 061 A2 (HEDSTROEM TURE) 7 September 1983 (1983-09-07) * page 6 - page 9 * * figures 1, 2, 6 * -----	1	
X	EP 2 402 279 A1 (LIKO RES & DEV AB [SE]) 4 January 2012 (2012-01-04) * paragraph [0022] - paragraph [0054] * * figures 1, 5, 8 * -----	1	
Y	US 2004/074414 A1 (PHILLIPS BRIAN [US]) 22 April 2004 (2004-04-22) * paragraph [0033] * * figure 1a * -----	11	

TECHNICAL FIELDS SEARCHED (IPC)

A61G

The supplementary search report has been based on the last set of claims valid and available at the start of the search.

Place of search	Date of completion of the search	Examiner
The Hague	10 August 2016	Schiffmann, Rudolf

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C04)

Aretech LLC - Exhibit 1004, Page 00736

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 74 0676

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

10-08-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CH 669780 A5	14-04-1989	NONE	
EP 0088061 A2	07-09-1983	AU 554190 B2	14-08-1986
		AU 1183683 A	01-09-1983
		CA 1200780 A	18-02-1986
		DE 3382487 D1	13-02-1992
		DK 78683 A	26-08-1983
		EP 0088061 A2	07-09-1983
		ES 8402543 A1	01-05-1984
		FI 830605 A	26-08-1983
		GB 2118119 A	26-10-1983
		IL 67983 A	28-02-1986
		IN 157974 B	09-08-1986
		JP H0433667 B2	03-06-1992
		JP S58202149 A	25-11-1983
		NO 830602 A	26-08-1983
		PT 76276 A	01-03-1983
		SE 435827 B	22-10-1984
		US 4602567 A	29-07-1986
		ZA 8301142 B	30-11-1983
EP 2402279 A1	04-01-2012	AU 2011203110 A1	19-01-2012
		EP 2402279 A1	04-01-2012
		EP 2559648 A1	20-02-2013
		EP 2559649 A1	20-02-2013
		EP 2930135 A1	14-10-2015
		US 2012000876 A1	05-01-2012
		US 2015136313 A1	21-05-2015
US 2004074414 A1	22-04-2004	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

The examination is being carried out on the **following application documents**

Description, Pages

1-47 as published

Claims, Numbers

1-15 filed with entry into the regional phase before the EPO

Drawings, Sheets

1/34-34/34 as published

1 Reference is made to the following documents; the numbering will be adhered to in the rest of the procedure.

D1 CH 669 780 A5 (BENNO NUSSBAUMER) 14 April 1989 (1989-04-14)

D2 EP 0 088 061 A2 (HEDSTROEM TURE) 7 September 1983 (1983-09-07)

D3 EP 2 402 279 A1 (LIKO RES & DEV AB [SE]) 4 January 2012 (2012-01-04)

D4 US 2004/074414 A1 (PHILLIPS BRIAN [US]) 22 April 2004 (2004-04-22)

2 The application does not meet the requirements of Article 84 EPC, because the claims are not clear.

2.1 The features of the claims are not provided with reference signs placed in parentheses to increase the intelligibility of the claims (Rule 43(7) EPC). This applies to both the preamble and characterising portion (see Guidelines F-IV, 4.19).

2.2 So far the independent claim 1 is not in the two-part form in accordance with Rule 43(1) EPC, with those features known in combination from the prior art being placed in the preamble (Rule 43(1)(a) EPC) and the remaining features being included in the characterising part (Rule 43(1)(b) EPC).

Aretech LLC - Exhibit 1004, Page 00738

3 Furthermore, notwithstanding the above-mentioned lack of clarity, the subject-matter of claim 1 is not new within the meaning of Article 54(1) and (2) EPC, and the requirements of Article 52(1) EPC are therefore not met. D1, see especially FIG. 1 and page 2, discloses:

An apparatus, comprising: a trolley (10, 11, 12, 13) configured to be movably suspended from a track (1); a powered conductor (7) operatively coupled to the track, the powered conductor being substantially parallel to the track, a portion of the trolley (13) being in contact with at least one conductive surface of the powered conductor to electrically couple the trolley to the powered conductor, the portion of the trolley configured to move along the at least one conductive surface when the trolley is moved along the track (p. 2, col. 2, l. 59-66); a patient support mechanism (12) coupled to the trolley, the patient support mechanism configured to actively support a single patient; and a control system (p. 2, col. 2, l. 56) coupled to the trolley and at least operably coupled to the powered conductor.

Further documents disclosing in combination all the features of claim 1 are document D2 and D3, see passages cited in the search report.

4 Dependent claims do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the EPC with respect of novelty (Article 54(1) and (2) EPC) and/or inventive step (Article 56 EPC). See documents and passages cited in the search report. As far as some of the dependent claims are not covered by these documents these dependent claims just define constructional details which come within the scope of the customary practice followed by persons skilled in the art.

Especially concerning inventive step in claim 7 it can be noted that making the track a closed loop is merely one of several straightforward possibilities which the skilled person would select, depending on the circumstances, without exercising inventive skill, in order to solve the problem posed.

Concerning inventive step in claim 11 see document D4, figure 1a and paragraph [33]. A track of I-beam cross section is a feature well known to the person skilled in the art.

5 It is not at present apparent which part of the application could serve as a basis for a new, allowable claim.

Should the applicant nevertheless regard some particular matter as patentable, an independent claim could be filed taking account of Rule 43(1)EPC.

Aretech LLC - Exhibit 1004, Page 00739

The applicant should also indicate how the subject-matter of the new claim differsfrom the state of the art and the significance thereof.

The problem to be solved by theclaimed invention should be clearly pointed out and the inventive step present, see Guidelines G-VII; 5.

6 If new claims are filed, attention should be paid to the following:

6.1 The features of the claims should be provided with reference signs placed in parentheses to increase the intelligibility of the claims (Rule 43(7) EPC). This applies to both the preamble and characterising portion (see Guidelines F-IV, 4.19).

6.2 To meet the requirements of Rule 42(1)(b) EPC, the prior art document D1 should be identified in the description and its relevant contents should be indicated.

The applicant should ensure that it is clear from the description which features of the subject-matter of the independent claim are known from the document D1.

6.3 The independent claim should be in the two-part form in accordance with Rule 43(1) EPC, with those features known in combination from the prior art being placed in the preamble (Rule 43(1)(a) EPC) and the remaining features being included in the characterising part (Rule 43(1)(b) EPC).

If, however, the applicant is of the opinion that the two-part form would be inappropriate, reasons therefor should be provided.

6.4 When filing amended claims the applicant should at the same time bring the description into conformity with the amended claims.

Care should be taken during revision, especially of the introductory portion and any statements of problem or advantage, not to add subject-matter which extends beyond the content of the application as originally filed (Article 123(2) EPC).

In order to facilitate the examination of the conformity of the amended application with the requirements of Article 123(2) EPC, the applicant should clearly identify the amendments carried out, irrespective of whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III; 2.2).

If the applicant regards it as appropriate these indications could be submitted in handwritten form on a copy of the relevant parts of the application as filed.

Aretech LLC - Exhibit 1004, Page 00740

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Substantive Examiner
Name: Schiffmann, Rudolf
Tel: +31 70 340 - 3271

Application No.	Ref.	Date
14 740 676.3 - 1113	SAH10396EP	14.06.2019
Applicant: Bioness Inc.		

Communication pursuant to Article 94(3) EPC

The examination of the above-identified application has revealed that it does not meet the requirements of the European Patent Convention for the reasons enclosed herewith. If the deficiencies indicated are not rectified the application may be refused pursuant to Article 97(2) EPC.

You are invited to file your observations and insofar as the deficiencies are such as to be rectifiable, to correct the indicated deficiencies within a period

of 4 months

from the notification of this communication, this period being computed in accordance with Rules 126(2) and 131(2) and (4) EPC. One set of amendments to the description, claims and drawings is to be filed within the said period on separate sheets (R. 50(1) EPC).

If filing amendments, you must identify them and indicate the basis for them in the application as filed. Failure to meet either requirement may lead to a communication from the Examining Division requesting that you correct this deficiency (R. 137(4) EPC).

In case you withdraw the application within the above-mentioned period, the examination fee will be refunded at a rate of 50% (Art. 11 (b) RFees).

Failure to comply with this invitation in due time will result in the application being deemed to be withdrawn (Art. 94(4) EPC).

Registered letter

Schiffmann, Rudolf
Primary Examiner
For the Examining Division

Enclosure(s): 3 page/s reasons (Form 2906)
WO-2009104096-A2, US-5138953-A1

The examination is being carried out on the **following application documents**

Description, Pages

2, 4-47	as published	
1, 3, 3a	filed in electronic form on	09-03-2017

Claims, Numbers

1-15	filed in electronic form on	09-03-2017

Drawings, Sheets

1/34-34/34	as published

1 Reference is made to the following document cited in the Supplematary European Search Report; the numbering will be adhered to in the rest of the procedure.

D1 CH 669 780 A5 (BENNO NUSSBAUMER) 14 April 1989 (1989-04-14)

D2 EP 0 088 061 A2 (HEDSTROEM TURE) 7 September 1983 (1983-09-07)

D3 EP 2 402 279 A1 (LIKO RES & DEV AB [SE]) 4 January 2012 (2012-01-04)

D4 US 2004/074414 A1 (PHILLIPS BRIAN [US]) 22 April 2004 (2004-04-22)

Additionally the following two documents found in a further search are cited by the Examiner (see Guidelines C-IV, 7.2 and 7.3). A copy of each document is annexed to the communication and the numbering will be adhered to in the rest of the procedure.

D5 US 5 138 953 A (HORCHER WILLI [DE] ET AL) 18 August 1992 (1992-08-18)

D6 WO 2009/104096 A2 (BHM MEDICAL INC [CA]; FAUCHER MARTIN [CA] ET AL.) 27 August 2009 (2009-08-27)

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2 The present application does not yet meet the requirements of Article 52(1) EPC because the subject-matter of new claim 1 is not new within the meaning of Article 54(1) and (2) EPC. D3 discloses, see especially figures 1, 2, 5, 6 and 8, and paragraphs [22] to [29] and [34]:

An apparatus, comprising: a trolley (104, 106) having a drive assembly (144) configured to movably suspend the trolley from a track (134); a powered conductor (114) coupled adjacent to the track, a portion of the trolley being in contact with at least one conductive surface of the powered conductor to electrically couple the trolley to the powered conductor, the portion of the trolley configured to move along the at least one conductive surface when the trolley is moved along the track, a portion of the track disposed between the powered conductor and at least one wheel of the drive assembly (see figures 6 and 8); an adjustable tether (108) coupled to the trolley, the adjustable tether configured to actively support a patient (by 110 etc.); and a control system (112) coupled to the trolley and at least operably coupled to the powered conductor.

Further documents disclosing in combination all the features of claim 1 are the newly introduced documents D5 and D6.

(Documents D1 and D2 can be regarded as not any more novelty destroying for the disclosure of claim 1 in its present form.)

3 In view of the above objection it is not at present practicable to carry out a full examination of the application. The applicant is therefore requested to file suitable amendments upon which the further prosecution of the application is to be based.

4 It is not at present apparent which part of the application could serve as a basis for a new, allowable claim.

4.1 Should the applicant nevertheless regard some particular matter as patentable, an independent claim should be filed taking account of Rule 43(1) EPC.

4.2 Care should be taken not to commit any intermediate generalisation. In case features appearing in combination within the originally filed application should be introduced together into the new independent claim.

4.3 The applicant should also indicate how the subject-matter of the new claim differsfrom the state of the art and the significance thereof.

4.4 The problem to be solved by theclaimed invention should be clearly pointed out and the inventive step present, see Guidelines G-VII; 5.

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5 If new claims are filed, attention should be paid to the following:

5.1 To meet the requirements of Rule 42(1)(b) EPC, the closest prior art document should be identified in the description and its relevant contents should be indicated, be it document D3, D1 or another one.

The applicant should ensure that it is clear from the description which features of the subject-matter of the independent claim are known from the document.

5.2 The independent claim generally should be in the two-part form in accordance with Rule 43(1) EPC, with those features known in combination from the prior art being placed in the preamble (Rule 43(1)(a) EPC) and the remaining features being included in the characterising part (Rule 43(1)(b) EPC).

If, however, the applicant is of the opinion that the two-part form would be inappropriate, reasons therefor should be provided.

5.3 When filing amended claims the applicant should at the same time bring the description into conformity with the amended claims.

Care should be taken during revision, especially of the introductory portion and any statements of problem or advantage, not to add subject-matter which extends beyond the content of the application as originally filed (Article 123(2) EPC).

In order to facilitate the examination of the conformity of the amended application with the requirements of Article 123(2) EPC, the applicant should clearly identify the amendments carried out, irrespective of whether they concern amendments by addition, replacement or deletion, and to indicate the passages of the application as filed on which these amendments are based (see Guidelines H-III; 2.2).

If the applicant regards it as appropriate these indications could be submitted in handwritten form on a copy of the relevant parts of the application as filed.

Aretech LLC - Exhibit 1004, Page 00745

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European Patent Office
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European Patent Office
80298 MUNICH
GERMANY

Questions about this communication ?
Contact Customer Services at www.epo.org/contact

Gill Jennings & Every LLP
SAH
The Broadgate Tower
20 Primrose Street
London EC2A 2ES
ROYAUME UNI

Date
27.07.18

Reference	Application No./Patent No.
SAH11202EP	16747097.0 - 1126 / 3253354 PCT/US2016016131
Applicant/Proprietor	
Bioness Inc.	

Communication

The extended European search report is enclosed.

The extended European search report includes, pursuant to Rule 62 EPC, the supplementary European search report (Art. 153(7) EPC) and the European search opinion.

Copies of documents cited in the European search report are attached.

☑ 0 additional set(s) of copies of such documents is (are) enclosed as well.

Refund of the search fee
If applicable under Article 9 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.

Should you wish to further prosecute this application in the examination phase, your attention is drawn to the provisions of Rule 70a EPC. An invitation to respond to the extended European search report will be issued shortly (R. 70(2) EPC).

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Aretech LLC - Exhibit 1004, Page 00746

The examination is being carried out on the **following application documents**

Description, Pages

1-79 as published

Claims, Numbers

1-15 filed in electronic form on 09-03-2018

Drawings, Sheets

1/53-53/53 as published

1 According to Article 53(c), European patents shall not be granted in respect of methods for treatment of the human or animal body by surgery or therapy and diagnostic methods practised on the human or animal body.

2 The set of claims 1-15 is directed to a method only.

3 The wording of claim 1 is the following:
"A method, comprising:
receiving a signal associated with a first operating condition of at least one of a drive mechanism or a *patient* support mechanism,
the *patient* support mechanism coupled to an active trolley and including tether having an end portion configured to couple to a *patient* via an attachment device,
the *patient* support mechanism configured to support a *patient*,
the drive mechanism coupled to the active trolley and configured to move the active trolley along a support track *in response to a movement of the patient*;
providing electric power to at least one of the drive mechanism or the *patient* support mechanism operable to transition at least one of the drive mechanism or the *patient* support mechanism, respectively, from the first operating condition to a second operating condition *in response to movement of the patient*;
receiving a signal associated with the second operating condition of at least one of the drive mechanism or the *patient* support mechanism;
determining a difference between the first operating condition and the second

Aretech LLC - Exhibit 1004, Page 00747

operating condition;
determining, based at least in part on the difference between the first operating condition and the second operating condition, a change in a position associated with the attachment device; and
defining, based at least in part on the change in the position of the attachment device, a gait characteristic of the *patient* supported by the *patient* support mechanism" (emphasis in italics added).

4 Claim 1 (claims 1-15) is (are) unambiguously directed to the treatment of a *patient* (according to general understanding, a patient is a person receiving *medical* treatment) by gait therapy (see e.g. par. 1012, first sentence, and various other places in the application).
Gait therapy (even when called gait training) is a type of physical therapy which improves or at least helps to improve the ability of a patient to stand and walk.

The subject-matter of claims 1-15 therefore concerns a medical treatment of the human body by therapy (Guidelines G-II, 4.2.1.2 Therapy).

Although the subject-matter of these claims may also in parts concern the functioning of an apparatus associated with a living human or animal body, there exists a functional relationship between the steps related to the apparatus and the therapeutic effect of the apparatus on the body (see T 245/87). In other words, the method does not work without a patient moving (see e.g. "*in response to movement of the patient*" in claim 1). The method is performed during gait therapy. Hence, any method related to the functioning of an apparatus is intrinsically linked to the therapeutic effect of the moving patient.

Such methods are not regarded as inventions which are susceptible of industrial application (Article 53(c) EPC), being excluded from patentability.

5 Therefore, these claims have to be deleted.

Moreover, the disclosure that the present invention is also related to a method of treatment has to deleted from the description (see Rule 48(1)(c) EPC).

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6 It is not at present apparent which part of the application could serve as a basis for new, allowable (especially with regard to Article 53(c) EPC) claim .

Should the applicant nevertheless regard some particular matter as patentable, attention should also be paid to the following.

6.1 The applicant should indicate in the letter of reply the difference of the subject-matter of the new claim vis-à-vis the state of the art and the significance thereof.

Preferably, the problem-solution-approach should be applied.

6.2 Independent claim 1 is not in the two-part form in accordance with Rule 43(1) EPC, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 43(1)(a) EPC) and the remaining features being included in the characterising part (Rule 43(1)(b) EPC).

6.3 The features of the claims should be provided with reference signs placed in parentheses to increase the intelligibility of the claims (Rule 43(7) EPC). This applies to both the preamble and characterising portion (see Guidelines F-IV, 4.19).

6.4 To meet the requirements of Rule 42(1)(b) EPC, at least document D1 should be properly identified in the description and the relevant background art disclosed therein should be briefly discussed.

6.5 The description must be brought into conformity with these claims; care should be taken during revision, especially of the introductory portion including any statements of problem or advantages, not to add subject-matter which extends beyond the content of the application as originally filed (Article 123(2) EPC).

6.6 In order to facilitate the examination of the conformity of the amended application with the requirements of Article 123(2) EPC, the applicant is requested to clearly identify the amendments carried out, irrespective of whether they concern amendments by addition, replacement or deletion, and

Aretech LLC - Exhibit 1004, Page 00749

to indicate the passages of the application as filed on which these amend ments are based.

6.7 Amendments should be made by filing replacement pages. Unnecessary recasting of the description should be avoided. An amended abstract is not required.

6.8 As of 1 January 2014, the EPO no longer accepts handwritten amendments in application documents and those replacing them in strict application of Rules 49(8) and 50(1) EPC. This change of practice has been announced in a Notice from the EPO dated 8 November 2013 (OJ EPO 2013, 603).

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Information on Search Strategy - Pilot phase (see OJ 2015, A86)
The type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
EP 16 74 7097

TITLE: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

APPLICANT: Bioness Inc.

IPC CLASSIFICATION: A61H3/00

EXAMINER: Oelschläger, Holger

CONSULTED DATABASES: WPI

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: A61H3/008, A61H1/0262, A61H2201/1652, A61H2201/5064, A61H2201/12/LOW, A61H2003/043, G06K9/00348

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:
Method: receiving signal associated with 1st operating condition (OC) of >=1 of drive mechanism or patient support mechanism (PSM), the PSM coupled to active trolley and including tether having end portion configured to couple to patient (P) via attachment device (AD), the PSM configured to support patient, the drive mechanism coupled to active trolley and configured to move active trolley along support track in response to movement of P; providing electric power to at least one of drive mechanism or PSM operable to transition at least one of drive mechanism or PSM, respectively, from the 1st OC to 2nd OC in response to movement of P; receiving a signal associated with 2nd OC of >=1 of drive mechanism or PSM; determining difference between 1st OC and 2nd OC; determining, based at least in part on difference between 1st OC and 2nd OC, a change in position associated with AD; and defining, based at least in part on change in position of AD, gait characteristic of P supported by PSM.

EPO FORM P04A42

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SUPPLEMENTARY EUROPEAN SEARCH REPORT

Application Number
EP 16 74 7097

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/201906 A1 (ERTURK EROL [US] ET AL) 24 July 2014 (2014-07-24) * the whole document *	1-15	INV. A61H3/00
A	US 6 645 126 B1 (MARTIN MATTHEW [US] ET AL) 11 November 2003 (2003-11-11) * the whole document *	11	
A	US 2014/206503 A1 (STOCKMASTER JAMES G [US] ET AL) 24 July 2014 (2014-07-24) * the whole document *	7	
A	WO 2013/117750 A1 (LUTZ MEDICAL ENGINEERING [CH]; ETH ZUERICH [CH]; UNIV ZUERICH [CH]) 15 August 2013 (2013-08-15) * the whole document *	1-15	
A	US 2007/004567 A1 (SHETTY DEVDAS [US] ET AL) 4 January 2007 (2007-01-04) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

A61H
A61B
G06K

The supplementary search report has been based on the last set of claims valid and available at the start of the search.

Place of search	Date of completion of the search	Examiner
Munich	19 July 2018	Oelschläger, Holger

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C04)

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 74 7097

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-07-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014201906 A1	24-07-2014	NONE	
US 6645126 B1	11-11-2003	AU 3344401 A	11-10-2001
		EP 1145682 A2	17-10-2001
		JP 2001299842 A	30-10-2001
		US 6645126 B1	11-11-2003
US 2014206503 A1	24-07-2014	AU 2014209536 A1	06-08-2015
		BR 112015017455 A2	11-07-2017
		CA 2898447 A1	31-07-2014
		CN 105473194 A	06-04-2016
		EP 2948222 A1	02-12-2015
		JP 2016511017 A	14-04-2016
		KR 20150110654 A	02-10-2015
		NZ 710129 A	22-12-2017
		US 2014206503 A1	24-07-2014
		US 2017135893 A1	18-05-2017
		WO 2014116628 A1	31-07-2014
WO 2013117750 A1	15-08-2013	AU 2013217939 A1	21-08-2014
		CA 2861575 A1	15-08-2013
		EP 2626051 A1	14-08-2013
		EP 2811962 A1	17-12-2014
		JP 5922800 B2	24-05-2016
		JP 2015511151 A	16-04-2015
		US 2015320632 A1	12-11-2015
		US 2018055715 A1	01-03-2018
		WO 2013117750 A1	15-08-2013
US 2007004567 A1	04-01-2007	NONE	

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80298 MUNICH
GERMANY

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The Broadgate Tower
20 Primrose Street
London EC2A 2ES
ROYAUME UNI

Date
02.04.19

Reference	Application No./Patent No.
SAH11290EP	16865093.5 - 1002 / 3373880 PCT/US2016061552
Applicant/Proprietor	
Bioness Inc.	

Communication

The extended European search report is enclosed.

The extended European search report includes, pursuant to Rule 62 EPC, the supplementary European search report (Art. 153(7) EPC) and the European search opinion.

Copies of documents cited in the European search report are attached.

☑ 0 additional set(s) of copies of such documents is (are) enclosed as well.

Refund of the search fee
If applicable under Article 9 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.

Should you wish to further prosecute this application in the examination phase, your attention is drawn to the provisions of Rule 70a EPC. An invitation to respond to the extended European search report will be issued shortly (R. 70(2) EPC).

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Aretech LLC - Exhibit 1004, Page 00754

The examination is being carried out on the **following application documents**

Description, Pages

1-32 as published

Claims, Numbers

1-15 filed in electronic form on 10-12-2018

Drawings, Sheets

1/12-12/12 as published

1 It appears that the claims first filed with the EPO on 10.12.2018 introduce subject-matter which extends beyond the content of the earlier application as originally filed, contrary to Article 76(1) EPC.

1.1 Indeed, claim 11 introduces parallel support track portions and in particular a further non-parallel portion which appears to constitute an extension of subject-matter beyond the content of the earlier application as filed.

1.2 The question of whether the claim is confined to subject-matter contained in the parent application is not decided until the examination procedure, cf. guidelines A-IV 1.2.1 and C-IV 9.1.4.

2 An International Preliminary Report on Patentability has already been drawn up for the present application in accordance with the PCT.

2.1 The applicant has not suitably addressed the deficiencies. The outstanding deficiencies give rise to an objection under the corresponding provisions of the EPC:

2.2 **US-A-2015/0283921** discloses a support system, comprising a support track (2) *configured to movably suspend a trolley (10) therefrom, the trolley configured to support at least a portion of a body weight of a patient*, a power rail (2) coupled to the support track (3), at least a portion of the power rail **[can be] *)** in electrical contact with the trolley, and a switch (50) having a support track portion and a power rail portion, the switch configured to

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transition between a first configuration (fig. 6), in which a first portion of the support track and the support track portion of the switch define a first path, and a second configuration (fig. 8), in which a second portion of the support track and the support track portion of the switch define a second path, *the trolley configured to receive a flow of electric power from at least one of the power rail or the power rail portion of the switch operable to move the trolley along the first path when the switch is in the first configuration and along the second path when the switch is in the second configuration,* and thereby all technical features of claim 1.

*) The trolley is not part of the subject-matter of claim 1

3 Dependent claims 2-15 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the EPC with respect to novelty and/or inventive step:

- claims 2-7: **US-A-2015/0283921**, see International Preliminary Report on Patentability;
- claim 8,12-14; **US-A-2015/0283921**, discontinuous power rail portions (fig. 6), second support track and power rail portion
- claim 9: trolley is not part of the subject-matter of claim 1, thus also not of claim 9, **US-A-2015/0283921** being considered suitable for such a trolley;
- claims 10,15; **CN-A-104308861**, third configuration.

Information on Search Strategy - Pilot phase (see OJ 2015, A86)
The type of information contained in this sheet may change during the pilot for improving the usefulness of this new service.

Application Number
EP 16 86 5093

TITLE: APPARATUS AND METHODS FOR SUPPORT TRACK AND POWER RAIL SWITCHING IN A BODY WEIGHT SUPPORT SYSTEM

APPLICANT: Bioness Inc.

IPC CLASSIFICATION: E01B25/26, A61G7/10, A61H1/00, A61H1/02, A61H3/00, B61J1/06

EXAMINER: Movadat, Robin

CONSULTED DATABASES: EPODOC, WPI

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: E01B25/26, A61H3/008, A61G7/1042

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:
Overhead support track, power rail, switch.

EPO FORM P04A42

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SUPPLEMENTARY EUROPEAN SEARCH REPORT

Application Number
EP 16 86 5093

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	US 2015/283921 A1 (ZIMMERMAN JOSEPH J [US] ET AL) 8 October 2015 (2015-10-08) * the whole document * -----	1-9, 11-14 10,15	INV. E01B25/26 A61G7/10 A61H1/00
Y	CN 104 308 861 A (SHANDONG LUNENG INTELLIGENCE TECHNOLOGY CO LTD) 28 January 2015 (2015-01-28) * the whole document * -----	10,15	A61H1/02 A61H3/00 B61J1/06
A	JP S50 20727 B1 (JAPANESE) 17 July 1975 (1975-07-17) * figures * -----	1-13	

TECHNICAL FIELDS SEARCHED (IPC)
E01B A61H A61G

The supplementary search report has been based on the last set of claims valid and available at the start of the search.

Place of search	Date of completion of the search	Examiner
Munich	22 March 2019	Movadat, Robin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons
.....
& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C04)

Aretech LLC - Exhibit 1004, Page 00758

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 86 5093

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

22-03-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015283921 A1	08-10-2015	CL 2016000409 A1	16-12-2016
		US 2015283921 A1	08-10-2015
		US 2016264000 A1	15-09-2016
		US 2017282721 A1	05-10-2017
CN 104308861 A	28-01-2015	NONE	
JP S5020727 B1	17-07-1975	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

Translation

Reference Number:
Mailing No.: 299464
Mailing Date: July 4, 2016

NOTICE OF REASONS FOR REJECTION

Patent Application No.: 2015-553851
Drafting Date: June 30, 2016
JPO Examiner: Sadao Imai 4129 3E00
Attorneys for Applicant: Yoshiyuki Inaba (and three others)
Applicable Section(s): Sections 29(1), 29(2), 36 and 37

The above-mentioned patent application should be rejected for the reasons stated below. The applicant may file an Argument against this notice with the Japan Patent Office within three months from the mailing date above.

Reasons

1. (Unity of invention) The present application fails to comply with the requirements set forth in Section 37 of the Patent Law regarding the following point(s).

2. (Novelty) The invention according to the claims below in the present application is unpatentable under Section 29(1)(iii) of the Patent Law, since it is an invention described in the below-identified publications distributed in Japan or overseas prior to the filing of the application, or an invention made available to the public through electronic media in Japan or overseas prior to the filing of the application.

3. (Inventive step) The invention according to the claims below in the present application is unpatentable under Section 29(2) of the Patent Law, since it could have easily been made prior to the filing of the application by a person skilled in the art to which the invention pertains, based on inventions described in the below-identified publications distributed in Japan or overseas prior to the filing of the application, or based on inventions made available to the public through electronic media in Japan or overseas prior to the filing of the application.

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4. (Clarity) The claims in the present application fail to comply with the requirements set forth in Section 36(6)(ii) of the Patent Law regarding the following point(s).

Notes (including List of Cited References)

Regarding reason 1

1. Determination of Subject of Examination based on Special Technical Features

The invention according to claims 1-2 lacks novelty over cited reference 1, and thus does not have a special technical feature.

Accordingly, the invention according to claims 1-2, for which whether there is any special technical feature or not has already been judged, is deemed to be the subject of examination.

2. Determination of Subject of Examination based on Examination Efficiency

Since it is efficient to examine the invention according to claims 3-8 together with the invention which has been deemed to be the subject of examination based on the existence of a special technical feature, the invention according to claims 3-8 is added to the subject of examination.

The invention according to claims 9-21 is not an invention in the same category as, and having all the features defining, the invention according to claim 1. Furthermore, the invention according to claims 9-21 is not an invention which would be able to be examined with substantially no need to perform additional prior art searches or make additional judgments as a result of examining the invention which has been deemed to be the subject of examination, and there are no other circumstances which indicate that it would be efficient to examine these inventions together.

Accordingly, the invention according to claims 9-21 is not deemed to be a subject of examination concerning any requirements other than those under Section 37 of the Patent Law.

Regarding reason 2

Claim 1

Cited reference 1

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Comments:

Cited reference 1 (see, in particular, paragraphs 0022-0054 and Figs. 1-11) discloses "an apparatus, comprising: a trolley (104, 106) configured to be movably suspended from a track (102); a powered conductor (114) operatively coupled to the track, the trolley configured to be electrically coupled to the powered conductor; a patient attachment (110) coupled to the trolley; and a control system (112)."

Claim 2
Cited reference 1
Comments:

Cited reference 1 discloses "including a passive coupling (168)."

Claims 5-6
Cited reference 1
Comments:

Cited reference 1 discloses that "the trolley includes a plurality of wheels (144) disposed above a drive assembly."

Regarding reason 3
Claims 1-2 and 5-6
Cited reference 1
Comments:

See the reason 2 above.

Claim 3
Cited references 1-2
Comments:

Cited reference 2 (see, in particular, paragraph 0013) discloses "a technique for actively supporting a patient."

Claim 4
Cited reference 1
Comments:

Cited reference 1 discloses "providing the drive assembly (104)."

Further, configuration in which a torque transfer assembly composed of a

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transfer sprocket etc. is provided is within a scope which could have been designed by a person skilled in the art as appropriate.

Claim 7
Cited references 1 and 3
Comments:

Cited reference 3 (see, in particular, paragraph 0009 and Fig. 2) discloses "a product in which a trolley is configured to be powered only from a powered conductor."

Claim 8
Cited references 1-2
Comments:

Cited reference 2 (see, in particular, Fig. 1) discloses that "a trolley is configured to be moved from an end of a track to the other end of the track."

Regarding reason 4
Claims 1-8

Claim 1 recites the phrase "the patient support assembly configured to support a single patient"; however, the patient support assembly is not recited previously, and thus is unclear.

The same applies to claims 2-8, which depend from claim 1.

Therefore, the invention according to claims 1-8 is unclear.

List of Cited References

1. US2012/0000876
2. JPH04-133830 U
3. JP2000-237250 A

Record of Prior Art Reference Search Results

- Technical Field(s) Searched: IPC A61H 1/20 3/00
- Prior Art References: JPH02-131435 U
  JPH07-213570 A
  JPS55-063647 A

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This record of prior art reference search results does not constitute a reason for rejection.

If you have any questions concerning the content of this Notice of Reasons for Rejection, or wish to have an interview, please contact:

Sadao Imai
Second Patent Examination Department, Nursing, Medical Device Division
TEL: 03-3581-1101 Extension Number: 3344
FAX: 03-3501-0672

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拒絶理由通知書

特許出願の番号	特願２０１５－５５３８５１
起案日	平成２８年　６月３０日
特許庁審査官	今井　貞雄　　４１２９　３Ｅ００
特許出願人代理人	稲葉　良幸（外　３名）　様
適用条文	第２９条第１項、第２９条第２項、第３６条、第３７条

この出願は、次の理由によって拒絶をすべきものです。これについて意見がありましたら、この通知書の発送の日から３か月以内に意見書を提出してください。

理由

１．（発明の単一性）この出願は、下記の点で特許法第３７条に規定する要件を満たしていない。

２．（新規性）この出願の下記の請求項に係る発明は、その出願前に日本国内又は外国において、頒布された下記の刊行物に記載された発明又は電気通信回線を通じて公衆に利用可能となった発明であるから、特許法第２９条第１項第３号に該当し、特許を受けることができない。

３．（進歩性）この出願の下記の請求項に係る発明は、その出願前に日本国内又は外国において、頒布された下記の刊行物に記載された発明又は電気通信回線を通じて公衆に利用可能となった発明に基いて、その出願前にその発明の属する技術の分野における通常の知識を有する者が容易に発明をすることができたものであるから、特許法第２９条第２項の規定により特許を受けることができない。

４．（明確性）この出願は、特許請求の範囲の記載が下記の点で、特許法第３６条第６項第２号に規定する要件を満たしていない。

記　　（引用文献等については引用文献等一覧参照）

●理由１について

１．特別な技術的特徴に基づく審査対象の決定

請求項１－２に係る発明は、引用文献１により新規性が欠如しており、特別な技術的特徴を有しない。

したがって、それまでに特別な技術的特徴の有無を判断した請求項１－２に係る発明を、審査対象とする。

２．審査の効率性に基づく審査対象の決定

請求項３－８に係る発明は、特別な技術的特徴に基づいて審査対象となった発明と、まとめて審査を行うことが効率的である発明であり、審査対象に加える。

請求項９－２１に係る発明は、請求項１に係る発明の発明特定事項を全て含む同一カテゴリーの発明ではない。そして、請求項９－２１に係る発明は、審査対象とされた発明を審査した結果、実質的に追加的な先行技術調査や判断を必要とすることなく審査を行うことが可能である発明ではなく、当該発明とまとめて審査を行うことが効率的であるといえる他の事情も無い。

したがって、請求項９－２１に係る発明は、特許法第３７条以外の要件についての審査対象としない。

●理由２について

・請求項　１
・引用文献等　１
・備考

引用文献１（特に段落［００２２］－［００５４］，図１－１１を参照）には、「軌道（１０２）から可動的に懸吊されるように構成されたトロリー（１０４，１０６）と、前記軌道に作動的に結合されて前記トロリーが電気的に接続されるように構成されている給電用コンダクタ（１１４）と、前記トロリーに結合された患者取付具（１１０）と、制御システム（１１２）とを含む装置」が開示されている。

・請求項　２
・引用文献等　１
・備考

引用文献１には、「受動カップリング（１６８）を含む点」が開示されている。

・請求項　５－６
・引用文献等　１
・備考

引用文献１には、「トロリーが駆動アセンブリ上方に配置される複数の車輪（１４４）を含む点」が開示されている。

●理由３について

・請求項　１－２，５－６
・引用文献等　１
・備考
　上記理由２を参照。

・請求項　３
・引用文献等　１－２
・備考
　引用文献２（特に段落［００１３］を参照）には、「患者を能動的に支持する技術」が開示されている。

・請求項　４
・引用文献等　１
・備考
　引用文献１には、「駆動アセンブリ（１０４）を備える点」が開示されている。
　また、伝達スプロケットなどで構成されるトルク伝達アセンブリを備える構成とすることは、当業者が適宜設計し得た範囲のものである。

・請求項　７
・引用文献等　１，３
・備考
　引用文献３（特に段落［０００９］，図２を参照）には、「トロリーが給電用コンダクタのみから電力を供給されるように構成されているもの」が開示されている。

・請求項　８
・引用文献等　１－２
・備考
　引用文献２（特に図１を参照）には、「トロリーが、軌道の一方の端部から他方の端部まで動くように構成されている点」が開示されている。

●理由４について

・請求項　１－８
　請求項１には、「前記患者支持アセンブリが１人の患者を支持するように構成

されている」と記載されているが、患者支持アセンブリは前記されていない点で不明確である。

また、請求項１に従属する請求項２－８についても同様である。

よって、請求項１－８に係る発明は明確でない。

＜引用文献等一覧＞

１.米国特許出願公開第２０１２／０００００８７６号明細書
２.実願平３－４０５３９号（実開平４－１３３８３０号）のマイクロフィルム
３.特開２０００－２３７２５０号公報

－－

＜先行技術文献調査結果の記録＞

・調査した分野　　ＩＰＣ　Ａ６１Ｈ　１／２０　３／００

・先行技術文献　　実願平１－４１９２０号（実開平２－１３１４３５号）のマイクロフィルム
特開平７－２１３５７０号公報
特開昭５５－６３６４７号公報
特開平１１－１１３９８６号公報

この先行技術文献調査結果の記録は、拒絶理由を構成するものではありません。

この拒絶理由通知の内容に関するお問い合わせ又は面接のご希望がありましたら次の連絡先までご連絡ください。

審査第二部　医療機器　今井　貞雄
ＴＥＬ．０３－３５８１－１１０１　内線３３４４
ＦＡＸ．０３－３５０１－０６７２

Translation

Reference Number: B0669HP1D1
Mailing No.: 012477
Mailing Date: January 15, 2018

NOTICE OF REASONS FOR REJECTION

Patent Application No.: 2017-052240
Drafting Date: January 10, 2018
JPO Examiner: Sadao Imai 4129 3E00
Attorneys for Applicant: Yoshiyuki Inaba (and three others)
Applicable Section(s): Sections 29(1) and 29(2)

The above-mentioned patent application should be rejected for the reasons stated below. The applicant may file an Argument against this notice with the Japan Patent Office within three months from the mailing date above.

Reasons

1. (Novelty) The invention according to the claims below in the present application is unpatentable under Section 29(1)(iii) of the Patent Law, since it is an invention described in the below-identified publications distributed in Japan or overseas prior to the filing of the application, or an invention made available to the public through electronic media in Japan or overseas prior to the filing of the application.

2. (Inventive step) The invention according to the claims below in the present application is unpatentable under Section 29(2) of the Patent Law, since it could have easily been made prior to the filing of the application by a person skilled in the art to which the invention pertains, based on inventions described in the below-identified publications distributed in Japan or overseas prior to the filing of the application, or based on inventions made available to the public through electronic media in Japan or overseas prior to the filing of the application.

Notes (including List of Cited References)

Regarding reason 1
Claim 1

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Cited reference 1
Comments:

Cited reference 1 (see, in particular, paragraphs 0007-0011 and Figs. 1-2) discloses "a trolley configured to support an amount of a user's weight, the trolley comprising: a drive assembly including a plurality of wheels (tires 5a) and a first motor (electric motor 10), the first motor configured to move the plurality of wheels along a track (moving rail 4) to move the trolley relative to the track; a patient support mechanism including an adjustable tether (hanging equipment 2) and a second motor (electric motor 6c), the adjustable tether having a first end portion coupled to a drum (hoisting drum) of the patient support mechanism and a second end portion coupled to a harness (belt 2a) worn by the user, the adjustable tether configured to support an amount of weight of the user, the second motor coupled to the drum and operable to adjust the amount of weight supported by the adjustable tether; and an electronic system electrically coupled to the first motor and the second motor, a portion of the electronic system in contact with at least one conductive surface of a powered conductor (power rail 13) coupled adjacent to the track, the electronic system configured to supply the first motor and the second motor with electric power received from the powered conductor."

Regarding reason 2
Claim 1
Cited reference 1
Comments:

See reason 1 above.

Claims 2-3
Cited references 1-2
Comments:

The present invention and the invention disclosed in cited reference 1 differ in that the present invention has the configuration in which an electronic system is configured to receive electric power from a battery and the battery is configured to receive electric power from a power rail, the electric power operable to electrically charge the battery, whereas cited reference 1 does not disclose such configuration.

The above difference will now be discussed. Cited reference 2 (see, in particular, page 6, line 7 to page 7, line 19 and Figs. 1-3) discloses "a technique

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for enabling a trolley to be driven even when power supply from a power rail is failed, with the configuration in which an electronic system is configured to receive electric power from a battery (battery 10) and the battery is configured to receive electric power from a power rail (insulating support 20 comprising a conductive stator 22), the electric power operable to electrically charge the battery."

The object of enabling a trolley to be driven even when power supply from a power rail is failed is also shared by the trolley disclosed in cited reference 1, and thus, a person skilled in the art could have easily thought of applying the technique disclosed in cited reference 2 to the trolley disclosed in cited reference 1 so as to achieve the configuration of the present invention.

Claim 4
Cited references 1 and 3
Comments:

The present invention and the invention disclosed in cited reference 1 differ in that in the present invention, a first motor is configured to move wheels along a track in response to movement of a patient, whereas cited reference 1 does not disclose such configuration.

The above difference will now be discussed. Cited reference 3 (see, in particular, paragraph 0058) discloses "a technique for moving wheels along a track by a motor in response to movement of a patient."

The object of actively driving a trolley is also shared by the trolley disclosed in cited reference 1, and thus, a person skilled in the art could have easily thought of applying the technique disclosed in cited reference 3 to the trolley disclosed in cited reference 1 so as to achieve the configuration of the present invention.

Claims 5-6
Cited references 1 and 3
Comments:

The present invention and the invention disclosed in cited reference 1 differ in that in the present invention, a second motor is configured to adjust the amount of weight supported by an adjustable tether in response to movement of the patient, whereas cited reference 1 does not disclose such configuration.

The above difference will now be discussed. Cited reference 3 (see, in particular, paragraph 0074) discloses "a technique for adjusting the amount of

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weight supported by an adjustable tether in response to movement of the patient by rotating a drum by the motor."

The object of actively adjusting a supported amount of weight is also shared by the trolley disclosed in cited reference 1, and thus, a person skilled in the art could have easily thought of applying the technique disclosed in cited reference 3 to the trolley disclosed in cited reference 1 so as to achieve the configuration of the present invention.

Claims 7-8
Cited reference 1
Comments:

In the trolley disclosed in cited reference 1, merely sending from the drive assembly to the electronic system a sort of signal associated with an operating condition of the drive assembly, and the patient support mechanism merely including a sensor configured to send to the electronic system a sort of signal associated with an operating condition of the patient support mechanism, are something within the scope of matters that could have been designed as appropriate by a person skilled in the art.

Claim 9
Cited reference 1
Comments:

A trolley in which a first wheel is disposed above a portion of a track and a second wheel is disposed below the portion of the track is well known without the need to cite a reference.

Applying the well-known configuration to the trolley disclosed in cited reference 1 so as to achieve the configuration of the present invention is something that could have been designed as appropriate by a person skilled in the art.

Claim 10
Cited references 1-2
Comments:

Cited reference 2 (see, in particular, Fig. 1) discloses "the configuration in which at least a portion of a track (rail 17) is disposed between at least one wheel from a plurality of wheels (roller 28) and a powered conductor (conductive stator 22)."

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Applying the configuration disclosed in cited reference 2 to the trolley disclosed in cited reference 1 so as to achieve the configuration of the present invention is something that could have been employed as appropriate by a person skilled in the art.

List of Cited References

1. JP2000-237250 A
2. JPH02-131435 U
3. US2008/0287268

Record of Prior Art Reference Search Results

- Technical Field(s) Searched: IPC A61H 1/02 3/00
- Prior Art References: US2012/0000876

This record of prior art reference search results does not constitute a reason for rejection.

If you have any questions concerning the content of this Notice of Reasons for Rejection, or wish to have an interview, please contact:

Sadao Imai
Second Patent Examination Department, Medical Device Division
TEL: 03-3581-1101 Extension Number: 3344
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拒絶理由通知書

特許出願の番号	特願２０１７－０５２２４０
起案日	平成３０年　１月１０日
特許庁審査官	今井　貞雄　　４１２９　３Ｅ００
特許出願人代理人	稲葉　良幸（外　３名）　様
適用条文	第２９条第１項、第２９条第２項

この出願は、次の理由によって拒絶をすべきものです。これについて意見がありましたら、この通知書の発送の日から３か月以内に意見書を提出してください。

理由

１．（新規性）この出願の下記の請求項に係る発明は、その出願前に日本国内又は外国において、頒布された下記の刊行物に記載された発明又は電気通信回線を通じて公衆に利用可能となった発明であるから、特許法第２９条第１項第３号に該当し、特許を受けることができない。

２．（進歩性）この出願の下記の請求項に係る発明は、その出願前に日本国内又は外国において、頒布された下記の刊行物に記載された発明又は電気通信回線を通じて公衆に利用可能となった発明に基いて、その出願前にその発明の属する技術の分野における通常の知識を有する者が容易に発明をすることができたものであるから、特許法第２９条第２項の規定により特許を受けることができない。

記　　（引用文献等については引用文献等一覧参照）

●理由１について

・請求項　１
・引用文献等　１
・備考
引用文献１（特に段落［０００７］－［００１１］、図１－２を参照）には、「使用者の重量を支持するように構成されたトロリーであって、前記トロリーは、複数の車輪（タイヤ５ａ）及び第１モータ（電動機１０）を含む駆動アセンブリであって、前記第１モータは、軌道（移動レール４）に沿って前記複数の車輪を移動させて前記軌道に対して前記トロリーを移動させるように構成される、駆

動アセンブリと、調整可能な係留具（吊具２）及び第２モータ（電動機６ｃ）を含む患者支持機構であって、前記調整可能な係留具は、前記患者支持機構のドラム（巻胴）に結合された第１端部部分と、使用者により着用されたハーネス（ベルト２ａ）に結合された第２端部部分と、を有し、前記調整可能な係留具は使用者の重量を支持するように構成され、前記第２モータは、前記ドラムに結合され、かつ、前記調整可能な係留具によって支持された前記重量を調整するように動作可能である、患者支持機構と、前記第１モータ及び前記第２モータに電気的に結合された電子システムであって、前記電子システムの一部が、前記軌道に隣接して結合された給電用コンダクタ（給電レール１３）の少なくとも１つの導電性表面に接触し、前記電子システムは、前記給電用コンダクタから受け取った電力を前記第１モータ及び前記第２モータに供給するように構成される、電子システムと、を備えるトロリー。」が記載されている。

●理由２について

・請求項　１
・引用文献等　１
・備考
　上記理由１を参照。

・請求項　２－３
・引用文献等　１－２
・備考
　本願発明は、電子システムは、バッテリから電力を受け取るように構成され、前記バッテリは、給電レールから電力を受け取るように構成され、前記電力は、前記バッテリを充電するように動作可能である構成であるのに対し、引用文献１には当該構成に関する記載がない点で、本願発明と引用文献１記載の発明は相違する。
　当該相違点について検討すると、引用文献２（特に第６ページ第７行－第７ページ第１９行、第１－３図を参照）には、「電子システムは、バッテリ（バッテリ１０）から電力を受け取るように構成され、前記バッテリは、給電レール（導電固定子２２を備える絶縁支持体２０）から電力を受け取るように構成され、前記電力は、前記バッテリを充電するように動作可能である構成により、給電レールからの給電が絶たれてもトロリーを駆動可能にする技術」が記載されている。
　そして、給電レールからの給電が絶たれてもトロリーを駆動可能にするという課題は、引用文献１に記載されたトロリーにおいても共通するものであるから、引用文献１に記載されたトロリーにおいて、引用文献２に記載された技術を適用して、本願発明の構成とすることは、当業者であれば容易に想到し得たものである。

・請求項　４
・引用文献等　１、３
・備考
本願発明は、第１モータは、患者の移動に応じて、軌道に沿って車輪を移動させる構成であるのに対し、引用文献１には当該構成に関する記載がない点で、本願発明と引用文献１記載の発明は相違する。
当該相違点について検討すると、引用文献３（特に段落［００５８］を参照）には、「患者の移動に応じて、軌道に沿ってモータが車輪を移動させる技術」が記載されている。
そして、トロリーを能動的に駆動するという課題は、引用文献１に記載されたトロリーにおいても共通するものであるから、引用文献１に記載されたトロリーにおいて、引用文献３に記載された技術を適用して、本願発明の構成とすることは、当業者であれば容易に想到し得たものである。

・請求項　５－６
・引用文献等　１、３
・備考
本願発明は、第２モータは、患者の移動に応じて、調整可能な係留具によって支持された重量を調整する構成であるのに対し、引用文献１には当該構成に関する記載がない点で、本願発明と引用文献１記載の発明は相違する。
当該相違点について検討すると、引用文献３（特に段落［００７４］を参照）には、「患者の移動に応じて、調整可能な係留具によって支持された重量をモータでドラムを回転させて調整する技術」が記載されている。
そして、支持重量を能動的に調整するという課題は、引用文献１に記載されたトロリーにおいても共通するものであるから、引用文献１に記載されたトロリーにおいて、引用文献３に記載された技術を適用して、本願発明の構成とすることは、当業者であれば容易に想到し得たものである。

・請求項　７－８
・引用文献等　１
・備考
引用文献１に記載されたトロリーにおいて、単に、駆動アセンブリが駆動アセンブリの動作状態に関連した何らかの信号を電子システムに送信することや、患者支持機構が患者支持機構の動作状態に関連した何らかの信号を電子システムに送信するためのセンサを備えること自体は、当業者が適宜設計し得た範囲のものである。

・請求項　９

・引用文献等　１

・備考

第１車輪が軌道の一部の上方に配置され、第２車輪が軌道の一部の下方に配置されるトロリーは、例を示すまでもなく、周知のものである。

そして、引用文献１に記載されたトロリーにおいて、周知の構成を適用して、本願発明の構成とすることは、当業者が適宜設計し得たものである。

・請求項　１０

・引用文献等　１－２

・備考

引用文献２（特に第１図を参照）には、「軌道（レール１７）の少なくとも一部は、複数の車輪（ローラ２８）のうちの少なくとも１つの車輪と給電コンダクタ（導電固定子２２）との間に配置される構成」が記載されている。

そして、引用文献１に記載されたトロリーにおいて、引用文献２に記載された構成を適用して、本願発明の構成とすることは、当業者が適宜採用し得たものである。

＜引用文献等一覧＞

１.特開２０００－２３７２５０号公報

２.実願平１－４１９２０号（実開平２－１３１４３５号）のマイクロフィルム

３.米国特許出願公開第２００８／０２８７２６８号明細書

－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－

＜先行技術文献調査結果の記録＞

・調査した分野　　ＩＰＣ　Ａ６１Ｈ　１／０２　３／００

・先行技術文献　　米国特許出願公開第２０１２／０００００８７６号明細書

この先行技術文献調査結果の記録は、拒絶理由を構成するものではありません。

この拒絶理由通知の内容に関するお問い合わせ又は面接のご希望がありましたら次の連絡先までご連絡ください。

審査第二部　医療機器　今井　貞雄

ＴＥＬ．０３－３５８１－１１０１　内線３３４４

ＦＡＸ．０３－３５８５－２０６７

Translation

Reference Number: B0669HP1D1
Mailing No.: 302956
Mailing Date: July 19, 2018

NOTICE OF REASONS FOR REJECTION

Patent Application No.: 2017-052240
Drafting Date: July 17, 2018
JPO Examiner: Akira Tachibana 4024 3E00
Attorneys for Applicant: Yoshiyuki Inaba (and three others)
Applicable Section(s): Section 17bis (3)

<<< Final Notice of Reasons for Rejection >>>

The above-mentioned patent application should be rejected for the reasons stated below. The applicant may file an Argument against this notice with the Japan Patent Office within three months from the mailing date above.

Reasons

(Addition of new matter) The amendment made on June 11, 2018 does not comply with the requirements set forth in Section 17bis(3) of the Patent Law, since it has not been made within the scope of the matter described in the translation of the foreign language document (or in the specification, claims, or drawings amended through correction of translation) regarding the following point(s).

Notes

Claims 1-10

Claims 1-10 have been amended to additionally specify that the track is a stationary track; however, such feature is not described in the translation of the foreign language document, etc., including paragraph 0039 mentioned in the Argument.

Since it is obvious that the matter recited in claims 1-10 amended as above is not within the scope of the matter described in the translation of the foreign language document (or in the specification, claims, or drawings amended

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through correction of translation), the invention according to claims 1-10 has not been examined for the patentability requirements such as novelty and inventive step.

Reason for Making This Notice the Final Notice

This Notice of Reasons for Rejection contains only the reasons for rejection necessitated by the amendments made in response to the previous Notice of Reasons for Rejection.

If you have any questions concerning the content of this Notice of Reasons for Rejection, or wish to have an interview, please contact:

Akira Tachibana
Second Patent Examination Department, Medical Device Division
TEL: 03-3581-1101 Extension Number: 3344
FAX: 03-3585-2067

Aretech LLC - Exhibit 1004, Page 00779

拒絶理由通知書

特許出願の番号	特願２０１７－０５２２４０
起案日	平成３０年　７月１７日
特許庁審査官	立花　啓　４０２４　３Ｅ００
特許出願人代理人	稲葉　良幸（外　３名）　様
適用条文	第１７条の２第３項

＜＜＜＜　　最後　　＞＞＞＞

この出願は、次の理由によって拒絶をすべきものです。これについて意見がありましたら、この通知書の発送の日から３か月以内に意見書を提出してください。

理由

（新規事項）平成３０年　６月１１日付け手続補正書でした補正は、下記の点で外国語書面の翻訳文（又は誤訳訂正書による補正後の明細書、特許請求の範囲若しくは図面）に記載した事項の範囲内においてしたものでないから、特許法第１７条の２第３項に規定する要件を満たしていない。

記

・請求項１－１０

補正により、請求項１－１０に、軌道が静止軌道であることが追加されたが、これは意見書で言及された段落００３９を含め外国語書面の翻訳文等に記載されたものではない。

なお、当該補正がなされた請求項１－１０に記載した事項は、外国語書面の翻訳文（又は誤訳訂正書による補正後の明細書、特許請求の範囲若しくは図面）に記載した事項の範囲内にないことが明らかであるから、当該請求項に係る発明については新規性、進歩性等の特許要件についての審査を行っていない。

＜最後の拒絶理由通知とする理由＞

この拒絶理由通知は、最初の拒絶理由通知に対する応答時の補正によって通知することが必要になった拒絶理由のみを通知するものである。

－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－－

この拒絶理由通知の内容に関するお問合せ又は面接のご希望がありましたら次の連絡先までご連絡ください。

審査第二部医療機器　立花啓
ＴＥＬ．０３－３５８１－１１０１　内線３３４４
ＦＡＸ．０３－３５８５－２０６７

Translation

Reference Number:
Mailing No.: 434133
Mailing Date: October 16, 2019

NOTICE OF REASONS FOR REJECTION

Patent Application No.: 2017-534701
Drafting Date: October 9, 2019
JPO Examiner: Yoshitaka DAN 3824 3E00
Attorneys for Applicant: Yoshiyuki Inaba (and three others)
Applicable Section(s): Sections 29 body, 29(1), 29(2) and 36

The above-mentioned patent application should be rejected for the reasons stated below. The applicant may file an Argument against this notice with the Japan Patent Office within three months from the mailing date above.

Reasons

1. (Novelty) The invention according to the claims below in the present application is unpatentable under Section 29(1)(iii) of the Patent Law, since it is an invention described in the below-identified publications distributed in Japan or overseas prior to the filing of the application, or an invention made available to the public through electronic media in Japan or overseas prior to the filing of the application.

2. (Inventive step) The invention according to the claims below in the present application is unpatentable under Section 29(2) of the Patent Law, since it could have easily been made prior to the filing of the application by a person skilled in the art to which the invention pertains, based on inventions described in the below-identified publications distributed in Japan or overseas prior to the filing of the application, or based on inventions made available to the public through electronic media in Japan or overseas prior to the filing of the application.

3. (Clarity) The claims in the present application fail to comply with the requirements set forth in Section 36(6)(ii) of the Patent Law regarding the following point(s).

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4. (Industrial applicability) The invention according to the claims below in the present application is unpatentable, since these inventions fail to comply with the requirements prescribed in the body of Section 29 of the Patent Law regarding the following point(s).

Notes (including List of Cited References)

Reason 1

Claim(s): 1-6, 8-17, and 20

Cited reference(s): 1

Comments:

Referring, in particular, to [0086]-[0151] and Figs. 1-47 in Cited reference 1, an apparatus comprising a first sensor 2470, a second sensor 2561, and a cum assembly 2570 is described; referring, in particular, to [0092] and [0149] in Cited reference 1, performing feedback loop control and identifying that a patient walks faster than a trolley 2100 (gait characteristic) are described; since the gait characteristic of the patient is identified based on signals received from the sensors, no practical difference can be found between the present invention and that disclosed in Cited reference 1.

Reason 2

Claim(s): 1-20

Cited reference(s): 1

Comments:

Claims 1-6, 8-17, and 20

Referring, in particular, to [0086]-[0151] and Figs. 1-47 in Cited reference 1, an apparatus comprising a first sensor 2470, a second sensor 2561, and a cum assembly 2570 is described; referring, in particular, to [0092] and [0149] in Cited reference 1, performing feedback loop control and identifying that a patient walks faster than a trolley 2100 (gait characteristic) are described; since the gait characteristic of the patient is identified based on signals received from the sensors, no practical difference can be found between the present invention and that disclosed in Cited reference 1.

Claims 7 and 18

What is employed as a gait characteristic is a matter of design choice to

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a person skilled in the art.

Claim 19

Since displaying a gait characteristic on a display is also commonly performed, whether to employ the common technology is a matter of design choice to a person skilled in the art.

Reason 3

Claim(s): 1-20

Comments:

(1) Claim 1 recites the following terms. However, since they are not general Japanese technical terms and the definitions of the following terms are not described even with reference to the detailed description of the invention in the present application, the following terms are unclear in Japanese:

"operatively coupled"
"tether"

If you argue that the above terms are clear in Japanese, you should indicate a basis in a Japanese dictionary etc.

Or you should make the recitation clear in Japanese without using the above terms.

Meanwhile, when making amendments, you should be careful not to introduce any new matter and should indicate grounds for each amendment in an argument etc.

The same terms in other claims are also unclear.

(2) Claim 3 recites the following term. However, since it is not general Japanese technical term and the definition of the following term is not described even with reference to the detailed description of the invention in the present application, the following term is unclear in Japanese:

"a set of wheels"

If you argue that the above term is clear in Japanese, you should indicate a basis in a Japanese dictionary etc.

Or you should make the recitation clear in Japanese without using the above term.

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Meanwhile, when making amendments, you should be careful not to introduce any new matter and should indicate grounds for each amendment in an argument etc.

The same term in other claims is also unclear.

(3) Claim 7 recites the following terms. However, since they are not general Japanese technical terms and the definitions of the following terms are not described even with reference to the detailed description of the invention in the present application, the following terms are unclear in Japanese:

"a swing to stance ratio"
"a cadence"
"a stride length"
"a stride height"
"a range of motion in an anterior and posterior direction"
"a range of motion in a lateral direction"
"ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction"

If you argue that the above terms are clear in Japanese, you should indicate a basis in a Japanese dictionary etc.

Or you should make the recitation clear in Japanese without using the above terms.

Meanwhile, when making amendments, you should be careful not to introduce any new matter and should indicate grounds for each amendment in an argument etc.

The same terms in other claims are also unclear.

(4) Claim 8 recites "receiving a signal associated with a first operating condition of at least one of a drive mechanism or a patient support mechanism, the patient support mechanism coupled to an active trolley and configured to support a patient, the drive mechanism coupled to the active trolley and configured to move the trolley along a support track in response to a movement of the patient." However, the meaning of the recitation is unclear in a Japanese sentence and the invention cannot be clearly understood.

The same terms in other claims are also unclear.

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(5) Claim 8 recites the following terms. However, since they are not general Japanese technical terms and the definitions of the following terms are not described even with reference to the detailed description of the invention in the present application, the following terms are unclear in Japanese:

"a first operating condition"
"a second operating condition"
"a difference between the first operating condition and the second operating condition"

If you argue that the above terms are clear in Japanese, you should indicate a basis in a Japanese dictionary etc.

Or you should make the recitation clear in Japanese without using the above terms.

Meanwhile, when making amendments, you should be careful not to introduce any new matter and should indicate grounds for each amendment in an argument etc.

The same terms in other claims are also unclear.

(6) Claim 14 recites "receiving a first signal from a first sensor, the first signal being associated with an operating condition of a patient support mechanism included in a patient support system, the patient support mechanism including a tether configured to tether a patient to the patient support mechanism, the patient support system supporting at least a portion of a weight of the patient when the patient is tethered to the patient support mechanism." However, the meaning of the recitation is unclear in a Japanese sentence and the invention cannot be clearly understood.

(7) Claim 14 recites "receiving a second signal from a second sensor, the second signal being associated with an operating condition of a drive mechanism included in the patient support system, the drive mechanism configured to (1) suspend the patient support system from a support track and (2) move along the support track in response to a movement of the patient." However, the meaning of the recitation is unclear in a Japanese sentence and the invention cannot be clearly understood.

(8) Claim 14 recites "sending, ... indicative of an instruction to output ... via

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the output device." However, the meaning of the recitation is unclear in a Japanese sentence and the invention cannot be clearly understood.

(9) Claim 20 recites "defining, ... a second operating condition." However, the technical meaning of the recitation is unclear in Japanese and the invention cannot be clearly understood.

Reason 4
Claim(s): 8-13
Comments:

The invention according to the above claims is "an invention of a method" including the following steps:

"determining a difference between the first operating condition and the second operating condition"

"defining, based at least in part on the determining, a gait characteristic of the patient supported by the patient support mechanism"

In this regard, the steps can include any treatment or operation which is performed by a medical doctor because an actor of the steps (subject) is unknown. Thus, the invention according to the above claims does not fall under "an invention of a method for controlling the operation of a medical device."

On the other hand, the steps as described above generally include a step in which a medical doctor makes a determination on a treatment plan based on a physical state of the patient. Then, the invention according to the above claims falls under "an invention of a method of diagnosis of humans."

The invention according to the above claims therefore falls under "an invention of a method of diagnosis of humans" and the invention according to the above claims is not considered to be "an industrially-applicable invention" set forth in Section 29(1) body of the Patent Law.

(Refer to Examination Guidelines, Part III, Chapter 1, 3.1.1 "Inventions of methods of surgery, therapy or diagnosis of humans.")

Meanwhile, if you can correctly describe that an actor of each step (subject) is a control means etc. while indicating a basis in the detailed

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description of the invention in the present application and can make the invention according to the above claims an invention of a method for controlling the operation of a medical device while indicating a basis in the detailed description of the invention in the present application, the above reason for rejection is overcome.

(Refer to Examination Guidelines, Part III, Chapter 1, 3.2.1 "Inventions which do not fall under 'inventions of methods of surgery, therapy or diagnosis of humans'" (2) A method for controlling the operation of a medical device.)

Reason 4
Claim(s): 14-20
Comments:

The invention according to the above claims is "an invention of a method" including the following steps:

"determining a gait characteristic based at least in part on the operating condition of the patient support mechanism and the operating condition of the drive mechanism"

"defining, based at least in part on the determining of the gait characteristic, a second operating condition associated with the patient support mechanism and a second operating condition associated with the drive mechanism"

"defining a second operating condition"

In this regard, the steps can include any treatment or operation which is performed by a medical doctor because an actor of the steps (subject) is unknown. Thus, the invention according to the above claims does not fall under "an invention of a method for controlling the operation of a medical device."

On the other hand, the steps as described above generally include a step in which a medical doctor makes a determination on a treatment plan based on a physical state of the patient. Then, the invention according to the above claims falls under "an invention of a method of diagnosis of humans."

The invention according to the above claims therefore falls under "an invention of a method of diagnosis of humans" and the invention according to the above claims is not considered to be "an industrially-applicable invention"

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set forth in Section 29(1) body of the Patent Law.

(Refer to Examination Guidelines, Part III, Chapter 1, 3.1.1 "Inventions of methods of surgery, therapy or diagnosis of humans.")

Meanwhile, if you can correctly describe that an actor of each step (subject) is a control means etc. while indicating a basis in the detailed description of the invention in the present application and can make the invention according to the above claims an invention of a method for controlling the operation of a medical device while indicating a basis in the detailed description of the invention in the present application, the above reason for rejection is overcome.

(Refer to Examination Guidelines, Part III, Chapter 1, 3.2.1 "Inventions which do not fall under 'inventions of methods of surgery, therapy or diagnosis of humans'" (2) A method for controlling the operation of a medical device.)

List of Cited References

1. US2014/0201906

· When making amendments, you should be careful not to introduce any new matter and should indicate grounds for each amendment in an argument etc.

Record of Prior Art Reference Search Results

- Technical Field(s) Searched: IPC A61H 1/00-99/00

- Prior Art References: JP2001-299842 A

- This record of prior art reference search results does not constitute a reason for rejection.

- If you have any questions concerning the content of this Notice of Reasons for Rejection, or wish to have an interview, please contact:

Second Patent Examination Department, Medical Equipment Division,
Toshitaka DAN

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TEL: 03-3581-1101 Extension Number: 3344
FAX: 03-3585-2067

· For any questions about the patent system in general, please contact the following:
National Center for Industrial Property Information and Training, Gazette Inspection/Consultation Section
TEL: 03-3581-1101 Extension Number: 2123

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拒絶理由通知書

特許出願の番号	特願２０１７－５３４７０１
起案日	令和　１年１０月　９日
特許庁審査官	段　吉享　　３８２４　３Ｅ００
特許出願人代理人	稲葉　良幸（外　３名）　様
適用条文	第２９条柱書、第２９条第１項、第２９条第２項、第３６条

この出願は、次の理由によって拒絶をすべきものです。これについて意見がありましたら、この通知書の発送の日から３か月以内に意見書を提出してください。

理由

１．（新規性）この出願の下記の請求項に係る発明は、その出願前に日本国内又は外国において、頒布された下記の刊行物に記載された発明又は電気通信回線を通じて公衆に利用可能となった発明であるから、特許法第２９条第１項第３号に該当し、特許を受けることができない。
２．（進歩性）この出願の下記の請求項に係る発明は、その出願前に日本国内又は外国において、頒布された下記の刊行物に記載された発明又は電気通信回線を通じて公衆に利用可能となった発明に基いて、その出願前にその発明の属する技術の分野における通常の知識を有する者が容易に発明をすることができたものであるから、特許法第２９条第２項の規定により特許を受けることができない。
３．（明確性）この出願は、特許請求の範囲の記載が下記の点で、特許法第３６条第６項第２号に規定する要件を満たしていない。
４．（産業上の利用可能性）この出願の下記の請求項に係る発明は、下記の点で特許法第２９条第１項柱書に規定する要件を満たしていないから、特許を受けることができない。

記　　（引用文献等がある場合は、引用文献等一覧を参照）

●理由1
・請求項1-6, 8-17, 20
・引用文献等1
・備考：
引用文献1の特に[0086-0151]図1-47を参照すると、第1センサ2470と、第2センサ2561と、カムアセンブリ2570を備えた装置が記載されており、引用文献1の特に[

0092][0149]を参照すると、フィードバックループ制御を行う点、トロリー2100より早く患者が歩いていること(歩行特徴)を特定する点が記載されており、センサからの受信信号に基づき患者の歩行特徴を特定しているため、本願発明と引用文献1に記載された発明とで実際的な差異は見出せない。

●理由2
・請求項1-20
・引用文献等1
・備考：
本願請求項1-6,8-17,20
引用文献1の特に[0086-0151]図1-47を参照すると、第1センサ2470と、第2センサ2561と、カムアセンブリ2570を備えた装置が記載されており、引用文献1の特に[0092][0149]を参照すると、フィードバックループ制御を行う点、トロリー2100より早く患者が歩いていること(歩行特徴)を特定する点が記載されており、センサからの受信信号に基づき患者の歩行特徴を特定しているため、本願発明と引用文献1に記載された発明とで実際的な差異は見出せない。
本願請求項7,18
歩行特徴として何を採用するかは、当業者が適宜設定し得る設計的事項である。
本願請求項19
歩行特徴をディスプレイに表示する点も、一般的に行われていることであるため、当該一般的技術を採用するかどうかは、当業者が適宜設定し得る設計的事項である。

●理由3
・請求項1-20
・備考：
（１）本願請求項1には、以下の用語が記載されているが、一般的な日本語の技術用語ではなく、本願の発明の詳細な説明を参照しても、以下の用語の定義が、記載されていないため、以下の用語は、日本語として、不明確である。

「作動的に結合」
「テザー」

仮に、上記の用語が、日本語として、明確であると主張するのであれば、日本語の辞書等による根拠を、示されたい。
若しくは、上記の用語を使用せずに、日本語として、明確に記載されたい。
なお、補正をされる場合には、新規事項の追加とならないよう注意されるとともに、それぞれ補正について、補正の根拠を、意見書等で示されたい。
その他の請求項の同じ用語も不明確である。

(2) 本願請求項3には、以下の用語が記載されているが、一般的な日本語の技術用語ではなく、本願の発明の詳細な説明を参照しても、以下の用語の定義が、記載されていないため、以下の用語は、日本語として、不明確である。

「車輪のセット」

仮に、上記の用語が、日本語として、明確であると主張するのであれば、日本語の辞書等による根拠を、示されたい。
若しくは、上記の用語を使用せずに、日本語として、明確に記載されたい。
なお、補正をされる場合には、新規事項の追加とならないよう注意されるとともに、それぞれ補正について、補正の根拠を、意見書等で示されたい。
その他の請求項の同じ用語も不明確である。

(3) 本願請求項7には、以下の用語が記載されているが、一般的な日本語の技術用語ではなく、本願の発明の詳細な説明を参照しても、以下の用語の定義が、記載されていないため、以下の用語は、日本語として、不明確である。

「遊脚対立脚比」
「ケイデンス」
「重複歩距離」
「重複歩高さ」
「前及び後方向の可動域」
「横方向の可動域」
「前及び後方向の前記可動域と前記横方向の前記可動域との間の比率」

仮に、上記の用語が、日本語として、明確であると主張するのであれば、日本語の辞書等による根拠を、示されたい。
若しくは、上記の用語を使用せずに、日本語として、明確に記載されたい。
なお、補正をされる場合には、新規事項の追加とならないよう注意されるとともに、それぞれ補正について、補正の根拠を、意見書等で示されたい。
その他の請求項の同じ用語も不明確である。

(4)本願請求項8に「駆動機構又は患者支持機構の少なくとも１つの第１動作状態に関連する信号を受信することであって、前記患者支持機構が、能動トロリーへ結合されるとともに患者を支持するように構成され、前記駆動機構が、前記能動トロリーへ結合されるとともに、前記患者の移動に応じて、前記トロリーを支持

トラックに沿って移動させるように構成される、受信する」と記載されているが、日本語の文章として意味不明であり、発明を明確に把握できない。
その他の請求項の同じ用語も不明確である。

(5) 本願請求項8には、以下の用語が記載されているが、一般的な日本語の技術用語ではなく、本願の発明の詳細な説明を参照しても、以下の用語の定義が、記載されていないため、以下の用語は、日本語として、不明確である。

「第1動作状態」
「第2動作状態」
「第１動作状態と前記第２動作状態との差」

仮に、上記の用語が、日本語として、明確であると主張するのであれば、日本語の辞書等による根拠を、示されたい。
若しくは、上記の用語を使用せずに、日本語として、明確に記載されたい。
なお、補正をされる場合には、新規事項の追加とならないよう注意されるとともに、それぞれ補正について、補正の根拠を、意見書等で示されたい。
その他の請求項の同じ用語も不明確である。

(6)本願請求項14には「第１センサから第１信号を受信することであって、前記第１信号が、患者支持システムに含まれる患者支持機構の動作状態に関連し、前記患者支持機構が、患者を前記患者支持機構へ係留するように構成されたテザーを含み、前記患者が前記患者支持機構へ係留されると、前記患者支持システムが前記患者の重量の少なくとも一部を支持する、受信することと」と記載されているが、日本語の文章として意味不明であり、発明を明確に把握できない。

(7)本願請求項14には「第２センサから第２信号を受信することであって、前記第２信号が、前記患者支持システムに含まれる駆動機構の動作状態に関連し、前記駆動機構が、（１）前記患者支持システムを支持トラックから懸吊するように、及び、（２）前記患者の移動に応じて前記支持トラックに沿って移動するように構成される、受信することと」と記載されているが、日本語の文章として意味不明であり、発明を明確に把握できない。

(8)本願請求項14には「出力デバイスを介して出力するという命令を示す、送信することと」と記載されているが、日本語の文章として意味不明であり、発明を明確に把握できない。

(9)本願請求項20には「第２動作状態を定義する」と記載されているが、日本語として、技術的に何を意味するのか不明であり、発明を明確に把握できない。

●理由4
・請求項8-13
・備考：
上記請求項に係る発明は、以下の工程を含む「方法の発明」である。

「第１動作状態と前記第２動作状態との差を決定する」
「決定に少なくとも部分的に基づき、前記患者支持機構により支持された前記患者の歩行特徴を定義する」

ここで、当該工程は、主体（主語）が不明なため、当該工程は、医師が行う処置や操作を含みうる。そのため、上記請求項に係る発明は「医療機器の作動方法の発明」に該当しない。

他方で、一般的に、上記のような工程には、医師が患者の身体状態に基づき治療計画についての判断を行う工程が含まれる。そうすると、上記請求項に係る発明は「人間を診断する方法の発明」に該当することになる。

したがって、上記請求項に係る発明は「人間を診断する方法の発明」に該当し、上記請求項に係る発明は特許法第２９条第１項柱書でいう「産業上利用できる発明」とは認められない。
（審査基準　第III部第1章3.1.1「人間を手術、治療又は診断する方法の発明」を参照。）

なお、仮に、本願の発明の詳細な説明中の根拠を示しつつ、各工程の主体（主語）が制御手段等であることを正確に記載でき、且つ、本願の発明の詳細な説明中の根拠を示しつつ、上記請求項に係る発明を「医療機器の作動方法の発明」にできるのであれば、上記の拒絶理由は解消される。
（審査基準　第III部第1章3.2.1「『人間を手術、治療又は診断する方法の発明』に該当しない発明」の(2)医療機器の作動方法を参照。）

●理由4
・請求項14-20
・備考：
上記請求項に係る発明は、以下の工程を含む「方法の発明」である。

「歩行特徴を、前記患者支持機構の前記動作状態及び前記駆動機構の前記動作状態に少なくとも部分的に基づき、決定する」
「歩行特徴の前記決定に少なくとも部分的に基づき、前記患者支持機構に関連する第２動作状態及び前記駆動機構に関連する第２動作状態を定義する」
「第２動作状態を定義する」

ここで、当該工程は、主体（主語）が不明なため、当該工程は、医師が行う処置や操作を含みうる。そのため、上記請求項に係る発明は「医療機器の作動方法の発明」に該当しない。

他方で、一般的に、上記のような工程には、医師が患者の身体状態に基づき治療計画についての判断を行う工程が含まれる。そうすると、上記請求項に係る発明は「人間を診断する方法の発明」に該当することになる。

したがって、上記請求項に係る発明は「人間を診断する方法の発明」に該当し、上記請求項に係る発明は特許法第２９条第１項柱書でいう「産業上利用できる発明」とは認められない。
（審査基準　第III部第1章3.1.1「人間を手術、治療又は診断する方法の発明」を参照。）

なお、仮に、本願の発明の詳細な説明中の根拠を示しつつ、各工程の主体（主語）が制御手段等であることを正確に記載でき、且つ、本願の発明の詳細な説明中の根拠を示しつつ、上記請求項に係る発明を「医療機器の作動方法の発明」にできるのであれば、上記の拒絶理由は解消される。
（審査基準　第III部第1章3.2.1「『人間を手術、治療又は診断する方法の発明』に該当しない発明」の(2)医療機器の作動方法を参照。）

＜引用文献等一覧＞
１.米国特許出願公開第2014／0201906号明細書
－－
・補正をされる場合には、新規事項の追加とならないよう注意されるとともに、

それぞれ補正について、補正の根拠を、意見書等で示されたい。

先行技術文献調査結果の記録

・調査した分野　　ＩＰＣ　　A61H 1/00-99/00

・先行技術文献　　特開2001－299842号公報

・この先行技術文献調査結果の記録は拒絶理由を構成するものではありません。

・この拒絶理由通知の内容に関するお問い合わせ、または面接のご希望がありましたら、下記までお問い合わせ下さい。

審査第二部医療機器　段　吉享（だん　よしたか）
ＴＥＬ．０３－３５８１－１１０１　内線３３４４
ＦＡＸ．０３－３５８５－２０６７

・特許制度一般に関するご質問は、下記までお問い合わせ下さい。

工業所有権情報・研修館　公報閲覧・相談部
ＴＥＬ．０３－３５８１－１１０１　内線２１２３

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference BION05100WO	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US2014/012064	International filing date *(day/month/year)* 17 January 2014	(Earliest) Priority Date *(day/month/year)* 20 January 2013
Applicant BIONESS INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

   a. the figure of the **drawings** to be published with the abstract is Figure No. 2

   ☒ as suggested by the applicant.

   ☐ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

Aretech LLC - Exhibit 1004, Page 00798

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/012064

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B66C 13/12 (2014.01)
USPC - 212/284
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - B66C 13/12 (2014.01)
USPC - 212/74, 119, 284, 291, 321, 327, 328, 346; 482/66, 69

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - B66C 7/00, 13/22 (2014.02)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google Patents, Google Scholar

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 4,243,147 A (TWITCHELL et al) 06 January 1981 (06.01.1981) entire document	1-12, 14, 16, 17, 20, 21 --- 13, 15, 18, 19
Y	US 7,883,450 B2 (HIDLER) 08 February 2011 (08.02.2011) entire document	13, 15
Y	US 7,137,771 B2 (MAURER et al) 21 November 2006 (21.11.2006) entire document	18, 19

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 April 2014	09 MAY 2014
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: ERIK B. MILCH
COOLEY LLP
1299 PENNSYLVANIA AVE
SUITE 700
WASHINGTON, DC 20004

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	09 MAY 2014
Applicant's or agent's file reference BION05100WO	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2014/012064	17 January 2014	20 January 2013

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - B66C 13/12 (2014.01)
USPC - 212/284

Applicant BIONESS INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer:
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	25 April 2014	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (July 2011)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2014/012064

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

a. (means)

☐ on paper

☐ in electronic form

b. (time)

☐ in the international application as filed

☐ together with the international application in electronic form

☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2014/012064

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	13, 15, 18, 19	YES
	Claims	1-12, 14, 16, 17, 20, 21	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-21	NO
Industrial applicability (IA)	Claims	1-21	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-12, 14, 16, 17, 20 and 21 lack novelty under PCT Article 33(2) as being anticipated by Twitchell et al. (hereinafter 'Twitchell'). As per claim 1, Twitchell discloses an apparatus (10), comprising: a trolley (20) configured to be movably suspended from a track (27), a powered conductor (col. 6, lns. 45-50) operatively coupled to the track (fig. 1), the trolley (20) configured to be electrically coupled to the powered conductor (fig. 1); at least one patient attachment (13) coupled to the trolley (fig. 1), the patient support assembly configured to support a single patient (11); and a control system (19) coupled to at least one of the trolley or the powered conductor (fig. 1; col. 5, lns. 6-12).

As per claim 2, Twitchell discloses the patient attachment (13) includes one of a passive coupling and an active coupling configured to be coupled to a patient harness (12; fig. 1).

As per claim 3, Twitchell discloses the trolley (20) includes a patient support system (12), the patient support system configured to actively support a patient (fig. 1).

As per claim 4, Twitchell discloses the trolley (20) includes a drive assembly (60a) and a torque transfer assembly (61a), the drive assembly and the torque transfer assembly being driven simultaneously (col. 6, lns. 51-67; col. 8, lns. 5-14).

As per claim 5, Twitchell discloses the trolley (20) including a plurality of wheels (56), the wheels disposed above the drive assembly when in an operative configuration (fig. 6).

As per claim 6, Twitchell discloses the trolley (20) including a plurality of wheels (56), the wheels disposed above at least a portion of the track (fig. 6).

As per claim 7, Twitchell discloses the trolley (20) is configured to be powered only from the powered conductor (col. 6, lns. 45-50).

As per claim 8, Twitchell discloses the trolley (20) is configured to be moved from a first position at an end of the track and a second position spaced apart from the end of the track (fig. 1).

As per claim 9, Twitchell discloses a system (10), comprising: a closed loop track (fig. 4); a power conductor (col. 6, lns. 45-50) coupled to the closed loop track (figs. 1, 4; col. 6, lns. 45-50); an actively controlled trolley (20) configured to be movably suspended from the closed loop track (figs. 1, 4) and electrically coupled to the power conductor (col. 6, lns. 45-50); a patient support assembly (12) coupled to the trolley (fig. 1), the patient support assembly (12) configured to dynamically support a body weight of a patient (11; fig. 1).

As per claim 10, Twitchell discloses the closed loop track is one of freestanding or suspended (figs. 1, 4).

As per claim 11, Twitchell discloses the trolley is one trolley from a plurality of trolleys (30, 55), each trolley from the plurality of trolleys being separately controllable (col. 2, lns. 58-64; col. 5, lns. 2-12; col. 8, lns. 36-44).

As per claim 12, Twitchell discloses a control system (19) configured to be in communication with the trolley (fig. 1; col. 5, lns. 6-12).

As per claim 14, Twitchell discloses the trolley (20) is controlled by at least one of a wired or wireless remote control (19).

As per claim 16, Twitchell discloses the trolley (20) includes a wheel assembly (56), the wheel assembly configured to be disposed above at least a portion of the closed loop track (fig. 6).

(Continued In Supplemental Box)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2014/012064

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:
Box No. V

As per claim 17, Twitchell discloses an apparatus (10), comprising: a housing (20); a drive element (60a) disposed at least partially within the housing (fig. 6); a wheel assembly (56) coupled to the drive element (60a) and disposed at least partially within the housing (fig. 6); and a patient support assembly (12) coupled to the housing (fig. 1), the patient support assembly (12) configured to dynamically support a body weight of a patient (11; fig. 1).

As per claim 20, Twitchell discloses at least one of a clutch or a brake associated with the drive element configured to inhibit movement of the drive element (col. 8, ins. 28-32).

As per claim 21, Twitchell discloses a second drive element (75) coupled to the patient support assembly (fig. 1), the second drive element configured to dynamically support the patient (fig. 1; col. 8, lns. 22-28).

Claims 13 and 15 lack an inventive step under PCT Article 33(3) as being obvious over Twitchell et al. (hereinafter 'Twitchell') in view of Hidler.
As per claim 13, Twitchell teaches the patient support assembly (12) is configured to move between a first configuration and a second configuration (fig. 1); but fails to teach in the first configuration, the patient support assembly is supporting a first percentage of the body weight of a patient and in the second configuration the patient support assembly is supporting a second percentage of the body weight of the patient.
However, Hidler teaches a system (10), comprising: in the first configuration, the patient support assembly is supporting a first percentage of the body weight of a patient and in the second configuration the patient support assembly is supporting a second percentage of the body weight of the patient (fig. 5; col. 5, lns. 61-67; col. 6, ln 1-10).
Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the patient support assembly of Twitchell and incorporate the patient support assembly as taught by Hidler, for the purpose of enhancing the versatility of the patient support assembly.

As per claim 15, Twitchell teaches the system, but fails to teach the track has an I-beam configuration in cross section.
However, Hidler teaches a system (10), comprising: the track (40) has an I-beam configuration in cross section (figs. 2-4, 7).
Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the system of Twitchell and incorporate the I-beam configuration as taught by Hidler, for the purpose of enhancing the versatility of the system.

Claims 18 and 19 lack an inventive step under PCT Article 33(3) as being obvious over Twitchell et al. (hereinafter 'Twitchell') in view of Maurer et al. (hereinafter 'Maurer').
As per claim 18, Twitchell teaches the apparatus, but fails to teach a light source coupled to the housing, the light source configured to project a light path on a surface opposite the housing.
However, Maurer teaches an apparatus (36; fig. 2), comprising: a light source (16) coupled to the housing (3; fig. 3), the light source (16) configured to project a light path on a surface (23) opposite the housing (3; fig. 3; col. 4, lns. 63-66; col. 5, lns. 5-17).
Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Twitchell and incorporate the light source as taught by Maurer, for the purpose of enhancing the versatility of the apparatus.

As per claim 19, Twitchell teaches the apparatus, but fails to teach a light source configured to illuminate a target location on a surface opposite the housing.
However, Maurer teaches an apparatus (36; fig. 2), comprising: a light source (16) configured to illuminate a target location (9) on a surface (23) opposite the housing (3; fig. 3; col. 4, lns. 63-66; col. 5, lns. 5-17).
Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the apparatus of Twitchell and incorporate the light source as taught by Maurer, for the purpose of enhancing the versatility of the apparatus.

Claims 1-21 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference BION05102WO	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US16/16131	International filing date *(day/month/year)* 02 February 2016 (02.02.2016)	(Earliest) Priority Date *(day/month/year)* 03 February 2015 (03.02.2015)
Applicant BIONESS INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

   a. the figure of the **drawings** to be published with the abstract is Figure No. 48

   ☒ as suggested by the applicant.

   ☐ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/16131

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61H 3/00 (2016.01)
CPC - A61H 3/008
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) Classification(s): A61H 3/00, 3/04 (2016.01)
CPC Classification(s): A61H 3/008, 3/04, 2201/1652

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data): gait, walking, training, improve, rehabilitation, therapy, feedback, sensor, detect, measure, encoder, harness, tether, cable, leash, calculate, hang, suspended, suspension, trolley, stride, length, height, duration, time, cadence, lateral, range, motion, support, body weight

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014/0201906 A1 (BIONESS INC) July 24, 2014; paragraphs [0087], [0092], [0149], [0151]	1-6, 8-17, 20
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Y		7, 18, 19
Y	US 6,645,126 B1 (MARTIN M. et al.) November 11, 2003; column 4, lines 5-15, claim 2	7, 18
Y	US 2014/0206503 A1 (GORBEL INC) July 24, 2014; paragraphs [0063]-[0065]	19
A	WO 2013/117750 A1 (LUTZ MEDICAL ENGINEERING) August 15, 2013; entire document	1-20
A	US 2007/0004567 A1 (SHETTY D. et al.) January 4, 2007; entire document	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 March 2016 (14.03.2016)	21 APR 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: Erik B. Milch
Cooley LLP
1299 Pennsylvania Ave.
Suite 700
Washington, DC 20004
United States of America

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	21 APR 2016
Applicant's or agent's file reference BION05102WO	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US16/16131	02 February 2016 (02.02.2016)	03 February 2015 (03.02.2015)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - A61H 3/00 (2016.01)
CPC - A61H 3/008

Applicant BIONESS INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	14 March 2016 (14.03.2016)	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/16131

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:
   - [x] the international application in the language in which it was filed.
   - [ ] a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. [ ] This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
   - a. [ ] forming part of the international application as filed:
     - [ ] in the form of an Annex C/ST.25 text file.
     - [ ] on paper or in the form of an image file.
   - b. [ ] furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
   - c. [ ] furnished subsequent to the international filing date for the purposes of international search only:
     - [ ] in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
     - [ ] on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. [ ] In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/16131

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	7, 18, 19	YES
	Claims	1-6, 8-17, 20	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-4, 6, 8-17, and 20 lack novelty under PCT Article 33(2) as being anticipated by US 2014/0201906 A1 (BIONESS).

As to claim 1, Bioness discloses an apparatus, comprising: a drive mechanism (drive system 2300; paragraph [0086]) included in a trolley (included in the trolley 2100; paragraph [0086]), the drive mechanism configured to suspend the trolley from a support track (the drive system 2300 is disposed such that the trolley 2100 can be suspended from the support track 2050; paragraph [0086]), the drive mechanism including a first sensor configured to sense an operating condition of the drive mechanism (encoder 2470 (first sensor) associated with a portion of the drive system 2300 that sends a signal for feedback control based on data (operating condition) of the drive system 2300; paragraphs [0092], [0149]); a patient support mechanism coupled to the trolley (the trolley 2100 includes a patient support mechanism 2500; paragraph [0086]), the patient support mechanism including a tether configured to be operatively coupled to a patient (the support mechanism 2500 can include a tether 2505 for coupling to the patient; paragraph [0122]) such that the patient support mechanism supports at least a portion of a weight of the patient (such that the support mechanism 2500 can support a portion of the body weight of the patient; paragraph [0122]), the patient support mechanism including a second sensor, the second sensor configured to sense an operating condition of the patient support mechanism (encoder 2561 (second sensor) associated with the guide mechanism 2540 (portion) of the support mechanism 2500 that sends a signal for feedback control based on data (operating condition) of the support mechanism 2500; paragraphs [0087], [0092], [0149]); and an electronic system (electronic system 2700; paragraph [0086]), the electronic system including at least a processor and a memory (including a processor and memory; paragraph [0091]); the processor configured to (the processor runs a feedback loop to actively control the trolley; paragraph [0092]) determine a gait characteristic of the patient (to indicate that the patient is walking faster than (gait characteristic) the trolley 2100; paragraph [0149]) based at least in part on a signal received from the first sensor and a signal received from the second sensor (based on information received through the signal (first signal) from the encoder 2470 (first sensor) and the signal (second signal) from encoder 2561 (second sensor); paragraph [0149]).

As to claim 2, Bioness discloses the apparatus of claim 1, and further discloses wherein the drive mechanism is movably disposed about a portion of the support track (drive assembly 2300 disposed about the support track 2050 for movement; paragraphs [0117], [0120]), the operating condition of the drive mechanism being associated with at least one of a position of the drive mechanism along the support track, a velocity of the drive mechanism (encoder 2470 (second sensor) sends signal (second signal) associated with data (operating condition) such as rotational velocity of the drive system 2300; paragraphs [0121], [0149]), or an acceleration of the drive mechanism.

As to claim 3, Bioness discloses the apparatus of claim 1, and further discloses wherein the drive mechanism (2300; paragraph [0086]) includes a set of wheels (wheels 2385; paragraph [0149]) in contact with a portion of the support track (wheels 2385 exert a compressive force on the track 2050; paragraph [0114]) and a motor (motor 2311; paragraph [0149]) operably coupled to the set of wheels (to rotate the wheels 2385; paragraph [0149]), the motor configured to rotate the set of wheels to move the drive mechanism along the support track (motor 2311 controls rotational velocity of the wheels 2385, which contact a surface of support track 2050; paragraphs [0114], [0149]), the operating condition of the drive mechanism being associated with a rotational velocity or a rotational acceleration of the set of wheels the first sensor configured to send to the electronic system a signal associated with the rotational velocity (signal with information (operating condition) of the drive system 2300 such as rotational velocity of the drive wheels 2385; paragraphs [0121], [0149]) or the rotational acceleration of the set of wheels.

As to claim 4, Bioness discloses the apparatus of claim 1, and further discloses wherein the operating condition of the patient support mechanism (signal with information (operating condition) of the guide mechanism 2540 of the support mechanism 2500; paragraphs [0087], [0149]) is associated with at least one of a length of a portion of the tether, an angle of the portion of the tether relative to the support track (signal with information (operating condition) based on the angle of the tether 2505 and the guide mechanism 2540 relative to the base 2210 (and support track); paragraph [0149]), a tension within a position of the tether, or a feed rate of the tether.

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claim 15 is objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because claim 15 is indefinite for the following reason(s):

Claim 15 refers to "the receiving the first signal from the first sensor includes receiving data associated with at least one of the rotational velocity of the set of wheels or the acceleration of the set of wheels". The first signal from the first sensor in claim 14 is associated with the patient support mechanism, however since in claim 15 the claimed signal and sensor are associated with the wheels of the drive mechanism claim 14 and claim 15 are contradictory. For the purpose of this opinion, as best understood, the claim is interpreted to read "the receiving the second signal from the second sensor includes receiving data associated with at least one of the rotational velocity of the set of wheels or the acceleration of the set of wheels".

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/16131

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:

-***-Continued from Box V: Citations and Explanations-***-

As to claim 6, Bioness discloses the apparatus of claim 1, and further discloses wherein the patient support mechanism (support mechanism 2500; paragraph [0122]) includes a cam assembly (cam mechanism 2570; paragraph [0122]), the cam assembly including a third sensor (encoder 2587 (third sensor); paragraph [0149]), the third sensor configured to sense an operating condition of the cam assembly (for sending information (operating condition) associated with the cam mechanism 2570 to the electronic system; paragraph [0149]), the processor configured to (the processor runs a feedback loop to actively control the trolley; paragraph [0092]) define the gait characteristic of the patient (to indicate that the patient is walking faster than (gait characteristic) the trolley 2100; paragraph [0149]) based at least in part on the signal received from the first sensor, the signal received from the second sensor, and a signal received from the third sensor (based on information received through signals (first, second, and third signals) from the encoder 2470 (first sensor), encoder 2561 (second sensor), and encoder 2587 (third sensor); paragraph [0149]).

As to claim 8, Bioness discloses a method, comprising: receiving a signal associated with a first operating condition of at least one of a drive mechanism or a patient support mechanism (encoder 2470 associated with a portion of the drive system 2300 sends a signal based on previous data (first operating condition) of the drive system 2300 (drive mechanism) and encoder 2561 of the guide mechanism 2540 of the support mechanism 2500 (patient support mechanism) sends a signal (first signal) based on previous data (first operating condition) which is received by the system 2700; paragraph [0149]), the patient support mechanism (2500; paragraph [0086]) coupled to an active trolley (coupled to trolley 2100; paragraph [0086]) and configured to support a patient (for supporting a patient; paragraph [0086]), the drive mechanism coupled to the active trolley (drive 2300 included in trolley 2100; paragraph [0086]) and configured to move the trolley along a support track in response to a movement of the patient (moves along support track 2050 in response to movement of the patient; paragraph [0149]); receiving a signal associated with a second operating condition of the at least one of the drive mechanism or the patient support mechanism (encoder 2470 associated with a portion of the drive system 2300 sends a signal based on current data (second operating condition) of the drive system 2300 and encoder 2561 of the guide mechanism 2540 of the support mechanism 2500 sends a signal based on current data (second operating condition) of the guide mechanism 2540 which is received by the system 2700; paragraphs [0092], [0149]); determining a difference between the first operating condition and the second operating condition (a change in the current state (between first and second operating condition) of the drive system 2300 via encoder 2470 and of the patient support mechanism 2500 via encoder 2561; paragraphs [0149], [0151]); and defining, based at least in part on the determining, a gait characteristic of the patient (the information from the encoders 2470 and 2561 indicate that the patient is walking faster than (gait characteristic) the trolley 2100; paragraph [0149]) supported by the patient support mechanism (the patient being supported by the patient support mechanism 2500; paragraph [0086]).

As to claim 9, Bioness discloses the method of claim 8, and further discloses wherein the first operating condition is a first operating condition of the patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism (encoder 2561 of the guide mechanism 2540 of the support mechanism 2500 sends signals based on previous data (first operating condition) and current data (second operating condition); paragraph [0149]), the method further comprising: receiving a first operating condition associated with the drive mechanism (encoder 2470 associated with a portion of the drive system 2300 sends a signal for feedback control based on previous data (first operating condition) of the drive system 2300 is received by the system 2700; paragraphs [0092], [0149]); receiving a second operating condition associated with the drive mechanism (encoder 2470 associated with a portion of the drive system 2300 sends a signal for feedback control based on current data (second operating condition) of the drive system 2300 is received by the system 2700; paragraphs [0092], [0149]); and determining a difference between the first operating condition of the drive mechanism and a second operating condition of the drive mechanism (a change in the current state (between first and second operating condition) of the drive system 2300 via encoder 2470; paragraphs [0149], [0151]), the defining of the gait characteristic includes defining the gait characteristic (the information from the encoder 2561 indicates that the patient is walking faster than (gait characteristic) the trolley 2100; paragraph [0149]) based at least in part of the difference between the first operating condition of the patient support mechanism and the second operating condition of the patient support mechanism (a change in the current state (between first and second operating condition) of the patient support mechanism 2500 via encoder 2561; paragraphs [0149], [0151]) and the difference between the first operating condition of the drive mechanism and the second operating condition of the drive mechanism (a change in the current state (between first and second operating condition) of the drive system 2300 via encoder 2470; paragraphs [0149], [0151]).

As to claim 10, Bioness discloses the method of claim 8, and further discloses wherein the at least one of the drive mechanism or the patient support mechanism (the guide mechanism 2540 of the patient support mechanism 2500; paragraph [0087]) is in the first operating condition when the patient is in a first position relative to the support track (encoder 2561 sends a signal (first operating condition) associated with the angle (first position) of the tether 2505 and the guide mechanism 2540 relative to the base 2210 (and support track); paragraph [0149]), the at least one of the drive mechanism or the patient support mechanism is in the second operating condition when the patient moves to a second position relative to the support track, different from the first position (determines a change in the current state (between first and second operating condition) of the patient support mechanism 2500 via encoder 2561; paragraphs [0149], [0151]).

As to claim 11, Bioness discloses the method of claim 8, and further discloses the first operating condition is a first operating condition of the patient support mechanism and the second operating condition is a second operating condition of the patient support mechanism (encoder 2561 of the guide mechanism 2540 of the support mechanism 2500 sends signals for feedback control based on previous data (first operating condition) and current data (second operating condition); paragraphs [0092], [0149]), the receiving the signal associated with the first operating condition includes receiving the signal from a sensor included in the patient support mechanism (previous data (first operating condition) signal from encoder 2561 (sensor) of the guide mechanism of the support mechanism 2500 is received by the system 2700; paragraph [0149]), the receiving the signal associated with the second operating condition includes receiving the signal from the sensor included in the patient support mechanism (current data (second operating condition) signal from encoder 2561 (sensor) of the guide mechanism of the support mechanism 2500 is received by the system 2700; paragraph [0149]).

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/16131

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:

-***-Continued from Previous Supplemental Box-***-

As to claim 12, Bioness discloses the method of claim 8, and further discloses the first operating condition is a first operating condition of the drive mechanism and the second operating condition is a second operating condition of the drive mechanism (encoder 2470 associated with a portion of the drive system 2300 sends signals based on previous (first operating condition) and current (second operating condition) data of the drive system 2300; paragraphs [0092], [0149]); the receiving the signal associated with the first operating condition includes receiving the signal from a sensor (previous data (first operating condition) signal from encoder 2470 (sensor) of the drive system 2300 is received by the system 2700; paragraph [0149]); the receiving the signal associated with the second operating condition includes receiving the signal from the sensor included in the drive mechanism (current data (second operating condition) signal from encoder 2470 (sensor) of the drive system 2300; paragraph [0149]).

As to claim 13, Bioness discloses the method of claim 8, and further discloses further comprising: sending a signal to an output device (sending a signal the motor 2311 (output device); paragraph [0149]), the signal indicative of an instruction to output data (to increase (instruction) rotational velocity (output data) of the drive wheels 2385; paragraph [0149]) associated with the gait characteristic via the output device (sent to the motor 2311 (output device) to actively control in response to a change in the current state of the relative to the position of the patient, for example of the patient is walking faster than (gait characteristic) the trolley 2100; paragraphs [0149], [0151]).

As to claim 14, Bioness discloses a method, comprising: receiving a first signal from a first sensor, the first signal being associated with an operating condition of a patient support mechanism (encoder 2561 (first sensor) associated with the guide mechanism 2540 of the support mechanism 2500 that sends a signal (first signal) based on data (operating condition) of the support mechanism 2500 which is received by the system 2700; paragraphs [0087], [0092], [0149]) included in a patient support system (2000; paragraph [0085]), the patient support mechanism including a tether (patient support mechanism 2500 includes a tether 2505; paragraph [0122]) configured to tether a patient to the patient support mechanism (the tether 2505 for supporting the body weight of a patient; paragraph [0122]), the patient support system supporting at least a portion of a weight of the patient when the patient is tethered to the patient support mechanism (the tether 2505 of the support mechanism 2500 actively supports at least a portion of the body weight of a patient; paragraph [0122]); receiving a second signal from a second sensor, the second signal being associated with an operating condition of a drive mechanism (encoder 2470 (second sensor) associated with the drive system 2300 that sends a signal (second signal) based on data (second operating condition) of the drive system 2300; paragraphs [0092], [0149]) included in the patient support system (2000; paragraph [0085]), the drive mechanism configured to suspend the patient support system from a support track (the drive system 2300 is disposed such that the trolley 2100 of the support system 2000 can be suspended from the support track 2050; paragraph [0086]) and move along the support track in response to a movement of the patient (moves along support track 2050 in response to movement of the patient; paragraph [0149]); determining at least one gait characteristic associated with the movement of the patient based at least in part on the operating condition of the patient support mechanism and the operating condition of the drive mechanism (the data (operating condition) from the encoder 2561 (first sensor) associated with the support mechanism 2500 and data (operating condition) from encoder 2470 (second sensor) associated with the drive system 2300 is used to determine if the patient is walking faster than (gait characteristic) the trolley 2100; paragraph [0149]); and sending, to an output device, a third signal (in response, the electronic system 2700 sends a signal (third signal) to the motor 2511 (output device) of the winch assembly 2510; paragraph [0151]), the third signal indicative of an instruction to output data associated with the at least one gait characteristic via the output device (to change (instruction) the current state (output data) of the drive system 2300 and patient support mechanism 2500 to actively control the over head position of the trolley 2100 relative to the patient for example of the patient is walking faster than (gait characteristic) the trolley 2100; paragraphs [0149]-[0151]).

As to claim 15, Bioness discloses the method of claim 14, and further discloses wherein drive mechanism includes a set of wheels (drive mechanism 2300 includes drive wheels 2385; paragraph [0111]) in contact with a portion of the support track (via exerting a compressive force on a surface of the horizontal portion 2051 of the support track 2050; paragraph [0114]) and a motor operably coupled to the set of wheels (motor 2311 controls the rotational velocity of drive wheels 2385; paragraph [0149]), the motor configured to rotate the set of wheels to move the drive mechanism along the support track (motor 2311 increases the rotational velocity of the drive wheels 2385, which rotates along the track 2050; paragraphs [0114], [0149]), the operating condition of the drive mechanism being associated with a rotational velocity or a rotational acceleration of the set of wheels (the data (operating condition) from encoder 2470 (second sensor) associated with the drive system 2300 includes rotational velocity information operative to change the rotational velocity of the drive wheels 2385; paragraphs [0121], [0149]), the receiving the first signal from the first sensor includes receiving data associated with at least one of the rotational velocity of the set of wheels or the acceleration of the set of wheels (the signal (second signal) sends data (operating condition) from encoder 2470 (second sensor) associated with the drive system 2300 which includes rotational velocity information operative to change the rotational velocity of the drive wheels 2385 is received by the system 2700; paragraphs [0121], [0149]).

As to claim 16, Bioness discloses the method of claim 14, and further discloses wherein the operating condition of the patient support mechanism is associated with at least one of a length of a portion of the tether, an angle of the portion of the tether relative to the support track (encoder 2561 (first sensor) sends a signal (first signal) associated with the angle of the tether 2505 and guide mechanism 2540 relative to the base 2210 (and support track); paragraphs [0149]), a tension within a portion of the tether, or a feed rate of the tether.

As to claim 17, Bioness discloses the method of claim 14, and further discloses wherein the movement of the patient is associated with the patient walking (the patient walking; paragraph [0149]), the drive mechanism configured to move along the support track in response to the patient walking (the trolley 2100 and drive system 2300 move along support track 2050 in response to movement of the patient; paragraphs [0149], [0152]).

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/16131

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:

-***-Continued from Previous Supplemental Box-***-

As to claim 20, Bioness discloses the method of claim 14, and further discloses wherein the operating condition of the patient support mechanism is a first operating condition (encoder 2561 (first sensor) signal (first signal) based on data (first operating condition) of the support mechanism 2500; paragraph [0149]), and the operating condition of the drive mechanism is a first operating condition (encoder 2470 (second sensor) signal (second signal) based on data (first operating condition) of the drive system 2300; paragraph [0149]), the method further comprising: defining, based at least in part on the determining of the at least one gait characteristic (indicating the patient is leading or trailing the trolley; paragraph [0149]), a second operating condition associated with the patient support mechanism (the tether 2505 angle associated with the desired leading/trailing amount of the patient; paragraph [0149]) and a second operating condition associated with the drive mechanism (the rotational velocity of the wheels 2385 which control the position of the trolley 2100 relative to the patient to provide the desired trailing/leading amount; paragraph [0149]); sending, to the patient support mechanism, a fourth signal, the fourth signal indicative of an instruction to place the patient support mechanism in its second operating condition (the user defines the amount that they want to trail/lead the trolley 2100, and the electronic system 2700 sends a signal (fourth signal) to the winch 2510 to change the current state of the patient support mechanism 2500; paragraphs [0149], [0151]) and sending, to the drive mechanism, a fifth signal, the fifth signal indicative of an instruction to place the drive mechanism in its second operating condition (in response, the electronic system 2700 sends a signal (fifth signal) to the motor 2311 to increase (instruction) the rotational velocity (to second operating condition) of the drive wheels 2385; paragraph [0149]).

In an alternative interpretation, claims 1 and 5 lack novelty under PCT Article 33(2) as being anticipated by Bioness.

As to claim 1, Bioness discloses an apparatus, comprising: a drive mechanism (drive system 2300; paragraph [0086]) included in a trolley (included in the trolley 2100; paragraph [0086]), the drive mechanism configured to suspend the trolley from a support track (the drive system 2300 is disposed such that the trolley 2100 can be suspended from the support track; paragraph [0086]), the drive mechanism including a first sensor configured to sense an operating condition of the drive mechanism (encoder 2470 (first sensor) associated with a portion of the drive system 2300 that sends a signal for feedback control based on current or previous data (operating condition) of the drive system 2300; paragraphs [0092], [0149]); a patient support mechanism coupled to the trolley (the trolley 2100 includes a patient support mechanism 2500; paragraph [0086]), the patient support mechanism including a tether configured to be operatively coupled to a patient (the support mechanism 2500 can include a tether for coupling to the patient; paragraph [0122]) such that the patient support mechanism supports at least a portion of a weight of the patient (such that the support mechanism 2500 can support a portion of the body weight of the patient; paragraph [0122]), the patient support mechanism including a second sensor, the second sensor configured to sense an operating condition of the patient support mechanism (encoder 2587 (second sensor) associated with the cam assembly 2570 (portion) of the support mechanism 2500 that sends a signal for feedback control based on current or previous data (operating condition) of the support mechanism 2500; paragraphs [0087], [0092], [0149]); and an electronic system (electronic system 2700; paragraph [0086]), the electronic system including at least a processor and a memory (including a processor and memory; paragraph [0091]); the processor configured to (the processor runs a feedback loop to actively control the trolley; paragraph [0092]) determine a gait characteristic of the patient (to indicate that the patient is walking faster than (gait characteristic) the trolley 2100; paragraph [0149]) based at least in part on a signal received from the first sensor and a signal received from the second sensor (based on information received through a signal from the encoder 2470 (first sensor) and encoder 2587 (second sensor); paragraph [0149]).

As to claim 5, in the alternative interpretation, Bioness discloses the apparatus of claim 1, and further discloses wherein the patient support mechanism (support mechanism 2500; paragraph [0122]) includes a cam assembly (cam mechanism 2570; paragraph [0122]), the operating condition of the patient support mechanism is an operating condition of the cam assembly (based on signal with information (operating condition) from the encoder 2587 (second sensor) of the cam assembly 2570, which is part of the patient support mechanism 2500; paragraphs [0122], [0149]), the second sensor configured to send, to the electronic system, a signal associated with the operating condition of the cam assembly (encoder 2587 (second sensor) sends signals to the electronic system 2700 with information (operating condition) of the cam assembly 2570; paragraph [0149]).

Claims 7 and 18 lack an inventive step under PCT Article 33(3) as being obvious over Bioness in view of US 6,645,126 B1 (MARTIN).

As to claims 7 and 18, Bioness discloses the apparatus of claim 1 and the method of claim 14. However, Bioness does not disclose wherein the gait characteristic of the patient is at least one of a step duration, a swing to stance duration, a swing to stance ratio, a cadence, a stride length, a stride height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction. Martin discloses wherein the gait characteristic of the patient is at least one of a step duration, a swing to stance duration, a swing to stance ratio, a cadence (sensed gait parameters can be used to evaluate cadence; claim 2), a stride length (stride length; claim 2), a stride height, a range of motion in an anterior and posterior direction, a range of motion in a lateral direction, and ratio between the range of motion in the anterior and posterior direction and the range of motion in the lateral direction. In order to provide feedback for gait therapy/training to the patient (Bioness, paragraphs [0076], [0153]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bioness' method of feedback to include Martin's feedback in the form of evaluation of gait characteristics such as cadence and gait patterns because, as Martin discloses, the gait training device evaluates the patient's stride length, cadence, gait velocity, and gait pattern and provides a quantified documentation to help patients (Martin, column 4, lines 5-15); furthermore, one of ordinary skill in the art would recognize that Bioness' plurality of sensors and encoders associated with the tether and drive system coupled with the processor would be configured to determine gait characteristics such as cadence, lateral motion, stride direction, or stride length.

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/16131

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:

-***-Continued from Previous Supplemental Box-***-

Claim 19 lacks an inventive step under PCT Article 33(3) as being obvious over Bioness in view of US 2014/0206503 A1 (GORBEL).

As to claim 19, Bioness discloses the method of claim 14. However, Bioness does not disclose wherein the output device includes a display, the sending the third signal includes sending the third signal to cause at least one of a graphical representation, a numeric representation, or an alpha-numeric representation of data associated with the gait characteristic to be presented on the display of the output device. Gorbel discloses wherein the output device includes a display (display; paragraphs [0063], [0064]), the sending the third signal includes sending the third signal to cause at least one of a graphical representation, a numeric representation, or an alpha-numeric representation of data associated with the gait characteristic to be presented on the display of the output device (for display of user performance (data associated with gait characteristic) metrics (numeric representation); paragraphs [0063], [0065]). In order to provide visual feedback for gait therapy/training to the patient (Bioness, paragraphs [0076], [0153]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bioness' visual feedback to include Gorbel's numeric representation of the user's performance information through the display because, as Gorbel discloses, the user interface facilitates the display of information relating to performance metrics and biometric information collected for the patient (Gorbel, paragraph [0063]).

Claims 1-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference BION05401WO	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US16/61552	International filing date *(day/month/year)* 11 November 2016 (11.11.2016)	(Earliest) Priority Date *(day/month/year)* 11 November 2015 (11.11.2015)
Applicant BIONESS INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

   b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

   c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

   ☒ the text is approved as submitted by the applicant.

   ☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. V. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

   a. the figure of the **drawings** to be published with the abstract is Figure No. 1

   ☒ as suggested by the applicant.

   ☐ as selected by this Authority, because the applicant failed to suggest a figure.

   ☐ as selected by this Authority, because this figure better characterizes the invention.

   b. ☐ none of the figures is to be published with the abstract.

Aretech LLC - Exhibit 1004, Page 00814

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US16/61552

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61G 7/10; A61H 1/00, 1/02, 3/00; B61J 1/06 (2017.01)
CPC - A61G 7/1042; A61H 1/0262, 3/008; B61J 1/06; B65G 9/008
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) Classifications: A61G 7/053, 7/10, 7/14; A61H 1/00, 1/02, 3/00; A63B 23/04; B61J 1/00, 1/02, 1/04, 1/06; B65G 9/00 (2016.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC Classifications: A61G 7/053, 7/10, 7/1042; A61H 1/02, 1/0237, 1/0262, 3/00, 3/008; A63B 23/04; B61J 1/00, 1/02, 1/04, 1/06; B65G 9/00, 9/008

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); patient, body weight, lift, support, transport, rail, track, trolley, suspend, overhead, ceiling, switch, change, select, different, modify, path, track, turntable, shift, translate, slide, rotate, electric, current, power, conduct, collector, contact

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 2015/0283921 A1 (JOY MM DELAWARE, INC) October 8, 2015; figures 3A, 3B, 10A-10D; paragraphs [0035]-[0037], [0042]	1-7 — 8-13, 16-20
Y	CN 104308861 A (JIANG K. et al.) January 28, 2015; abstract; figures 1, 2; paragraph [0058]	8-13, 16-20
A	US 6,315,138 B1 (DYSON D. J.) November 13, 2001; entire document	1-20
A	US 2,360,505 A (MEDENWALD A. L. et al.) October 17, 1944; entire document	1-20
A	US 2,211,220 A (VERPLANCK P.) August 13, 1940; entire document	1-20
A	US 764,781 A (SUMNER W. J.) July 12, 1904; entire document	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 January 2017 (08.01.2017)	31 JAN 2017

Name and mailing address of the ISA/US	Authorized officer
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: Erik B. Milch
Cooley LLP
1299 Pennsylvania Ave.
Suite 700
Washington, DC 20004
United States of America

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 31 JAN 2017

Applicant's or agent's file reference
BION05401WO

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US16/61552	11 November 2016 (11.11.2016)	11 November 2015 (11.11.2015)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - A61G 7/10; A61H 1/00, 1/02, 3/00; B61J 1/06 (2017.01)
CPC - A61G 7/1042; A61H 1/0262, 3/008; B61J 1/06; B65G 9/008

Applicant BIONESS INC.

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [x] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1 *bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	08 January 2017 (08.01.2017)	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/61552

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a. ☐ forming part of the international application as filed:

☐ in the form of an Annex C/ST.25 text file.

☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/61552

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	8-20	YES
	Claims	1-7	NO
Inventive step (IS)	Claims	14, 15	YES
	Claims	1-13, 16-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-7 lack novelty under PCT Article 33(2) as being anticipated by US 2015/0283921 A1 (JOY).

As to claim 1, Joy discloses a body weight support system, comprising: a support track (rails 3 on the primary tracks 210 and auxiliary track 220; figures 3A, 10A) configured to movably suspend a trolley therefrom (guide wheels 11 of trolley 10 run along rail segments 3 (support track); figure 3A; paragraph [0027]), the trolley configured to support at least a portion of a body weight of a patient (trolley 10 is capable of supporting a portion of a patient's body weight); a power rail (conductors 2; figure 3A; paragraph [0027]) coupled to the support track (as shown; figure 3A), at least a portion of the power rail in electrical contact with the trolley (conductors 2 are in electrical communication with a power source; and are connected to trolley 10 via commutators 15; figures 3A, 3B: paragraph [0033]; claim 1); and a switch (switch device 30; figure 4) having a support track portion and a power rail portion (switch device 230 is shown to have the identical rails 3 (support track portion) and conductors 2 (power rail portion) as is shown in figure 3A; figure 10A), the switch configured to transition between a first configuration (when switch device 230 is in the position shown in figure 10B, where the overall track is straight), in which a first portion of the support track (rail 3 of the lower primary track 210; figure 10B) and the support track portion of the switch (rail 3 of switch segment A of switch device 230; figure 10B) define a first path (defining a straight path as shown; figure 10B) and a second configuration (when switching device 230 is in the position shown in figure 10C, where the overall track is curved), in which a second portion of the support track (rail 3 of the auxiliary track 220; figure 10C) and the support track portion of the switch (rail 3 of switch segment B of switch device 230; figure 10D) define a second path (defining a curved path as shown; figure 10D), the trolley configured to receive a flow of electric power from at least one of the power rail (trolley 10 is in electrical communication to receive current from the conductors 2 (power rail); claim 1) or the power rail portion of the switch (trolley 10 is in electrical communication to receive current from the conductors 2 (power rail portion) on the switch device 230; figures 10A-10D; claims 1, 3) operable to move the trolley along the first path when the switch is in the first configuration (trolley 10 moves along the track sections when in the position of figure 10B defining the straight path; paragraph [0042]) and along the second path when the switch is in the second configuration (trolley 10 moves along the track sections when in the position of figure 10C defining the curved path; paragraph [0042]).

As to claim 2, Joy discloses the body weight support system of claim 1, and further discloses wherein the first portion of the support track (rail 3 of lower primary track 210; figure 10A) is discontinuous from (not continuous with as shown; figure 10A) the second portion of the support track (rail 3 of auxiliary track 220; figure 10A).

As to claim 3, Joy discloses the body weight support system of claim 1, and further discloses wherein transitioning the switch from the first configuration to the second configuration includes moving the switch in a translational motion from a first position to a second position (in moving switching device 230 from the position of figure 10C (first configuration) to the position of figure 10C (second configuration), switch segment A is translated to the left, and switch segment B is translated diagonally downward and to the left; figures 10B, 10C).

As to claim 4, Joy discloses the body weight support system of claim 1, and further discloses wherein transitioning the switch from the first configuration to the second configuration includes moving the switch in a rotational motion from a first position to a second position (in a compatible embodiment, the switching device is a turntable 50 that rotates from the position of figure 8 defining a straight path to the position of figure 6 defining a curved path; figures 6-9; paragraphs [0036], [0037]).

As to claim 5, Joy discloses the body weight support system of claim 1, and further discloses wherein the switch is configured to transition between the first configuration and the second configuration while the trolley is movably suspended from the support track (the shifting from the position of figure 10B to the position of figure 10C of the switch segments A, B, and C of the switching device are controlled by an electronic controller, i.e., configured to shift while the trolley 10 is moving along the rails 3 of tracks 210 or 220 since controller is independent of trolley; paragraph [0035]).

As to claim 6, Joy discloses the body weight support system of claim 1, and further discloses wherein the switch is configured to transition between the first configuration and the second configuration while the trolley is movably suspended from the support track portion of the switch (the shifting from the position of figure 10B to the position of figure 10C of the switch segments A, B, and C of the switching device are controlled by an electronic controller, i.e., configured to shift while the trolley 10 is moving along the rails 3 of switch segments A, B, or C since controller is independent of trolley; paragraph [0035]).

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/61552

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

Claim 17 is objected to under PCT Rule 66.2(a)(iii) as containing the following defect in the form or contents thereof: the phrase "includes first electrical collector" is interpreted as being a grammatical error, and for the purposes of this opinion, will be interpreted as the phrase "includes a first electrical collector".

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/61552

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
Continuation of:

-***-Continued from Box V: Citations and Explanations-***-

As to claim 7, Joy discloses the body weight support system of claim 1, and further discloses wherein the trolley (10; figures 3A, 3B) includes a first electrical collector and a second electrical collector (includes multiple commutators 15; figure 3B; paragraph [0032]), at leas one of the first electrical collector or the second electrical collector being maintained in electrical contact with at least one of the power rail (the commutators 15 connect to grid conductors 2; figure 3B; paragraph [0033]) or the power rail portion of the switch.

Claims 8-13 and 16-20 lack an inventive step under PCT Article 33(3) as being obvious over Joy in view of CN 104308861 A (JIANG).

As to claim 8, Joy discloses a body weight support system, comprising: a support track (rails 3 on the primary tracks 210 and auxiliary track 220; figures 3A, 10A) having a first track portion (rails 3 of the lower primary track 210) and a second track portion (rails 3 of auxiliary track 220; figure 10A) discontinuous from the first track portion (not continuous as shown; figure 10A), a power rail (conductors 2 on the lower primary track 210 and auxiliary track 220; figures 3A, 10A) having a first power rail portion (conductors 2 of primary track 210) and a second power rail portion (conductors 2 of auxiliary track 220) discontinuous from the first power rail portion (not continuous as shown; figure 10A), the first power rail portion coupled to the first track portion, the second power rail portion coupled to the second track portion (the rails 3 and the conductors 2 are connected on each of the lower primary track 210 and auxiliary track 220; figures 3A, 10A); a switch (switching device 230; figure 10A) having a support track portion (rails 3 on switch segments A, B, and C of switching device 230) and a power rail portion (conductors 2 on switch segments A, B, and C of switching device 230), the switch configured to transition between a first configuration (position of figure 10B), in which the support track portion of the switch is aligned with the first track portion and the power rail portion of the switch is aligned with the first power rail portion (in the position of figure 10B, the rails 3 and conductors 2 on the lower primary track 210 are aligned with the rails 3 and conductors 2 on the switch segments of switching device 230; figure 10B), and a second configuration (position of figure 10C), in which the support track portion of the switch is aligned with the second track portion and the power rail portion of the switch is aligned with the second power rail portion (in the position of figure 10C, the rails 3 and conductors 2 on the auxiliary track 220 are aligned with the rails 3 and conductors 2 on the switch segments of switching device 230; figure 10C); and a trolley (10; figures 3A, 3B) configured to support at least a portion of a body weight of a patient (capable of supporting a portion of a patient's body weight), the trolley configured to be moved from a first position to a second position while the switch is in the first configuration (when the switching device 230 is in the position of figure 10B, the trolley 10 would be capable of traveling between the lower primary track 210 (first position) to the switch segment A of the switch device 230 (second position); figure 10B), the trolley being movably suspended from the first track portion (guide wheels 11 of trolley 10 run along rail segments 3, including rail segments 3 of the lower primary track 210 (first track portion); figures 3A, 10A; paragraph [0027]) and in electrical contact with the first power rail portion (trolley 10 is in electrical communication to receive current from the conductors 2, including conductors 2 of the lower primary track 210 (first power rail portion); figure 10A; claim 1) when in the first position (when trolley 10 is located at the lower primary segment 210; figure 10B), the trolley being movably suspended from the support track portion of the switch (guide wheels 11 of trolley 10 run along rail segments 3, including rail segments 3 of the switch segments of switch device 230 (support track portion of switch); figures 3A, 10A; paragraph [0027]) and in electrical contact with the power rail portion of the switch (trolley 10 is in electrical communication to receive current from the conductors 2, including conductors 2 of the switch segments of switch device 230 (power rail portion of switch); figure 10A; claim 1) when in the second position (when trolley 10 is located at the switch segment A of switch device 230; figure 10B), the trolley configured to be moved to a third position (when the trolley 10 is located along auxiliary track 220; figure 10C), the trolley being movably suspended from the second track portion (guide wheels 11 of trolley 10 run along rail segments 3, including rail segments 3 of the auxiliary track 220 (second track portion); figures 3A, 10A; paragraph [0027]) and in electrical contact with the second power rail portion (trolley 10 is in electrical communication to receive current from the conductors 2, including conductors 2 of the auxiliary track 220 (second power rail portion); figure 10A; claim 1) when in the third position (when trolley 10 is located at the auxiliary segment 220; figure 10C). However, Joy does not disclose the trolley configured to be moved from the second position to a third position after the switch is transitioned from the firs configuration to the second configuration. Jiang discloses the robot (rail mounted walking robot; abstract) configured to be moved from the second position (when positioned on platform 5; figures 1, 2) to a third position (when positioned on track 3) after the switch (5) is transitioned from the first configuration to the second configuration (platform 5 would be capable of rotating into alignment with track 3 (second configuration) from the position where platform is aligned with tracks 1 and 4 (first configuration) while the robot is located on platform 5, because the robot brakes and stops on the platform 5 during path conversion operation; figures 1, 2; paragraph [0058]). In order to provide a switching device in the form of a turntable for switching tracks (Joy, paragraph [0036]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Joy's support system switching device to include Jiang's rotatable switch plate such that the trolley would be configured to switch from the first configuration to the second configuration to move the trolley from the second position to the third position after switching because, as Jiang discloses, the rail mounted walking robot direction changing platform can be rotated between a plurality of paths such that multi-direction selection is realized due to the robot braking and stopping on the switching platform during path conversion operation (Jiang, abstract; paragraph [0058]).

As to claim 9, Joy and Jiang, in combination, disclose the body weight support system of claim 8. Joy further discloses wherein the trolley (10; figures 3A, 3B) includes a first electrical collector and a second electrical collector (includes multiple commutators 15; figure 3B; paragraph [0032]), at least one of the first electrical collector or the second electrical collector is in electrical contact with at least one of the first power rail portion, the second power rail portion, or the power rail portion of the switch (the commutators 15 connect to the grid conductors 2, including grid conductors 2 of the lower primary track 210 (first power rail portion), the auxiliary track 220 (second power rail portion), and segments of the switching device 230 (power rail portion of the switch); figures 3B, 10A; paragraph [0033]) as the trolley is moved between the first position, the second position, and the third position (when trolley 10 is located along lower primary track 210 (first position), segments of the switching device 230 (second position), and auxiliary track 220 (third position); figures 10A-10C).

As to claim 10, Joy and Jiang, in combination, disclose the body weight support system of claim 8. Joy further discloses wherein the switch is in a first switch position relative to the support track when in the first configuration (position of switching device 230 relative to tracks 210 and 220 in the position shown in figure 10B) and is in a second switch position relative to the support track when in the second configuration (position of switching device 230 relative to tracks 210 and 220 in the position shown in figure 10C).

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/61552

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

-***-Continued from Previous Supplemental Box-***-

As to claim 11, Joy and Jiang, in combination, disclose the body weight support system of claim 10. Joy further discloses wherein the first switch position is a first translational position and the second switch position is a second translational position (when switching device 230 moves between the position of figure 10B and 10C, the segments A and B of the switching device 230 are shown to translate along arrows; figures 10B, 10C).

As to claim 12, Joy and Jiang, in combination, disclose the body weight support system of claim 10. Joy further discloses wherein the first switch position is a first rotational position and the second switch position is a second rotational position (in a compatible embodiment, the switching device is a turntable 50 that rotates from the position of figure 8 defining a straight path to the position of figure 6 defining a curved path; figures 6-9; paragraphs [0036], [0037]).

As to claim 13, Joy and Jiang, in combination, disclose the body weight support system of claim 8. Joy further discloses wherein the support track includes a third track portion (upper primary track 210; figure 10A) discontinuous from the first track portion and the second track portion (discontinuous from lower primary track 210 (first track portion) and auxiliary track 220 (second track portion) as shown; figure 10A), the power rail (conductors 2 of tracks 210 and 220) includes a third power rail portion (conductors 2 of upper primary track 210) coupled to the third track portion (as shown), the trolley configured to be moved to a fourth position (when trolley 10 is moving along upper primary track 210; figure 10A), the trolley being movably suspended from the third track portion (guide wheels 11 of trolley 10 run along rail segments 3, including rail segments 3 of the upper primary track 210 (third track portion); figures 3A, 10A; paragraph [0027]) and in electrical contact with the third power rail portion (trolley 10 is in electrical communication to receive current from the conductors 2, including conductors 2 of the upper primary track 210 (third power rail portion); figure 10A; claim 1) when in the fourth position (when trolley 10 is moving along upper primary track 210). Joy does not disclose the switch has a third configuration, in which the support track portion of the switch is aligned with the third track portion and the power rail portion of the switch is aligned with the third power rail portion, the trolley configured to be moved from the second position to a fourth position after the switch is placed in the third configuration. Jiang discloses the switch (switching platform 5; figures 1, 2) has a third configuration (when switching platform 5 is aligned with track 2 as shown; figure 2), in which the support track portion of the switch is aligned with the third track portion (as shown, the tracks on switch platform 5 (support track portion of switch) are aligned with the track 2 (third track portion); figure 2), the trolley configured to be moved from the second position to a fourth position after the switch is placed in the third configuration (the walking robot would be configured to move from being located on the switching platform 5, i.e., the second position, to being located on the track 2, i.e., the fourth position, after switching platform 5 is aligned with the track 2, i.e., third configuration, because the robot brakes and stops on the platform 5 during path conversion operation; figures 1, 2; paragraph [0058]). In order to provide a switching device in the form of a turntable for switching tracks (Joy, paragraph [0036]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Joy's support system switching device to include Jiang's rotatable switch plate's third configuration such that the trolley would be configured to from the second to fourth position when in the third configuration which would align the respective support track portion and power rail portion of the switch with the third track portion and third power rail portion because, as Jiang discloses, the rail mounted walking robot direction changing platform can be rotated between a plurality of paths such that multi-direction selection is realized due to the robot braking and stopping on the switching platform during path conversion operation (Jiang, abstract; paragraph [0058]).

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/61552

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

-***-Continued from Previous Supplemental Box-***-

As to claim 16, Joy discloses a method, comprising: moving, from a first position to a second position, a trolley (trolley 10 rolls along rails 3 from the upper primary track 210 (first position) onto the segment A of the switching device 230 (second position); figures 3A, 10B; paragraph [0027]) configured to support at least a portion of a body weight of a patient (trolley 10 is capable of supporting a patient's body weight), the trolley being movably suspended from a first support track portion (guide wheels 11 of trolley 10 run along rail segments 3, including rail segments 3 of the upper primary track 210 (first track portion); figures 3A, 10A; paragraph [0027]) and being in electrical contact with a first power rail portion (trolley 10 is in electrical communication to receive current from the conductors 2, including conductors 2 of the upper primary track 210 (first power rail portion); figure 10A; claim 1) when in the first position (when trolley 10 is located at the upper primary segment 210; figure 10B), the trolley being movably suspended from a support track portion of a switch (guide wheels 11 of trolley 10 run along rail segments 3, including rail segments 3 of the switch segments of switch device 230 (support track portion of switch); figures 3A, 10A; paragraph [0027]) and being in electrical contact with a power rail portion of the switch (trolley 10 is in electrical communication to receive current from the conductors 2, including conductors 2 of the switch segments of switch device 230 (power rail portion of switch); figure 10A; claim 1) when in the second position (when trolley 10 is located at the switch segment A of switch device 230; figure 10B), transitioning the switch from a first configuration to a second configuration (switching device 230 is shown to shift from the position of figure 10B (first configuration) to the position of figure 10C (second configuration)), the support track portion and the power rail portion of the switch being aligned with the first support track portion and the first power rail portion, respectively, when the switch is in the first configuration (in the position of figure 10B, the rails 3 and conductors 2 on the upper primary track 210 are aligned with the rails 3 and conductors 2 on the switch segments of switching device 230; figure 10B), the support track portion of the switch being aligned with a second support track portion discontinuous from the first support track portion and the power rail portion of the switch being aligned with a second power rail portion discontinuous from the first power rail portion when the switch is in the second configuration (in the position of figure 10C, the rails 3 and conductors 2 on the auxiliary track 220 are aligned with the rails 3 and conductors 2 on the switch segments of switching device 230 and are discontinuous with the rails 3 and conductors 2 on the upper primary track 210; figure 10C). However, Joy does not disclose moving the trolley from the second position to a third position, the trolley being movably suspended from the second support track portion and being in electrical contact with the second power rail portion when in the third position. Joy does disclose moving the trolley to a third position (when the trolley 10 is located along auxiliary track 220; figure 10C), the trolley being movably suspended from the second support track portion (guide wheels 11 of trolley 10 run along rail segments 3, including rail segments 3 of the auxiliary track 220 (second track portion); figures 3A, 10A; paragraph [0027]) and being in electrical contact with the second power rail portion (trolley 10 is in electrical communication to receive current from the conductors 2, including conductors 2 of the auxiliary track 220 (second power rail portion); figure 10A; claim 1) when in the third position (when trolley 10 is located along auxiliary track 220; figure 10C). Jiang discloses moving the robot from the second position to a third position (the walking robot is rail mounted; switching platform 5 (second position) can be rotated into alignment with track rail 3 (third position), i.e., for the robot to move from switching platform 5 to track rail 3, because the robot brakes and stops on the platform 5 during path conversion operation; figures 1, 2; paragraph [0058]). In order to provide a switching device in the form of a turntable for switching tracks (Joy, paragraph [0036]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Joy's support system switching device to include Jiang's rotatable switch plate such that the trolley would move from the second position to third position as taught by Jiang because, as Jiang discloses, the rail mounted walking robot direction changing platform can be rotated between a plurality of paths such that multi-direction selection is realized due to the robot braking and stopping on the switching platform during path conversion operation (Jiang, abstract; paragraph [0058]).

As to claim 17, Joy and Jiang, in combination, disclose the method of claim 16. Joy further discloses wherein the trolley (10; figures 3A, 3B) includes a first electrical collector and a second electrical collector (includes multiple commutators 15; figure 3B; paragraph [0032]), the moving of the trolley from the first position to the second position being such that at least one of the first electrical collector or the second electrical collector is in electrical contact with at least one of the first power rail portion or the power rail portion of the switch as the trolley is moved from the first position to the second position (the commutators 15 connect to the grid conductors 2, including when trolley 10 is located along, i.e., first position, grid conductors 2 of the upper primary track 210 (first power rail portion), and when trolley 10 is located along, i.e., second position, segments of the switching device 230 (power rail portion of the switch); figures 3B, 10B; paragraph [0033]).

As to claim 18, Joy and Jiang, in combination, disclose the method of claim 16. Joy does not disclose further comprising withholding electrical power from the trolley when the switch is transitioned between the first configuration and the second configuration. Jiang discloses stopping the robot when the switch is transitioned between the first configuration and the second configuration (during path conversion operation of the switching platform 5 between the position where platform 5 is aligned with tracks 1 and 4 (first configuration) to the position where platform 5 is aligned with track 3 (second configuration), the robot executes braking and stopping on the platform 5; figures 1, 2; paragraph [0058]). In order to provide a switching device in the form of a turntable for switching tracks (Joy, paragraph [0036]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Joy's support system switching device to include Jiang's rotatable switch plate which switches between configurations while the robot is located along the switch by stopping the robot such that the trolley powered by the electrical conductors stops by withholding electrical current because, as Jiang discloses, the rail mounted walking robot direction changing platform can be rotated between a plurality of paths such that multi-direction selection is realized due to the robot braking and stopping on the switching platform during path conversion operation (Jiang, abstract; paragraph [0058]), and in order to stop Joy's trolley which is powered by electrical current via the conductors, current would be withheld during path conversion using Jiang's path conversion method.

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US16/61552

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

-***-Continued from Previous Supplemental Box-***-

As to claim 19, Joy and Jiang, in combination, disclose the method of claim 16. Joy further discloses wherein the transitioning the switch from the first configuration to the second configuration is prior to moving the trolley from the first position to the second position (inherently, the switching device 230 would have to move from the position of figure 10B (first configuration) to the position of figure 10C (second configuration) prior to the trolley 10 reaching the switching device 230 in order from the trolley 10 to move from the upper primary track 210 (first position) and to the auxiliary track 220 via moving across the switch segment B of the switching device 230 (second position); figure 10C).

As to claim 20, Joy and Jiang, in combination, disclose the method of claim 16. Joy does not disclose wherein the transitioning the switch from the first configuration to the second configuration is after moving the trolley from the first position to the second position. Jiang discloses wherein the transitioning the switch (5; figures 1, 2) from the first configuration (from the position where platform 5 is aligned with track rails 1 and 4; figure 1) to the second configuration (where platform 5 is aligned with track rail 3; figure 2) is after moving the robot from the first position to the second position (would have to occur after the robot moves from for example track rail 1 (first position) and onto the switching platform 5 (second position), because the robot brakes and stops on the platform 5 during path conversion operation; figures 1, 2; paragraph [0058]). In order to provide a switching device in the form of a turntable for switching tracks (Joy, paragraph [0036]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Joy's support system switching device to include Jiang's rotatable switch plate such that the switch would move from the first to second configuration after the trolley would move from the first position to the second position as taught by Jiang because, as Jiang discloses, the rail mounted walking robot direction changing platform can be rotated between a plurality of paths such that multi-direction selection is realized due to the robot braking and stopping on the switching platform during path conversion operation (Jiang, abstract; paragraph [0058]).

Claim 14 meets the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest the second support track portion of the switch and the second power rail portion of the switch are aligned with the second track portion and the second power rail portion, respectively when the switch is in the first configuration.

Joy wherein the support track portion of the switch is a first support track portion of the switch and the power rail portion of the switch is a first power rail portion of the switch (respective rails 3 and conductors 2 associated with switch segment A of the switching device 230; figures 10A, 10B), the switch including a second support track portion and a second power rail portion (respective rails 3 and conductors 2 associated with switch segment B of the switching device 230; figures 10A, 10C), the first support track portion of the switch and the first power rail portion of the switch are aligned with the first track portion and the first power rail portion, respectively, when the switch is in the first configuration (when in the position shown in figure 10B (first configuration), the power rails 3 and the conductors 2 of the switch segment A are aligned with the rails 3 and conductors 2 of the lower primary track 210; figure 10B), the second support track portion of the switch and the second power rail portion of the switch are aligned with the second track portion and the second power rail portion, respectively when the switch is in the second configuration (when in the position shown in figure 10C (second configuration), the power rails 3 and the conductors 2 of the switch segment B are aligned with the rails 3 and conductors 2 of the auxiliary track 220; figure 10C).

Nonetheless, it would not have been obvious to one of ordinary skill in the art at the time of the invention to modify Joy's second support track portion and second power rail portion of the switch to be aligned with the second track portion and the second power rail portion when the switch is in the first configuration because Joy's support system provides this alignment only when the switch is in the second configuration; furthermore, the references of record fail to disclose a support system where the switch includes first and second support track portions and power rail portions, where the first portion are aligned with the first support track and first power rail portions in the first configuration, and the second portions are aligned with the second track portion and second power rail portion in the first configuration; furthermore, it would require impermissible hindsight to modify Joy's support system to incorporate the claimed alignments during the first configuration because Joy's support system would not be capable of providing both of these alignments during the first configuration simultaneously.

Claim 15 meets the criteria set out in PCT Article 33(2)-(3), because of dependency on claim 14.

Claims 1-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: ERIK B. MILCH
COOLEY LLP
1299 PENNSYLVANIA AVE.
SUITE 700
WASHINGTON, DC 20004

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference BION05109WO	Date of mailing *(day/month/year)* 21 DEC 2017 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 17/50482	International filing date *(day/month/year)* 07 September 2017 (07.09.2017)
Applicant BIONESS INC.	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau of WIPO preferably through ePCT or on paper to, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 338 82 70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Lee W. Young Telephone No. PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/220 (July 2014)

Aretech LLC - Exhibit 1004, Page 00824

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference BION05109WO	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US 17/50482	International filing date *(day/month/year)* 07 September 2017 (07.09.2017)	(Earliest) Priority Date *(day/month/year)* 09 September 2016 (09.09.2016)
Applicant BIONESS INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 2 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 1

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

Aretech LLC - Exhibit 1004, Page 00825

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 17/50482

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61G 7/00; A61H 3/00; A61G 7/10; E01B 25/20 (2017.01)
CPC - A61G 7/00; A61H 3/00; A61G 7/10; E01B 25/20; A61H 3/008; A61G 7/042

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History Document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 2015/0143267 A1 (MCBRIDE) 28 May 2015 (28.05.2015); entire document, especially para [0077]-[0081], [0097]-[0098], and Fig. 2.	1-5, 9-12, 16-17 -- 6-8, 13-15, 18-20
Y	US 4,706,782 A (SPOELER et al.) 17 November 1987 (17.11.1987); entire document, especially col 3 ln 23-39, and Fig. 1.	6-7, 13, 15, 18, 20
Y	DE 102008015879 A1 (BERWALD et al.) 9 April 2009 (09.04.2009); especially Translation para [0112]-[0118], and Fig. 8.	8, 14, 19
A	US 2008/0287268 A1 (HIDLER) 20 November 2008 (20.11.2008); entire document.	1-20
A	US 7,462,138 B2 (SHETTY et al.) 9 December 2008 (09.12.2008); entire document.	1-20
A	US 2006/0189453 A1 (LEBLOND) 24 August 2006 (24.08.2006); entire document.	1-20
A	US 5,490,293 A (NILSSON) 13 February 1996 (13.02.1996); entire document.	1-20
A	US 2006/0189453 A1 (LOVE et al.) 24 August 2006 (24.08.2006); entire document.	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 October 2017	21 DEC 2017
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: ERIK B. MILCH
COOLEY LLP
1299 PENNSYLVANIA AVE.
SUITE 700
WASHINGTON, DC 20004

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 21 DEC 2017

Applicant's or agent's file reference
BION05109WO

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 17/50482	07 September 2017 (07.09.2017)	09 September 2016 (09.09.2016)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - A61G 7/00; A61H 3/00; A61G 7/10; E01B 25/20 (2017.01)
CPC - A61G 7/00; A61H 3/00; A61G 7/10; E01B 25/20; A61H 3/008; A61G 7/042

Applicant BIONESS INC.

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [ ] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [ ] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	2 November 2017	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 17/50482

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Aretech LLC - Exhibit 1004, Page 00828

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 17/50482

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	6-8, 13-15, 18-20	YES
	Claims	1-5, 9-12, 16-17	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-20	NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-5, 9-12, and 16-17 lack novelty under PCT Article 33(2) as being anticipated by US 2015/0143627 A1 (MCBRIDE) (hereinafter McBride).

As pertaining to claim 1, McBride teaches a body weight support system (2000; Fig. 2), comprising: a support track (2050; Fig. 2; para [0097]) having a first portion (leftmost portion of 2050; Fig. 2) and a second portion (rightmost portion of 2050; Fig. 2); a trolley (2100; Fig. 2) having a support assembly (2500; Fig. 2) and a drive assembly (2300; Fig. 2; para [0106]), the support assembly configured to support at least a portion of a body weight of a user (para [0097]-[0098]), the drive assembly configured to movably suspend the trolley from the first portion of the support track when the user moves along a first surface (para [0077], [0097]-[0098]) and configured to movably suspend the trolley from the second portion of the support track when the user moves along a second surface separate from the first surface (para [0077], [0097]-[0098]; user moving up or down stairs): and a power rail (2620; Fig. 2; para [0097]) coupled to the support track (coupled via unlabeled horizontal connector, see fig. 3), the power rail configured to be in electrical contact with a portion of the trolley as the trolley moves along the first portion of the support track and the second portion of the support track (para [0097]).

As pertaining to claim 2, McBride teaches the system of claim 1, and further discloses wherein the first surface has a first elevation and the second surface has a second elevation different from the first elevation (para [0077]; first and second steps of a staircase having different elevations).

As pertaining to claim 3, McBride teaches the system of claim 1, and further discloses wherein the first surface has a first elevation (para [0077], [0097]-[0098]), the support assembly configured to support a predetermined portion of the body weight of the user as the user moves along the first surface (para [0097]-[0098]), the second surface has a second elevation different from the first elevation (para [0077]; first and second steps of a staircase having different elevations), the support assembly configured to support the predetermined portion of the body weight of the user as the user moves along the second surface (para [0097]-[0098]), and the support assembly configured to transition from a first configuration to a second configuration as the user moves from the first surface to the second surface (trolley tether configured to coil and uncoil; Fig. 2; para [0077]-[0081]).

As pertaining to claim 4, McBride teaches the system of claim 1, and further discloses wherein the support track has a third portion disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2), the drive assembly is configured to movably suspend the trolley from a portion of the support track (para [0097]-[0098]).

As pertaining to claim 5, McBride teaches the system of claim 1, and further discloses wherein the first portion of the track is disposed at a first elevation associated with an elevation of the first surface (two ends of track disposed at different heights; para [0077]) and the second portion of the track is disposed at a second elevation associated with an elevation of the second surface (two ends of track disposed at different heights; para [0077]), the first elevation is different from the second elevation (para [0077]).

As pertaining to claim 9, McBride teaches a body weight support system (2000; Fig. 2), comprising: a support track (2050; Fig. 2; para [0097]) having a first portion (leftmost portion of 2050; Fig. 2), a second portion (rightmost portion of 2050; Fig. 2), and a third portion of the support track disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2); and a trolley (2100; Fig. 2) having a support assembly (2500; Fig. 2) and a drive assembly (2300; Fig. 2; para [0106]), the support assembly configured to support at least a portion of a body weight of a user (para [0097]-[0098]), the drive assembly configured to movably suspend the trolley from the first portion of the support track when the user moves along a first surface (para [0077], [0097]-[0098]) and configured to movably suspend the trolley from the second portion of the support track when the user moves along a second surface separate from the first surface (two steps on a staircase elevated at different heights; para [0077], [0097]-[0098]), the drive assembly capable of movably suspending the trolley from a third portion of the support track as the user moves between the first surface and the second surface (para [0097]-[0098]).

As pertaining to claim 10, McBride teaches the system of claim 9, and discloses further comprising: a power rail (2620; Fig. 2; para [0097]) coupled to the support track, the power rail configured to be in electrical contact with a portion of the trolley as the trolley moves along the first portion of the support track, the second portion of the support track, and the third portion of the support track (note coupling of power rail 2620 to track 2050; Fig. 2).

-*- See Supplemental Box -*-

Aretech LLC - Exhibit 1004, Page 00829

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*- Box V.2 - Citations and explanations -*-

As pertaining to claim 11, McBride teaches the system of claim 9, and further discloses wherein the support assembly is configured to support a predetermined portion of the body weight of the user as the trolley moves along the first portion of the support track, the second portion of the support track, and the third portion of the support track (para [0097]-[0098]).

As pertaining to claim 12, McBride teaches the system of claim 9, and further discloses wherein the first portion of the track is disposed at a first elevation associated with an elevation of the first surface (two ends of track disposed at different heights; para [0077]) and the second portion of the track is disposed at a second elevation associated with an elevation of the second surface (two ends of track disposed at different heights; para [0077]), the first elevation is different from the second elevation (para [0077]).

As pertaining to claim 16, McBride teaches a method of using a body weight support system (2000; Fig. 2) including at least a trolley (2100; Fig. 2) and a support track (2050; Fig. 2; para [0097]), the trolley having a support assembly (2500; Fig. 2) configured to support at least a portion of a body weight of a user and a drive assembly (2300; Fig. 2; para [0106]) configured to movably suspend the trolley from the support track, the method comprising: advancing the trolley along a first portion of the support track in response to the user moving along a first surface (para [0077], [0097]-[0098]); supporting a predetermined portion of the body weight of the user as the user moves along the first surface (para [0077], [0097]-[0098]); advancing the trolley along a second portion of the support track in response to the user moving along a second surface separate from the first surface (para [0077], [0097]-[0098]); supporting the predetermined portion of the body weight of the user as the user moves along the second surface (para [0077], [0097]-[0098]); adjusting the support assembly after advancing the trolley along the first portion of the support track and prior to advancing the trolley along the second portion of the support track (trolley tether configured to coil and uncoil; Fig. 2; para [0079]-[0081]), the adjusting of the support assembly being (1) in response to the trolley being suspended from a third portion of the support track disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2; para [0097]) and (2) such that the support assembly supports the predetermined portion of the body weight of the user (para [0077], [0097]-[0098]).

As pertaining to claim 17, McBride teaches the method of claim 16, and further discloses wherein the first surface has a first elevation (para [0077]) and the second surface has a second elevation different from the first elevation (para [0077]), the first portion of the support track being disposed a predetermined distance above the first surface (para [0077]), and the second portion of the support track being disposed the predetermined distance above the second surface (para [0077]).

Claims 6-7, 13, 15, 18, and 20 lack an inventive step under PCT Article 33(3) as obvious over McBride in view of US 4,706,782 A to SPOELER et al. (hereinafter Spoeler).

As pertaining to claim 6, McBride teaches the system of claim 5, and further discloses wherein the support track has a third portion disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2); but is silent wherein the third portion of the support track is configured to move between a first position in which the third portion is adjacent to the first portion of the support track and a second position in which the third portion is adjacent to the second portion of the support track.
However, Spoeler teaches a rail track device (Fig. 1), comprising a third portion of track (2; Fig. 1) disposed between a first portion of track (leftmost instance of 1; Fig. 1) and a second portion of track (rightmost instance of 1; Fig. 1), the third portion of the support track is configured to move between a first position in which the third portion is adjacent to the first portion of the support track and a second position in which the third portion is adjacent to the second portion of the support track (col 3 ln 23-39).
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the track of Spoeler upon the device of McBride, in order to elevate or lower the device when in use during gait therapy or for device storage.

As pertaining to claim 7, McBride teaches the system of claim 5, and further discloses the drive assembly is configured to movably suspend the trolley from the third portion of the support track as the user moves along (para [0097]-[0098]), and further discloses wherein the support track has a third portion disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2); but is silent wherein the support track has a third portion coupled between the first portion of the support track and the second portion of the support track.
However, Spoeler teaches a rail track device (Fig. 1), having a first portion of track (leftmost instance of 1; Fig. 1) and a second portion of track (rightmost instance of 1; Fig. 1), wherein the track has a third portion (2; Fig. 1) coupled between the first portion of the support track and the second portion of the support track.
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the track of Spoeler upon the device of McBride, in order to elevate or lower the device when in use during gait therapy or for device storage.

As pertaining to claim 13, McBride teaches the system of claim 9, and further discloses wherein the first portion of the track is disposed at a first elevation associated with an elevation of the first surface (two ends of track disposed at different heights; para [0077]) and the second portion of the track is disposed at a second elevation associated with an elevation of the second surface (two ends of track disposed at different heights; para [0077]), the first elevation is different from the second elevation (para [0077]), and further discloses wherein the support track has a third portion disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2); but is silent wherein the third portion of the support track is coupled between the first portion and the second portion (2; Fig. 1).
However, Spoeler teaches a rail track device (Fig. 1), having a first portion of track (leftmost instance of 1; Fig. 1) and a second portion of track (rightmost instance of 1; Fig. 1), wherein the track has a third portion (2; Fig. 1) coupled between the first portion of the support track and the second portion of the support track.
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the track of Spoeler upon the device of McBride, in order to elevate or lower the device when in use during gait therapy or for device storage.

-*- See Next Supplemental Box -*-

Aretech LLC - Exhibit 1004, Page 00830

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*- Supplemental Box V.2 - Citations and explanations -*-

As pertaining to claim 15, McBride teaches the system of claim 9, and further discloses wherein the first portion of the track is disposed at a first elevation associated with an elevation of the first surface (para [0077]) and the second portion of the track is disposed at a second elevation associated with an elevation of the second surface (para [0077]), the first elevation is different from the second elevation (para [0077]), and further discloses wherein the support track has a third portion disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2); but is silent wherein the third portion is configured to move between a first position in which the third portion is adjacent to the first portion of the support track, and a second position in which the third portion is adjacent to the second portion of the support track.
However, Spoeler teaches a rail track device (Fig. 1), comprising a third portion of track (2; Fig. 1) disposed between a first portion of track (leftmost instance of 1; Fig. 1) and a second portion of track (rightmost instance of 1; Fig. 1), the third portion of the support track is configured to move between a first position in which the third portion is adjacent to the first portion of the support track and a second position in which the third portion is adjacent to the second portion of the support track (col 3 ln 23-39).
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the track of Spoeler upon the device of McBride, in order to elevate or lower the device when in use during gait therapy or for device storage.

As pertaining to claim 18, McBride teaches the method of claim 17, and further discloses wherein the support track has a third portion disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2); but is silent wherein the third portion of the support track is coupled between the first portion and the second portion.
However, Spoeler teaches a rail track device (Fig. 1), having a first portion of track (leftmost instance of 1; Fig. 1) and a second portion of track (rightmost instance of 1; Fig. 1), wherein the track has a third portion (2; Fig. 1) coupled between the first portion of the support track and the second portion of the support track.
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the track of Spoeler upon the device of McBride, in order to elevate or lower the device when in use during gait therapy or for device storage.

As pertaining to claim 20, McBride teaches the method of claim 16, and further discloses wherein the first surface has a first elevation (para [0077]) and the second surface has a second elevation different from the first elevation (para [0077]), the first portion of the support track being disposed a predetermined distance above the first surface (para [0077]), the second portion of the support track being disposed the predetermined distance above the second surface (para [0077]), and further discloses wherein the support track has a third portion disposed between the first portion and the second portion (middlemost portion of track 2050; Fig. 2); but is silent wherein the third portion of the support track is configured to move between a first position in which the third portion of the support track is adjacent to the first portion of the support track and a second position in which the third portion of the support track is adjacent to the second portion of the support track.
However, Spoeler teaches a rail track device (Fig. 1), having a first portion of track (leftmost instance of 1; Fig. 1) and a second portion of track (rightmost instance of 1; Fig. 1), wherein the track has a third portion (2; Fig. 1) disposed between the first portion of the support track and the second portion of the support track (note positioning of 2 between instances of 1; Fig. 1), the third portion of the support track is configured to move between a first position in which the third portion is adjacent to the first portion of the support track and a second position in which the third portion is adjacent to the second portion of the support track (col 3 ln 23-39).
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the rail arrangement of Spoeler upon the device of McBride, in order to elevate or lower the device when in use during gait therapy or for device storage.

Claim 8, 14, and 19 lack an inventive step under PCT Article 33(3) as being obvious over McBride in view of Spoeler in view of in view of DE 102008015879 A1 to BERWALD et al. (hereinafter Berwald).

As pertaining to claim 8, McBride in view of Spoeler teaches the system of claim 7, but is silent wherein the third portion of the support track includes a set of protrusions, the drive assembly includes a gear configured to engage the set of protrusions when the trolley moves along the third portion of the support track.
However, Berwald teaches a trolley system (collectively Fig. 8; Translation para [0112]-[0118]), comprising a support track (10; Fig. 8) including a set of protrusions (67; Fig. 8), a drive assembly includes a gear (7; Fig. 8; Translation para [0090]) configured to engage the set of protrusions when the trolley moves along the support track (Translation para [0090]).
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the gear drive of Berwald upon the system of McBride in view of Spoeler, in order to improve the grippability of the system to a sloped incline track.

As pertaining to claim 14, McBride in view of Spoeler teaches the system of claim 13, but is silent wherein the third portion of the support track includes a set of protrusions, the drive assembly includes a gear configured to engage the set of protrusions when the trolley moves along the third portion of the support track.
However, Berwald teaches a trolley system (collectively Fig. 8; Translation para [0112]-[0118]), comprising a support track (10; Fig. 8) including a set of protrusions (67; Fig. 8), a drive assembly includes a gear (7; Fig. 8; Translation para [0090]) configured to engage the set of protrusions when the trolley moves along the support track (Translation para [0090]).
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the gear drive of Berwald upon the system of McBride in view of Spoeler, in order to improve the grippability of the system to a sloped incline track.

-*- See Next Supplemental Box -*-

Aretech LLC - Exhibit 1004, Page 00831

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-*- Supplemental Box V.2 - Citations and explanations -*-

As pertaining to claim 19, McBride in view of Spoeler teaches the method of claim 18, but is silent wherein the third portion of the support track includes a set of protrusions, the drive assembly includes a gear configured to engage the set of protrusions when the trolley moves along the third portion of the support track.
However, Berwald teaches a trolley system (collectively Fig. 8; Translation para [0112]-[0118]), comprising a support track (10; Fig. 8) including a set of protrusions (67; Fig. 8), a drive assembly includes a gear (7; Fig. 8; Translation para [0090]) configured to engage the set of protrusions when the trolley moves along the support track (Translation para [0090]).
Accordingly, it would have been obvious to a person having ordinary skill in the art to have employed the gear drive of Berwald upon the method of McBride in view of Spoeler, in order to improve the grippability of the system to a sloped incline track.

Claims 1-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used by industry.

Aretech LLC - Exhibit 1004, Page 00832

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference BION05112WO	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US18/18166	International filing date *(day/month/year)* 14 February 2018 (14.02.2018)	(Earliest) Priority Date *(day/month/year)* 14 February 2017 (14.02.2017)
Applicant BIONESS INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☒ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 77

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US18/18166

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
-***-Please See Within the Next Supplemental Box-***-

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-7 and 14-20

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US18/18166

-***-Continued from Box No. III Observations where unity of invention is lacking-***-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-7 and 14-20 are directed toward a method of using a body weight support system, the method comprising: defining a threshold length of a tether; providing a predetermined amount of body weight support during a gait training as a user moves relative to a surface; and displaying data associated with the gait training on a display of an electronic device included in the body weight support system.

Group II: Claims 8-13 are directed toward a method of using a body weight support system, the method comprising: defining a first criterion; defining a second criterion; determining a fall has occurred based on the first criterion and the second criterion being satisfied; and providing an amount of body weight support in response to the first criterion and the second criterion being satisfied.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons.

The special technical features of Group I include defining a threshold length of a 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; defining a threshold number of falls during the gait training; providing a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls; increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met; and displaying data associated with the gait training on a display of an electronic device included in the body weight support system (which are not present in Group II).

The special features of Group II include 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; 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 (which are not present in Group I).

The common technical features of Groups I and II include 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.

These common technical features are disclosed by US 2006/0229167 A1 (KRAM). Kram discloses a method of using a body weight support system (weight support device 123; figure 2) to provide body weight support during gait training (used to bear weight of patient 122 over treadmill 110 during physical therapy; paragraphs [0018], [0034]), the body weight support system including a tether (cord between pulley 124 and support harness 102 shown in figure 2) configured to be coupled to an attachment device worn by a user (coupled to support harness 102 worn by patient 122 as shown) to couple the user to the body weight support system (coupling patient 122 to weight support device 123 as shown), the method comprising: defining a reference length of the tether when the attachment device is in an initial position (length of cord connecting pulley 124 and harness 102 is defined as shown in figure 2 when harness 102 is in initial position shown).

Since the common technical features are previously disclosed by the Kram reference, the common features are not special and so Groups I and II lack unity.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US18/18166

A. CLASSIFICATION OF SUBJECT MATTER
IPC - A61H 3/00; A63B 24/00, 69/00 (2018.01)
CPC - A61H 3/008; A63B 24/0087, 69/0064

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012/0018249 A1 (MEHR, C) Jan. 26, 2012; figure 1, paragraphs [0051], [0063], [0067], [0068], [0071]	1-4, 6-7
Y	EP 1 296 595 B1 (LIFEWAVES INTERNATIONAL, INC) Aug. 15, 2007; paragraphs [0023], [0024]	1-4, 6-7
A	US 2006/0229167 A1 (KRAM et al.) Oct. 12, 2006; figure 2, paragraphs [0018], [0034]	1-7, 14-20
A	US 2004/0143198 A1 (WEST, R G) Jul. 22, 2004; figures 1, 1a, 2, paragraphs [0001], [0007], [0035], claim 1	1-7, 14-20
A	US 5,695, 432 A (SODERLUND, B P) Dec. 9, 1997; figures 1, 2, column 1, lines 5-10, column 2, lines 60-67, column 3, lines 1-5	1-7, 14-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 April 2018 (13.04.2018)	02 JUL 2018
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: Erik B. Milch
Cooley LLP
1299 Pennsylvania Ave.
Suite 700
Washington, District of Columbia 20004
United States of America

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	02 JUL 2018

Applicant's or agent's file reference	FOR FURTHER ACTION
BION05112WO	See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US18/18166	14 February 2018 (14.02.2018)	14 February 2017 (14.02.2017)

International Patent Classification (IPC) or both national classification and IPC
IPC - A61H 3/00; A63B 24/00, 69/00 (2018.01)
CPC - A61H 3/008; A63B 24/0087, 69/0064

Applicant BIONESS INC.

1. This opinion contains indications relating to the following items:

- [x] Box No. I Basis of the opinion
- [ ] Box No. II Priority
- [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- [x] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- [ ] Box No. VI Certain documents cited
- [ ] Box No. VII Certain defects in the international application
- [x] Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	13 April 2018 (13.04.2018)	Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:

   ☐ paid additional fees.

   ☐ paid additional fees under protest and, where applicable, the protest fee.

   ☐ paid additional fees under protest but the applicable protest fee was not paid.

   ☒ not paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is

   ☐ complied with.

   ☒ not complied with for the following reasons:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-7 and 14-20 are directed toward a method of using a body weight support system, the method comprising: defining a threshold length of a tether; providing a predetermined amount of body weight support during a gait training as a user moves relative to a surface; and displaying data associated with the gait training on a display of an electronic device included in the body weight support system.
Group II: Claims 8-13 are directed toward a method of using a body weight support system, the method comprising: defining a first criterion; defining a second criterion; determining a fall has occurred based on the first criterion and the second criterion being satisfied; and providing an amount of body weight support in response to the first criterion and the second criterion being satisfied.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons.

The special technical features of Group I include defining a threshold length of a 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; defining a threshold number of falls during the gait training; providing a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls; increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met; and displaying data associated with the gait training on a display of an electronic device included in the body weight support system (which are not present in Group II).
The special features of Group II include 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; 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 (which are not present in Group I).

The common technical features of Groups I and II include 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.
These common technical features are disclosed by US 2006/0229167 A1 (KRAM). Kram discloses a method of using a body weight support system (weight support device 123; figure 2) to provide body weight support during gait training (used to bear weight of patient 122 over treadmill 110 during physical therapy; paragraphs [0018], [0034]), the body weight support system including a tether (cord between pulley 124 and support harness 102 shown in figure 2) configured to be coupled to an attachment device worn by a user (coupled to support harness 102 worn by patient 122 as shown) to couple the user to the body weight support system (coupling patient 122 to weight support device 123 as shown), the method comprising: defining a reference length of the tether when the attachment device is in an initial position (length of cord connecting pulley 124 and harness 102 is defined as shown in figure 2 when harness 102 is in initial position shown).

Since the common technical features are previously disclosed by the Kram reference, the common features are not special and so Groups I and II lack unity.

4. Consequently, this opinion has been established in respect of the following parts of the international application:

   ☐ all parts.

   ☒ the parts relating to claims Nos. 1-7 and 14-20

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Claims	1-7, 14-20	YES
	Claims	NONE	NO
Inventive step (IS)	Claims	5, 14-20	YES
	Claims	1-4, 6-7	NO
Industrial applicability (IA)	Claims	1-7, 14-20	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-4 and 6-7 lack an inventive step under PCT Article 33(3) as being obvious over US 2012/0018249 A1 (MEHR) in view of EP 1 296 595 B1 (LIFEWAVES).

As per claim 1, Mehr discloses a method of using a body weight support system (fall protection device; figure 1; paragraph [0063]) to provide body weight support (which catches person 1 in event of falling; paragraph [0068]) during gait training (during bouncing practice which strengthens muscles for users with difficulties walking; paragraphs [0051], [0068]), the body weight support system including a tether (rope 10) configured to be coupled to an attachment device worn by a user (which is clipped to vest in region of shoulders of user 1; paragraph [0067]) to couple the user to the body weight support system (such that user 1 is secured to fall protection device as shown in figure 1), the method comprising: defining a reference length of the tether (length of rope 10 from stop 13 to user 1 when user 1 is not falling or bouncing as shown in figure 1; paragraph [0071]) when the attachment device is in an initial position (when vest at shoulders of user 1 is at height shown in figure 1); defining a threshold length of the tether (length of rope 10 from immediately above weight 12 to user 1 in initial position shown in figure 1); providing a first amount of body weight support during the gait training (holding rope 10 substantially taught via weight 12 during bouncing practice; paragraph [0068]) as the user moves relative to a surface (as user 1 bounces with amplitude from trampoline mat of trampoline 8, i.e. moves relative to ground surface supporting trampoline 8 in figure 1; paragraph [0068]) and a length of the tether is less than the threshold length of the tether (while weight 12 is not in contact with stop 13, i.e. length of rope 10 from stop 13 to user 1 while user 1 is bouncing or falling is shorter than length of rope 10 from user 1 to directly above weight 12, rope 10 is held taught by only weight 12; paragraphs [0068], [0071]); providing a second amount of body weight support during the gait training (catching user 1 in event of fall during bouncing practice, i.e. providing support via tension of rope 10 equivalent to weight of user 1; paragraph [0068]) as the user moves relative to the surface (as user 1 bounces with amplitude from trampoline mat, i.e. moves relative to ground surface supporting trampoline 8 in figure 1; paragraph [0068]) and the length of the tether is greater than the threshold length of the tether (and weight 12 strikes stop 13, i.e. length from stop 13 to user 1 is greater than length from user 1 to directly above weight 12 in initial position shown in figure 1; paragraphs [0068], [0071]). Mehr does not disclose displaying data associated with the gait training on a display of an electronic device included in the body weight support system. Lifewaves discloses displaying data associated with a gait training (user interface 60 provides visual information regarding heart rate or other type of data from individual 10 exercising on exerciser 20 which can be a trampoline; paragraphs [0023], [0024]) on a display of an electronic device (interface 60 may be display monitor; paragraph [0094]). In order to provide data from the user while the user is performing bouncing practice to train and strengthen muscles (MEHR; paragraph [0051]), it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Mehr's weight support system to include Lifewaves's electronic device display to display data associated with the gait training, since Lifewaves discloses that the display can provide users with information regarding heart rate or any other type of data (LIFEWAVES; paragraph [0024]); furthermore, providing digital displays for training procedures is well known in the art.

As per claim 2, Mehr and Lifewaves, in combination, disclose the method of claim 1. Mehr further discloses wherein the length of the tether (length of rope 10 from stop 13 to user 1 while user 1 is bouncing or falling; figure 1) is increased in response to an increase in force exerted by the user on the tether (event of falling of user 1, i.e. increase in downward pull from user 1 on rope 10, increases tension on rope 10 and increases length of rope 10 from stop 13 to user 1 until weight 12 strikes stop 13; figure 1; paragraphs [0068], [0071]).

As per claim 3, Mehr and Lifewaves, in combination, disclose the method of claim 2. Mehr further discloses wherein the increase in the force exerted by the user on the tether is associated with the user falling (increase of downward pull from user 1 is due to event of user 1 falling; paragraph [0068]) during the gait training (during bouncing practice; paragraph [0068]).

As per claim 4, Mehr and Lifewaves, in combination disclose the method of claim 1. Mehr further discloses wherein the surface (ground surface supporting trampoline 8 in figure 1) relative to which the user moves (user 1 bounces with amplitude from trampoline mat, i.e. moves relative to ground surface; paragraph [0068]) is a stationary surface (is fixed ground surface also supporting fixed equipment as shown in figure 1).

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 1 and 14 are objected to under PCT Rule 66.2(a)(v) as lacking clarity under PCT Article 6 because the claims are indefinite for the following reasons:

Claim 1 refers to "the length of the tether";

Claim 14 refers to "the number of falls".

There is a lack of antecedent basis for these limitations in the claims. For the purpose of this opinion, as best understood, the claims are interpreted to read:

Claim 1: "a length of the tether";

Claim 14: "a number of falls".

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

-***-Continued from Box V: Citations and Explanations-***-

As per claim 6, Mehr and Lifewaves, in combination, disclose the method of claim 1. Mehr does not further disclose wherein the surface relative to which a user moves is a moving surface included in a treadmill. Lifewaves discloses a treadmill (exerciser 20 can be a treadmill machine; paragraph [0023]). In order to provide the user with an alternative method for users with disabilities or difficulties walking to strengthen muscles, it would have been obvious to one of ordinary skill in the art at the time of the invention to replace Mehr's trampoline with Soderlund's treadmill such that the surface relative to which the user moves is a moving surface included in Lifewaves's treadmill, since Lifewaves discloses that a treadmill can be used for an individual to exercise on to asses the individual's physiological condition (LIFEWAVES; paragraph [0023]).

As per claim 7, Mehr and Lifewaves, in combination, disclose the method of claim 6. Mehr does not further disclose wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill. Lifewaves discloses displaying the data associated with the gait training (user interface 60 provides visual information regarding heart rate or other type of data from individual 10 exercising on exerciser 20 which can be a trampoline; paragraphs [0023], [0024]). In order to provide more types of data from the individual, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Lifewave's displaying of data to include data associated with an operating condition of Mehr's body weight support system and an operating condition of Lifewaves's treadmill, since doing so would provide even more information to better asses the physiological condition of the user (LIFEWAVES; paragraph [0024]); furthermore, modifying a display monitor to display operating conditions such as treadmill speed or tether tension would require only routine skill in the art.

Claim 5 meets the criteria set out in PCT Article 33(2)-(3) because the prior art does not teach or fairly suggest a motivation to combine references.

US 2004/0143198 A1 (WEST) discloses wherein a body weight support system (winch frame 53, harness H, collectively; figures 1, 1a, 2) includes a drive assembly (winch frame 53) configured to movably suspend the body weight support system from a support track (which controls harness H and is slidably supported on rail 50; paragraphs [0036], [0046]), the drive assembly configured to move the body weight support system relative to the support track (harness H suspends from winch frame 53 as shown which is slidably supported on rail 50; paragraph [0036]) in response to a user moving relative to a surface (and is capable of moving along rail 50 in response to user shown in figure 1a moving toward treadmill 140 as shown in figures 1, 1a) such that the body weight support system is maintained in a substantially overhead position relative to the user (such that harness H and winch frame 53 remain overhead relative to user as shown in figure 1a).

Nonetheless, it would not have been obvious to one of ordinary skill in the art at the time of the invention to modify Mehr's body weight support system to move along West's support track in response to the user moving since West's and Mehr's body weight support systems are structurally very different and Mehr's entire body weight support system is not capable of movably suspending from West's support track; furthermore, as per claim 1, an electronic device with a display must be included in the body weight support system and West's electronic device is included with supports for the support track; finally, the prior art fails to teach or fairly suggest a body weight support system with an electronic device with a display included in it with the support system configured to be movably suspended from a support track such that is moves relative to the track in response to a user moving relative to a surface.

-***-Continued Within the Next Supplemental Box-***-

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US18/18166

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:

-***-Continued from Previous Supplemental Box-***-

Claim 14 meets the criteria set out in PCT Article 33(2)-(3) because the prior art does not teach or fairly suggest defining a threshold number of falls during gait training; providing a predetermined amount of body weight support during the gait training as a user moves relative to a surface and a number of falls is less than the threshold number of falls; and increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met.

Mehr discloses a method of using a body weight support system (fall protection device; figure 1; paragraph [0063]) to provide body weight support (which catches person 1 in event of falling; paragraph [0068]) during gait training (during bouncing practice which strengthens muscles for users with difficulties walking; paragraphs [0051], [0068]), the body weight support system including a tether (rope 10) configured to be coupled to an attachment device worn by a user (which is clipped to vest in region of shoulders of user 1; paragraph [0067]) to couple the user to the body weight support system (such that user 1 is secured to fall protection device as shown in figure 1), the method comprising: defining a reference length of the tether (length of rope 10 from stop 13 to user 1 when user 1 is not falling or bouncing as shown in figure 1; paragraph [0071]) when the attachment device is in an initial position (when vest at shoulders of user 1 is at height shown in figure 1); defining a threshold length of the tether (length of rope 10 from immediately above weight 12 to user 1 while user 1 is falling or bouncing), the threshold length of the tether being associated with the user falling during the gait training (associated with user 1 falling or bouncing during bounce practice); providing a predetermined amount of body weight support during the gait training (holding rope 10 substantially taught via weight 12 during bouncing practice; paragraph [0068]) as the user moves relative to a surface (as user 1 bounces with amplitude from trampoline mat, i.e. moves relative to ground surface supporting trampoline 8 in figure 1; paragraph [0068]); and increasing the predetermined amount of body weight support to be provided to the user during the gait training (catching user 1 in event of fall during bouncing practice, i.e. providing increased support via tension of rope 10 equivalent to weight of user 1; paragraph [0068]).

West discloses displaying data associated with gait training on a display of an electronic device (touch screen 46 of control panel displays set-up and historical information for rehabilitation of non-ambulatory patients; figures 1, 1a, 2; paragraphs [0001], [0007], [0035]) included in a body weight support system (within powered gait orthosis as shown in figure 2; claim 1).

Nonetheless, it would not have been obvious to one of ordinary skill in the art at the time of the invention to modify Mehr's and West's body weight support system to define a threshold number of falls and increase the amount of body weight support to be provided in response to the threshold number of falls being met since neither system includes elements which record the number of falls by the user; furthermore, the prior art fails to teach or fairly suggest defining a threshold number of falls during gait training; providing a predetermined amount of body weight support during the gait training as a user moves relative to a surface and a number of falls is less than the threshold number of falls; and increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met.

Claims 15-20 meet the criteria set out in PCT Article 33(2)-(3) for dependency on clam 14.

Claims 1-7 and 14-20 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

Multidirectional Transparent Support for Overground Gait Training

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***Abstract*—Gait and balance training is an essential ingredient for locomotor rehabilitation of patients with neurological impairments. Robotic overhead support systems may help these patients train, for example by relieving them of part of their body weight. However, there are only very few systems that provide support during overground gait, and these suffer from limited degrees of freedom and/or undesired interaction forces due to uncompensated robot dynamics, namely inertia. Here, we suggest a novel mechanical concept that is based on cable robot technology and that allows three-dimensional gait training while reducing apparent robot dynamics to a minimum. The solution does not suffer from the conventional drawback of cable robots, which is a limited workspace. Instead, displaceable deflection units follow the human subject above a large walking area. These deflection units are not actuated, instead they are implicitly displaced by means of the forces in the cables they deflect. This leads to an underactuated design, because the deflection units cannot be moved arbitrarily. However, the design still allows accurate control of a three-dimensional force vector acting on a human subject during gait. We describe the mechanical concept, the control concept, and we show first experimental results obtained with the device, including the force control performance during robot-supported overground gait of five human subjects without motor impairments.**

***Keywords*—Gait training, body weight support, cable robots, series elastic actuation, underactuation.**

I. Introduction

A growing body of clinical studies suggests that effective training in neurorehabilitation allows subjects to participate actively and to perform unhindered movements. Therefore, strategies like "Assist as Needed" [1] or the "challenge point" concept [2] recommend tailor-made assistance or challenge during training. For gait rehabilitation robots, this denotes a change in paradigm, because currently available devices have been designed to ensure accurate reproduction of physiological kinematics. Such devices cannot fully "get out of the way" when not needed, because their intrinsic dynamics generate undesired interaction forces.

One step towards more cooperative training environments was marked by the "KineAssist" robot [3], which is a moving frame with attached harness that can gently catch the subject in case of fall. However, the device cannot move fast due to its heavy structure, so it is more suitable for use in standing and stepping training, when the robot does not need to move.

We recently suggested a multidirectional overhead support system for rats [4], which allows highly transparent gait training. With this device, it was shown that treadmill training does not necessarily promote voluntary gait [5], in contrast to body-weight supported overground training. However, the mechanical structure of this robot cannot simply be enlarged to human scale.

Classical body weight support (BWS) systems for humans are often realized by use of cable systems. Mostly the user wears a harness, which is suspended by a single cable. The cable is tensed by passive and/or active elements, resulting in a 1-dimensional, uni-directional vertical force. Adding further dimensions is often realized by repositioning the pulley guiding the cable to the user. For example, the Zero-G [6] provides support during overground walking by means of a trolley that runs on a rail and contains a pulley mechanism. However, this constrains subjects to walking along a given path, which unfavorably influences balance tasks by generating horizontal "pendulum" forces [7].

NASA's ARGOS [8] or the NaviGAITor [9] are overhead gantry systems that also allow lateral movements. However, their massive structure leads to low bandwidth and restricts dynamic movements of the subject.

Another approach for multi-directional support is represented by cable-driven robots [10], [11]: Spatially distributed pulleys guide multiple cables, which are driven by motorized drums, into the workspace. The free cable ends inside the workspace are attached in parallel to one or multiple points. Such cable robots, as parallel robots in general, usually have one disadvantage: Their load capabilities vary strongly depending on the position of the end-effector inside the workspace. This results from the increasingly inhomogeneous distribution of cable force vectors when the end-effector is moved away from its central position towards the outer workspace zones. This disadvantage can be compensated by actively moving the pulleys; however, this solution is costly due to its high mechanical complexity [12].

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Aretech LLC - Exhibit 1004, Page 00844

Here, we suggest a new concept for a cable robot for gait and balance training that employs pulleys that are neither fixed nor actuated. Instead, they are moved along guiding rails by the forces resulting through the deflection of the cables while being directed to the human subject [13], [12]. This general concept minimizes moving masses of the robot. This way, we achieve minimal inertia, yet still a large workspace. As a consequence of the passive deflection units, the device is underactuated [14]. However, appropriate control still allows exact control of the forces that are exerted on the user.

In the following sections, we will first describe the hardware and control concept, followed by an experimental evaluation that identifies apparent robot dynamics and that assesses force control performance in experiments with human subjects.

II. Hardware Concept

A. Mechanics

The robotic system FLOAT (Free Levitation for Overground Active Training) is an overhead support system that is designed to precisely control forces acting on a human subject in vertical and in both horizontal directions (Fig.1). The device capitalizes on cable robot technology.

The FLOAT allows the subjects to move in a large space (approximately 8 m length by 1.5 m width by 2.8 m height in our setup in Zürich, which is mainly limited by room size), so that diverse activities can be trained and analyzed in healthy subjects or in patients, such as level walking, running, walking on uneven terrain, and even stair climbing. During these activities, FLOAT needs to transparently follow the subject while precisely controlling magnitude and direction of the force vector acting on the human subject. To this end, two parallel rails are arranged horizontally on the ceiling and tilted by 45° towards the workspace along their longitudinal axis. Each rail guides two deflection units: Each deflection unit is composed of a ball-beared cart carrying an inclinable pulley. The inclination axis of the pulley is parallel to the rail. A Dyneema cable with 2.5 mm diameter connects the two carts on one rail, so that they form a "trolley".

At each end of the two rails, a winch is positioned. From each winch, a cable extends via the closest deflection unit into the workspace. The design of the winches (Fig. 1, inset right) is similar to the one proposed in [15]. AC motors (type AKM54G from Kollmorgen) with 2.6 kW power, a continuous torque of 14.3 Nm, and with an integrated brake are used. The motor shaft is connected to the drum via a backlash-free shaft coupling. The Polyamid drums have an effective diameter of 71 mm and a length of 245 mm. The entire drive train (i.e. motor shaft with brake, coupling, shaft within the drum, drum) has a moment of inertia of 0.00186 kgm^2. Each winch unit is additionally equipped with a light-weight hollow pressure roller, which maintains the contact pressure of the cable on the drum in order to avoid derailing of the cable. The hollow roller rotates passively and its contact pressure can be adjusted. The cables are Dyneema ropes with 4 mm diameter.

Following the principle of Series Elastic Actuation [16], [17], four elastic elements connect the cables to stainless steel rings, which are arranged so that the four cables approximately intersect in one point, which we define as the "node" (Fig. 2). This virtual intersection of the cables is located in the center of a steel ring. The elastic elements consist of spiral steel springs, each with a parallel rubber cord inside. They exhibit a slightly nonlinear force-length relationship, with a mean stiffness of approximately 6.2 kN/m.

The human user wears a harness, which is attached to a beam, which in turn is pivot-mounted to the lower end of the node. Due to these decoupling joints, the steel ring in the node always aligns in direction of the resultant force vector that is generated by the four cables and acts on the subject. The beam can rotate infinitely, allowing the subject to take arbitrary turns. The beam further includes an emergency release system, allowing the subject to be lowered manually in case of electronic and/or mechanical failure of the robot.

In this setup, the force vector acting on the human can theoretically assume any direction within the polygon that is defined by five vertices: the node and the four winches (or, more precisely, extreme locations of the deflection units). This polygon is much larger than the one spanned by the node and any current location of the deflection units, which would confine the force vector in case the pulleys were fixed.

B. Sensing, Communication, and Safety

Winch positions, and thereby the amount of cable that has been released from the winch, are measured by multi-turn high-resolution encoders on the motor shafts.

The lengths of the elastic elements and thereby the force acting on any single cable is measured by wire potentiometers (Micro-Epsilon, Ortenburg) guided inside the spiral spring, next to the rubber cord.

The position of each of the carts is measured by a laser distance sensor, which is attached next to the respective winch. The laser beams are collinear to the rails. As there are two laser sensors per trolley (one for each cart), the measurement is redundant and is used both to improve signal quality and to serve for fault detection purposes.

These sensors already provide redundant information to calculate the position of the node and the resultant force vector on the subject by means of optimization, similar to [18].

Additionally, inside the steel ring in the node, an inertial measurement unit (IMU) is located, which contains accelerometers, gyroscopes, and a magnetometer (Fig. 2). This unit measures accelerations, angular rates, and orientation of the steel ring in the node in 3D. As the steel ring always aligns with the resultant force acting on the user, the IMU unit senses the direction of this force. The orientation is redundant to the information from cable forces and geometry, so that it allows improvement of signal quality as well as fault detection. In addition, the IMU can be used to estimate speed and acceleration of the node, which is beneficial for dynamic control regimes. In the current state of development, however, the IMU is not yet used in the control scheme.

Below the node, a rotary potentiometer is attached, which measures the rotation of the harness beam around the vertical axis, and thereby the current walking direction of the user.

The signals from the IMU and the five potentiometers are transmitted the control unit via a spiral cable attached to an

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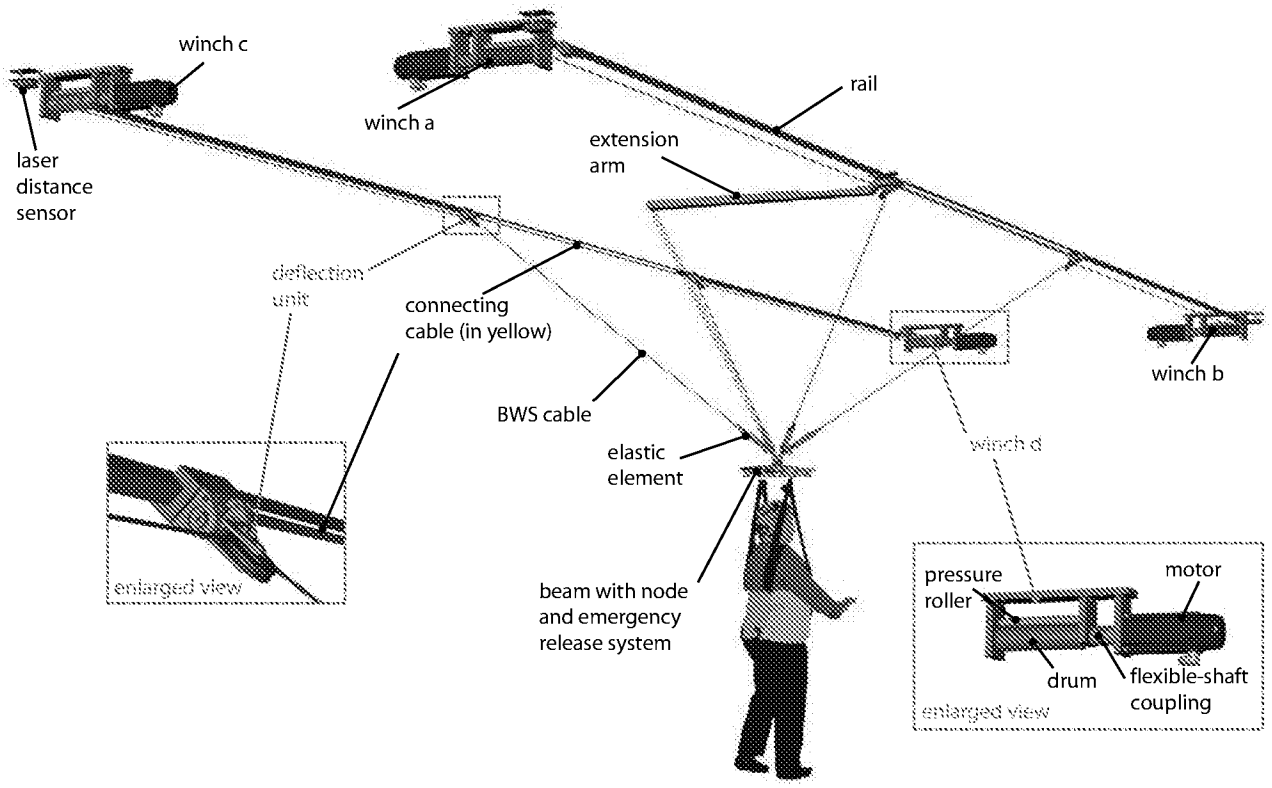


Fig. 1. Concept of the FLOAT training system, with enlarged views of a deflection unit and a winch unit.

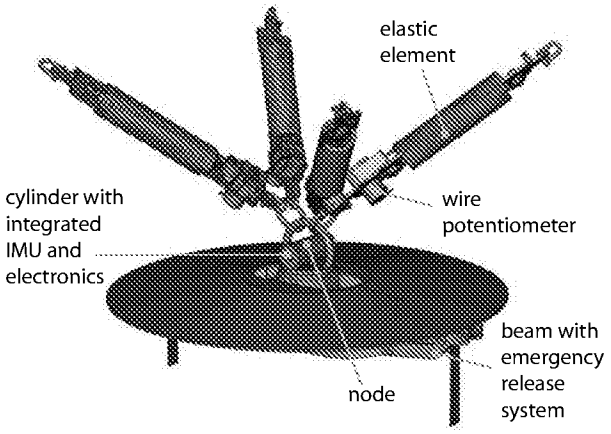


Fig. 2. Detailed view of elastic elements and node.

extension arm. The extension arm is mounted to a fifth cart, which is driven by a dedicated motor via a belt. The position of this cart is measured by an additional laser sensor, in order to enable a position controller that keeps the distance to the neighboring trolley constant.

Communication is realized with an updated and extended version of the solution proposed in [19]: The real-time control PC (Matlab xPC) and the motor drives communicate via an EtherCat network. Also the signals of the laser sensor are digitized by decentral EtherCat boxes (Beckhoff, Germany) and transmitted over this network. The EtherCat cycle and the control algorithms run at a frequency of 1 kHz. The signals that are collected at the node (lengths of wire potentiometers, angle of rotary potentiometers, and signals of the IMU) are digitized (in case of the analog wire potentiometers) and transmitted via RS485 to the xPC (Fig. 3).

In addition to diverse software fault detection mechanisms, a human operator can halt the FLOAT anytime by a wireless emergency stop or two wall-mounted emergency stops. A watchdog surveys the operational reliability of the xPC-target, by verifying the correct generation of a pulsed check signal. The signals from the watchdog, emergency switches, remote control, motor drives, and the xPC-target are all surveyed by a FLEXI soft safety control unit (SICK AG, Stans, Switzerland), which enables/disables the motor drives and the main power supply.

III. Modeling and Control

A. Modeling

In the chosen right-handed Cartesian coordinate system, z points upward and x points forward in the default gait direction, parallel to the rails (Fig. 4). As the joints in the node ensure that only a force vector is transmitted, the harness can be represented by a single cable that connects the node $\boldsymbol{n} = (n_x \quad n_y \quad n_z)^T$ to a specific point on the human.

The geometric configuration is fully described by the length of cables that have been released from each winch, subsumed in the vector $\boldsymbol{s}_W \in \mathbb{R}^4$, with $\boldsymbol{s}_W = (s_a \quad s_b \quad s_c \quad s_d)^T$, and by the positions of the trolleys, subsumed in the vector $\boldsymbol{x}_T = (x_{T,ab} \quad x_{T,cd})^T$. This means that a twelve-dimensional vector (containing $\boldsymbol{s}_W$, $\boldsymbol{x}_T$, $\dot{\boldsymbol{s}}_W$, and $\dot{\boldsymbol{x}}_T$) suffices to describe the current state of the robot.

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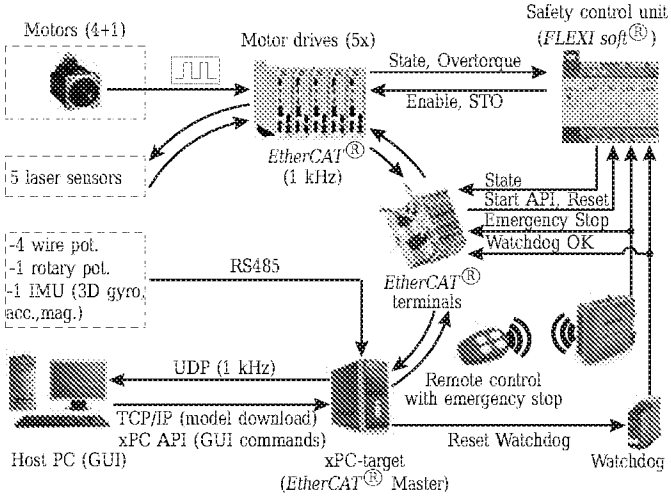


Fig. 3. Communication and safety flow chart of the FLOAT system.

Cable forces are subsumed in the vector $\boldsymbol{F}_r \in \mathbb{R}_+^4$ with $\boldsymbol{F}_r = (F_a \quad F_b \quad F_c \quad F_d)^T$, and the Cartesian force vector $\boldsymbol{F}_n \in \mathbb{R}^3$ acting on the subject is $\boldsymbol{F}_n = (F_{nx} \quad F_{ny} \quad F_{nz})^T$. Force equilibrium on the node maps cable forces to node forces:

$$\boldsymbol{F}_n = \mathbf{J}(\boldsymbol{x}_T, \boldsymbol{n})\boldsymbol{F}_r. \tag{1}$$

The Jacobian $\mathbf{J}$ can be computed in an efficient way by first summing up the cable forces within the two planes spanned by the cables, via the matrix $\mathbf{R}$, to obtain the component $F_{n,x}$ and the components F_{ab} and F_{cd} (Fig. 4, right), and then converting these to Cartesian space via the matrix $\mathbf{S}$:

$$\mathbf{J} = \begin{pmatrix} 1 & \mathbf{0} \\ \mathbf{0} & \mathbf{S} \end{pmatrix} \mathbf{R}, \tag{2}$$

with

$$\mathbf{S} = \begin{pmatrix} -\cos\varphi_{ab} & \cos\varphi_{cd} \\ \sin\varphi_{ab} & \sin\varphi_{cd} \end{pmatrix}, \tag{3}$$

$$\mathbf{R} = \begin{pmatrix} \cos\varphi_a & -\cos\varphi_b & \cos\varphi_c & -\cos\varphi_d \\ \sin\varphi_a & \sin\varphi_b & 0 & 0 \\ 0 & 0 & \sin\varphi_c & \sin\varphi_d \end{pmatrix}. \tag{4}$$

Current trolley positions $\boldsymbol{x}_T$ and the node position $\boldsymbol{n}$ define the angles in these matrices (Fig. 4).

Trolley movement is governed by the equations of motion:

$$m_T \ddot{\boldsymbol{x}}_T = \mathbf{T}\boldsymbol{F}_r, \tag{5}$$

with

$$\mathbf{T} = \begin{pmatrix} \cos\varphi_a - 1 & 1 - \cos\varphi_b & 0 & 0 \\ 0 & 0 & \cos\varphi_c - 1 & 1 - \cos\varphi_d \end{pmatrix} \tag{6}$$

The equations of motion for the winches are given by:

$$m_W \ddot{\boldsymbol{s}}_W = \boldsymbol{F}_r - \boldsymbol{F}_W, \tag{7}$$

with the winch actuator forces $\boldsymbol{F}_W$. This means that in static conditions or when the winches rotate at a constant speed, cable forces are equal to winch forces.

B. Control Design

An ideal controller would command actuator torques in such a way that the force vector $\boldsymbol{F}_n$ that acts on the subject matches the reference force vector $\boldsymbol{F}_{n,ref}$ regardless of the movement of the subject.

We implement a force controller in Cartesian space, which commands a Cartesian force vector ${}^C\boldsymbol{F}_{fc}$ that is to be realized by the winches. This force is calculated by PI control and feed-forward of the reference:

$${}^C\boldsymbol{F}_{fc} = \boldsymbol{F}_{n,ref} + \left(\mathbf{K}_P + \frac{\mathbf{K}_I}{s}\right)(\boldsymbol{F}_{n,ref} - \boldsymbol{F}_n), \tag{8}$$

with s being the Laplace operator, $\mathbf{K}_P$ being a positive definite matrix of proportional gains, and $\mathbf{K}_I$ being a positive definite matrix of integral gains.

Cartesian forces need to be mapped to winch forces $\boldsymbol{F}_w$, which is the inverse problem of (1). Given that there are four winch forces and only three node force components, there are multiple solutions to (1) with a given node force. If the trolleys were not movable, quadratic programming could be used to find the minimal cable forces that fulfill the constraints. However, in the current system, the cable forces do not only influence the output force vector, but they also influence the movement of the trolleys, according to (5). In turn, the position of the trolleys defines the polygon of applicable forces.

Therefore, instead of minimizing cable forces, we take trolley dynamics into account to solve the rank deficiency in the inverse mapping of (1). The idea is to generate cable forces that force the trolleys to stay together, leading to a polygon with rectangular base. This behavior is enforced by the law:

$$m_T(\ddot{x}_{T,ab} - \ddot{x}_{T,cd}) \stackrel{!}{=} -k_T(x_{T,ab} - x_{T,cd}) \tag{9}$$

with the positive constant k_T.

With (5) and (6), this gives

$$\boldsymbol{r}^T\boldsymbol{F}_r \stackrel{!}{=} k_T(x_{T,ab} - x_{T,cd}), \tag{10}$$

whereby

$$\boldsymbol{r}^T = (1 - \cos\varphi_a \quad \cos\varphi_b - 1 \quad \cos\varphi_c - 1 \quad 1 - \cos\varphi_d). \tag{11}$$

Using this additional control goal, the control law maps reference forces in Cartesian space to winch forces:

$$\boldsymbol{F}_w = \mathbf{R}'^{-1}\begin{pmatrix} \begin{pmatrix} 1 & \mathbf{0} \\ \mathbf{0} & \mathbf{S}^{-1} \end{pmatrix} {}^C\boldsymbol{F}_{fc} \\ k_T(x_{T,ab} - x_{T,cd}) \end{pmatrix} \tag{12}$$

with the reference force in Cartesian space $\boldsymbol{F}_{n,ref}$ and the modified mapping matrix

$$\mathbf{R}' = \begin{pmatrix} \mathbf{R} \\ \boldsymbol{r}^T \end{pmatrix}. \tag{13}$$

The winch forces are realized via underlying control loops, which also realize substantial artificial damping based on the winch velocity, similar to [20].

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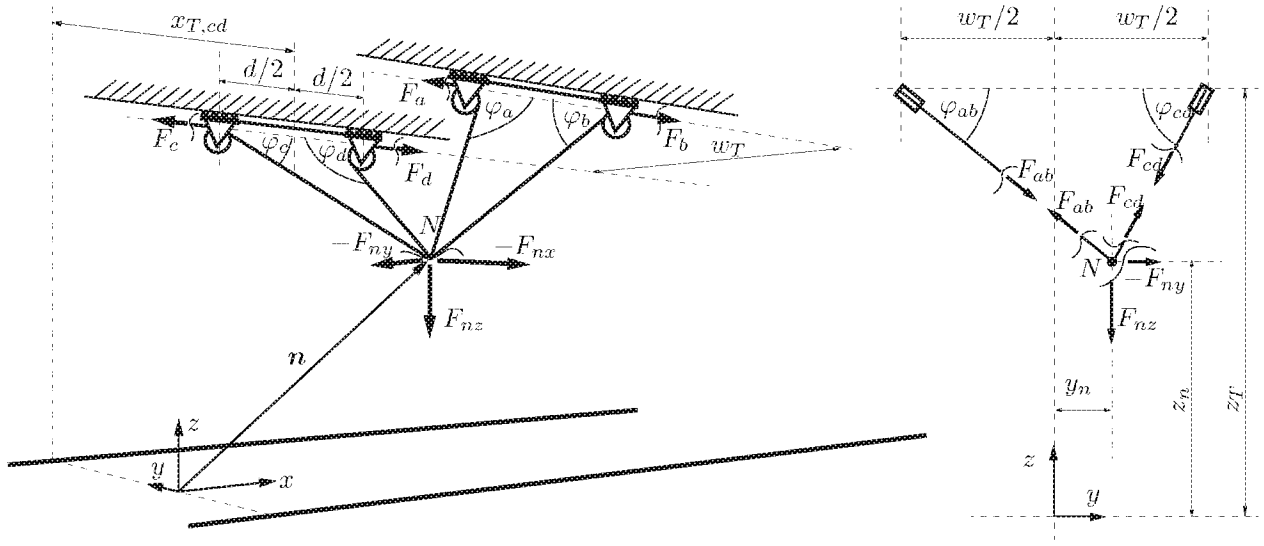


Fig. 4. Free-Body Diagrams with coordinate and variable definitions; 3D view and projection into $y-z$-plane. The object or human subject is connected to the node N. The force $\boldsymbol{F}_n$ acts on the subject, while the reaction force $-\boldsymbol{F}_n$ acts on the robot.

IV. Evaluation Protocol

A. Identification of Apparent Dynamics

In a first experiment, we aimed to identify apparent robot dynamics by exciting the node in all three directions. For each direction individually, we modeled the robot as a linear mass-damper system, whose uncompensated dynamics can be captured by a simple linear model:

$$\Delta\hat{F}_i = m\ddot{n}_i + d\dot{n}_i \text{ , with } i \in \{x, y, z\}. \tag{14}$$

The parameters m and d are the model's mass and damping factor, and $\Delta\hat{F}_i$ is the predicted difference between reference and actual force (as this is only the difference, gravitational components do not occur in the equation).

In order to identify the two parameters, harmonic movements at different frequencies were manually applied to the node, separately for each direction. During these experiments, the robot tracked a reference force in vertical direction of 200 N, to maintain cable tension.

For the individual data sets for each direction, we found m and d by minimizing the linear-quadratic cost function

$$J = |(F_{ref,i} - F_{n,i}) - \Delta\hat{F}_i|^2 \text{ , } i \in \{x, y, z\}. \tag{15}$$

Values for velocity and acceleration of the node were calculated via offline differentiation of the low-pass-filtered node position (non-causal 4th-order Butterworth with cutoff frequency 10 Hz).

As the elastic elements measure the force that acts on the node, not directly on the user, the identified mass has to be augmented by the mass of the beam and harness structure, which is approximately 5 kg. This mass is mainly caused by the emergency release system.

To validate the model, we recorded an additional data set where all directions were excited simultaneously, to assess cross-talk effects. To compare this data with the model predictions, we calculated the coefficient of determination R^2.

B. Force Control Performance during Walking

In a second experiment, we aimed to quantify force control performance in realistic conditions. Five subjects (2m/3f, aged 25-30y, weight 50-85kg) with no known movement disorders participated. Subjects were asked to walk back and forth while attached to the robot and receiving constant body weight support for a duration of 30 s.

The controller described in Sec. III-B was used to track a constant reference force in vertical direction, and zero forces in horizontal directions, as long as the subject remained within virtual workspace limits. At the workspace extremities, an additional spring-like force was applied to limit the workspace before reaching the actual mechanical limits. Subjects were allowed to use the haptic information from these "virtual walls", especially in x direction, to know when to stop and turn around. The experiment was done with two different BWS values in z-direction: 10 kg and 25 kg. As the beam and harness have an additional mass of 5 kg, the reference force in z-direction was increased by an equivalent amount.

Off-line, the acquired force data was smoothed with a 4th-order phaseless Butterworth low-pass filter with a cut-off frequency of 50 Hz. Force tracking performance was evaluated with the root mean square (RMS) error between the reference and the actual force:

$$RMS_i = \sqrt{\frac{1}{N}\sum_{k=1}^{N}[F_{n,i}(k) - F_{ref,i}]^2} \text{ , } i \in \{x, y, z\}. \tag{16}$$

where N is the number of registered samples.

To assess the impact of these forces on human gait, we also recorded the displacement of the node in the three directions, which approximately reflects the movement of the subject's center of mass. From this data, we also calculated the node speed in walking direction, by numerical differentiation with a 10 Hz, non-causal 4th-order Butterworth low-pass filter.

V. Results

A. Apparent Dynamics

The identified values for the apparent mass m were 0.00 kg in x-direction, 1.04 kg in y-direction, and 1.02 kg in z-direction, and the values for damping d were 9.7 Ns/m, 67.4 Ns/m, and 61.6 Ns/m for x, y, and z, respectively. The model matched the multidimensional evaluation data with a coefficient of determination R^2 of 0.68 for x, 0.94 for y, and 0.91 for z. An excerpt of the evaluation data and the model predictions is depicted in (Fig. 5). In all directions, the additional (uncompensable) mass of the bar and harness construction further adds to the apparent mass (with 5 kg).

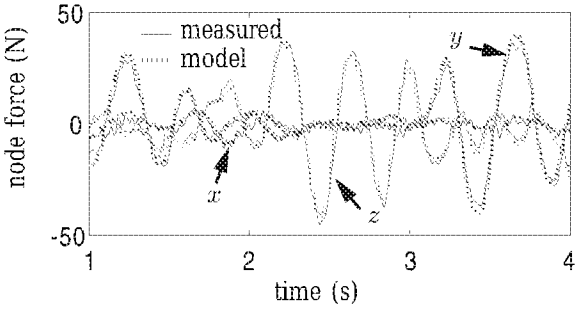


Fig. 5. Measured and predicted forces for multi-directional excitation.

B. Force Control Performance during Walking

Fig. 6, Fig. 7, and Fig. 8 show a concatenation of ten-second excerpts from each subject with 10 kg BWS.

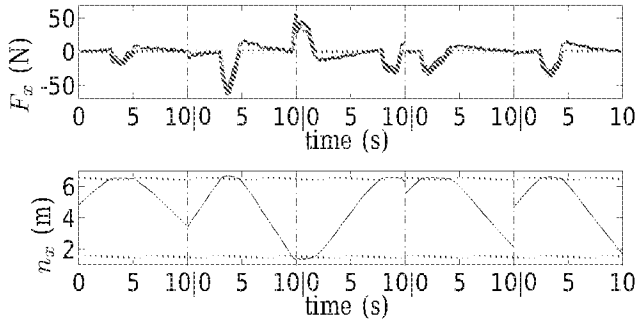


Fig. 6. Concatenated data excerpts from the 5 subjects in x-direction. Top: Reference force (dotted red) and measured force (solid blue). Bottom: Associated node movement in x-direction, with virtual walls (dotted green).

The node forces that were measured are shown in the top plots of the figures. The reference force in the x and y directions was mostly zero, unless the subjects hit the virtual workspace boundaries. This mostly happened in x-direction. In the z-direction, the boundaries were not reached because no large vertical movements were performed in this direction.

Periodic force fluctuations in response to human movements are observed in all three directions (the ones in x are less visible, due to a scaling effect). Across all data sets with the full 30 seconds for each subject, the RMS error was calculated: For 10 kg BWS, the RMS error in force was 6.6 N, 4.6 N, and 7.2 N in x,y, and z direction, respectively. For 25 kg BWS, the

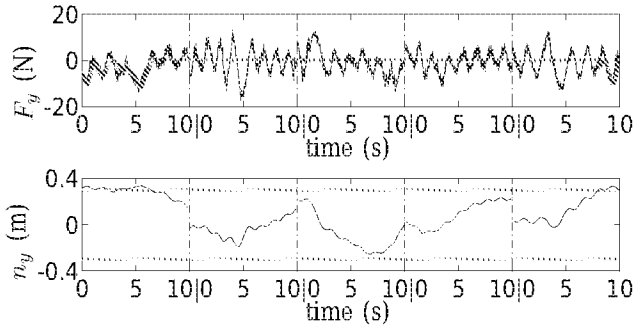


Fig. 7. Concatenated data excerpts from the 5 subjects in y-direction. Top: Reference force (dotted red) and measured force (solid blue). Bottom: Associated node movement in y-direction, with virtual walls (dotted green).

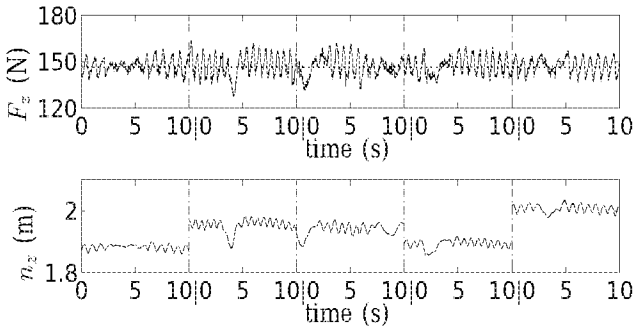


Fig. 8. Concatenated data excerpts from the 5 subjects in z-direction. Top: Reference force (dotted red) and measured force (solid blue). Bottom: Associated node movement in z-direction.

RMS error in force was 9.7 N, 5.7 N, and 9.6 N in x,y, and z direction, respectively.

In the bottom plots of the figures, it can be seen that the movements in the z-direction contain small periodic movements of 1-2 cm amplitude. The position along the y-axis varies more, although it also contains a frequency component with an amplitude of 2-3 cm. In the x-direction, periodic movements are also present, but they are hidden by the large slopes corresponding to the forward and backward movements. The self-selected walking speed for all subjects was between 1 m/s and 1.5 m/s in steady state, without visible influence of the unloading force. Speed oscillations in x-directions were in the range of about 0.1 m/s to 0.2 m/s in amplitude.

VI. Discussion

The achieved force control performance enables highly transparent interaction with walking subjects. This is particularly true for the walking (x)-direction, where the passive degrees of freedom, represented by the trolleys, take the function of hiding virtually all inertia of the actuation units.

As a consequence of this transparency, subjects exhibited rhythmic movements in all three directions that were similar in amplitude to what has been reported in literature for free overground gait. However, there are still undesired forces in response to these movements. In the future, we expect this behavior to be further improved once the IMU is integrated in the control scheme. Furthermore, we have already developed

a non-causal extension to the controller (also presented at this conference [21]), which is based on synchronizing oscillators.

The current controller only applied vertical forces on the subjects, no dedicated assistance in lateral direction was given (besides virtual walls at the workspace limits). For specialized therapy, further algorithms may support subjects in balance tasks, possibly based on the approach we proposed in [22]. The question remains how humans might alter their balance reactions when additional help is provided. The FLOAT offers a research platform to address this question, as well as more general questions on human balance control and falls: In contrast to existing experimental techniques, which induce sudden translations at the feet [23] via perturbation platforms or treadmills, the FLOAT enables perturbations on the upper body during overground locomotion.

VII. Conclusion

In this contribution, we presented the overhead support robot FLOAT, which can apply forces in three directions on the upper body of a human subject. We outlined the control concept and showed first results on force control performance, which demonstrate device transparency. Our next steps are to iteratively evaluate and improve control algorithms in experiments with non-impaired subjects and patients.

In the long run, we aim to make the FLOAT available for diverse therapeutic and research applications: As a therapeutic device, FLOAT can not only support the weight of a user during voluntary movements, but it can also help to initiate movements and to track a 3D reference trajectory for the body's center of mass. Recorded data can also serve diagnostic and prognostic purposes. As a research platform, FLOAT can emulate reduced gravity conditions, but it can also apply horizontal force components on the upper body, for example to laterally perturb or assist the upper body during gait.

Acknowledgment

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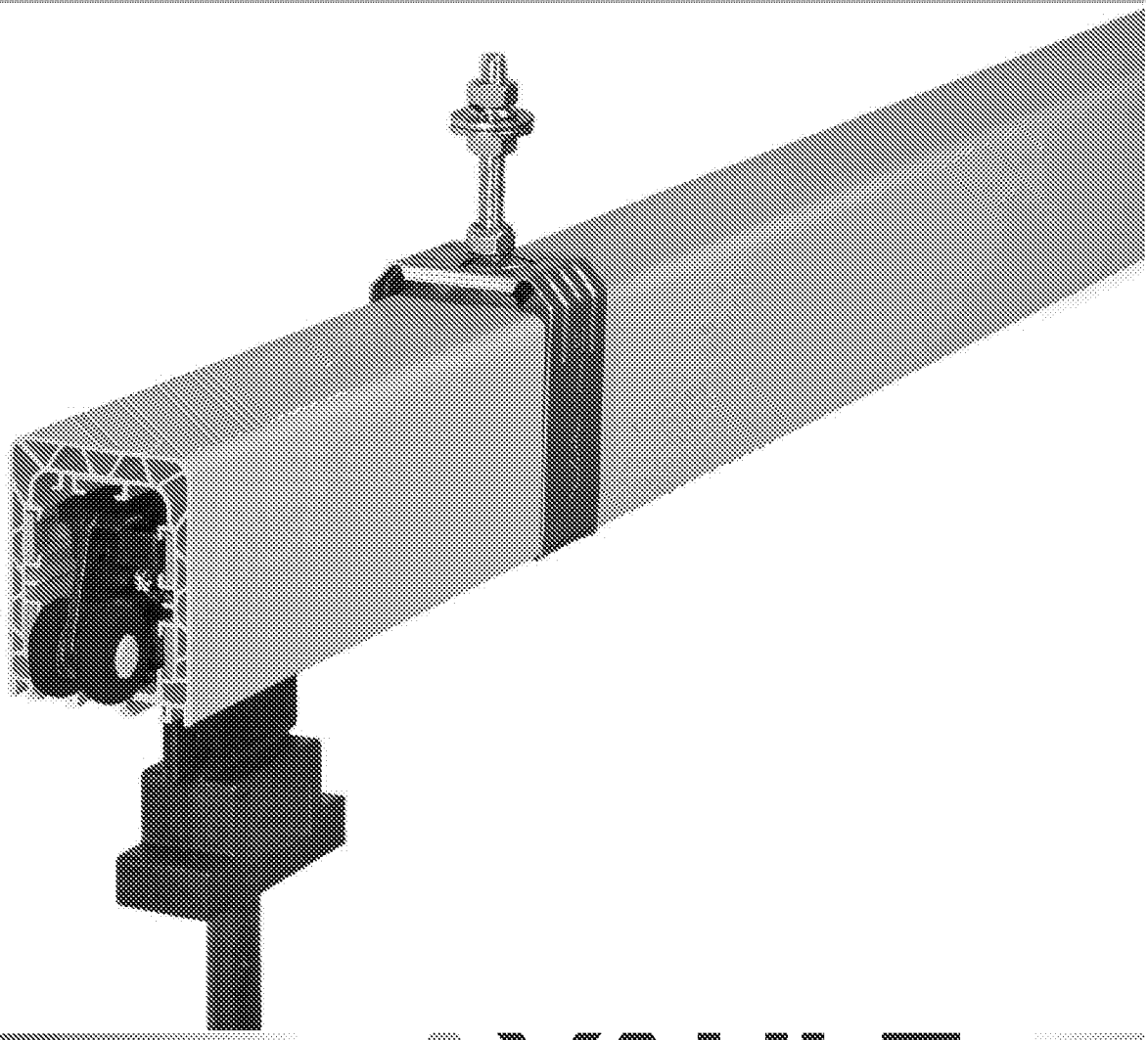
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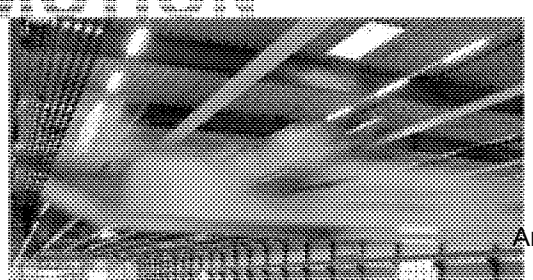


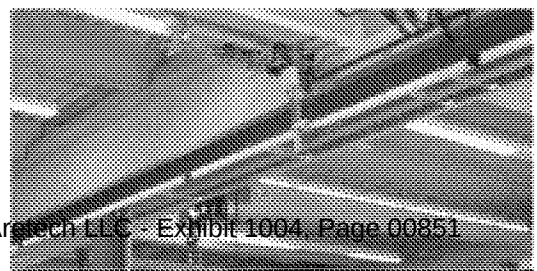
VAHLE

Enclosed Conductor System KBH

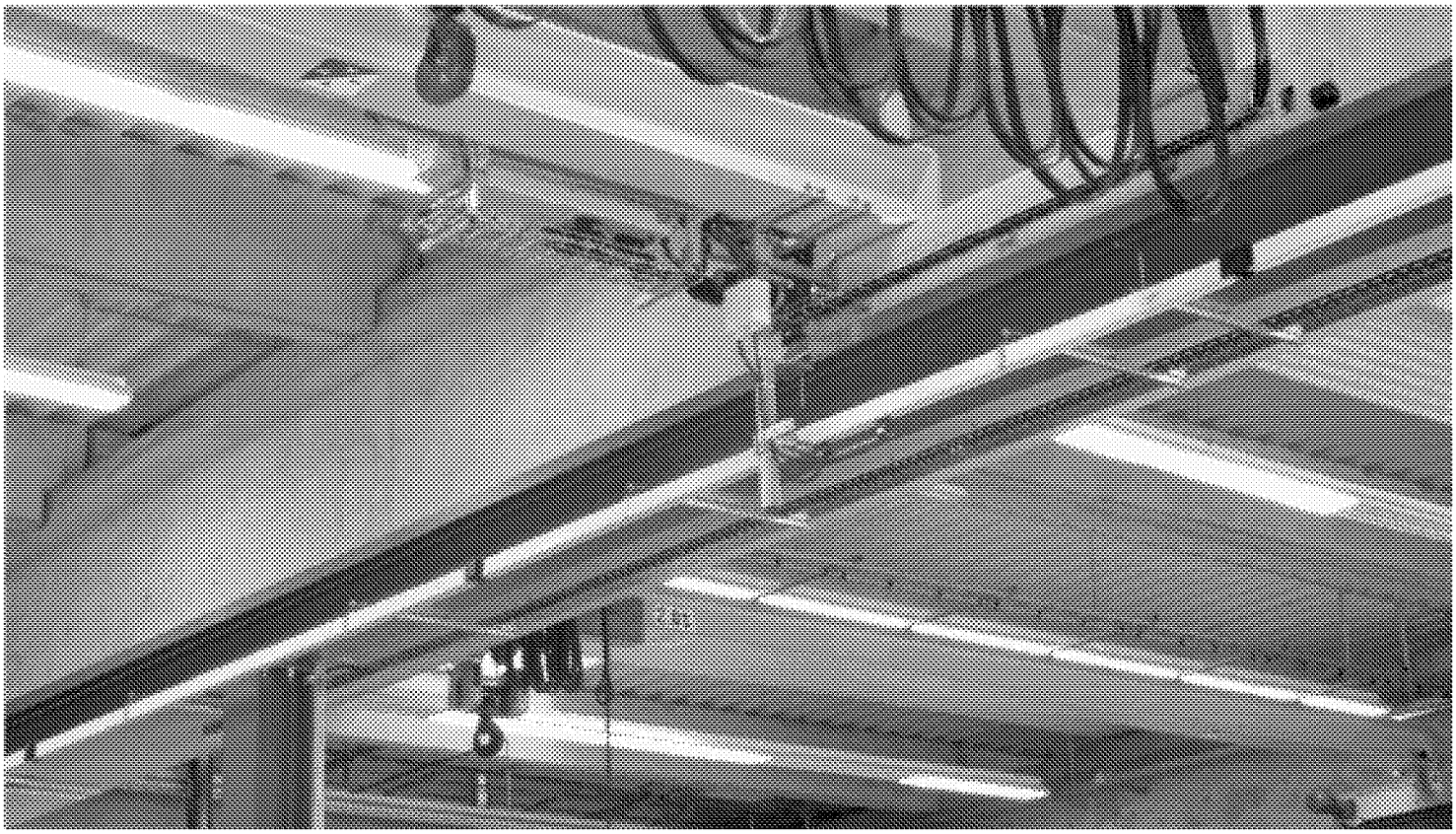
SYSTEMS IN MOTION







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KBH Installation - Overhead Crane



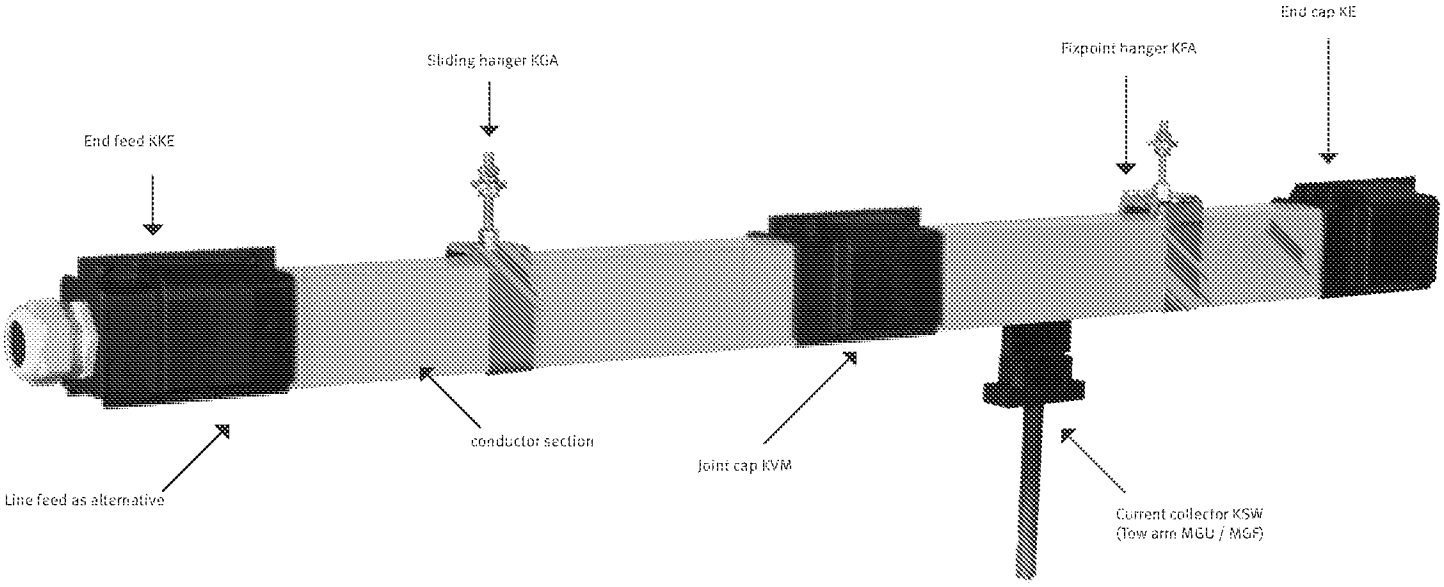
KBH Installation - Process Crane

Enclosed Conductor System KBH

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System Identification



System Overview

VAHLE KBH is a fully enclosed conductor bar solution for both outdoor and indoor applications. The "honeycomb" design housing can accommodate various copper profiles depending on amperage requirements.

KBHF: in 4- and 5-conductor version, with preassembled copper conductors and spring loaded connectors from 40 to 100 A.

KBHS: in 4- and 5-conductor version, with preassembled copper conductors and bolted joints from 40 to 200 A.

A compact design, corrosion resistance and an easy installation are the main benefits to the KBH. The KBH complies with VDE, European and international standards as well as accident prevention regulations. It is protected to IP 23 standards.

The KBH can be supplied with sealing strip and a heating system. The conductor system with sealing strip is protected to IP 24 standards and EN 60529 (0470, part 1) regulation. Current collectors are touch proof only when fully entered into the conductor system.

System Data

Applications
For mobile power consumers, e.g. cranes, monorails, electric hoists, machine tools, automated storage and retrieval systems, lighting systems. Suitable for outdoor and indoor applications.

Approvals
UL

Housing
Color gray, PVC housing for 4 or 5 conductors.
Standard section 4 m. Custom length sections are available.
The ground conductor is identified by green/yellow stripe.
Safety key design of housing and collector prevent phase reversing due to improper installation.
Higher number of conductors possible by combination of several KBH systems.

Couplings
Spring loaded plug in style joints or bolted style joints.

Feed Sets
63A or 90A end feeds, 40-200A line feeds.

Hangers
Easy install sliding and fixpoint hangers.
Max. support distance of the conductor at following ambient temperatures:
- indoor systems and roofed outdoor systems: ≤ 35° C = 2,00 m
- indoor and outdoor systems with and without heating: ≤ 35° C = 1,33 m
- Cold storage: ≤ 0° C = 1.33 m

Expansion During Temperature Fluctuation
Expansion sections are required to compensate the different expansions between copper conductors and steel- or concrete structures, in varying temperatures without interrupting electrical power. The different expansions between the plastic housing and the copper conductors are compensated at each joint.

Anti-Condensation Sections
These sections are used at the transfer of the conductor bar to outdoor areas to avoid condensation. The conductor system is not separated electrically.

Contact Sections, Turntables and Switches
Conductor sections for working areas and transfer applications.
See page 17 and 18.

Sectionalizing
Conductor dead sections are electrical interrupts of the conductor. Under normal operating conditions a cross over with collectors to switch the voltage off or on is only allowed with low power ratings (control current).
The conductors can be separated through air gaps (5 mm) or insulating pieces (35 mm). With the air gap the collector carbon bridges the gap, e.g. for mains.
The insulating piece is longer than the carbon and each conductor section can be separated electrically, e.g. for control.

Collectors
The current collectors are made of re-enforced polyester fiberglass, for high strength and light weight. Spring loaded carbon brushes maintain uniform contact. 1m connecting cables included. Longer lengths available on request.

With the following system requirements double collectors must be used:
- Transfers with switches and turntables
- Low voltages, frequency controlled drives
- Transmission of data and/or emergency stop signals
- High electrical loads

The length of the collector cable may not exceed 3 m if the added overcurrent protection device is not designed for the load capacity of this cable. Please refer also to regulations VDE 0100, part 430 and EN 60204-32.
(Note: this might happen in case of several collectors running in one system).

Proper Spacing - Installation
Ensure proper spacing is followed during assembly. Minimum of 250mm spacing between hangers, joints, feeds, etc. must be followed to ensure proper function. See the KBH installation instructions for details.

Curves
Customer curves and length available on request. Minimum bending radius applies. See page 13 for details.

Please note: For use in galvanizing and pickling plants, under aggressive conditions and low voltage applications we would appreciate receiving detailed information, especially of the environmental conditions.
For quotations and order processing including conductor systems with curves, dead sections, turntables, switches etc. we require system layout drawings. Please use our questionnaire on page 27.

Technical Data

Electrical Values:

Type	max. continuous current	Nominal voltage (UL)	Dielectric strength	Spec. resistance	Surface resistivity	Leakage resistance
KBH	200 A (at 100% DC)	690 V (600 V)	IEC 60243–1–3 30–40 kV/mm	IEC 60093 5×10^{15} Ω/cm	IEC 60093 10^{13} Ω	EN 60112 CTI 400–2,7

Mechanical Properties:

Type	Flexible strength	Tensile strength	Temperature range (ambient):	Combustibility:	Resistance to chemicals: (at 45 °C)
KBH	75 N/mm² ± 10%	40 N/mm² ± 10%	-30 °C up to +60 °C	flame retardant DIN 4102 part 1 class B1; self extinguishing	Gasoline, Mineral Oil, Grease, acid sulfur up to 50%, caustic soda up to 50% and hydrochloric acid up to 25%, concentrated

Consider the voltage drop calculation to maintain the limits established by the motor manufacturers!

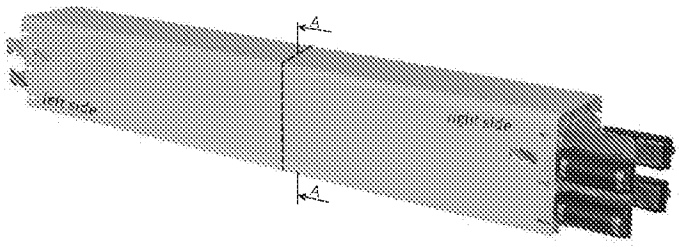
AC: $\Delta U = \sqrt{3} \times I \times I \times Z$
DC: $\Delta U_1 = 2 \times I \times I \times R$

ΔU_1 = Voltage drop [V]
ΔU_2 = Voltage drop in %
I = Ampere load [A]
R = Resistance [Ω/1000 m]
I = Power feed length [m]
L = System length [m]

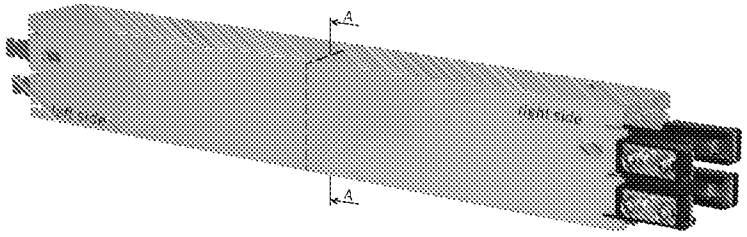
I = L power feed located at the end of the system
I = L/2 power feed located at the center of the system
I = L/4 power feed located at both ends of the system
I = L/6 power feed located at L/6 from each end of the system
Z = impedance [Ω/1000 m]
V = Voltage rating [V]

The total ampere load is determined from the nominal rated current of all motors working simultaneously on the same feed section of your electrification system. A diversity factor of 0.5-0.9 can be considered.
The conductor size and/or number of feed points should be increased or booster cables should be used in parallel in case the drop is exceeding the limitations.

KBH Conductor Bar - Order No & Specifications



KBHF with spring loaded connectors



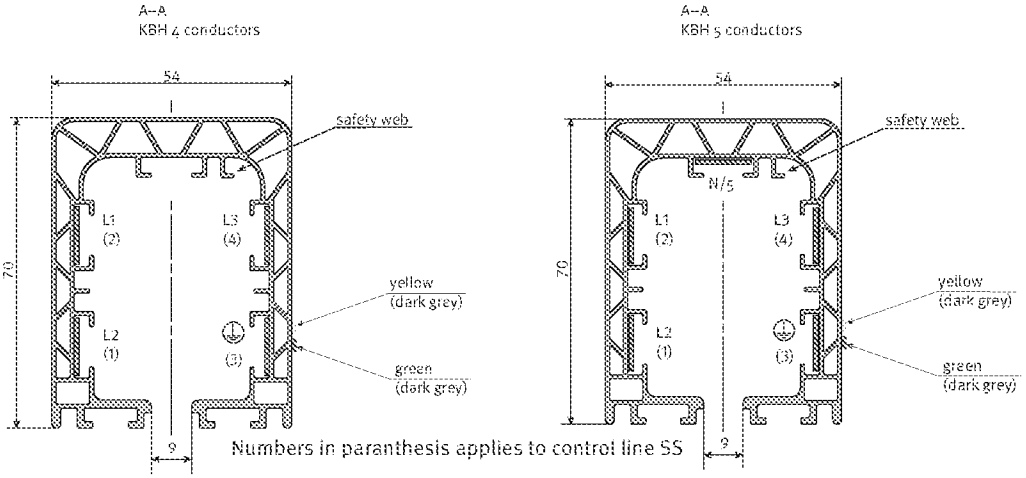
KBHS with bolted joints

Type[1] HS with PE SS without PE	# of conductors	Max. continuous current A at 35°C L1 L2 L3			Copper cross section mm²				Nominal voltage V[4]
		60 % DC	80 % DC	100 % DC	L1 L2 L3	⏚	N / 5[2]	contro line	
KBHF									
KBHF 4 / 40 ... HS	4	52	45	40	3 x 10	10	-	-	690
KBHF 4 / 40 ... SS[5]	4	52	45	40	-	-	-	4 x 10	690
KBHF 4 / 63 ... HS	4	81	70	63	3 x 14	14	-	-	690
KBHF 4 / 100 ... HS	4	129	112	100	3 x 26	26	-	-	690
KBHF 5 / 40 ... HS	5	52	45	40	3 x 10	10	10	-	690
KBHF 5 / 40 ... SS[5]	5	52	45	40			-	5 x 10	690
KBHF 5 / 63 ... HS	5	81	70	63	3 x 14	14	14	-	690
KBHF 5 / 100 ... HS	5	129	112	100	3 x 26	26	26[3]	-	690
KBHS									
KBHS 4 / 40 ... HS	4	52	45	40	3 x 10	10	-	-	690
KBHS 4 / 40 ... SS[5]	4	52	45	40	-	-	-	4 x 10	690
KBHS 4 / 63 ... HS	4	81	70	63	3 x 14	14	-	-	690
KBHS 4 / 100 ... HS	4	129	112	100	3 x 26	26	-	-	690
KBHS 4 / 125 ... HS	4	161	140	125	3 x 33	26	-	-	690
KBHS 4 / 160 ... HS	4	207	179	160	3 x 51	26	-	-	690
KBHS 4 / 200 ... HS	4	258	224	200	3 x 70	42	-	-	690
KBHS 5 / 40 ... HS	5	52	45	40	3 x 10	10	10	-	690
KBHS 5 / 40 ... SS[5]	5	52	45	40	-	-	-	5 x 10	690
KBHS 5 / 63 ... HS	5	81	70	63	3 x 14	14	14	-	690
KBHS 5 / 100 ... HS	5	129	112	100	3 x 26	26	26[3]	-	690
KBHS 5 / 125 ... HS	5	161	140	125	3 x 33	26	26[3]	-	690
KBHS 5 / 160 ... HS	5	207	179	160	3 x 51	26	26[3]	-	690
KBHS 5 / 200 ... HS	5	258	224	200	3 x 70	42	26[3]	-	690

(1) KBHF - Plug in joints, KBHS - Bolted joints, SS - Control only
(2) In case of using a conductor as N please note: VDE 0100 part 430
(3) 5th. Conductor max. 80 A at 100% DC
(4) Nominal voltage UL= 600 V
(5) Control line

KBH Conductor Bar - Order No & Specifications

- Standard order length is 4 meters.
- Cut lengths available on request.

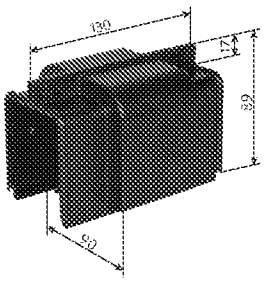


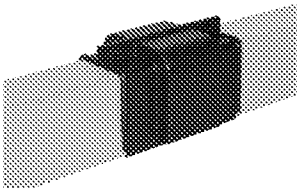
Leakage distance mm	Impedance at 50 Hertz and 20 °C Ω / 1000 m	Resistance at 20 °C Ω/1000 M	Weight kg(lb)/m	Order-No. (1)
33	1.724	1.717	1.351(3)	600 004
33	1.724	1.717	1.351(3)	600 034
33	1.258	1.249	1.487(3.5)	600 014
33	0.702	0.687	1.903(4)	600 024
33	1.724	1.717	1.452(3.5)	600 104
33	1.724	1.717	1.452(3.5)	600 134
33	1.258	1.249	1.622(3.5)	600 114
33	0.702	0.687	2.142(4.5)	600 124
33	1.724	1.717	1.481(3.5)	600 044
33	1.724	1.717	1.481(3.5)	600 094
33	1.258	1.249	1.617(3.5)	600 054
33	0.702	0.687	2.033(4.5)	600 064
33	0.568	0.549	2.207(5)	600 074
30	0.376	0.351	2.699(5)	600 084
27	0.283	0.255	3.357(7.5)	600 314
33	1.724	1.717	1.614(3.5)	600 144
33	1.724	1.717	1.614(3.5)	600 194
33	1.258	1.249	1.784 (4)	600 154
33	0.702	0.687	2.304 (5)	600 164
33	0.568	0.549	2.479 (5.5)	600 174
30	0.376	0.351	2.970 (6.5)	600 184
27	0.283	0.255	3.638 (8)	600 324

(1) The last digit of the order no. specifies the section length. Please change the suffix of the order number with 1, 2, 3, 4 depending on length required.

Ground = PE

Joint Caps, Hangers & End Caps

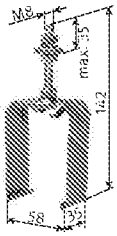


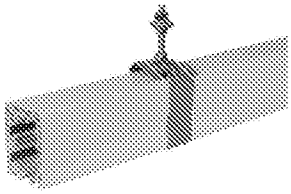


Installed

Joint Cap, self locking

Type	Weight kg (lb)	Order-No.
KVM	.096 (.4)	600 005



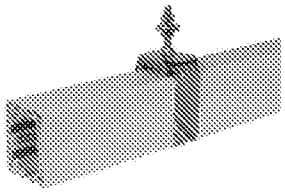


Installed

Sliding Hanger

Type[1]	Weight kg (lb)	Order-No.
KGA	.100 (.5)	600 000
KGA / K	.100 (.5)	600 397

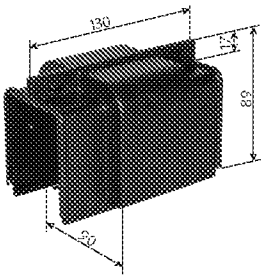


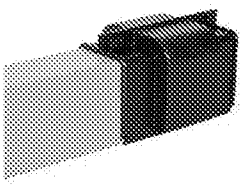


Installed

Fixpoint Hanger

Type[1]	Weight kg (lb)	Order-No.
KFA	.132 (.5)	600 007
KFA / K	.132 (.5)	600 398





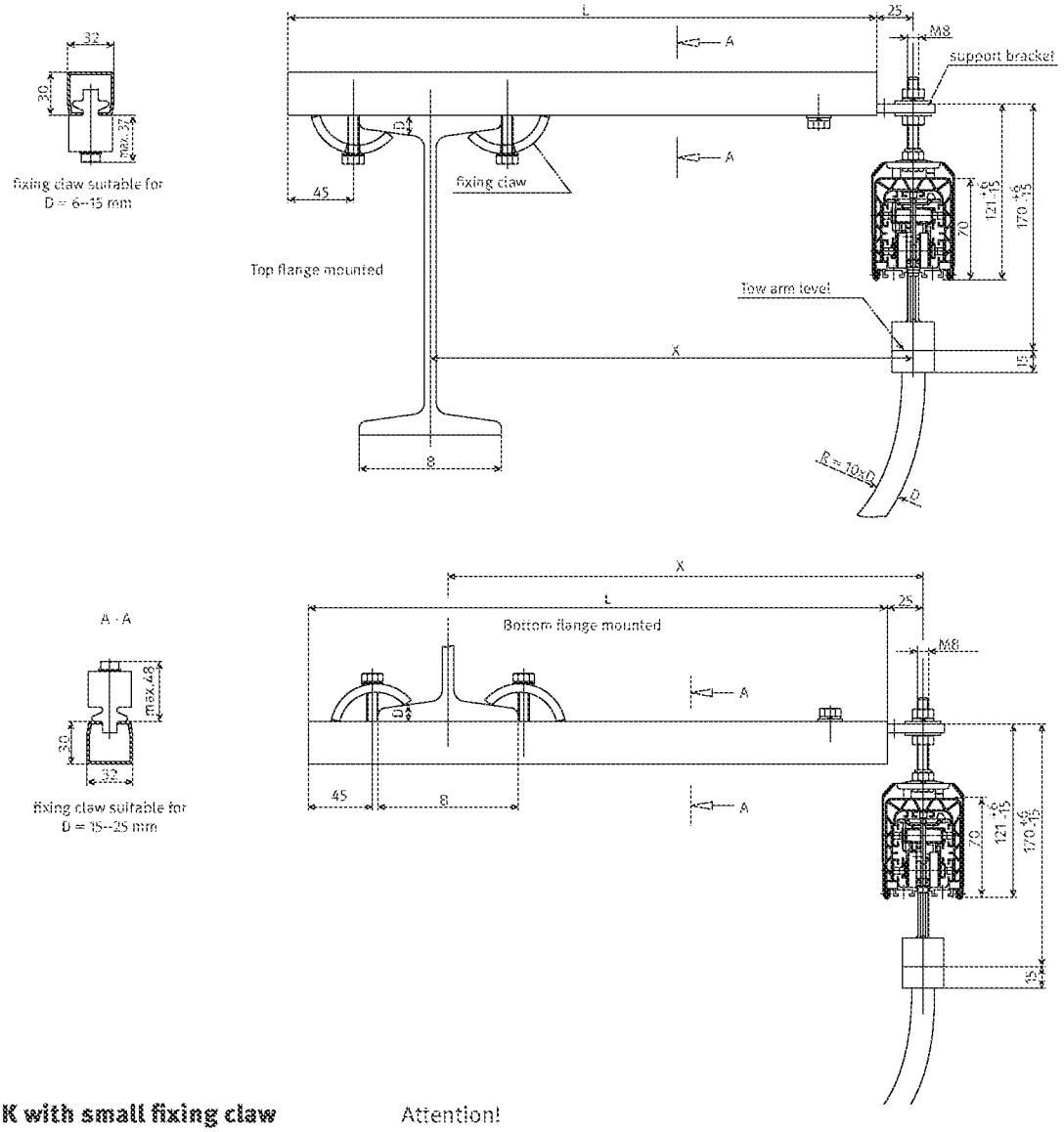
Installed

End Cap
left and right version

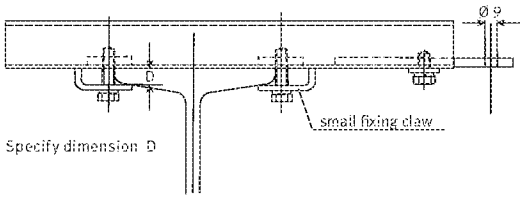
Type	Weight kg (lb)	Order-No.
KE	.120 (.4)	600 008

(1) /K = stainless steel

Brackets



Arrangement EHK with small fixing claw



Attention!
Make sure that hoist wheels have enough clearance.
Use small claw if necessary.

Select next larger size bracket when your I-beam dimension B is more than 170mm up to 300 mm.

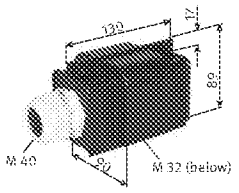
□ - rail of EHK is identical to type S 1, Cat. 8 a

Type	X mm	L mm	B max. mm	Weight kg (lb)	Order No. standard version	Order No. with small fixing claw
EHK 250	250	350	170	1.070 (2)	251 600	251 720
EHK 300	300	400	170	1.150 (2.5)	251 610	251 730
EHK 400	400	500	170	1.300 (2.5)	251 620	251 740
EHK 500	500	600	170	1.450 (3)	251 630	251 750
EHK 600	600	700	170	1.600 (3.5)	251 640	251 760
EHK 700	700	800	170	1.750 (4)	251 650	251 770
EHK 750	750	850	170	1.820 (4)	251 660	251 780

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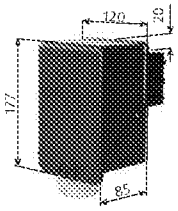
End Feeds & Joint Feeds

63A End Feed (up to 63 A)
- End feed comes loose without conductor section
- It can be mounted on the left or right hand side
- Electrical connection with customer supplied cable shoes to M6 terminals
- Max. connecting cross section 10 mm²



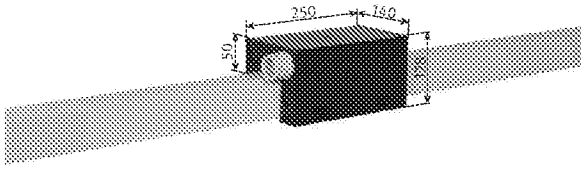
Type	Weight kg (lb)	Cable gland (Dimensions see page 13)	Order-No.
KKE 4 / 40–63 HS	.218 (.5)	M 40	600 010
KKE 5 /40–63 HS	.230 (.5)	M 40	600 107
KKE 4 / 40 SS	.196 (.4)	M 32	600 015
KKE 5 / 40 SS	.208 (.5)	M 32	600 108

90° End Feed (up to 100 A)
- End feed comes loose without conductor section
- It can be mounted on the left or right hand side
- Electrical connection with customer supplied cable shoes to M6 terminals
- Max. connecting cross section 35 mm²



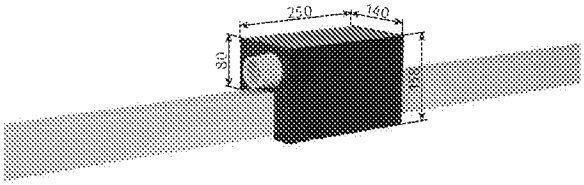
Type	Weight kg (lb)	Cable gland (Dimensions see page 13)	Order-No.
KKE 4 / 40–100 HS	.570 (1.2)	M 32 & M 50[1)]	600 422
KKE 5 / 40–100 HS	.610 (1.3)	M 32 & M 50[1)]	600 423

Joint Feed (up to 63 A)
- KSE type comes loose without conductor section
- It can be mounted at any joint
- Electrical connection with customer supplied cable shoes to M6 terminals



Type	Weight kg (lb)	Cable gland (Dimensions see page 13)	Order-No.
KSE 4 / 40 HS	.756 (1.6)	M 25	600 030
KSE 4 / 63 HS	.776 (1.7)	M 32	600 035
KSE 5 / 40 HS	.812 (1.8)	M 25	600 037
KSE 5 / 63 HS	.832 (1.8)	M 32	600 038
KSE 4 / 40 SS	.756 (1.6)	M 25	600 028
KSE 5 / 40 SS	.812 (1.8)	M 25	600 029

Joint Feed (up to 100 A)
- KSE type comes loose without conductor section
- It can be mounted at any joint
- Electrical connection with customer supplied cable shoes to M6 terminals

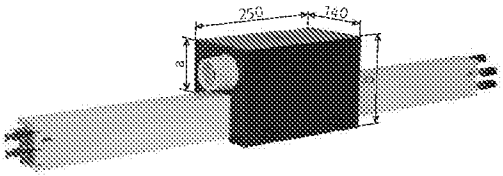


Type	Weight kg (lb)	Cable gland (Dimensions see page 13)	Order-No.
KSE 4 / 100 HS	.908 (2)	M 50	600 036
KSE 5 / 100 HS	.964 (2.1)	M 50	600 039

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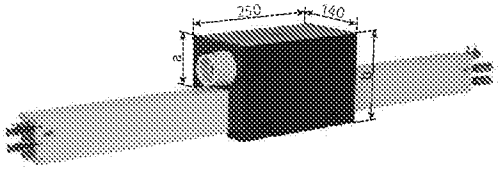
Line Feeds

Line Feed
- Includes 1 m section, 40–100 A
- With plug in joints
- Electrical connection with customer supplied cable shoes to M6 terminals



Type	Weight kg (lb)	Dimension mm		Cable gland (Dimensions see page 13)	Order No.
		a	b		
KEF 4 / 40 HS	2.099 (4.6)	50	128	M 25	600 197
KEF 4 / 63 HS	2.255 (5)	50	128	M 32	600 199
KEF 5 / 40 HS	2.256 (5)	50	128	M 25	600 205
KEF 5 / 63 HS	2.446 (5.4)	50	128	M 32	600 207
KEF 4 / 100 HS	2.803 (6)	80	158	M 50	600 201
KEF 5 / 100 HS	3.098 (6.8)	80	158	M 50	600 209
KEF 4 / 40 SS	2.099 (4.6)	50	128	M 25	600 195
KEF 5 / 40 SS	2.256 (5)	50	128	M 25	600 203

Line Feed
- Includes 1 m section, 40–125 A
- With bolted joints
- Electrical connection with customer supplied cable shoes M6 terminals to 100 A, with M8 terminals to 125 A

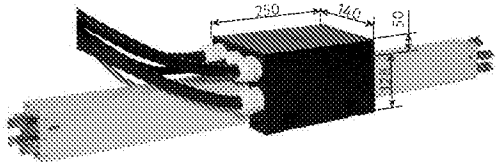


Type	Weight kg (lb)	Dimension mm		Cable gland (Dimensions see page 13)	Order No.
		a	b		
KES 4 / 40 HS	2.229 (5)	50	128	M 25	600 221
KES 4 / 63 HS	2.385 (5.3)	50	128	M 32	600 223
KES 5 / 40 HS	2.413 (5.3)	50	128	M 25	600 229
KES 5 / 63 HS	2.608 (5.7)	50	128	M 32	600 231
KES 4 / 100 HS	2.933 (6.5)	80	158	M 50	600 225
KES 4 / 125 HS	3.251 (7.2)	80	158	M 50	600 045
KES 5 / 100 HS	3.260 (7.2)	80	158	M 50	600 233
KES 5 / 125 HS	3.606 (8)	80	158	M 50	600 049
KES 4 / 40 SS	2.229 (5)	50	128	M 25	600 219
KES 5 / 40 SS	2.418 (5.3)	50	128	M 25	600 227

Feeds in the curve area on request.

Line Feed & Terminal Box

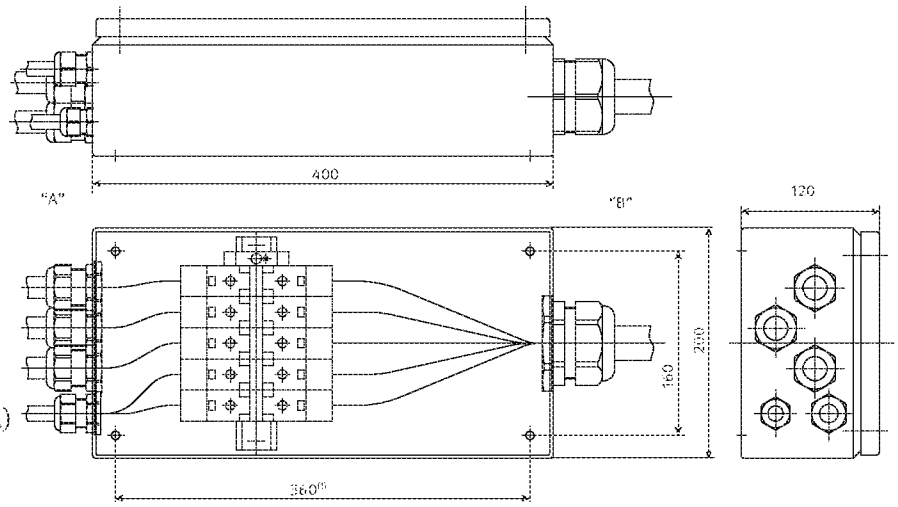
Line Feed
- Includes 1m section (125 - 200 A) with 2m single cores
- With bolted joints
- Electrical connection with customer supplied cable shoes to M 6 terminals. See below



Type	Weight kg (lb)	Cable cross section in mm² / Diameter in mm			Order-No.
		L1–L3	Ground	N / 5	
KELS 4 / 125 HS	8.560 (18.9)	35 / 16	25 / 10		600 069
KELS 4 / 160 HS	9.784 (21.5)	50 / 18	25 /10	-	600 075
KELS 4 / 200 HS	11.400 (25)	70 / 21	35 / 11	-	600 385
KELS 5 / 125 HS	9.372 (20.6)	35 / 16	25 / 10	25 / 15	600 077
KELS 5 / 160 HS	10.596 (23.4)	50 / 18	25 / 10	25 / 15	600 079
KELS 5 / 200 HS	12.212 (27)	70 / 21	35 / 11	25 / 15	600 387

Terminal Box
(for KELS, 125–200 A)

- Connection with customer supplied cable
- Clamping range 16-95 mm²
- View A input of the single cores of the KELS (a.m.)
- View B with M 63 (Dimensions see page 13)



Type	Weight kg (lb)	for line feed	Order-No.
ZK 1	5.030 (11)	KELS 4 / 125 HS	600 389
ZK 2	5.040 (11)	KELS 4 / 160–200 HS	600 390
ZK 3	5.370 (11.8)	KELS 5 / 125 HS	600 391
ZK 4	5.380 (11.8)	KELS 5 / 160–200 HS	600 392

Feeds in the bow area on request.
(1) Fixing borings ø 7 mm at the bottom of the box.

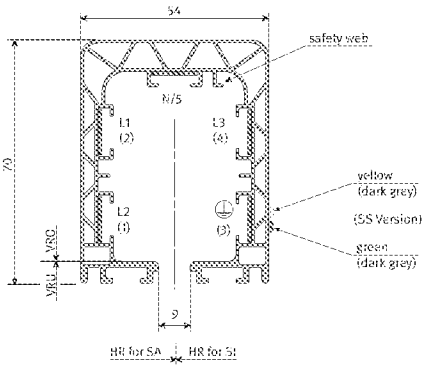
Aretech LLC - Exhibit 1004, Page 00862

Curves, Sealing Strip & Cable Glands for Feeds

Curves

Production corresponding to customer layout

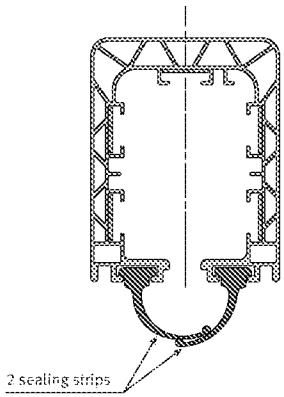
Min. horizontal bending radius	40–125 A	= 600 mm
	160 A	= 1000 mm
	200 A	= on request
max. 120°		
min. bending radius, vertical		= 2000 mm
max. curved length		= 3600 mm



Horizontal curve designate SI and SA
SI = Safety-web inside
SA = Safety web outside

Vertical curve designate VRO and VRU
VRU =Vertical radius downwards
VRO =Vertical radius upwards

Safety web will be mounted in direction of track.
Changes in measurements of curves have to be specified for replacement orders.



Sealing Strip & accessories

(1)Strip sold in 10m increments. Max continuous length is 40m

(1)Strip for KBH works in pairs. Example: 40m system length requires 80m sealing strip.

Type	Order No.
Sealing strip[1]	600 551
Fixing clamp (1 per end)	600 354
Joint coupling (2 for each joint, required every 40m)	258 300
Installation tool for sealing strip	600 109
Slide plate for collectors (KSW)	600 640

Cable glands for feeds

for type	Cable gland	for cable diam. in mm	Power rating in A	Page
KKE	M 50	27–35	40 –100 HS	10
KKE	M 40	17–28	40 / 63 HS	10
KKE	M 32	15–21	40 SS	10
KSE/KEF/KES	M 25	9–19	40 HS / SS	10 and 11
KSE/KEF/KES	M 32	17–26	63 HS	10 and 11
KSE/KEF/KES	M 50	23–34	100 HS	10 and 11
KES	M 50	29–40	125 HS	11
ZK 1–4 (Seite 8)	M 63	27–48	125 / 160 / 200 HS	10

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Heating Cable

Type	Resistance[1]	Order No.
Heating cable: H 0.15	0.15 Ω/m	196 382
Heating cable: H 0.20	0.20 Ω/m	196 383
Heating cable: H 0.32	0.32 Ω/m	196 384
Heating cable: H 0.38	0.38 Ω/m	196 385
Heating cable: H 0.48	0.48 Ω/m	196 386
Heating cable: H 0.60	0.60 Ω/m	196 387
Heating cable: H 0.81	0.81 Ω/m	196 389
Heating cable: H 1,00	1.00 Ω/m	196 390
Heating cable: H 1.44	1.44 Ω/m	196 391
Heating cable: H 2.00	2.00 Ω/m	196 392
Heating cable: H 3.00	3.00 Ω/m	196 393

We recommend a heating system for exposed (uncovered) cold outdoor installations and in high humidity plants. The heating consists of two heating cables which are arranged according to fig. 1A. System and application specifics must be considered when ordering heating systems. Contact VAHLE directly for additional details and quotations.

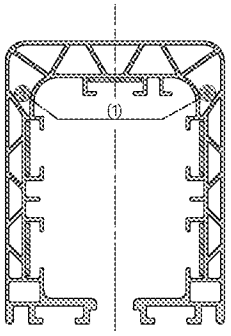
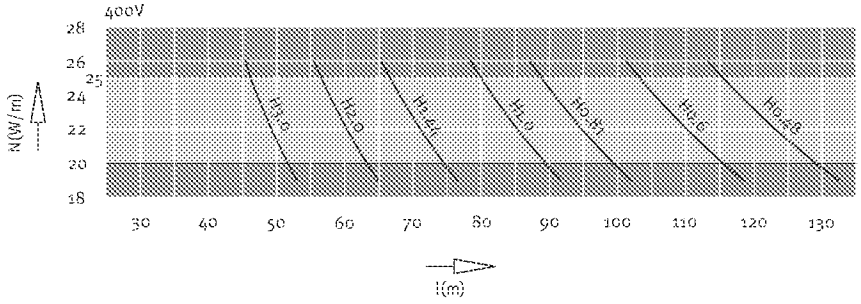
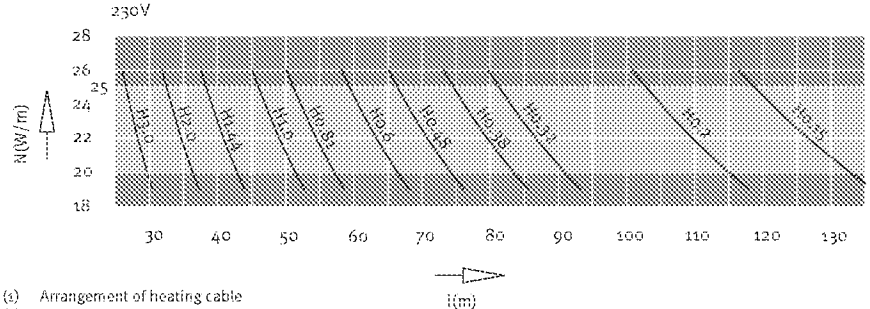


Fig. 1A

Construction of the heating cable: Heating resistor made of CrNi (different conductors)
Isolation of heating cable PTFE (Teflon)
Nickel-plated copper netting
Sheath PTFE-Isolation
Outer diameter: 3.7mm - 4.3 mm





$$\text{Heating capacity Watt/m: } N' = \frac{U^2}{R \cdot L^2}$$

U = Supply voltage (Volt)
R = Resistance of heating cable (Ohm/m)
L = Lenght of heating section (m)

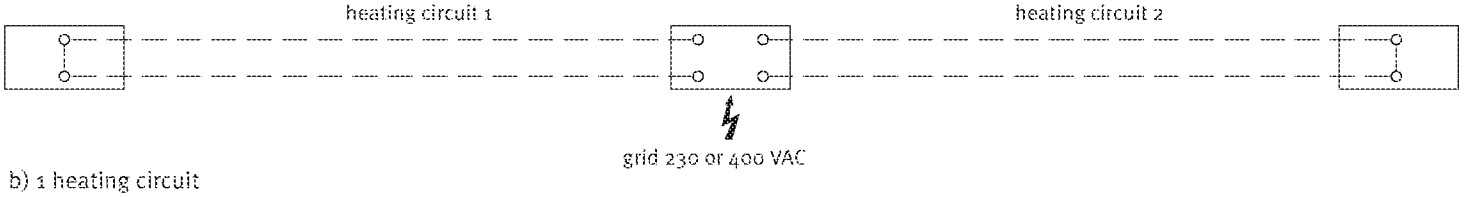
(1) Arrangement of heating cable

Aretech LLC - Exhibit 1004, Page 00864

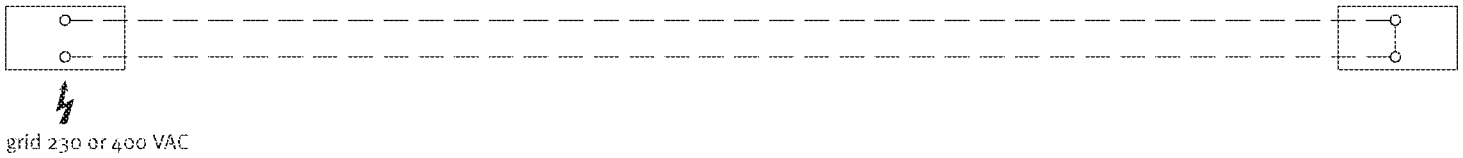
Heating Cable

Layout examples (depending on system situation)

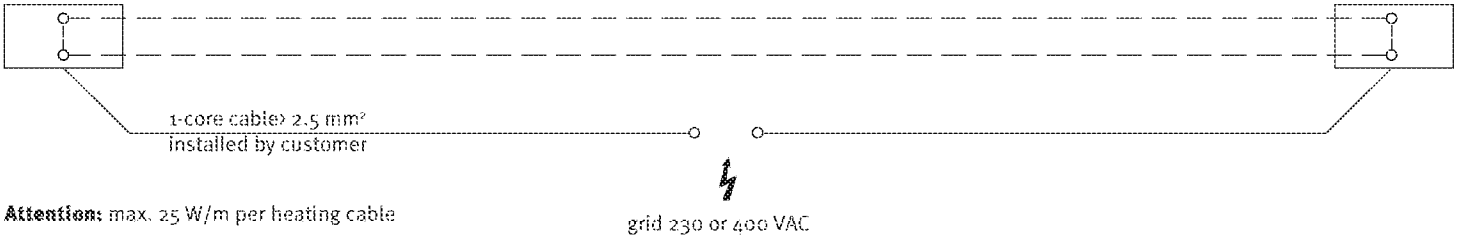
a) 2 heating circuits



b) 1 heating circuit



c) 2 heating circuits



Attention: max. 25 W/m per heating cable

Terminal box

Terminal boxes for heating

Type	Version	Cable gland Measurements see page 13	Order-No.
Teminal box	left end	M 25	600 155
Teminal box	right end	M 25	600 156
Teminal box	line feed	2 x M 25	600 065
1 set material for connecting clamps*			195 291

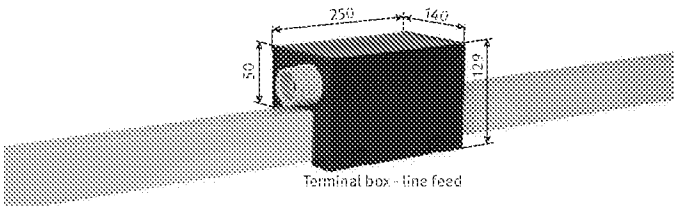
* For each end feed box: 2 sets of material for connecting ends are required.
* For line feed: 4 sets of material for connection ends are required.

Order for 60 m powerail (example only)

1) 122 m heating cable type H 2,0
   (2 x 60 m and 2 x 1 m additional)
   Voltage 400 V, two heating circles parallel
   heating capacity as per above mentioned diagramm
   2 x 22 W/m at 60 m 2 x 22 W/m ~2640 W = 2,64 kW.

2) 1x junction box left end
   1x junction box right end

3) 4x sets of material for connection ends.

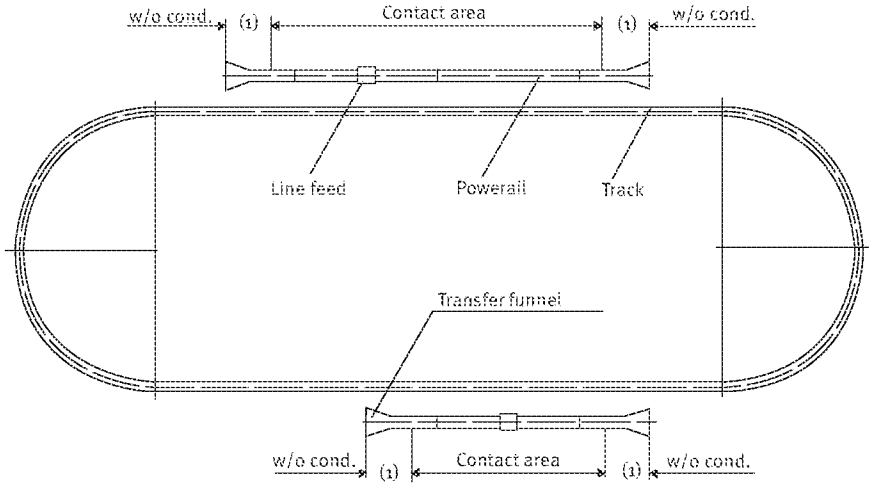


Switch gear assembly and temperature control unit as per customer's inquiry.
Fuses, cables etc. are to be provided by the customer.

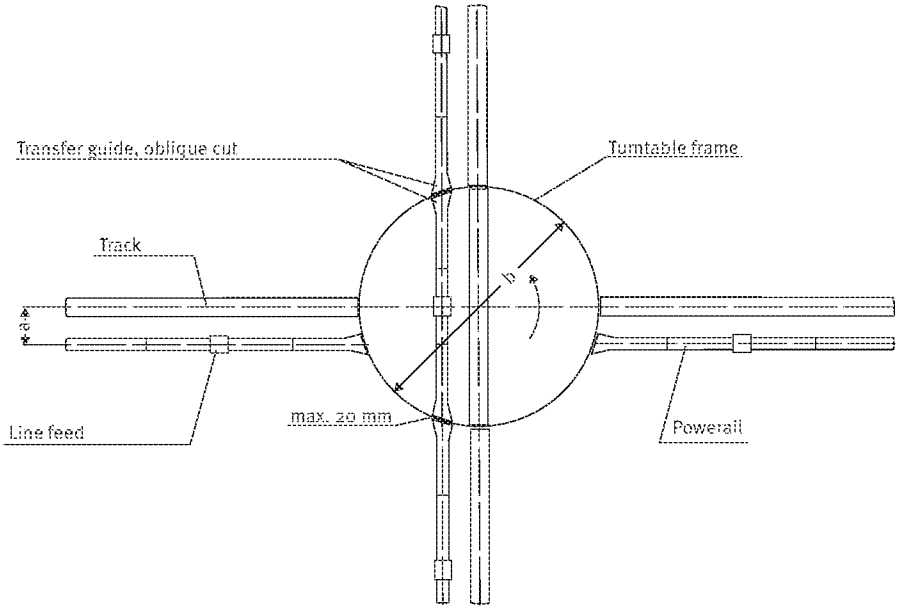
Aretech LLC - Exhibit 1004, Page 00865

Contact sections, Turntables & Switches

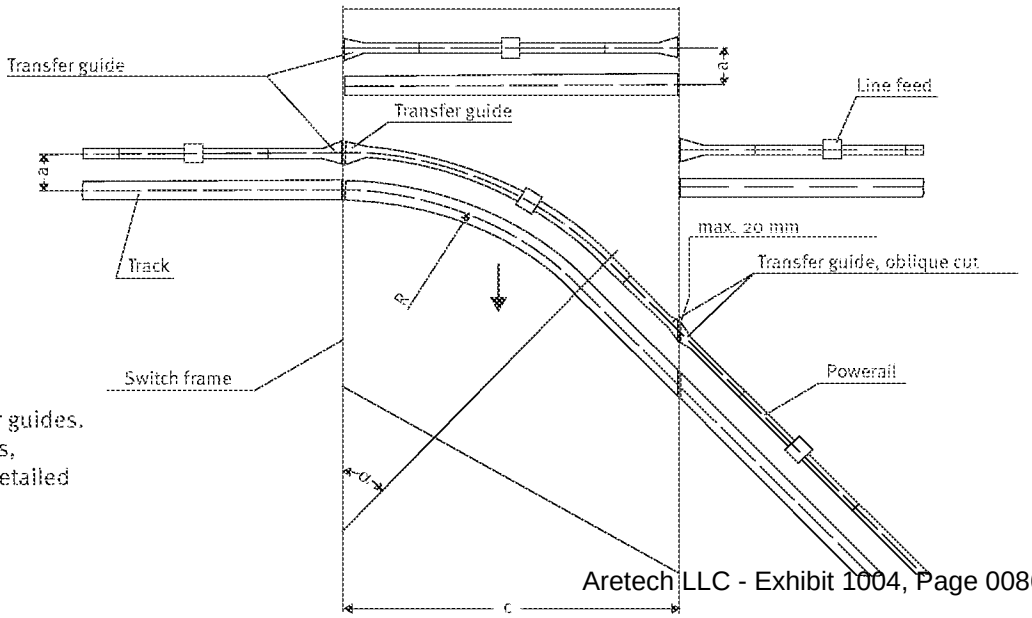
Contact section[1]



Turntable



Switch



Please submit drawings of transfer applications.
Specify dimensions a, b, c, R and angle (max. 50°)

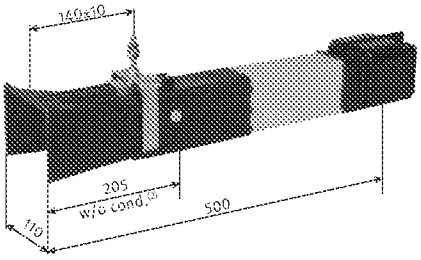
Max. 20 mm air gap between transfer guides.
To create all parts for contact sections, turntables and switches we require detailed construction drawings.

Aretech LLC - Exhibit 1004, Page 00866

Transfer Funnels & Transfer Guides

Transfer Funnel

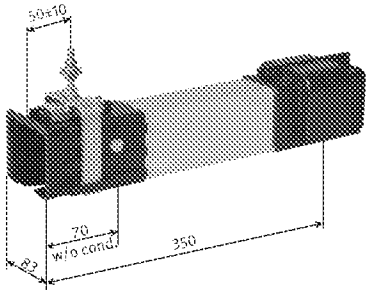
- Conductor system should not be activated until the collectors are fully inserted into the system.
- Offset: max. 10 mm horizontal
  max. 10 mm vertical
- Max. speed for crossover of the current collector 60 m/min.



Type(1)	Weight kg (lb)	Order No.	
		left version	right version
KET 4 / 40–125 HS	1.612 (3.5)	600 285	600 279
KET 4 / 160 HS	1.724 (3.8)	600 286	600 280
KET 4 / 200 HS	1.943 (4.3)	600 305	600 303
KET 5 / 40–125 HS	1.720 (3.8)	600 288	600 282
KET 5 / 160 HS	1.858 (4)	600 289	600 283
KET 5 / 200 HS	2.128 (4.7)	600 306	600 304
KET 4 / 40 SS	1.612 (3.6)	600 287	600 281
KET 5 / 40 SS	1.720 (3.8)	600 290	600 284

Transfer Guides - straight

- Necessary with all types of double collectors or 2 single collectors.
- Staggered arrangement of the transfer guides to each other: max. 5 mm horizontal
  max. 3 mm vertical
- Max. speed for crossover of the current collector 80 m/min.



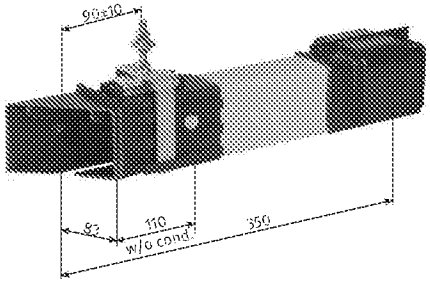
Type(1)	Weight kg (lb)	Order No.	
		left version	right version
KÜ 4 / 40–125 HS	1.348 (3)	600 261	600 255
KÜ 4 / 160 HS	1.448 (3.2)	600 262	600 256
KÜ 4 / 200 HS	1.640 (3.6)	600 309	600 307
KÜ 5 / 40–125 HS	1.500 (3.3)	600 264	600 258
KÜ 5 / 160 HS	1.625 (3.6)	600 265	600 259
KÜ 5 / 200 HS	1.865 (4.1)	600 310	600 308
KÜ 4 / 40 SS	1.348 (3.0)	600 263	600 257
KÜ 5 / 40 SS	1. 500 (3.3)	600 266	600 260

(1) Add types e.g. KET 4/40-125...HS Left hand version KET 4/40-125 L HS Order-No. 600 285.
(2) Corresponding to the center of collector

Transfer Guides

Transfer Guides - oblique

- Necessary with all types of double collectors or 2 single collectors.
- Staggered arrangement of the transfer guides to each other: max. 5 mm horizontal
  max. 3 mm vertical
- Measurements (oblique) and angle to be specified by customer
- Max. speed for crossover of the current collector 80 m/min.



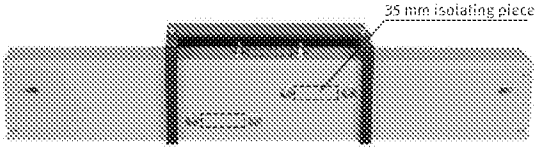
Type[1]	Weight kg (lb)	Order-No.	
		left version	right version
KÜS 4 / 40–125 HS	1.312 (2.9)	600 273	600 267
KÜS 4 / 160 HS	1.396 (3)	600 274	600 268
KÜS 4 / 200 HS	1.560 (3.4)	600 317	600 315
KÜS 5 / 40–125 HS	1.450 (3.2)	600 276	600 270
KÜS 5 / 160 HS	1.555 (3.4)	600 277	600 271
KÜS 5 / 200 HS	1.760 (3.9)	600 318	600 316
KÜS 4 / 40 SS	1.312 (2.9)	600 275	600 269
KÜS 5 / 40 SS	1.450 (3.2)	600 278	600 272

(1) Add types e.g. KÜS 4/40-125...HS Left hand version KÜS 4/40-125 L HS Order-No. 600 267

Conductor Dead Section

Conductor Dead Section

Please advise which conductors should be disconnected
(see Page 6 and 7). The dead section comes factory assembled.



Picture shows an isolating piece.

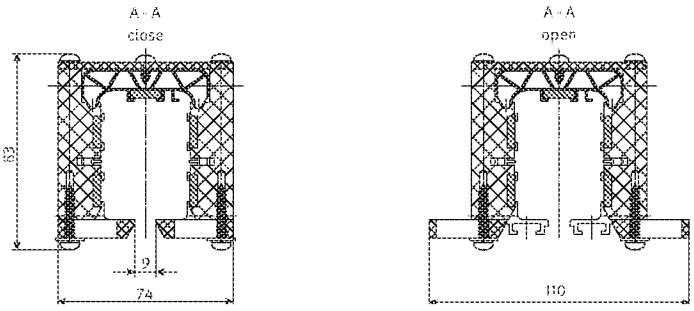
Air gap 5 mm		Isolating piece 35 mm	
Type	Order-No.	Type	Order-No.
KTL 1	600 298	KTI 1	600 293
KTL 2	600 299	KTI 2	600 294
KTL 3	600 300	KTI 3	600 295
KTL 4	600 301	KTI 4	600 296
KTL 5	600 302	KTI 5	600 297

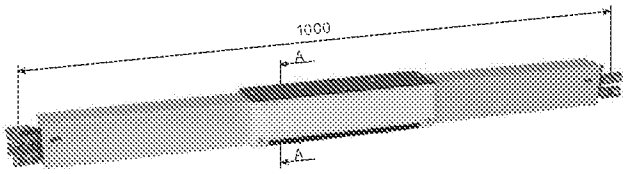
Removing Section

Removing section
Includes 1m conductor section with special bolted joints for KBHF & KBHS

Application
Removal and insertion of the collector is possible at any point a removal section is installed. Standard method of removal or insertion of collector is at system ends. By opening and closing the sliders at the bottom of the removing section housing the collector can be removed or inserted easily.

All safety restrictions must be followed before removal or insertion of collector as the removing section does not interrupt the conductor system electrically.





For single collectors

Type	Weight kg (lb)	Order-No.
KAT 4 / 40–125 HS	3.450 (7.6)	600 165
KAT 4 / 160 HS	3.802 (8.4)	600 166
KAT 4 / 200 HS	4.494 (9.9)	600 327
KAT 5 / 40–125 HS	3.781 (8.3)	600 167
KAT 5 / 160 HS	4.133 (9.1)	600 168
KAT 5 / 200 HS	4.825 (10.6)	600 328
KAT 4 / 40 SS	3.450 (7.6)	600 169
KAT 5 / 40 SS	3.781 (8.3)	600 170

For double collectors

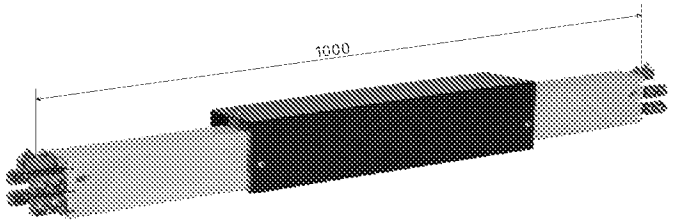
Type	Weight kg (lb)	Order-No.
KATD 4 / 40–125 HS	4.044 (8.9)	600 175
KATD 4 / 160 HS	4.396 (9.7)	600 176
KATD 4 / 200 HS	5.088 (11.2)	600 329
KATD 5 / 40–125 HS	4.375 (9.6)	600 177
KATD 5 / 160 HS	4.727 (10.4)	600 178
KATD 5 / 200 HS	5.419 (11.9)	600 330
KATD 4 / 40 SS	4.044 (8.9)	600 179
KATD 5 / 40 SS	4.375 (9.6)	600 180

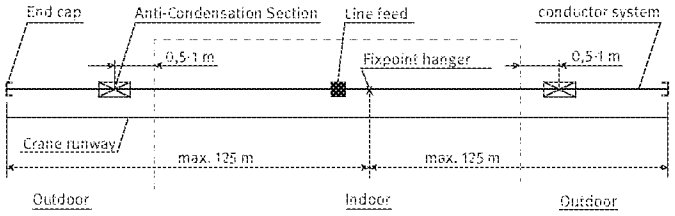
Anti-Condensation Section

Anti-Condensation Section
Includes 1m section with special bolted joints for KBHF & KBHS

Application
The anti-condensation section is be used anywhere the conductor systems are passing from indoor to outdoor, preventing condensation of the outside mounted conductor section. The warm air from indoors can escape through the anti condensation section (see sketch). The anti-condensation section does not interrupt the conductor system electrically. Additional feeds are not required.

Assembly
The anti-condensation section is to be placed directly (0.5m - 1m max.) at the transfer point from indoor to outdoor. See sketch.





Type	Weight kg (lb)	Order-No.
KBT 4 / 40–125 HS	3.858 (8.5)	600 185
KBT 4 / 160 HS	4.210 (9.3)	600 186
KBT 4 / 200 HS	4.902 (10.8)	600 319
KBT 5 / 40–125 HS	4.180 (9.2)	600 188
KBT 5 / 160 HS	4.532 (10)	600 189
KBT 5 / 200 HS	5.224 (11.5)	600 320
KBT 4 / 40 SS	3.858 (8.5)	600 187
KBT 5 / 40 SS	4.180 (9.2)	600 190

Expansion Section

Expansion Section
Includes 1m section with special bolted joints for KBHF & KBHS

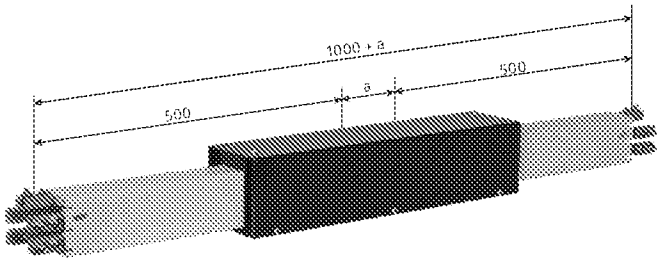
Application
Expansion sections are required to compensate the different expansions, between copper conductors and steel or concrete structures, in varying temperatures without interrupting electrical power. Placement of expansion sections is dependant on total system length, changes in ambient temperature, and distance between fixpoints (curves,switches, feeds, etc.)

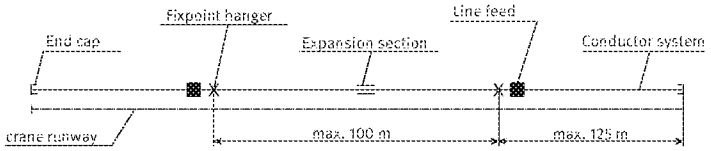
See figure 1a & 1b

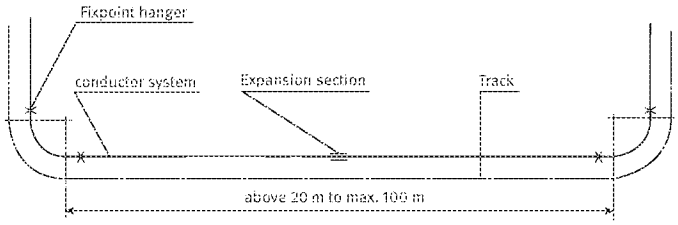
Contact VAHLE for additional information or consult installation instructions.

Additional feeds or current collectors are not required as the expansion-sections do not interrupt electrical power.

Assembly
The gap dimension "a" is 75 mm and is valid for an ambient temperature of -10 °C (14°F)to +35 °C (95°F) during installation.

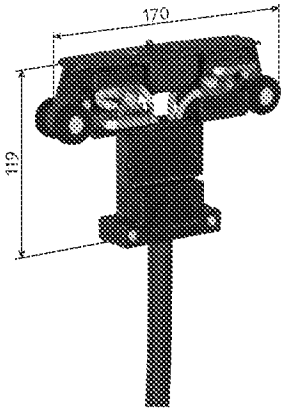






Type	Weight kg (lb)	Order-No.
KD 4 / 40–125 HS	4.400 (9.7)	600 135
KD 4 / 160 HS	4.752 (10.5)	600 136
KD 4 / 200 HS	5.444 (12)	600 325
KD 5 / 40–125 HS	4.895 (10.8)	600 138
KD 5 / 160 HS	5.247 (11.6)	600 139
KD 5 / 200 HS	5.939 (13)	600 326
KD 4 / 40 SS	4.400 (9.7)	600 137
KD 5 / 40 SS	4.895 (10.8)	600 140

Single Current Collector

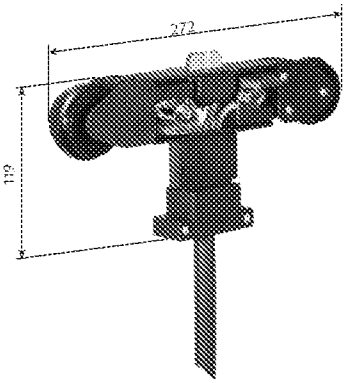


Collector KSW
- Max. speed 150 m/min or 100 m/min with sealing strip

Connecting cable
- 1m long, additional lengths available*
- 25 A with 2.5 mm²/core
- 40 A with 4.0 mm²/core
- 60 A with 6.0 mm²/core

*Order example for a 2 m long cable: Order-No. 600 096.2 for collector KSW 4/40-2 HS

Type	Weight kg (lb)	No. of conductors	Power rating at 60 % DC in A	approx. diam. of connecting-cables in mm	Order-No. (2)
KSW 4 / 25–1 HS	0.552 (1.2)	4	25	13.0	600 095.1
KSW 4 / 40–1 HS	0.656 (1.45)	4	40	15.0	600 096.1
KSW 4 / 60–1 HS	0.797 (1.7)	4	60(1)	17.0	600 066.1
KSW 5 / 25–1 HS	0.634 (1.4)	5	25	14.0	600 098.1
KSW 5 / 40–1 HS	0.771 (1.7)	5	40	17.0	600 099.1
KSW 5 / 60–1 HS	0.945 (2.1)	5	60(1)	19.0	600 413.1
KSW 4 / 25–1 ST	0.472 (1)	4	25	11.0	600 097.1
KSW 5 / 25–1 ST	0.534 (1.2)	5	25	12.0	600 100.1



Collector KSWS
Max. speed 250 m/min or 100 m/min with sealing strip

Connecting cable:
- 1 m long, longer cables on request*
- 25 A with 2.5 mm²/core
- 40 A with 4.0 mm²/core
- 60 A with 6.0 mm²/core

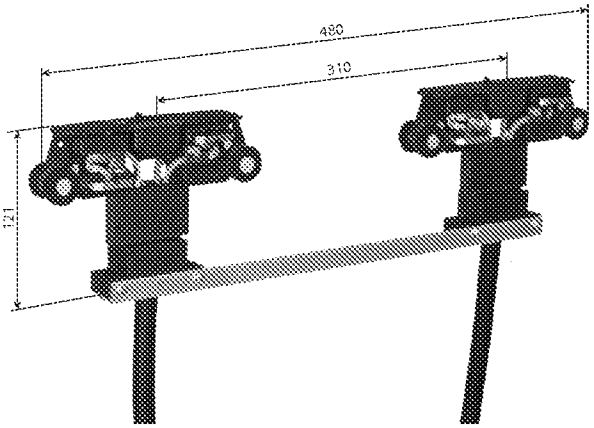
*Order example for a 2 m long cable: Order-No. 600 149.2 for collector KSWS 5/40-2 HS

Type	Weight kg (lb)	No. of conductors	Power rating at 60 % DC in A	approx. diam. of connecting-cables in mm	Order-No. (2)
KSWS 4 / 25–1 HS	0.664 (1.5)	4	25	13.0	600 145.1
KSWS 4 / 40–1 HS	0.768 (1.7)	4	40	15.0	600 146.1
KSWS 4 / 60–1 HS	0.942 (2.1)	4	60(1)	17.0	600 416.1
KSWS 5 / 25–1 HS	0.724 (1.6)	5	25	13.5	600 148.1
KSWS 5 / 40–1 HS	0.861 (1.9)	5	40	16.0	600 149.1
KSWS 5 / 60–1 HS	1.035 (2.3)	5	60(1)	19.0	600 417.1
KSWS 4 / 25–1 ST	0.584 (1.3)	4	25	11.0	600 147.1
KSWS 5 / 25–1 ST	0.624 (1.4)	5	25	12.0	600 150.1

(1) at 40% DC
(2) Order No. for 1m cable

Double Collector & Tow arms

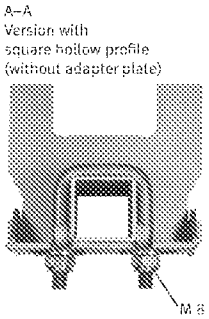
Double collector DKSW
Max. speed 150 m/min or 100 m/min with sealing strip
The double collectors are supplied as an assembly kit consisting of 2 collectors (KSW) and a connecting bar with mounting material.

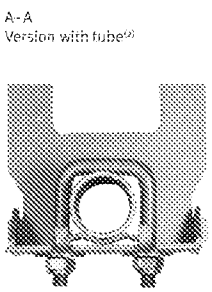


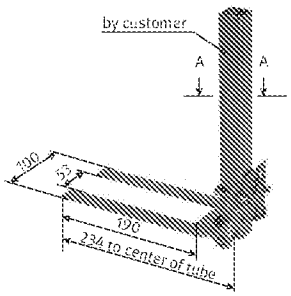
Connecting cable:
- 1m long, additional lengths available*
- 50 A with (2x) 2.5 mm²/core
- 80 A with (2x) 4.0 mm²/core
- 120 A with (2x) 6.0 mm²/core

*Order example for 2 m long cables: Order-No. 600 119.2 for collector DKSW 5/80-2 HS

Type	Weight kg (lb)	No. of conductors	Power rating at 60 % DC in A	approx. diam. of connecting cables in mm	Order-No. [1]
DKSW 4 / 50–1 HS	1.170 (2.6)	4	50	12.5	600 115.1
DKSW 4 / 80–1 HS	1.378 (3)	4	80	14.5	600 116.1
DKSW 4 / 120–1 HS	1.660 (3.7)	4	120[1]	17.0	600 414.1
DKSW 5 / 50–1 HS	1.334 (2.9)	5	50	13.5	600 118.1
DKSW 5 / 80–1 HS	1.608 (3.5)	5	80	16.0	600 119.1
DKSW 5 / 120–1 HS	1.956 (4.3)	5	120[1]	19.0	600 415.1
DKSW 4 / 50–1 ST	1.010 (2.2)	4	50	11.0	600 117.1
DKSW 5 / 50–1 ST	1.134 (2.5)	5	50	12.0	600 120.1

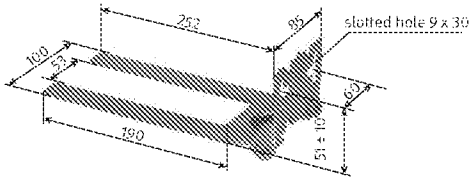






Tow Arm
Installation options of 30 mm square, hollow profile or tube with 30 - 34 mm

Type	Weight kg (lb)	Order-No.
MGU	0.550 (1.2)	600 334
MGU / K[2]	0.550 (1.2)	600 336



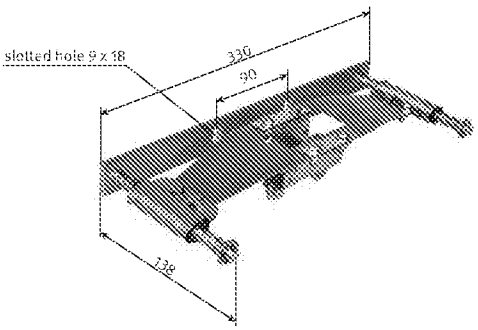
Tow Arm
Installation option for plane surface

Type	Weight kg (lb)	Order-No.
MGF	0.510 (1.1)	600 335
MGF / K[2]	0.510 (1.1)	600 337

(1) At 40% DC
(2) For assembly use enclosed adapter plate

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Flexible Tow Arm

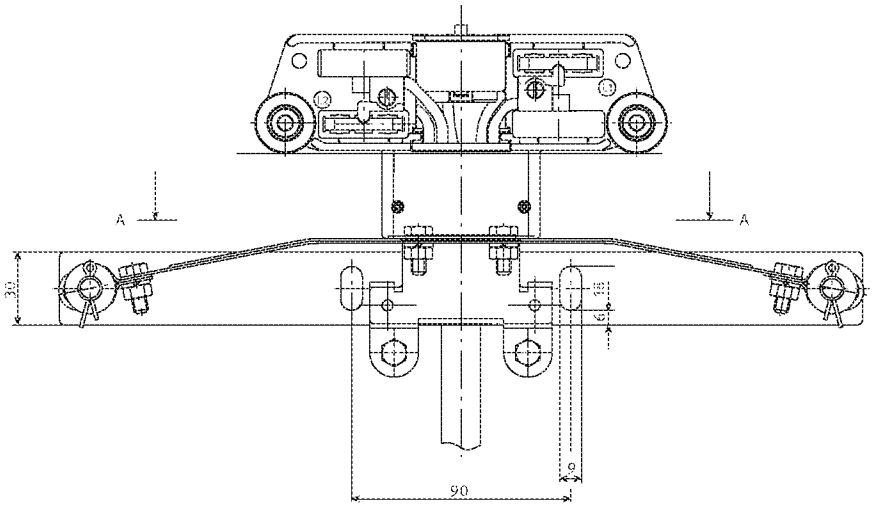


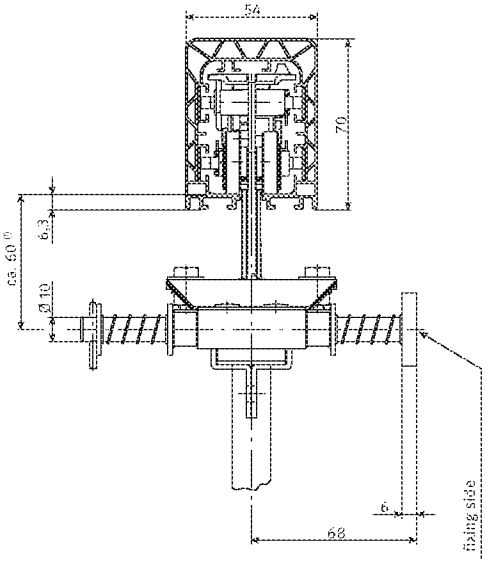
Flexible Tow Arm
Fexible support tow arm for single collector for installations with transfer funnels type KET (see page 17). Measurements for installation see below.
Please consult with factory before using flex tow arm in systems with curves.

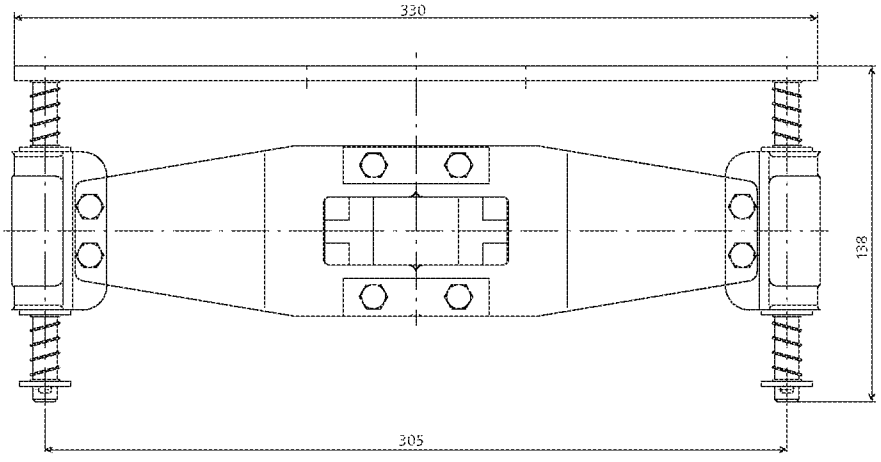
Type	Weight kg (lb)	Order No.
KFMHN	0.790 (1.7)	600 558

Arrangement of a Flexible Tow Arm

KFMHN with collector type KSW







max. horizontal offset =10 mm
max. vertical offset = 10 mm

Spare Part List

For Conductor System

Type	KBHF & KBHS
	Order-No.
Spring loades connector 40–100A (KBHF)	600 483
Bolted joints 40–160A (KBHS)	262 018
Bolted joints 200A (KBHS)	600 712
KBH Housing HS (housing only, does not contain copper)	250 4155
KBH Housing SS (housing only, does not contain copper)	250 4149
Feed terminal for end feed (40/63A)	600 006
Feed terminal for line feed (lateral)	600 017
Feed terminal for line feed (on top, 5th conductor)	600 016

For Current Collector

Type	KSW(S)/DKSW
	Order-No.
Carbon brush phase (side pole)	600 088
Carbon brush 5th conductor (top pole)	600 089
Carbon brush ground (side pole PE)	600 090
Carbon pressure spring (standard, suitable for all carbon brushes)	600 338
Connecting bar for double collector DKSW	600 105
Assembly kit (to convert KSW to KSWS)	600 106
Sealing strip slide plate for collectors KSW	600 640

Cleaning Collectors for KBH

Type	KSW
	Order-No.
KSW 4 SC cleaning collector (w/ 4x scotch brite cleaning brushes)	600 335
KSW 4 BSC cleaning collector (w/ 4x scotch brite cleaning brushes & 2x bristle brushes)	600 445
KSW 5 BSC cleaning collector (w/ 5x scotch brite cleaning brushes & 2x bristle brushes)	600 446
Spare cleaning brushes (side pole)	600 357
Spare cleaning brush (top pole)	600 358
Bristle brush (side mounted)	600 479

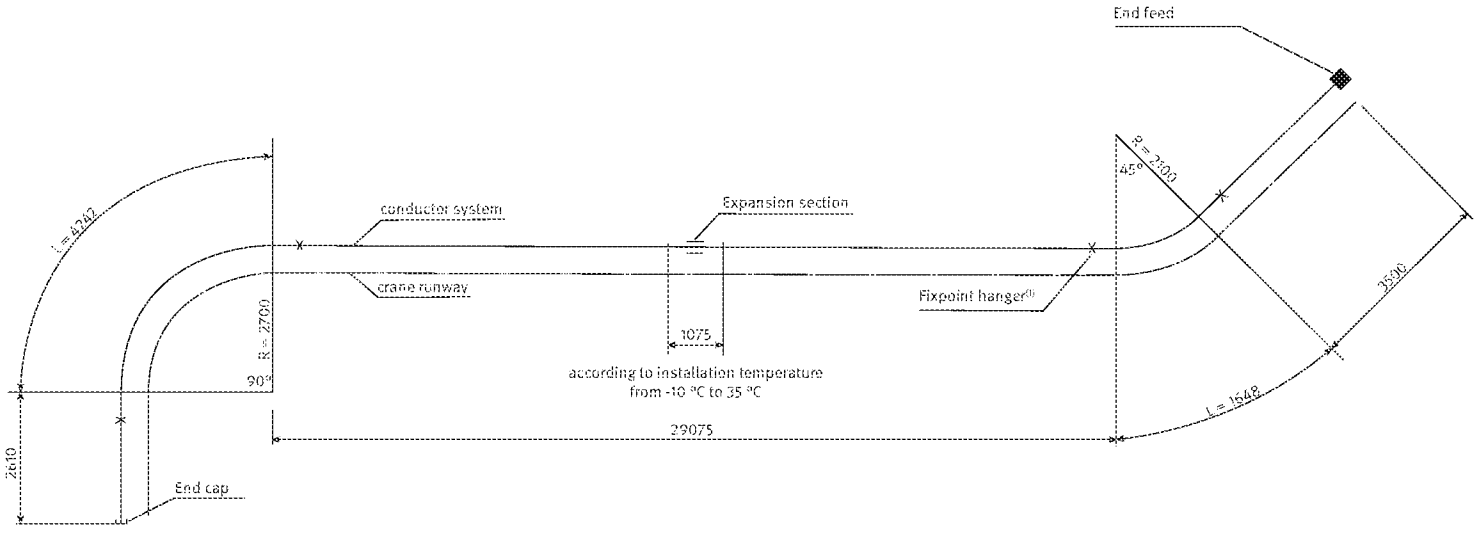
Sample System Order*

***Installations with curves as per customer drawing**

*41.075 m conductor system KBHF

QTY	Description	KBHF 4/63		KBHS 5/63	
		Type	Order-No.	Type	Order-No.
7	KBHF conductor bar, 4m length	KBHF 4/63–4 HS	600 014	KBHS 5/63–4 HS	600 154
1	KBHF conductor bar, 1 x 3500 mm cut length	KBHF 4/63–4 HS	600 014	KBHS 5/63–4 HS	600 154
1	KBHF conductor bar, 1 x 2610 mm cut length	KBHF 4/63–3 HS	600 013	KBHS 5/63–3 HS	600 153
1	KBHF conductor bar, 2 m long for horizontal curve 45°, R = 2100 mm, L = 1648 mm, SA	KBHF 4/63–2 HS	600 012.C*	KBHS 5/63–2 HS	600 152.C
2	KBHF conductor bar, 3 m long for horizontal curve 2 x 45°, R = 2700 mm, L = 2121 mm, SI	KBHF 4/63–3 HS	600 013.C*	KBHS 5/63–3 HS	600 153.C
1	End feed	KKE 4/40–63 HS	600 010	KKE 5/40–63 HS	600 107
1	Expansion section	KD 4/40–125 HS	600 135	KD 5/40–125 HS	600 138
11	Joint cap	KVM	600 005	KVM	600 005
4	Fixpoint hanger	KFA	600 007	KFA	600 007
24	Sliding hanger	KGA	600 000	KGA	600 000
1	End cap	KE	600 008	KE	600 008
1	Current collector w/ 1m cable	KSW 4/40–1 HS	600 096.1	KSW 5/40–1 HS w/ 1m cable	600 099.1
1	Tow arm	MGF	600 335	MGF	600 335

* .C desginates curved KBH



(1) Rest of conductor system to be installed with sliding hangers

Questionnaire

Contact Name: _____ Phone: _____

Company: _____ Address: _____

Email: _____ Date: _____

1. Type of application: _____

2. Type of equipment to be powered: _____

3. Operating voltage: _____ Volt Frequency: _____ Hz

Three phase voltage: ☐ AC voltage: ☐ DC voltage: ☐

4. Total system length: _____

5. Number of conductors: _____ neutral: _____ control: _____ ground: _____

6. Power required per vehicle(amps/hp/kw/etc): _____

7. Number of vehicles per system: _____

8. Indoor: ☐ Outdoor: ☐

9. Other operating conditions (humidity, dust, chemical influence, etc.) _____

10. Ambient temperature: _____ °C min. _____ °C max.

11. Mounting Location: _____

12. Position and number of feeds[1]: _____

13. Position and number of isolating sections (e.g. for maintenance)[1]: _____

14 Brackets required: yes ☐ no ☐ c/c distance beam/conductor system: _____

15. Travel speed: _____ m/min. in curves: _____ m/min. at transfers: _____ m/min.

16. Maximum allowable voltage drop: _____

Motor data	Crane 1							Crane 2						
	Power kW	Nominal current			Starting current		Type of Motors [2]	Power kW	Nominal current			Starting current		Type of Motors [2]
		A	cos Φ_N	% DC	A	cos Φ_A			A	cos Φ_N	% DC	A	cos Φ_A	
Hoist motors														
Auxiliary hoist														
Long travel														
Cross travel														

Mark with * those motors which can run simultaneously.

Mark with # those motors which can start up simultaneously.

Further remarks: _____

_____

_____

Signature _____

[1] For curved tracks, powerail with isolating sections etc., we require a layout drawing to enable us to prepare a quotation

[2] Use: K for squirrel cage motor, S for slipring motor, F for frequency controlled motor

We reserve all rights to make alterations in the interests of further development.

Products and Service

Catalog No. 4b |2014

1	**Open Conductor Systems**	
	Open conductor systems	1a
2	**Insulated Conductor Systems**	
	U10	2a
	U15, U25, U35	2c
	U20, U30, U40	2d
3	**Compact Conductor Systems**	
	VKS 10	3a
	VKS - VKL	3b
4	**Enclosed Conductor Systems**	
	KSL	4a
	KBH	4b
	MKH	4c
	LSV - LSVG	4d
5	**Contactless Power Supply**	
	Contactless power supply (CPS®)	5a
6	**Data Transmission**	
	VAHLE Powercom®	6a
	Slotted Microwave Guide (SMG)	6b
	Mini-Slotted Microwave Guide (M-SMG)	6c
7	**Positioning Systems**	
	VAHLE APOS®	7a
	VAHLE APOS Optic	7b
8	**Festoon Systems**	
	Light duty festoon systems - ▢ tracks & ◇ tracks	8a
	Heavy duty festoon systems - I Beam tracks	8b
9	**Reels**	
	Spring operated cable reels	9a
	Motor powered cable reels	9b
10	**Port Technology**	
	eRTG Solutions	10a
11	**Control Systems**	
	VAHLE-DETO	11a
12	**Other**	
	Battery charging contacts	12a
	VMT	12b
	BOK	12c
	Speciality Components Conductor Rings , Heavy Enclosed, Handling Systems, Cleaning Components, Polarity Protection	Misc
13	**Services**	
	Installation Services · On site supervision & training, pre-assembly, and commissioning	
	Troubleshooting · Site inspection, maintenance, and repair	

Docket No.: BION-051/12US 307799-2333
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor:	Keith MCBRIDE	Confirmation No.:	4706
Application No.:	15/896,731	Group Art Unit:	3784
Filed:	February 14, 2018	Examiner:	L. H. Thanh

For: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

VIA EFS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT
UNDER 37 C.F.R. §§ 1.56, 1.97, AND 1.98

In accordance with the duty of disclosure set forth in 37 C.F.R. §1.56, Applicant hereby submits the following information in conformance with 37 C.F.R. §§1.97 and 1.98. It is respectfully requested that the information be expressly considered during the prosecution of this application, and the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

[X] Pursuant to 37 C.F.R. §1.98, a copy of each non-US patent document cited in the attached Form used in lieu of PTO/SB/08 is enclosed.

[] No copies of the publications listed on the attached Form used in lieu of PTO/SB/08 are being provided pursuant to 37 C.F.R. §1.98(d) because the publications were previously cited by or submitted to the Office in prior Application Serial No(s). ____ to which the above-identified application claims priority under 35 U.S.C. §120.

[X] No copies of any U.S. patents or U.S. patent application publications listed on the attached Form used in lieu of PTO/SB/08 are being provided pursuant to 37 C.F.R. §1.98.

[] Publication(s) listed on the attached Form used in lieu of PTO/SB/08 were cited in a foreign search or examination report corresponding to application serial no. and mailed on .

[] Enclosed is a copy of a non-English publication(s) _____ Pursuant to §609 of the M.P.E.P., Applicant submits the attached foreign search or examination report, which cites such non-English language publication(s).

[] Enclosed is a copy of a non-English publication(s) _____ English language publication _____ (copy enclosed) claims priority from this non-English publication.

[] Enclosed is an explanation of non-English publication(s) _____ for which an English translation is not available.

[] Enclosed is an English translation of non-English publication(s) _____ cited in the attached Form used in lieu of PTO/SB/08.

[] Enclosed is a copy of pending patent Application Serial No. _____.

[] In accordance with **37 C.F.R. §1.97(b)**, no additional fee for submission of this Information Disclosure Statement is required, as it is filed within any one of the following time periods:

[] within three months from the filing date of this national application other than a CPA under 37 C.F.R. § 1.53(d);

[] within three months from the date of entry of the national stage as set forth in 37 C.F.R. §1.491 in this international application;

[] before the mailing date of a first office action on the merits; or

[] before the mailing of a first office action after the filing of a request for continued examination under 37 C.F.R. § 1.114.

[X] In accordance with **37 C.F.R. §1.97(c)**, this Information Disclosure Statement is filed after the period specified in 37 C.F.R. § 1.97(b), but before the mailing of any of the following:

[X] a final action under 37 C.F.R. §1.113;

[X] a notice of allowance under 37 C.F.R. §1.311; or

[X] an action that otherwise closes prosecution in this application.

In accordance with 37 C.F.R. §1.97(c) also enclosed is:

[X] Fee under 37 C.F.R. §1.17(p) in the amount of $240.00;

[] Fee under 37 C.F.R. §1.17(p) in the amount of $120.00;

[] Fee under 37 C.F.R. §1.17(p) in the amount of $60.00; or

[] Statement as specified in 37 C.F.R. §1.97(e):

[] Each item of information contained in the Information Disclosure Statement cited herein was first cited in any communication from a foreign patent office

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in a counterpart foreign application not more than three months prior to the filing date of the Information Disclosure Statement; or

[] No item of information contained in the Information Disclosure Statement submitted herewith was cited in any communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the undersigned, having made a reasonable inquiry, no item of information contained in the Information Disclosure Statement was known to any individual designated in 37 C.F.R. §1.56(c) more than three months prior to the filing date of the Information Disclosure Statement.

In accordance with 37 C.F.R. § 1.97(g), this Information Disclosure Statement shall not be construed as to mean that a search has been made. In accordance with 37 C.F.R. § 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that the information cited in the statement is, or is considered to be material to patentability as defined by 37 C.F.R § 1.56(b).

Remarks

It is respectfully requested that the Examiner consider the above-noted information and return an initialed copy of the attached Form used in lieu of PTO/SB/08 to the undersigned. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Director is hereby authorized to charge any additional fees which may be required with respect to this communication, or credit any overpayment, to Deposit Account No. 50-1283, under Order No. BION-051/12US 307799-2333.

Dated: December 6, 2019

Respectfully submitted,
COOLEY LLP

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue NW, Suite 700
Washington, DC 20004

Tel: (202) 842-7800
Fax: (202) 842-7899

By: /Michael D. Winternitz/
Michael D. Winternitz
Reg. No. 73,102

Aretech LLC - Exhibit 1004, Page 00881

PTO/SB/08b (07-09)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	1.	764,781	07-12-1904	Sumner	
	2.	895,055	08-04-1908	Spooner	
	3.	1,536,766	05-05-1925	Cammann	
	4.	1,648,930	11-15-1927	Zouck	
	5.	1,971,294	08-21-1934	Bunker	
	6.	2,211,220	08-13-1940	Verplanck	
	7.	2,360,505	10-17-1944	Medenwald et al.	
	8.	2,519,165	08-15-1950	Weise et al.	
	9.	2,688,933	09-14-1954	Spafford	
	10.	2,819,755	01-14-1958	Berger et al.	
	11.	3,424,458	01-28-1969	Hopps, Jr.	
	12.	3,720,172	03-13-1973	Dehne	
	13.	3,780,663	12-25-1973	Pettit	
	14.	3,985,082	10-12-1976	Barac	
	15.	4,243,147	01-06-1981	Twitchell et al.	
	16.	4,360,307	11-23-1982	Larsson	
	17.	4,372,452	02-08-1983	McCord	
	18.	4,427,398	01-24-1984	Eisbrecher et al.	
	19.	4,606,082	08-19-1986	Kuhlman	
	20.	4,627,119	12-09-1986	Hachey et al.	
	21.	4,639,955	02-03-1987	Carminati et al.	
	22.	4,706,782	11-17-1987	Spoeler et al.	
	23.	4,944,056	07-31-1990	Schroeder et al.	
	24.	5,048,822	09-17-1991	Murphy	
	25.	5,138,953	08-18-1992	Horcher et al.	
	26.	5,337,908	08-16-1994	Beck, Jr.	
	27.	5,490,293	02-13-1996	Nilsson	
	28.	5,511,486	04-30-1996	Pollard et al.	
	29.	5,632,206	05-27-1997	Summa et al.	
	30.	5,638,755	06-17-1997	Love et al.	
	31.	5,695,432	12-09-1997	Soderlund	
	32.	5,809,591	09-22-1998	Capaldi et al.	
	33.	5,850,928	12-22-1998	Kahlman et al.	
	34.	5,904,099	05-18-1999	Danneker	
	35.	6,080,087	06-27-2000	Bingham	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet	2	of	6

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Attorney Docket Number	BION-051/12US 307799-2333

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Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	36.	6,192,803	02-27-2001	Nishino	
	37.	6,315,138	11-13-2001	Dyson	
	38.	6,464,208	10-15-2002	Smith	
	39.	6,520,484	02-18-2003	Shimizu et al.	
	40.	6,645,126	11-11-2003	Martin et al.	
	41.	6,679,185	01-20-2004	Sullivan et al.	
	42.	6,890,288	05-10-2005	Bingham	
	43.	7,137,771	11-21-2006	Maurer et al.	
	44.	7,240,621	07-10-2007	Chepurny et al.	
	45.	7,303,049	12-04-2007	Greenlee	
	46.	7,377,377	05-27-2008	Christiansson	
	47.	7,462,138	12-09-2008	Shetty et al.	
	48.	7,618,223	11-17-2009	Begley	
	49.	7,883,450	02-08-2011	Hidler	
	50.	7,938,757	05-10-2011	Cockrell	
	51.	7,993,248	08-09-2011	Rasmussen	
	52.	8,397,320	03-19-2013	Capaldi	
	53.	8,584,274	11-19-2013	Hushek	
	54.	8,789,682	07-29-2014	Fisher	
	55.	8,978,905	03-17-2015	Bergenstrale et al.	
	56.	9,510,991	12-06-2016	Stockmaster et al.	
	57.	9,682,000	06-20-2017	Glukhovsky	
	58.	9,839,569	12-12-2017	Behnke et al.	
	59.	9,855,177	01-02-2018	Erturk et al.	
	60.	10,219,960	03-05-2019	Behnke et al.	
	61.	2001/0027149	10-04-2001	Bingham	
	62.	2003/0084508	05-08-2003	Faucher et al.	
	63.	2003/0146069	08-07-2003	Kaiser	
	64.	2003/0153438	08-14-2003	Gordon et al.	
	65.	2003/0200607	10-30-2003	Faucher et al.	
	66.	2003/0201374	10-30-2003	Faucher et al.	
	67.	2004/0074414	04-22-2004	Phillips	
	68.	2004/0143198	07-22-2004	West	
	69.	2004/0200795	10-14-2004	Summa	
	70.	2005/0115914	06-02-2005	Chepurny et al.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 3 of 6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	71.	2006/0189453	08-24-2006	Leblond	
	72.	2006/0229167	10-12-2006	Kram et al.	
	73.	2006/0240952	10-26-2006	Schlosser	
	74.	2007/0004567	01-04-2007	Shetty et al.	
	75.	2008/0287268	11-20-2008	Hidler	
	76.	2009/0308828	12-17-2009	Hansen	
	77.	2010/0000546	01-07-2010	Park	
	78.	2010/0312152	12-09-2010	Sarkodie-Gyan et al.	
	79.	2011/0000015	01-06-2011	Faucher et al.	
	80.	2011/0072580	03-31-2011	Imhoff	
	81.	2011/0265260	11-03-2011	Darrow	
	82.	2012/0000876	01-05-2012	Bergenstrale et al.	
	83.	2012/0198612	08-09-2012	Tindall	
	84.	2012/0325586	12-27-2012	Meggs et al.	
	85.	2014/0201905	07-24-2014	Glukhovsky	
	86.	2014/0201906	07-24-2014	Erturk et al.	
	87.	2014/0206503	07-24-2014	Stockmaster et al.	
	88.	2015/0143627	05-28-2015	McBride	
	89.	2015/0283921	10-08-2015	Zimmerman et al.	
	90.	2017/0128313	05-11-2017	Gluhkovsky et al.	
	91.	2018/0036196	02-08-2018	Behnke et al.	
	92.	2018/0071159	03-15-2018	Glukhovsky et al.	
	93.	2019/0216664	07-18-2019	Behnke et al.	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet	4	of	6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	94.	CH 669780 A5	04-14-1989	Nussbaumer		✓
	95.	CN 104308861 B	01-28-2015	Shandong Luneng Intelligence Technology Co Ltd		✓
	96.	DE 102008015879 A1	04-09-2009	Berwald et al.		✓
	97.	EP 0088061 A2	09-07-1983	Hedstrom		
	98.	EP 2402279 A1	01-04-2012	Liko Research & Development AB		
	99.	JP 2000-237250 A	09-05-2000	Iwauchi		✓
	100.	JPH02-131435 A	11-01-1990	Denken Electricity Co. Ltd.		✓
	101.	JPS-50-20727	07-17-1975			✓
	102.	JP 2001-299842 A	10-30-2001	Biodex Medical Systems Inc.		✓
	103.	WO 2009/104096	08-27-2009	BHM Medical Inc.		
	104.	WO 2013/117750	08-15-2013	Lutz Medical Engineering		
	105.	WO 2017/083666	05-18-2017	Bioness Inc.		

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

PTO/SB/08b (07-09)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet	5	of	6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	106.	Office Action for U.S. Application No. 13/745,830, mailed June 15, 2015, 9 pages	
	107.	Office Action for U.S. Application No. 13/745,830, mailed December 17, 2015, 9 pages	
	108.	Office Action for U.S. Application No. 13/745,830, mailed June 2, 2016, 11 pages	
	109.	Office Action for U.S. Application No. 14/226,021, mailed September 14, 2016, 13 pages	
	110.	Office Action for U.S. Application No. 14/226,021, mailed February 22, 2017, 11 pages	
	111.	Office Action for U.S. Application No. 14/613,140, mailed August 28, 2017, 25 pages	
	112.	Office Action for U.S. Application No. 14/613,140, mailed March 26, 2018, 28 pages	
	113.	Office Action for U.S. Application No. 14/613,140, mailed October 30, 2018, 28 pages	
	114.	Office Action for U.S. Application No. 15/783,755, mailed May 7, 2018, 13 pages	
	115.	Office Action for U.S. Application No. 15/349,390, mailed January 17, 2019, 15 pages	
	116.	Extended European Search Report for European Application No. 14740676.3, mailed August 18, 2016, 6 pages	
	117.	European Examination Report for European Application No. 14740676.3, mailed June 14, 2019, 5 pages	
	118.	Extended European Search Report for European Application No. 16747097.0, mailed July 27, 2018, 8 pages	
	119.	Extended European Search Report for European Application No. 16865093.5, mailed April 2, 2019, 6 pages	
	120.	Notice of Reasons for Rejection for Japanese Application No. 2015-553851, mailed July 4, 2016, 9 pages	✓

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 6 of 6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	121.	Notice of Reasons for Rejection for Japanese Application No. 2017-052240, mailed January 15, 2018, 9 pages	✓
	122.	Final Notice of Reasons for Rejection for Japanese Application No. 2017-052240, mailed July 19, 2018, 4 pages	✓
	123.	Notice of Reasons for Rejection for Japanese Application No. 2017-534701, mailed October 16, 2019, 16 pages	✓
	124.	International Search Report and Written Opinion for International Application No. PCT/US2014/012064, mailed May 9, 2014, 6 pages	
	125.	International Search Report and Written Opinion for International Application No. PCT/US2016/016131, mailed April 21, 2016, 10 pages	
	126.	International Search Report and Written Opinion for International Application No. PCT/US2016/061552, mailed January 31, 2017, 10 pages	
	127.	International Search Report and Written Opinion for International Application No. PCT/US2017/050482, mailed December 21, 2017, 9 pages	
	128.	International Search Report and Written Opinion for International Application No. PCT/US2018/018166, mailed July 2, 2018, 11 pages	
	129.	VALLERY, H. et al., "Multidirectional Transparent Support for Overground Gait Training," 2013 IEEE International Conference on Rehabilitation Robotics, Seattle, WA (June 2013), 7 pages	
	130.	VAHLE Electrification Systems, “Enclosed Conductor System KBH,” Catalogue, 2014, 28 pages	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Applicant’s unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/896,731	Filing Date 02/14/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	12/06/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 19	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/DENISE HOPKINS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

58249 7590 01/10/2020

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

EXAMINER
ATKINSON, GARRETT K

ART UNIT	PAPER NUMBER
3784	

DATE MAILED: 01/10/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333	4706

TITLE OF INVENTION: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	04/10/2020

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

58249 7590 01/10/2020

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333	4706

TITLE OF INVENTION: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	04/10/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
ATKINSON, GARRETT K	3784	482-139000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

Aretech LLC - Exhibit 1004, Page 00890

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United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333	4706

58249 7590 01/10/2020

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

EXAMINER	
ATKINSON, GARRETT K	
ART UNIT	**PAPER NUMBER**
3784	

DATE MAILED: 01/10/2020

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice Requiring Inventor's Oath or Declaration	Application No. 15/896,731	Applicant(s) Keith MCBRIDE	
	Examiner ATKINSON, GARRETT K	Art Unit 3784	

This notice is an attachment to the Notice of Allowability (PTOL-37), or the Notice of Allowability For A Design Application (PTOL-37D).

An inventor's oath or declaration in compliance with 37 CFR 1.63 or 1.64 executed by or with respect to each inventor has not yet been submitted.

An oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each inventor (for any inventor for which a compliant oath, declaration, or substitute statement has not yet been submitted) MUST be filed no later than the date on which the issue fee is paid. See 35 U.S.C. 115(f). Failure to timely comply will result in ABANDONMENT of this application.

A properly executed inventor's oath to declaration has not been received for the following inventor(s):

If applicant previously filed one or more oaths, declarations, or substitute statements, applicant may have received an informational notice regarding deficiencies therein.

The following deficiencies are noted:

INFORMAL ACTION PROBLEMS

- A properly executed inventor's oath or declaration has not been received for the following inventor(s): **Keith MCBRIDE**, **Arkady GLUKHOVSKY**, and **Augustine SMITH**.
  Applicant may submit the inventor's oath or declaration at any time before the Notice of Allowance and Fee(s) Due, PTOL-85, is mailed.

Questions relating to this Notice should be directed to the Application Assistance Unit at 571-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Aretech LLC - Exhibit 1004, Page 00893

Notice of Allowability	Application No. 15/896,731	Applicant(s) MCBRIDE et al.	
	Examiner GARRETT K ATKINSON	Art Unit 3784	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the 12/6/2019 amendment.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-4 and 6-20 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date SEE ATTACHED IDS SHEETS.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/GARRETT K ATKINSON/
Primary Examiner, Art Unit 3784

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/896,731	MCBRIDE et al.
	Examiner	Art Unit
	GARRETT K ATKINSON	3784

CPC - Searched*		
Symbol	Date	Examiner
A63B21/4001, A63B69/0002, A63B21/00181, A63B24/0087, A63B23/0464, A63B21/068, A63B69/0064, A63B21/4007, A63B2225/50, A63B2225/20, A63B2220/805, A63B2220/54, A63B2220/51, A63B2220/40, A63B2220/30, A63B2220/10, A63B2071/0018, A63B2024/0093, A63B23/0458, A63B22/0235, A63B71/0622, A63B2022/0092, A63B2208/0204, A63B2022/0094	08/05/2019	GA

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
EAST SEARCH	08/05/2019	GA
INVENTOR NAME SEARCH	08/05/2019	GA
UPDATED SEARCH	12/22/2019	GA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	SEE EAST SEARCH	12/22/2019	GA

/GARRETT K ATKINSON/ Primary Examiner, Art Unit 3784	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/896,731	MCBRIDE et al.
	Examiner	**Art Unit**
	GARRETT K ATKINSON	3784

/GARRETT K ATKINSON/ Primary Examiner, Art Unit 3784	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/896,731	MCBRIDE et al.
	Examiner	**Art Unit**
	GARRETT K ATKINSON	3784

CPC								
Symbol							**Type**	**Version**
A63B	/	21	/	4001			F	2015-10-01
A63B	/	24	/	0087			I	2013-01-01
A63B	/	21	/	068			I	2013-01-01
A63B	/	69	/	0064			I	2013-01-01
A63B	/	69	/	0002			I	2013-01-01
A63B	/	23	/	0464			I	2013-01-01
A63B	/	21	/	00181			I	2013-01-01
A63B	/	2208	/	0204			A	2013-01-01
A63B	/	2022	/	0094			A	2013-01-01
A63B	/	2022	/	0092			A	2013-01-01
A63B	/	2220	/	30			A	2013-01-01
A63B	/	2220	/	10			A	2013-01-01
A63B	/	2225	/	20			A	2013-01-01
A63B	/	2225	/	50			A	2013-01-01
A63B	/	23	/	0458			A	2013-01-01
A63B	/	2220	/	40			A	2013-01-01
A63B	/	2220	/	805			A	2013-01-01
A63B	/	2220	/	54			A	2013-01-01
A63B	/	2024	/	0093			A	2013-01-01
A63B	/	2071	/	0018			A	2013-01-01
A63B	/	21	/	4007			A	2015-10-01
A63B	/	22	/	0235			A	2013-01-01
A63B	/	2220	/	51			A	2013-01-01
A63B	/	71	/	0622			A	2013-01-01

CPC Combination Sets									
Symbol							**Type**	**Set**	**Ranking**	**Version**
	/		/							

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	19	
/GARRETT K ATKINSON/ Primary Examiner, Art Unit 3784	22 December 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office

Part of Paper No.: 20191222

Aretech LLC - Exhibit 1004, Page 00897

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/896,731	MCBRIDE et al.
	Examiner	**Art Unit**
	GARRETT K ATKINSON	3784

INTERNATIONAL CLASSIFICATION				
CLAIMED				
A63B21/00	/	21	/	00
A63B24/00	/	24	/	00
A63B21/068	/	21	/	068
A63B69/00	/	69	/	00
A63B23/04	/	23	/	04
A63B22/00	/	22	/	00
A63B71/00	/	71	/	00
A63B22/02	/	22	/	02
A63B71/06	/	71	/	06

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 19	
/GARRETT K ATKINSON/ Primary Examiner, Art Unit 3784 (Primary Examiner) 22 December 2019 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2

U.S. Patent and Trademark Office Part of Paper No.: 20191222

Aretech LLC - Exhibit 1004, Page 00898

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/896,731	MCBRIDE et al.
	Examiner	**Art Unit**
	GARRETT K ATKINSON	3784

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	19	
/GARRETT K ATKINSON/ Primary Examiner, Art Unit 3784	22 December 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office

Part of Paper No.: 20191222

Aretech LLC - Exhibit 1004, Page 00899

Bibliographic Data

Application No: 15/896,731

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /GARRETT K ATKINSON/ Examiner's Signature | Initials

Title: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
02/14/2018	482	3784	BION-051/12US 307799-2333
RULE			

APPLICANTS

Bioness Inc., Valencia, CA, UNITED STATES

INVENTORS

Keith MCBRIDE Ventura, CA, UNITED STATES

Arkady GLUKHOVSKY Valencia, CA, UNITED STATES

Augustine SMITH Santa Clarita, CA, UNITED STATES

CONTINUING DATA

This application has PRO of 62458648 02/14/2017

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

03/08/2018

STATE OR COUNTRY

UNITED STATES

ADDRESS

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004
UNITED STATES

FILING FEE RECEIVED

$2,280

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	93	("0764781" | "0895055" | "10219960" | "1536766" | "1648930" | "1971294" | "20010027149" | "20030084508" | "20030146069" | "20030153438" | "20030200607" | "20030201374" | "20040074414" | "20040143198" | "20040200795" | "20050115914" | "20060189453" | "20060229167" | "20060240952" | "20070004567" | "20080287268" | "20090308828" | "20100000546" | "20100312152" | "20110000015" | "20110072580" | "20110265260" | "20120000876" | "20120198612" | "20120325586" | "20140201905" | "20140201906" | "20140206503" | "20150143627" | "20150283921" | "20170128313" | "20180036196" | "20180071159" | "20190216664" | "2211220" | "2360505" | "2519165" | "2688933" | "2819755" | "3424458" | "3720172" | "3780663" | "3985082" | "4243147" | "4360307" | "4372452" | "4427398" | "4606082" | "4627119" | "4639955" | "4706782" | "4944056" | "5048822" | "5138953" | "5337908" | "5490293" | "5511486" | "5632206" | "5638755" | "5695432" | "5809591" | "5850928" | "5904099" | "6080087" | "6192803" | "6315138" | "6464208" | "6520484" | "6645126" | "6679185" | "6890288" | "7137771" | "7240621" | "7303049" | "7377377" | "7462138" | "7618223" | "7883450" | "7938757" | "7993248" | "8397320" | "8584274" | "8789682" | "8978905" | "9510991" | "9682000" | "9839569" | "9855177").PN.	US-PGPUB; USPAT	OR	ON	2019/12/22 19:48
L2	2003	(A63B$ or A61H$).cpc. and (trip$4 or fall) with (catch$4 or prevent$4)	US-PGPUB; USPAT	OR	ON	2019/12/22 19:49
L3	27	L2 and ((rope or cord or tether or strap) with (adjust$4)) same sens$4	US-PGPUB; USPAT	OR	ON	2019/12/22 19:49
L4	25	L3 and accelerat$4	US-PGPUB; USPAT	OR	ON	2019/12/22 19:49
L5	21	(US-20170027803-$ or US-20060229167-$ or US-20120018249-$ or US-20040143198-$).did. or (US-5314390-$ or US-6880487-$ or US-5830162-$ or US-7381163-$ or US-7125388-$ or US-4423864-$ or US-7621850-$ or US-	US-PGPUB; USPAT; USOCR	OR	ON	2019/12/22 19:49

		8002674-$ or US-8550962-$ or US-4204673-$ or US-4733858-$ or US-9713439-$ or US-7998040-$ or US-0229167-$ or US-0143198-$ or US-0018249-$).did. or (US-3408067-$).did.				
L6	1	L5 and (trip$4 or fall$4) with sensor	US-PGPUB; USPAT	OR	ON	2019/12/22 19:49
S1	27	(("ARIZONA") near3 ("BOARD") near3 ("OF") near3 ("REGENTS") near3 ("ON") near3 ("BEHALF") near3 ("OF") near3 ("ARIZONA") near3 ("STATE") near3 ("UNIVERSITY")).AANM.	USPAT	AND	ON	2017/04/13 15:24
S2	4	(("ARTEMIADIS") near3 ("Panagiotis")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2017/04/13 15:24
S3	1	(("BARKAN") near3 ("Andrew")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2017/04/13 15:24
S4	4	("20060052728" | "5302162" | "8246354" | "8262590").PN.	US-PGPUB; USPAT	AND	ON	2017/04/13 15:25
S5	4265	(482/51-54).CCLS.	US-PGPUB; USPAT	OR	OFF	2017/04/13 15:27
S6	5888	(A63B22/0292 or A63B22/02$ or A63B69/0064 or A63B22/0235 or A63B24/0087 or A63B21/00181 or A63B22/0221 or A61B5/6892 or A61B5/1036 or A63B2220/52 or A63B2024/0093 or A63B2220/18).cpc.	US-PGPUB; USPAT	AND	ON	2017/04/13 15:28
S7	8655	S5 or S6	US-PGPUB; USPAT	AND	ON	2017/04/13 15:28
S8	161	S7 and counterweight	US-PGPUB; USPAT	AND	ON	2017/04/13 15:28
S9	102	S8 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2017/04/13 15:29
S10	5	S9 and (belt with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2017/04/13 15:29
S11	0	S9 and (tread with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2017/04/13 15:31
S12	55	S7 and counterweight and treadmill	US-PGPUB; USPAT	AND	ON	2017/04/13 15:31
S13	38	S12 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2017/04/13 15:31
S14	268	S7 and treadmill and (belt near2 (two or split or dual))	US-PGPUB; USPAT	AND	ON	2017/04/13 15:34
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		"20010016542" | "20030064862" | "20040192514" | "20040214693" | "20050209059" | "20050209060" | "20050209061" | "20050233864" | "20060223680" | "20090176626" | "20090264260" | "20100062904" | "20100093500" | "2017128" | "2117957" | "2512904" | "3408067" | "3580340" | "3637206" | "3642279" | "3650529" | "3711090" | "3792860" | "3814420" | "3826491" | "4066257" | "4126326" | "4204673" | "4274625" | "4334676" | "4342452" | "4344616" | "4374587" | "4406451" | "4423864" | "4555108" | "4659074" | "4659077" | "4733858" | "4747612" | "4830362" | "4838543" | "4842268" | "5039088" | "5048821" | "5054770" | "5110117" | "5135447" | "5139255" | "5149084" | "5199934" | "5207621" | "5226866" | "5263910" | "5267923" | "5282776" | "5299993" | "5320588" | "5336142" | "5336146" | "5338273" | "5370592" | "5385520" | "5411279" | "5431612" | "5441467" | "5460586" | "5490818" | "5492517" | "5512025" | "5518470" | "5538489" | "5575740" | "5607376" | "5626539" | "5643144" | "5645512" | "5669856" | "5679101" | "5690582" | "5762587" | "5803871" | "5803874" | "5803880" | "5816372" | "5833584" | "5871421" | "5879271" | "5882281" | "5897459" | "5897460" | "5897461" | "5913384" | "5919115" | "5951449" | "5967944" | "5993358" | "6033344" | "6042519" | "6045490" | "6152859" | "6179754" | "6217487" | "6264042" | "6283896" | "6409633" | "6461279" | "6554749" | "6645124" | "6761667" | "6811517" | "6811519" | "6824502" | "6849034" | "6893383" | "6923746" | "7097593" | "7163493").PN. OR ("7166062" | "7179204" | "7306546" | "7377882" | "7517303" | "7553260" | "7621850" | "7645214" | "7704191" | "7811209" | "7819779" | "D521577").PN. OR ("8002674").URPN.	PGPUB; USPAT; USOCR			22:19
S31	64	(("ARIZONA") near3 ("BOARD") near3 ("OF") near3 ("REGENTS") near3 ("ON") near3 ("BEHALF") near3 ("OF") near3 ("ARIZONA") near3 ("STATE") near3 ("UNIVERSITY")).AANM.	USPAT	AND	ON	2018/04/02 09:03
S32	8	(("ARTEMIADIS") near3 ("Panagiotis")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2018/04/02 09:03
S33	2	(("BARKAN") near3 ("Andrew")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2018/04/02 09:03
S34	4	("20060052728" | "5302162" | "8246354" | "8262590").PN.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03

S35	4266	(482/51-54).CCLS.	US-PGPUB; USPAT	OR	OFF	2018/04/02 09:03
S36	6818	(A63B22/0292 or A63B22/02$ or A63B69/0064 or A63B22/0235 or A63B24/0087 or A63B21/00181 or A63B22/0221 or A61B5/6892 or A61B5/1036 or A63B2220/52 or A63B2024/0093 or A63B2220/18).cpc.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S37	9574	S35 or S36	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S38	180	S37 and counterweight	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S39	113	S38 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S40	7	S39 and (belt with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S41	0	S39 and (tread with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S42	66	S37 and counterweight and treadmill	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S43	46	S42 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S44	289	S37 and treadmill and (belt near2 (two or split or dual))	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S45	154	("0964898" | "1082940" | "20010016542" | "20030064862" | "20040192514" | "20040214693" | "20050209059" | "20050209060" | "20050209061" | "20050233864" | "20060223680" | "20090176626" | "20090264260" | "20100062904" | "20100093500" | "2017128" | "2117957" | "2512904" | "3408067" | "3580340" | "3637206" | "3642279" | "3650529" | "3711090" | "3792860" | "3814420" | "3826491" | "4066257" | "4126326" | "4204673" | "4274625" | "4334676" | "4342452" | "4344616" | "4374587" | "4406451" | "4423864" | "4555108" | "4659074" | "4659077" | "4733858" | "4747612" | "4830362" | "4838543" | "4842268" | "5039088" | "5048821" | "5054770" | "5110117" | "5135447" | "5139255" | "5149084" | "5199934" | "5207621" | "5226866" | "5263910" | "5267923" | "5282776" | "5299993" | "5320588" | "5336142" | "5336146" | "5338273" | "5370592" | "5385520" | "5411279" | "5431612" | "5441467" | "5460586" | "5490818" | "5492517" | "5512025" | "5518470" | "5538489" |	US-PGPUB; USPAT; USOCR	AND	ON	2018/04/02 09:03

		"5575740" | "5607376" | "5626539" | "5643144" | "5645512" | "5669856" | "5679101" | "5690582" | "5762587" | "5803871" | "5803874" | "5803880" | "5816372" | "5833584" | "5871421" | "5879271" | "5882281" | "5897459" | "5897460" | "5897461" | "5913384" | "5919115" | "5951449" | "5967944" | "5993358" | "6033344" | "6042519" | "6045490" | "6152859" | "6179754" | "6217487" | "6264042" | "6283896" | "6409633" | "6461279" | "6554749" | "6645124" | "6761667" | "6811517" | "6811519" | "6824502" | "6849034" | "6893383" | "6923746" | "7097593" | "7163493").PN. OR ("7166062" | "7179204" | "7306546" | "7377882" | "7517303" | "7553260" | "7621850" | "7645214" | "7704191" | "7811209" | "7819779" | "D521577").PN. OR ("8002674").URPN.				
S46	12052	(A61H3/008 or A63B71/0622 or A63B21/4009 or A63B22/02 or A63B23/0405 or A63B21/154 or A63B24/0087 or A61H2201/1619 or A63B2220/51 or A63B2220/803 or A63B2220/40 or A61H2205/10).cpc.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:06
S47	4	(("DIAO") near3 ("Xiumin")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2018/04/02 09:07
S48	257	(("PURDUE") near3 ("RESEARCH") near3 ("FOUNDATION")).AANM.	USPAT	AND	ON	2018/04/02 09:07
S49	17607	S35 or S36 or S46	US-PGPUB; USPAT	AND	ON	2018/04/02 09:11
S50	0	S49 and (harness same motion same force same sensor same acceler$6 same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:23
S51	0	S49 and (harness same motion same force same sensor same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:23
S52	2	S49 and (harness same force same sensor same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:23
S53	151	S49 and harness and ((tension or force) same sensor) and cable and actuat$4	US-PGPUB; USPAT	AND	ON	2018/04/02 09:25
S54	45	S49 and harness and ((tension or force) same sensor) and (cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:25
S55	34	S54 and (motion same sens$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:25
S56	26	S54 and (motion with sens$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:25
S57	44	S49 and harness and ((tension or force) with sens$4) and (cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:26

S58	25	S57 and (motion with sens$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:26
S59	21	S58 and acceler$	US-PGPUB; USPAT	AND	ON	2018/04/02 09:26
S60	20	S59 and signal	US-PGPUB; USPAT	AND	ON	2018/04/02 09:28
S61	9	S58 and (acceler$ with chang$4)	US-PGPUB; USPAT	AND	ON	2018/04/02 09:58
S77	161	(("ARIZONA") near3 ("BOARD") near3 ("OF") near3 ("REGENTS") near3 ("ON") near3 ("BEHALF") near3 ("OF") near3 ("ARIZONA") near3 ("STATE") near3 ("UNIVERSITY")).AANM.	USPAT	AND	ON	2019/08/05 09:50
S78	11	(("ARTEMIADIS") near3 ("Panagiotis")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
S79	2	(("BARKAN") near3 ("Andrew")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
S80	4	("20060052728" | "5302162" | "8246354" | "8262590").PN.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S81	4261	(482/51-54).CCLS.	US-PGPUB; USPAT	OR	OFF	2019/08/05 09:50
S82	8209	(A63B22/0292 or A63B22/02$ or A63B69/0064 or A63B22/0235 or A63B24/0087 or A63B21/00181 or A63B22/0221 or A61B5/6892 or A61B5/1036 or A63B2220/52 or A63B2024/0093 or A63B2220/18).cpc.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S83	10959	S81 or S82	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S84	210	S83 and counterweight	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S85	132	S84 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S86	7	S85 and (belt with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S87	0	S85 and (tread with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S88	83	S83 and counterweight and treadmill	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S89	60	S88 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50

S90	333	S83 and treadmill and (belt near2 (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S91	162	("0964898" | "1082940" | "20010016542" | "20030064862" | "20040192514" | "20040214693" | "20050209059" | "20050209060" | "20050209061" | "20050233864" | "20060223680" | "20090176626" | "20090264260" | "20100062904" | "20100093500" | "2017128" | "2117957" | "2512904" | "3408067" | "3580340" | "3637206" | "3642279" | "3650529" | "3711090" | "3792860" | "3814420" | "3826491" | "4066257" | "4126326" | "4204673" | "4274625" | "4334676" | "4342452" | "4344616" | "4374587" | "4406451" | "4423864" | "4555108" | "4659074" | "4659077" | "4733858" | "4747612" | "4830362" | "4838543" | "4842268" | "5039088" | "5048821" | "5054770" | "5110117" | "5135447" | "5139255" | "5149084" | "5199934" | "5207621" | "5226866" | "5263910" | "5267923" | "5282776" | "5299993" | "5320588" | "5336142" | "5336146" | "5338273" | "5370592" | "5385520" | "5411279" | "5431612" | "5441467" | "5460586" | "5490818" | "5492517" | "5512025" | "5518470" | "5538489" | "5575740" | "5607376" | "5626539" | "5643144" | "5645512" | "5669856" | "5679101" | "5690582" | "5762587" | "5803871" | "5803874" | "5803880" | "5816372" | "5833584" | "5871421" | "5879271" | "5882281" | "5897459" | "5897460" | "5897461" | "5913384" | "5919115" | "5951449" | "5967944" | "5993358" | "6033344" | "6042519" | "6045490" | "6152859" | "6179754" | "6217487" | "6264042" | "6283896" | "6409633" | "6461279" | "6554749" | "6645124" | "6761667" | "6811517" | "6811519" | "6824502" | "6849034" | "6893383" | "6923746" | "7097593" | "7163493").PN. OR ("7166062" | "7179204" | "7306546" | "7377882" | "7517303" | "7553260" | "7621850" | "7645214" | "7704191" | "7811209" | "7819779" | "D521577").PN. OR ("8002674").URPN.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
S92	161	(("ARIZONA") near3 ("BOARD") near3 ("OF") near3 ("REGENTS") near3 ("ON") near3 ("BEHALF") near3 ("OF") near3 ("ARIZONA") near3 ("STATE") near3 ("UNIVERSITY")).AANM.	USPAT	AND	ON	2019/08/05 09:50
S93	11	(("ARTEMIADIS") near3 ("Panagiotis")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
S94	2	(("BARKAN") near3 ("Andrew")).INV.	US-PGPUB;	AND	ON	2019/08/05 09:50

			USPAT; USOCR			
S95	4	("20060052728" | "5302162" | "8246354" | "8262590").PN.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S96	4261	(482/51-54).CCLS.	US-PGPUB; USPAT	OR	OFF	2019/08/05 09:50
S97	8209	(A63B22/0292 or A63B22/02$ or A63B69/0064 or A63B22/0235 or A63B24/0087 or A63B21/00181 or A63B22/0221 or A61B5/6892 or A61B5/1036 or A63B2220/52 or A63B2024/0093 or A63B2220/18).cpc.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S98	10959	S96 or S97	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S99	210	S98 and counterweight	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S100	132	S99 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S101	7	S100 and (belt with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S102	0	S100 and (tread with (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S103	83	S98 and counterweight and treadmill	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S104	60	S103 and (tension$4 or stiff$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S105	333	S98 and treadmill and (belt near2 (two or split or dual))	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S106	162	("0964898" | "1082940" | "20010016542" | "20030064862" | "20040192514" | "20040214693" | "20050209059" | "20050209060" | "20050209061" | "20050233864" | "20060223680" | "20090176626" | "20090264260" | "20100062904" | "20100093500" | "2017128" | "2117957" | "2512904" | "3408067" | "3580340" | "3637206" | "3642279" | "3650529" | "3711090" | "3792860" | "3814420" | "3826491" | "4066257" | "4126326" | "4204673" | "4274625" | "4334676" | "4342452" | "4344616" | "4374587" | "4406451" | "4423864" | "4555108" | "4659074" | "4659077" | "4733858" | "4747612" | "4830362" | "4838543" | "4842268" | "5039088" | "5048821" | "5054770" | "5110117" | "5135447" | "5139255" | "5149084" | "5199934" | "5207621" | "5226866" | "5263910" | "5267923" | "5282776" | "5299993" |	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50

		"5320588" | "5336142" | "5336146" | "5338273" | "5370592" | "5385520" | "5411279" | "5431612" | "5441467" | "5460586" | "5490818" | "5492517" | "5512025" | "5518470" | "5538489" | "5575740" | "5607376" | "5626539" | "5643144" | "5645512" | "5669856" | "5679101" | "5690582" | "5762587" | "5803871" | "5803874" | "5803880" | "5816372" | "5833584" | "5871421" | "5879271" | "5882281" | "5897459" | "5897460" | "5897461" | "5913384" | "5919115" | "5951449" | "5967944" | "5993358" | "6033344" | "6042519" | "6045490" | "6152859" | "6179754" | "6217487" | "6264042" | "6283896" | "6409633" | "6461279" | "6554749" | "6645124" | "6761667" | "6811517" | "6811519" | "6824502" | "6849034" | "6893383" | "6923746" | "7097593" | "7163493").PN. OR ("7166062" | "7179204" | "7306546" | "7377882" | "7517303" | "7553260" | "7621850" | "7645214" | "7704191" | "7811209" | "7819779" | "D521577").PN. OR ("8002674").URPN.				
S107	14441	(A61H3/008 or A63B71/0622 or A63B21/4009 or A63B22/02 or A63B23/0405 or A63B21/154 or A63B24/0087 or A61H2201/1619 or A63B2220/51 or A63B2220/803 or A63B2220/40 or A61H2205/10).cpc.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S108	6	(("DIAO") near3 ("Xiumin")).INV.	US-PGPUB; USPAT; USOCR	AND	ON	2019/08/05 09:50
S109	440	(("PURDUE") near3 ("RESEARCH") near3 ("FOUNDATION")).AANM.	USPAT	AND	ON	2019/08/05 09:50
S110	20551	S96 or S97 or S107	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S111	1	S110 and (harness same motion same force same sensor same acceler$6 same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S112	1	S110 and (harness same motion same force same sensor same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S113	7	S110 and (harness same force same sensor same cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S114	208	S110 and harness and ((tension or force) same sensor) and cable and actuat$4	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S115	61	S110 and harness and ((tension or force) same sensor) and (cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S116	45	S115 and (motion same sens$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S117	36	S115 and (motion with sens$4)	US-	AND	ON	2019/08/05

			PGPUB; USPAT			09:50
S118	60	S110 and harness and ((tension or force) with sens$4) and (cable same actuat$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S119	37	S118 and (motion with sens$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S120	33	S119 and acceler$	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S121	28	S120 and signal	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S122	10	S119 and (acceler$ with chang$4)	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S123	287	((("MCBRIDE") near3 ("Keith")) OR (("GLUKHOVSKY") near3 ("Arkady")) OR (("SMITH") near3 ("Augustine"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	ON	2019/08/05 09:50
S124	20	((("BIONESS") near3 ("INC"))).AS,AANM.	USPAT	OR	ON	2019/08/05 09:50
S125	14	2006/0229167	US-PGPUB; USPAT	OR	ON	2019/08/05 10:11
S126	14	2006/0229167	US-PGPUB; USPAT	OR	ON	2019/08/05 10:11
S127	0	(2006/0229167).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/08/05 10:11
S128	2	"20060229167"	US-PGPUB; USPAT	OR	ON	2019/08/05 10:12
S129	16	(US-20170027803-$ or US-20060229167-$).did. or (US-5314390-$ or US-6880487-$ or US-5830162-$ or US-7381163-$ or US-7125388-$ or US-4423864-$ or US-7621850-$ or US-8002674-$ or US-8550962-$ or US-4204673-$ or US-4733858-$ or US-9713439-$ or US-7998040-$).did. or (US-3408067-$).did.	US-PGPUB; USPAT; USOCR	OR	ON	2019/08/05 10:12
S130	6	(US-0018249-$ | US-0143198-$ | US-0229167-$ | US-20040143198-$ | US-20060229167-$ | US-20120018249-$).DID.	US-PGPUB; USPAT	OR	ON	2019/08/05 10:13
S131	21	(US-20170027803-$ or US-20060229167-$ or US-20120018249-$ or US-20040143198-$).did. or (US-5314390-$ or US-6880487-$ or US-5830162-$ or US-7381163-$ or US-7125388-$ or US-4423864-$ or US-7621850-$ or US-8002674-$ or US-8550962-$ or US-4204673-$ or US-4733858-$ or US-9713439-$ or US-7998040-$ or US-	US-PGPUB; USPAT; USOCR	OR	ON	2019/08/05 10:13

		0229167-$ or US-0143198-$ or US-0018249-$).did. or (US-3408067-$).did.				
S132	8	S131 and (trip$4 or fall$4)	US-PGPUB; USPAT	OR	ON	2019/08/05 10:13
S133	1	S131 and (trip$4 or fall$4) with sensor	US-PGPUB; USPAT	OR	ON	2019/08/05 10:16
S134	434	("0131163" | "0407724" | "1050400" | "1192832" | "2117957" | "2227526" | "2399915" | "2765786" | "2969768" | "3047291" | "3118315" | "3195889" | "3222061" | "3323366" | "3364736" | "3408067" | "3465592" | "3485213" | "3529474" | "3602502" | "3709197" | "3711089" | "3750479" | "3778052" | "3784194" | "3814417" | "3826491" | "3892404" | "3894437" | "3941377" | "3961751" | "3970302" | "4023795" | "4074903" | "4087088" | "4122840" | "4249725" | "4383684" | "4416293" | "4496147" | "4550908" | "4681316" | "4691694" | "4709918" | "4733858" | "4813667" | "4878384" | "4900013" | "4907797" | "4911430" | "4928708" | "4958830" | "4973044" | "5050590" | "5080109" | "5088504" | "5186695" | "5192305" | "5273502" | "5311880" | "5388591" | "5623944").PN. OR ("143198" | "18249" | "2004/0143198" | "229167" | "3408067" | "4204673" | "4423864" | "4733858" | "5314390" | "5830162").URPN.	US-PGPUB; USPAT; USOCR	OR	ON	2019/08/05 10:19
S135	7	S134 and (trip$4 or fall$4) with sensor	US-PGPUB; USPAT	OR	ON	2019/08/05 10:22
S136	19078	(A63B21/4001 or A63B69/0002 or A63B21/00181 or A63B24/0087 or A63B23/0464 or A63B21/068 or A63B69/0064 or A63B21/4007 or A63B2225/50 or A63B2225/20 or A63B2220/805 or A63B2220/54 or A63B2220/51 or A63B2220/40 or A63B2220/30 or A63B2220/10 or A63B2071/0018 or A63B2024/0093 or A63B23/0458 or A63B22/0235 or A63B71/0622 or A63B2022/0092 or A63B2208/0204 or A63B2022/0094).cpc.	US-PGPUB; USPAT	OR	ON	2019/08/05 10:24
S137	1934	(A63B$ or A61H$).cpc. and (trip$4 or fall) with (catch$4 or prevent$4)	US-PGPUB; USPAT	OR	ON	2019/08/05 10:25
S138	1	S137 and (rope or cord or tether or strap) with (length) with (adjust$4) with sensor	US-PGPUB; USPAT	OR	ON	2019/08/05 10:27
S139	23	S137 and ((rope or cord or tether or strap) with (adjust$4)) same sens$4	US-PGPUB; USPAT	OR	ON	2019/08/05 10:29
S140	11	S139 and acceler$4	US-PGPUB; USPAT	OR	ON	2019/08/05 10:34

S141	22	S139 and accelerat$4	US-PGPUB; USPAT	OR	ON	2019/08/05 10:34

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L7	0	(body with weight with support$4 with (tether or strap) with (adjust$4 or chang$4) with length with (above or overhead) with maintain).clm.	US-PGPUB; USPAT	AND	ON	2019/12/22 20:04
L8	3	((body or weight) with support$4 with (tether or strap) with (adjust$4 or chang$4) with length with (above or overhead) with maintain).clm.	US-PGPUB; USPAT	AND	ON	2019/12/22 20:04
L9	1	((body or weight) with support$4 with (tether or strap) with (adjust$4 or chang$4) with length with (overhead) with maintain).clm.	US-PGPUB; USPAT	AND	ON	2019/12/22 20:05
S27	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:05
S28	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with lever).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:05
S29	1	(treadmill with belt with (split or two or dual) with (tension or stiffness) with lever).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:06
S30	2	(treadmill with belt with (split or two or dual) with (tension or stiffness)).clm.	US-PGPUB; USPAT	AND	ON	2017/04/14 23:06
S62	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S63	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S64	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S65	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S66	0	(treadmill with belt with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S67	0	(treadmill with belt with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S68	0	(treadmill with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S69	0	(treadmill with (tension or stiffness) with track with counterweight).clm.	US-PGPUB;	AND	ON	2018/04/02 09:03

			USPAT			
S70	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S71	3	(treadmill with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S72	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S73	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S74	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with lever).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S75	2	(treadmill with belt with (split or two or dual) with (tension or stiffness) with lever).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S76	4	(treadmill with belt with (split or two or dual) with (tension or stiffness)).clm.	US-PGPUB; USPAT	AND	ON	2018/04/02 09:03
S142	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S143	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S144	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S145	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S146	0	(treadmill with belt with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S147	0	(treadmill with belt with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S148	0	(treadmill with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S149	0	(treadmill with (tension or stiffness) with track with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S150	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S151	4	(treadmill with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S152	0	(treadmill with (tension or stiffness) with	US-	AND	ON	2019/08/05

		counterweight).clm.	PGPUB; USPAT			09:50
S153	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S154	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S155	2	(treadmill with belt with (split or two or dual) with (tension or stiffness) with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S156	4	(treadmill with belt with (split or two or dual) with (tension or stiffness)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S157	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S158	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (harness or body) with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S159	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight with (column or post)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S160	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S161	0	(treadmill with belt with (tension or stiffness) with motor with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S162	0	(treadmill with belt with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S163	0	(treadmill with (tension or stiffness) with track with lever with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S164	0	(treadmill with (tension or stiffness) with track with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S165	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S166	4	(treadmill with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S167	0	(treadmill with (tension or stiffness) with counterweight).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S168	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with track with spring with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S169	0	(treadmill with belt with (split or two or dual) with (tension or stiffness) with motor with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50

S170	2	(treadmill with belt with (split or two or dual) with (tension or stiffness) with lever).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50
S171	4	(treadmill with belt with (split or two or dual) with (tension or stiffness)).clm.	US-PGPUB; USPAT	AND	ON	2019/08/05 09:50

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet	1	of	6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	1.	764,781	07-12-1904	Sumner	
	2.	895,055	08-04-1908	Spooner	
	3.	1,536,766	05-05-1925	Cammann	
	4.	1,648,930	11-15-1927	Zouck	
	5.	1,971,294	08-21-1934	Bunker	
	6.	2,211,220	08-13-1940	Verplanck	
	7.	2,360,505	10-17-1944	Medenwald et al.	
	8.	2,519,165	08-15-1950	Weise et al.	
	9.	2,688,933	09-14-1954	Spafford	
	10.	2,819,755	01-14-1958	Berger et al.	
	11.	3,424,458	01-28-1969	Hopps, Jr.	
	12.	3,720,172	03-13-1973	Dehne	
	13.	3,780,663	12-25-1973	Pettit	
	14.	3,985,082	10-12-1976	Barac	
	15.	4,243,147	01-06-1981	Twitchell et al.	
	16.	4,360,307	11-23-1982	Larsson	
	17.	4,372,452	02-08-1983	McCord	
	18.	4,427,398	01-24-1984	Eisbrecher et al.	
	19.	4,606,082	08-19-1986	Kuhlman	
	20.	4,627,119	12-09-1986	Hachey et al.	
	21.	4,639,955	02-03-1987	Carminati et al.	
	22.	4,706,782	11-17-1987	Spoeler et al.	
	23.	4,944,056	07-31-1990	Schroeder et al.	
	24.	5,048,822	09-17-1991	Murphy	
	25.	5,138,953	08-18-1992	Horcher et al.	
	26.	5,337,908	08-16-1994	Beck, Jr.	
	27.	5,490,293	02-13-1996	Nilsson	
	28.	5,511,486	04-30-1996	Pollard et al.	
	29.	5,632,206	05-27-1997	Summa et al.	
	30.	5,638,755	06-17-1997	Love et al.	
	31.	5,695,432	12-09-1997	Soderlund	
	32.	5,809,591	09-22-1998	Capaldi et al.	
	33.	5,850,928	12-22-1998	Kahlman et al.	
	34.	5,904,099	05-18-1999	Danneker	
	35.	6,080,087	06-27-2000	Bingham	

Examiner Signature		Date Considered	

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Sheet 2 of 6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

U. S. PATENT DOCUMENTS

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	36.	6,192,803	02-27-2001	Nishino	
	37.	6,315,138	11-13-2001	Dyson	
	38.	6,464,208	10-15-2002	Smith	
	39.	6,520,484	02-18-2003	Shimizu et al.	
	40.	6,645,126	11-11-2003	Martin et al.	
	41.	6,679,185	01-20-2004	Sullivan et al.	
	42.	6,890,288	05-10-2005	Bingham	
	43.	7,137,771	11-21-2006	Maurer et al.	
	44.	7,240,621	07-10-2007	Chepurny et al.	
	45.	7,303,049	12-04-2007	Greenlee	
	46.	7,377,377	05-27-2008	Christiansson	
	47.	7,462,138	12-09-2008	Shetty et al.	
	48.	7,618,223	11-17-2009	Begley	
	49.	7,883,450	02-08-2011	Hidler	
	50.	7,938,757	05-10-2011	Cockrell	
	51.	7,993,248	08-09-2011	Rasmussen	
	52.	8,397,320	03-19-2013	Capaldi	
	53.	8,584,274	11-19-2013	Hushek	
	54.	8,789,682	07-29-2014	Fisher	
	55.	8,978,905	03-17-2015	Bergenstrale et al.	
	56.	9,510,991	12-06-2016	Stockmaster et al.	
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	59.	9,855,177	01-02-2018	Erturk et al.	
	60.	10,219,960	03-05-2019	Behnke et al.	
	61.	2001/0027149	10-04-2001	Bingham	
	62.	2003/0084508	05-08-2003	Faucher et al.	
	63.	2003/0146069	08-07-2003	Kaiser	
	64.	2003/0153438	08-14-2003	Gordon et al.	
	65.	2003/0200607	10-30-2003	Faucher et al.	
	66.	2003/0201374	10-30-2003	Faucher et al.	
	67.	2004/0074414	04-22-2004	Phillips	
	68.	2004/0143198	07-22-2004	West	
	69.	2004/0200795	10-14-2004	Summa	
	70.	2005/0115914	06-02-2005	Chepurny et al.	

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Sheet 3 of 6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	71.	2006/0189453	08-24-2006	Leblond	
	72.	2006/0229167	10-12-2006	Kram et al.	
	73.	2006/0240952	10-26-2006	Schlosser	
	74.	2007/0004567	01-04-2007	Shetty et al.	
	75.	2008/0287268	11-20-2008	Hidler	
	76.	2009/0308828	12-17-2009	Hansen	
	77.	2010/0000546	01-07-2010	Park	
	78.	2010/0312152	12-09-2010	Sarkodie-Gyan et al.	
	79.	2011/0000015	01-06-2011	Faucher et al.	
	80.	2011/0072580	03-31-2011	Imhoff	
	81.	2011/0265260	11-03-2011	Darrow	
	82.	2012/0000876	01-05-2012	Bergenstrale et al.	
	83.	2012/0198612	08-09-2012	Tindall	
	84.	2012/0325586	12-27-2012	Meggs et al.	
	85.	2014/0201905	07-24-2014	Glukhovsky	
	86.	2014/0201906	07-24-2014	Erturk et al.	
	87.	2014/0206503	07-24-2014	Stockmaster et al.	
	88.	2015/0143627	05-28-2015	McBride	
	89.	2015/0283921	10-08-2015	Zimmerman et al.	
	90.	2017/0128313	05-11-2017	Gluhkovsky et al.	
	91.	2018/0036196	02-08-2018	Behnke et al.	
	92.	2018/0071159	03-15-2018	Glukhovsky et al.	
	93.	2019/0216664	07-18-2019	Behnke et al.	

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Sheet	4	of	6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] *(if known)*	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	94.	CH 669780 A5	04-14-1989	Nussbaumer		✓
	95.	CN 104308861 B	01-28-2015	Shandong Luneng Intelligence Technology Co Ltd		✓
	96.	DE 102008015879 A1	04-09-2009	Berwald et al.		✓
	97.	EP 0088061 A2	09-07-1983	Hedstrom		
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	99.	JP 2000-237250 A	09-05-2000	Iwauchi		✓
	100.	JPH02-131435 A	11-01-1990	Denken Electricity Co. Ltd.		✓
	101.	JPS-50-20727	07-17-1975			✓
	102.	JP 2001-299842 A	10-30-2001	Biodex Medical Systems Inc.		✓
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	104.	WO 2013/117750	08-15-2013	Lutz Medical Engineering		
	105.	WO 2017/083666	05-18-2017	Bioness Inc.		

Examiner Signature		Date Considered	

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Sheet	5	of	6

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Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	106.	Office Action for U.S. Application No. 13/745,830, mailed June 15, 2015, 9 pages	
	107.	Office Action for U.S. Application No. 13/745,830, mailed December 17, 2015, 9 pages	
	108.	Office Action for U.S. Application No. 13/745,830, mailed June 2, 2016, 11 pages	
	109.	Office Action for U.S. Application No. 14/226,021, mailed September 14, 2016, 13 pages	
	110.	Office Action for U.S. Application No. 14/226,021, mailed February 22, 2017, 11 pages	
	111.	Office Action for U.S. Application No. 14/613,140, mailed August 28, 2017, 25 pages	
	112.	Office Action for U.S. Application No. 14/613,140, mailed March 26, 2018, 28 pages	
	113.	Office Action for U.S. Application No. 14/613,140, mailed October 30, 2018, 28 pages	
	114.	Office Action for U.S. Application No. 15/783,755, mailed May 7, 2018, 13 pages	
	115.	Office Action for U.S. Application No. 15/349,390, mailed January 17, 2019, 15 pages	
	116.	Extended European Search Report for European Application No. 14740676.3, mailed August 18, 2016, 6 pages	
	117.	European Examination Report for European Application No. 14740676.3, mailed June 14, 2019, 5 pages	
	118.	Extended European Search Report for European Application No. 16747097.0, mailed July 27, 2018, 8 pages	
	119.	Extended European Search Report for European Application No. 16865093.5, mailed April 2, 2019, 6 pages	
	120.	Notice of Reasons for Rejection for Japanese Application No. 2015-553851, mailed July 4, 2016, 9 pages	✓

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /G.K.A/

PTO/SB/08b (07-09)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet	6	of	6

Complete if Known	
Application Number	15/896,731
Filing Date	February 14, 2018
First Named Inventor	Keith MCBRIDE
Art Unit	3784
Examiner Name	Garrett K. ATKINSON
Attorney Docket Number	BION-051/12US 307799-2333

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	121.	Notice of Reasons for Rejection for Japanese Application No. 2017-052240, mailed January 15, 2018, 9 pages	✓
	122.	Final Notice of Reasons for Rejection for Japanese Application No. 2017-052240, mailed July 19, 2018, 4 pages	✓
	123.	Notice of Reasons for Rejection for Japanese Application No. 2017-534701, mailed October 16, 2019, 16 pages	✓
	124.	International Search Report and Written Opinion for International Application No. PCT/US2014/012064, mailed May 9, 2014, 6 pages	
	125.	International Search Report and Written Opinion for International Application No. PCT/US2016/016131, mailed April 21, 2016, 10 pages	
	126.	International Search Report and Written Opinion for International Application No. PCT/US2016/061552, mailed January 31, 2017, 10 pages	
	127.	International Search Report and Written Opinion for International Application No. PCT/US2017/050482, mailed December 21, 2017, 9 pages	
	128.	International Search Report and Written Opinion for International Application No. PCT/US2018/018166, mailed July 2, 2018, 11 pages	
	129.	VALLERY, H. et al., "Multidirectional Transparent Support for Overground Gait Training," 2013 IEEE International Conference on Rehabilitation Robotics, Seattle, WA (June 2013), 7 pages	
	130.	VAHLE Electrification Systems, “Enclosed Conductor System KBH,” Catalogue, 2014, 28 pages	

Examiner Signature	/GARRETT K ATKINSON/	Date Considered	12/22/2019

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Applicant’s unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

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Application	Document	Mailroom Date	Attorney Docket No.
15896731	NOA	01/10/2020	BION-051/12US 307799-2333
	1449	01/10/2020	BION-051/12US 307799-2333

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333	4706

58249 7590 03/03/2020

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

EXAMINER	
ATKINSON, GARRETT K	

ART UNIT	PAPER NUMBER
3784	

NOTIFICATION DATE	DELIVERY MODE
03/03/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

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Application No. : 15896731
Applicant : McBride
Filing Date : 02/14/2018
Date Mailed : 03/03/2020

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

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/Steven Barbano/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 15896731 **Drawings filed: 02/14/2018**

IDENTIFICATION OF DRAWING DEFICIENCIES

- [ ] There is a hole or the image thereof within the illustration. FIG(s)
- [ ] The illustration is penetrated or traversed by a solid or broken line that is not intended to be part of the drawing, such as a dark line caused by a flaw in the copying process. FIG(s)
- [ ] An ink stamp or the image thereof obscures part of the illustration. FIG(s)
- [ ] The drawing is marred by black smudges, obliterations, or fax/copier marks (for example, speckles or dots in a substantial portion of the drawing). FIG(s)
- [ ] Figure numbers are duplicated or missing. FIG(s)
- [ ] Drawing sheet or figure is missing. FIG(s)
- [ ] Numbers, letters, or reference characters in the drawing have been crossed out or are illegibly handwritten. FIG(s)
- [ ] The character of the lines, numbers, and letters is poor. FIG(s)
- [ ] The drawing's background shows that the original drawing was made on graph paper or other paper with a pattern or decoration. FIG(s)
- [ ] The FIG. number label is placed in a location that causes the drawing to be read upside down. FIG(s)
- [ ] Data, a reference number, or part of the drawing is truncated or missing, or a lead line has no reference number. FIG(s)
- [ ] The drawing and/or the FIG. label contain(s) foreign language. FIG(s)
- [X] This utility application contains a photograph of a view that is capable of being illustrated as a line drawing. FIG(s) 38-44 and 72-73
- [ ] A petition under 37 CFR 1.84(a)(2) to accept color drawings has been granted, but the brief description of the drawings in the specification does not contain (or has not been amended to contain) the paragraph required by 37 CFR 1.84(a)(2)(iii).
- [ ] This reissue application contains added and/or amended drawings that are not labeled as "New" or "Amended" or "Canceled" as required by 37 CFR 1.173(b)(3). FIG(s)
- [ ] This Design reissue application contains a drawing that is labeled as "Canceled" but is not surrounded by brackets, or a drawing that is surrounded by brackets but is not labeled as "Canceled." See 37 CFR 1.173(b)(3). FIG(s)
- [X] OTHER: Fig. 50 contains overlapping data.
- [ ] COMMENTS:

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Application	Document	Mailroom Date	Attorney Docket No.
15896731	M327	03/03/2020	BION-051/12US 307799-2333

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [ ] The attached application, or
- [x] United States application or PCT international application number 15/896,731 filed on 02/14/2018.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Keith MCBRIDE Date (Optional): 3/2/2018

Signature: Keith McBride

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

Aretech LLC - Exhibit 1004, Page 00927

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [ ] The attached application, or
- [x] United States application or PCT international application number 15/896,731 filed on 02/14/2018.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

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LEGAL NAME OF INVENTOR

Inventor: Arkady GLUKHOVSKY Date (Optional): 03/13/2018

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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Title of Invention	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☐ The attached application, or
- ☒ United States application or PCT international application number 15/896,731 filed on 02/14/2018 .

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

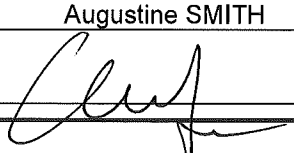
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LEGAL NAME OF INVENTOR

Inventor: Augustine SMITH Date (Optional): 03/19/2018

Signature: 

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

Aretech LLC - Exhibit 1004, Page 00929

Electronic Acknowledgement Receipt

EFS ID:	38878138
Application Number:	15896731
International Application Number:	
Confirmation Number:	4706
Title of Invention:	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM
First Named Inventor/Applicant Name:	Keith MCBRIDE
Customer Number:	58249
Filer:	Michael D. Winternitz/Rebecca Phelan
Filer Authorized By:	Michael D. Winternitz
Attorney Docket Number:	BION-051/12US 307799-2333
Receipt Date:	16-MAR-2020
Filing Date:	14-FEB-2018
Time Stamp:	16:16:07
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Oath or Declaration filed	BION-051-12US-Declaration.pdf	2798125 ea27ed932fc8d6a915ba7c8795f54798a9e4 8e5c	no	3

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Docket No.: BION-051/12US 307799-2333
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor:	Keith MCBRIDE	Confirmation No.:	4706
Application No.:	15/896,731	Group Art Unit:	3784
Filed:	February 14, 2018	Examiner:	Garrett K. ATKINSON

For: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

Via EFS or
MS Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS AND AMENDMENT UNDER 37 C.F.R. § 1.312
Notice of Allowance Mailed

In response to the Notice to File Corrected Application Papers dated March 3, 2020, the response to which is due May 3, 2020, the Applicant submits the following Amendments and Remarks. The Applicant further submits herewith a copy of the Notice to File Corrected Application Papers.

Amendments to the Drawings begin on page 2 of this paper.

Amendments to the Claims begin on page 3 of this paper.

Remarks begin on page 8 of this paper.

Replacement Sheet

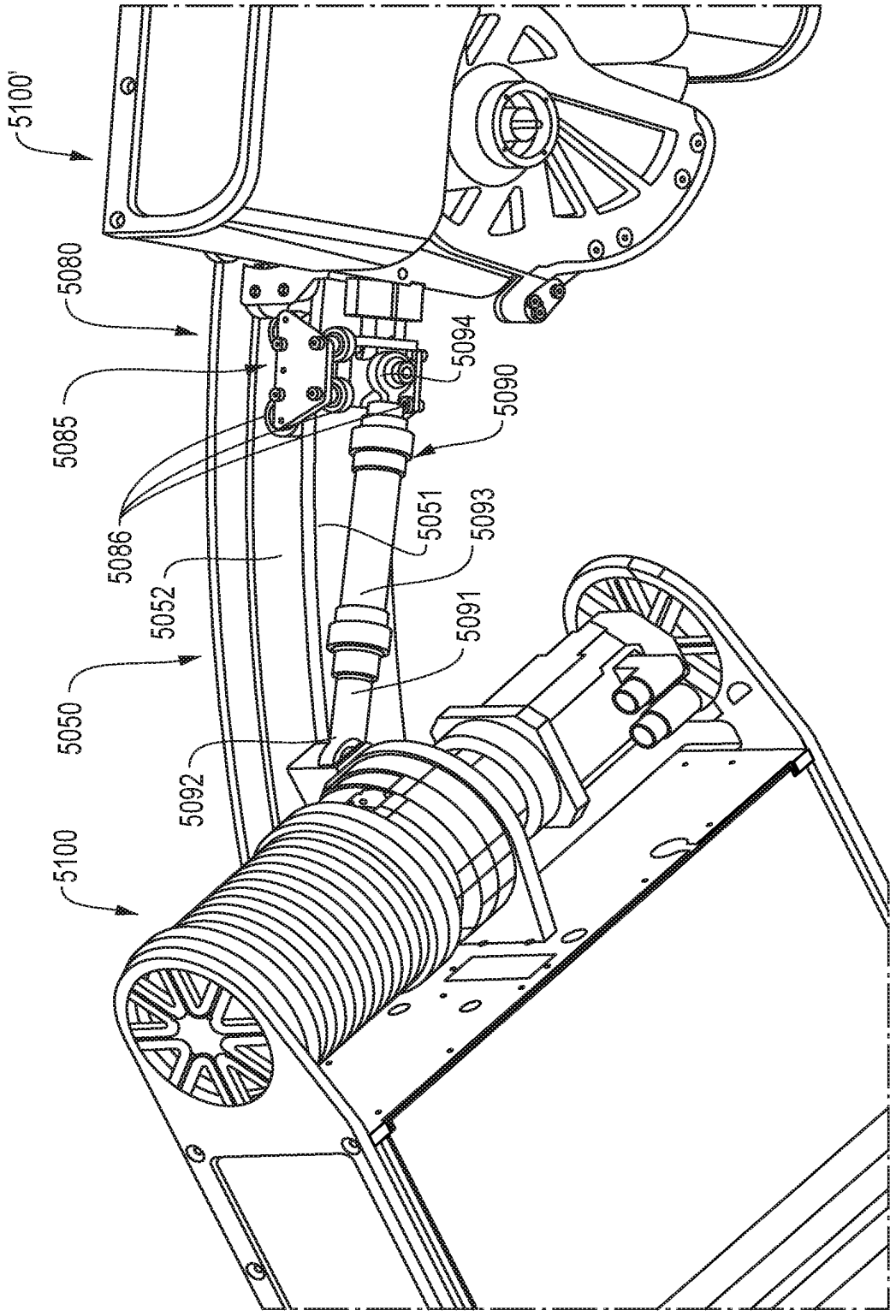


FIG. 38

Replacement Sheet

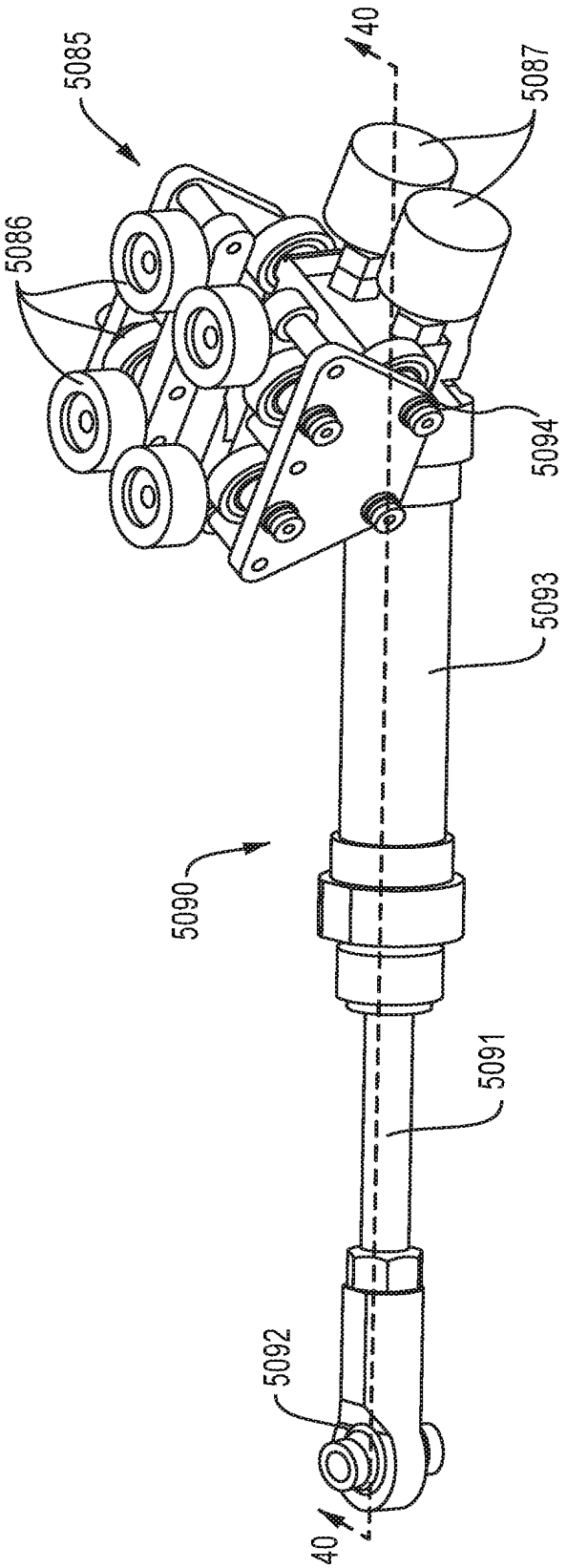


FIG. 39

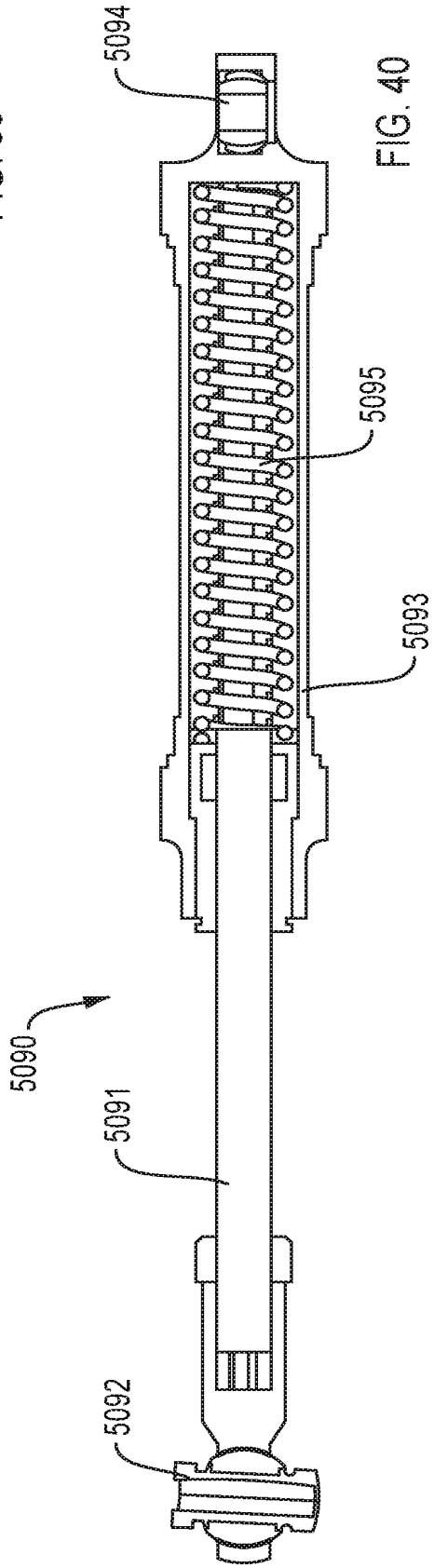


FIG. 40

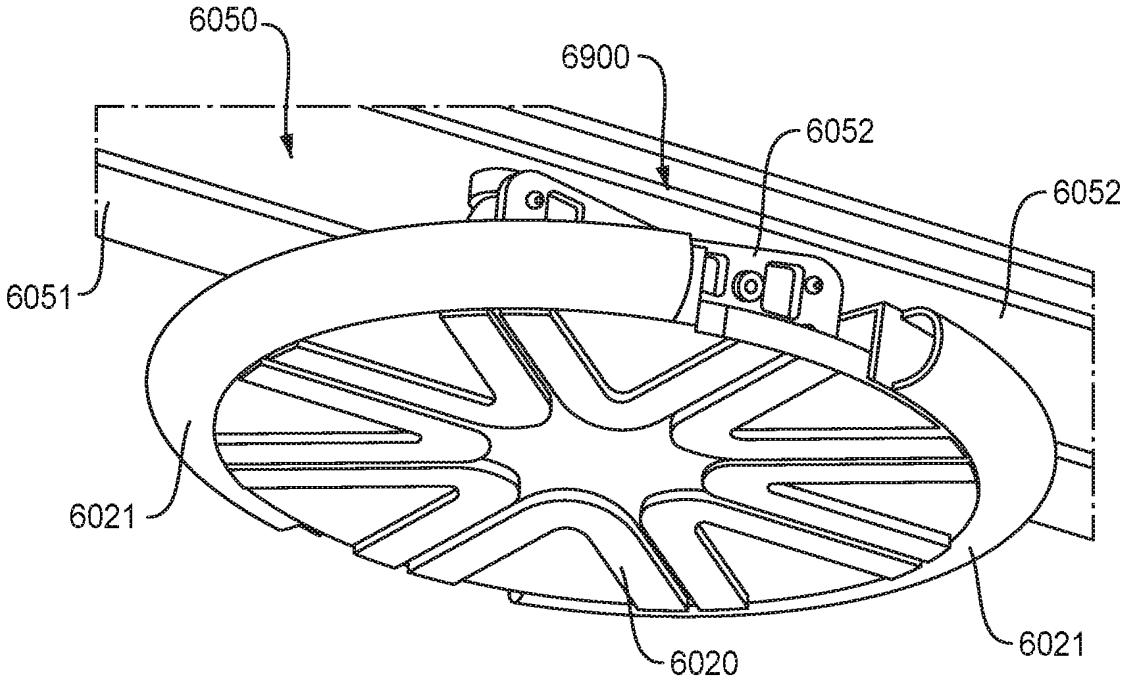

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FIG. 41

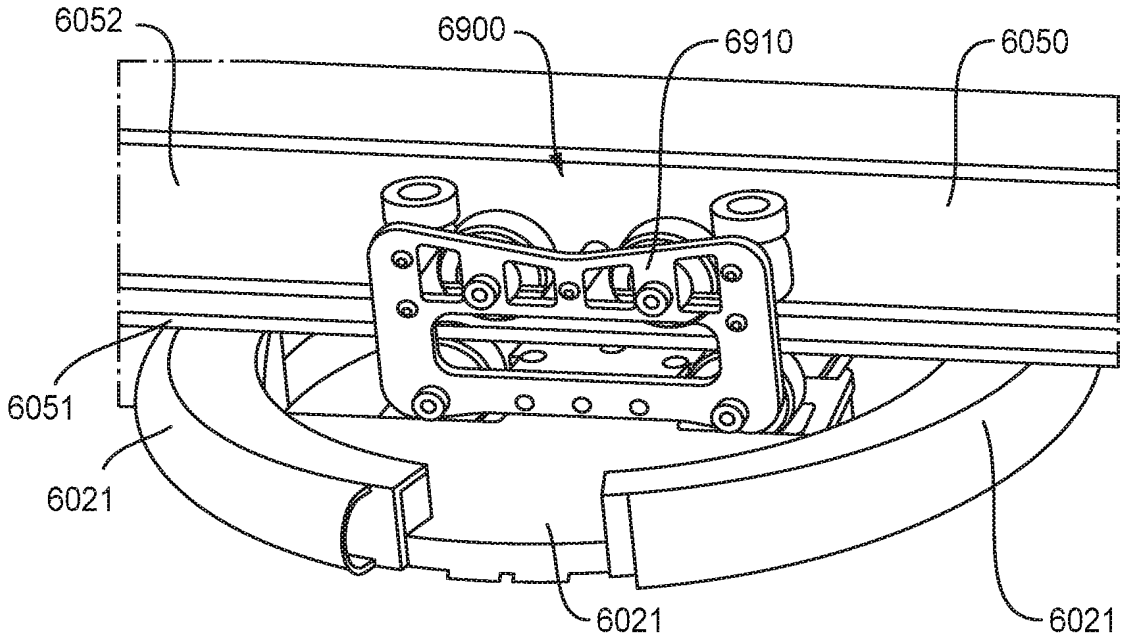

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FIG. 42

Replacement Sheet

4/7

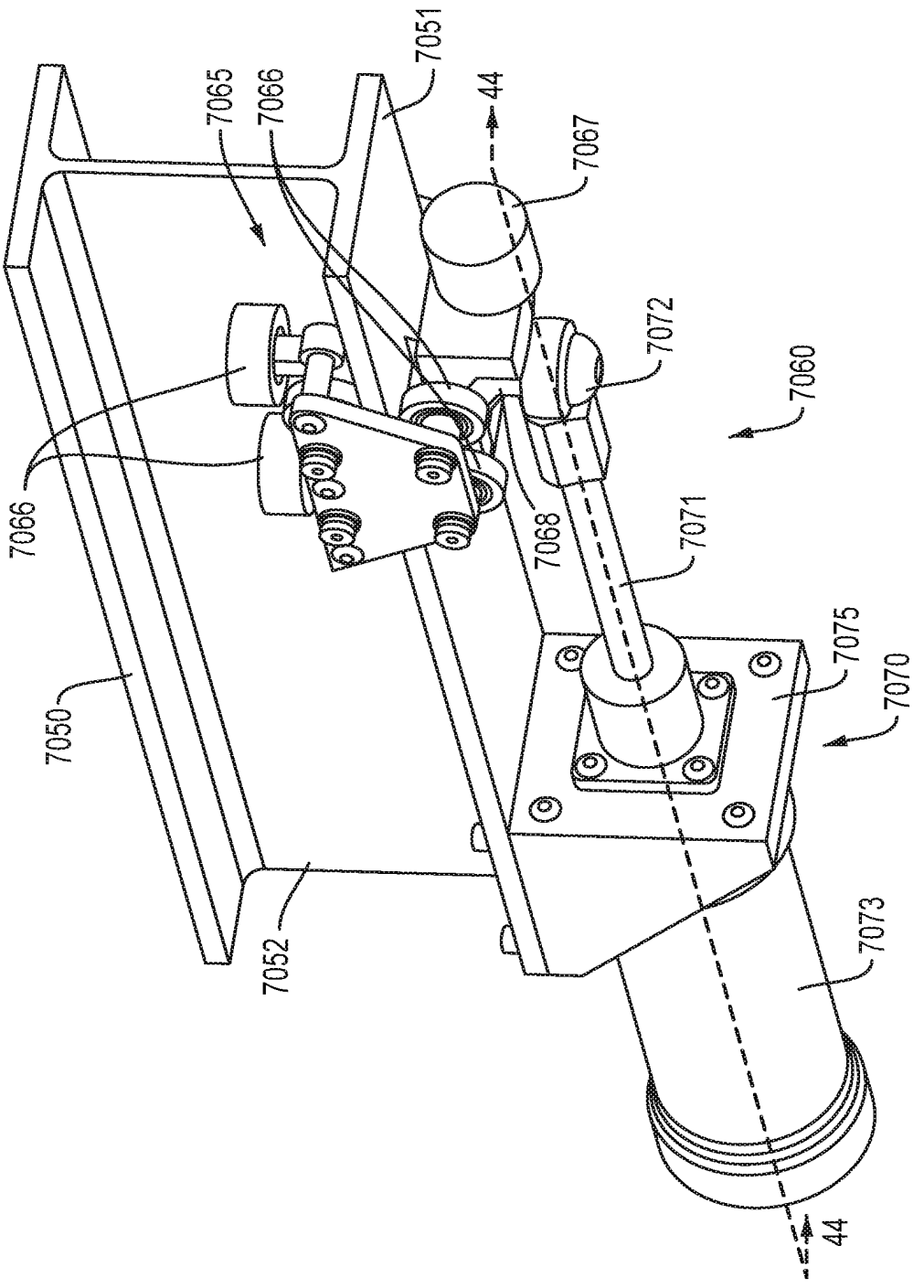


FIG. 43

Replacement Sheet

5/7

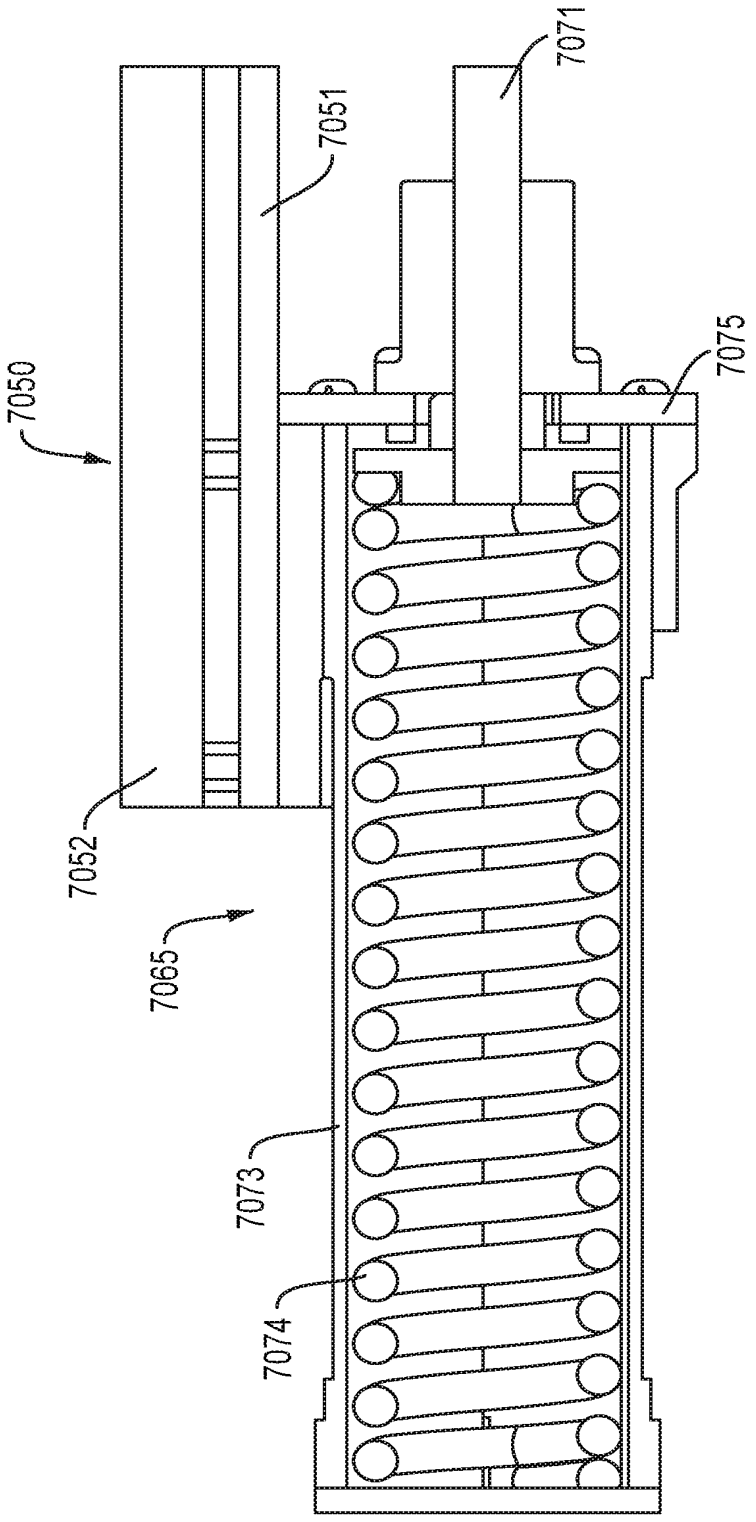


FIG. 44

Replacement Sheet

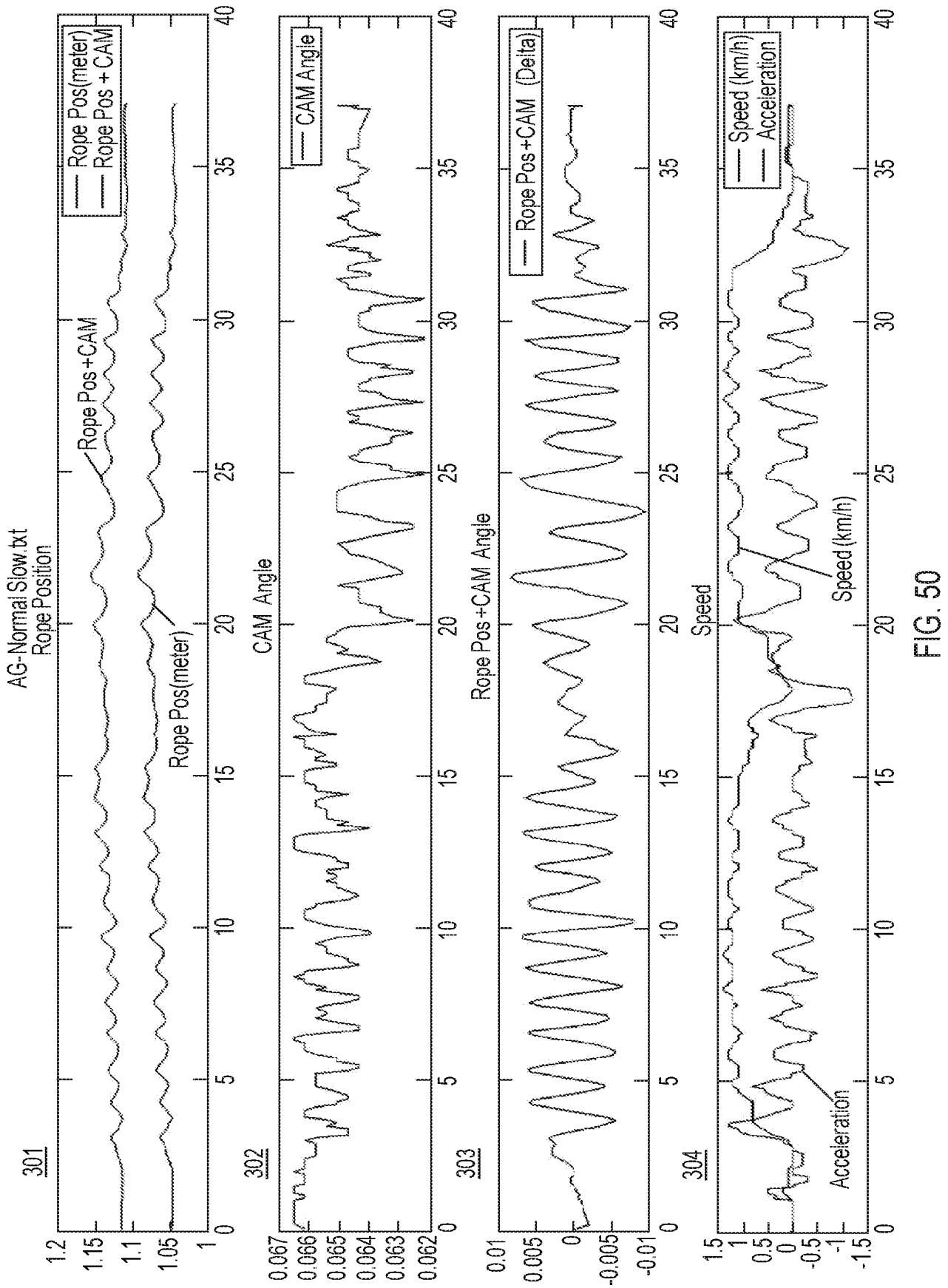


FIG. 50

Replacement Sheet

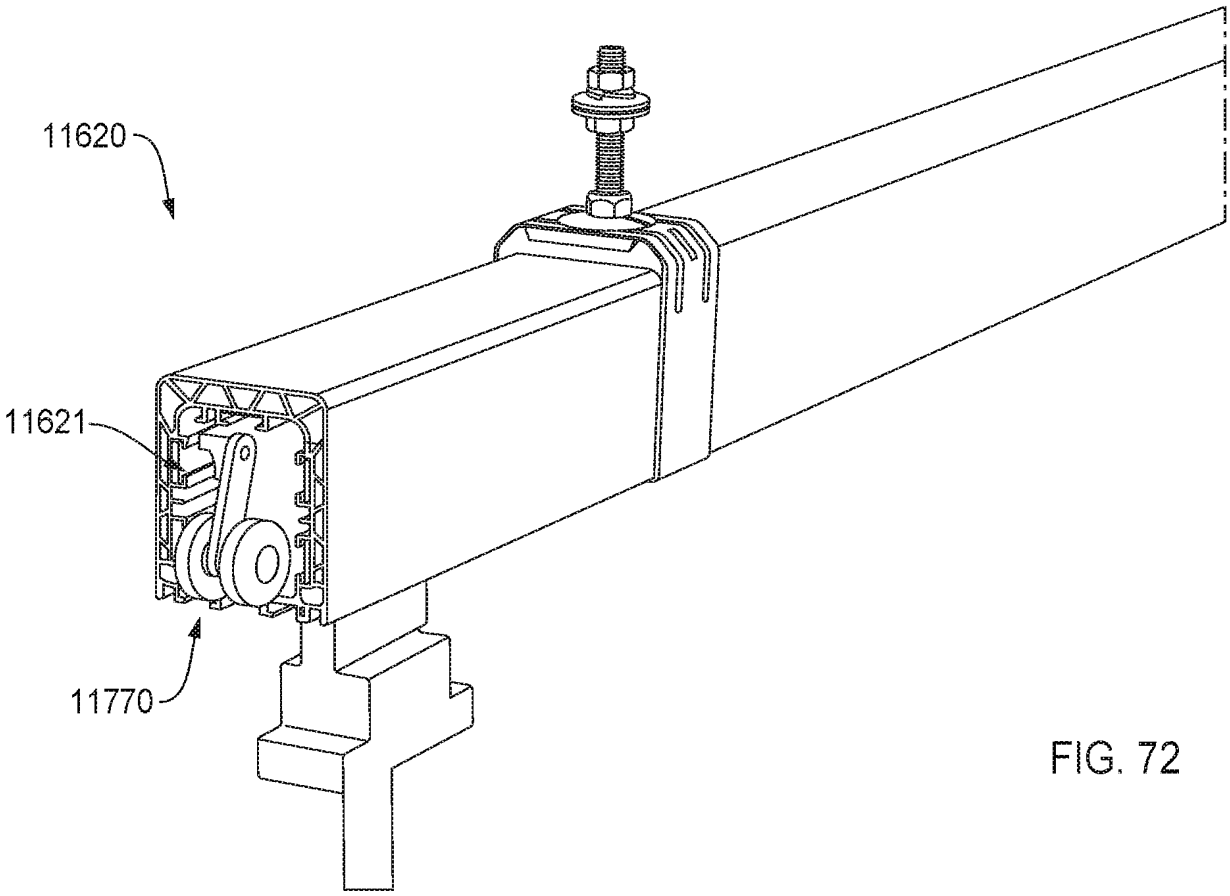


FIG. 72

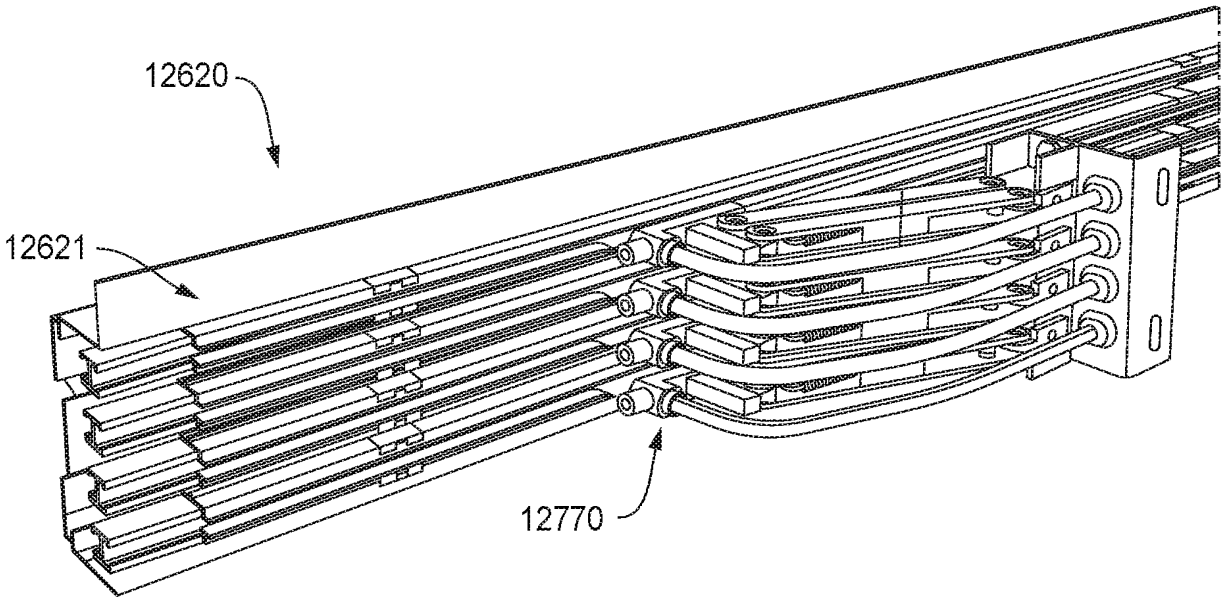


FIG. 73

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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Bioness, Inc.

Application No./Patent No.: 15/896,731 Filed/Issue Date: February 14, 2018

Titled: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

Bioness Inc., a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 051175, Frame 0058, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

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This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

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4. From: _____ To: _____

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5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

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6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Michael D. Winternitz/	2020-04-10
Signature	Date
Michael D. Winternitz	73102
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333	4706

58249 7590 03/03/2020

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

EXAMINER	
ATKINSON, GARRETT K	

ART UNIT	PAPER NUMBER
3784	

NOTIFICATION DATE	DELIVERY MODE
03/03/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zIPPatentDocketingMailboxUS@cooley.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 15896731
Applicant : McBride
Filing Date : 02/14/2018
Date Mailed : 03/03/2020

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Steven Barbano/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 15896731 **Drawings filed: 02/14/2018**

IDENTIFICATION OF DRAWING DEFICIENCIES

- [ ] There is a hole or the image thereof within the illustration. FIG(s)
- [ ] The illustration is penetrated or traversed by a solid or broken line that is not intended to be part of the drawing, such as a dark line caused by a flaw in the copying process. FIG(s)
- [ ] An ink stamp or the image thereof obscures part of the illustration. FIG(s)
- [ ] The drawing is marred by black smudges, obliterations, or fax/copier marks (for example, speckles or dots in a substantial portion of the drawing). FIG(s)
- [ ] Figure numbers are duplicated or missing. FIG(s)
- [ ] Drawing sheet or figure is missing. FIG(s)
- [ ] Numbers, letters, or reference characters in the drawing have been crossed out or are illegibly handwritten. FIG(s)
- [ ] The character of the lines, numbers, and letters is poor. FIG(s)
- [ ] The drawing's background shows that the original drawing was made on graph paper or other paper with a pattern or decoration. FIG(s)
- [ ] The FIG. number label is placed in a location that causes the drawing to be read upside down. FIG(s)
- [ ] Data, a reference number, or part of the drawing is truncated or missing, or a lead line has no reference number. FIG(s)
- [ ] The drawing and/or the FIG. label contain(s) foreign language. FIG(s)
- [X] This utility application contains a photograph of a view that is capable of being illustrated as a line drawing. FIG(s) 38-44 and 72-73
- [ ] A petition under 37 CFR 1.84(a)(2) to accept color drawings has been granted, but the brief description of the drawings in the specification does not contain (or has not been amended to contain) the paragraph required by 37 CFR 1.84(a)(2)(iii).
- [ ] This reissue application contains added and/or amended drawings that are not labeled as "New" or "Amended" or "Canceled" as required by 37 CFR 1.173(b)(3). FIG(s)
- [ ] This Design reissue application contains a drawing that is labeled as "Canceled" but is not surrounded by brackets, or a drawing that is surrounded by brackets but is not labeled as "Canceled." See 37 CFR 1.173(b)(3). FIG(s)
- [X] OTHER: Fig. 50 contains overlapping data.
- [ ] COMMENTS:

REMARKS

Entry of the foregoing amendments to the drawings is respectfully requested in view of the following remarks. Replacement Sheets 1-7 are submitted herewith to remedy the purported deficiencies identified in the Notice to File Corrected Application Papers and introduce no new matter. Please replace the originally filed drawing sheets as follows:

Replacement Sheet 1 illustrating FIG. 38 replaces Drawing Sheet 35;
Replacement Sheet 2 illustrating FIGS. 39 and 40 replaces Drawing Sheet 36;
Replacement Sheet 3 illustrating FIGS. 41 and 42 replaces Drawing Sheet 37;
Replacement Sheet 4 illustrating FIG. 43 replaces Drawing Sheet 38;
Replacement Sheet 5 illustrating FIG. 44 replaces Drawing Sheet 39;
Replacement Sheet 6 illustrating FIG. 50 replaces Drawing Sheet 44; and
Replacement Sheet 7 illustrating FIGS. 72 and 73 replaces Drawing Sheet 64.

Entry of the foregoing amendment to the claims under 37 C.F.R. § 1.312 is respectfully requested in view of the following remarks. Specifically, claim 12 has been amended to correct a typographical error and does not substantially change the scope of the claim. Accordingly, no additional search or examination is required on the part of the Office.

Aretech LLC - Exhibit 1004, Page 00946

Conclusion

The Applicant respectfully requests that the Examiner enter the foregoing amendments prior to issuance. Should any questions arise in connection with these amendments, the Examiner is invited to telephone the undersigned at the number provided.

The Director is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 50-1283 **referencing Docket No.** BION-051/12US 307799-2333**.**

Dated: April 10, 2020

Respectfully submitted,
COOLEY LLP

By: /Michael D. Winternitz/
Michael D. Winternitz
Reg. No. 73,102

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue NW, Suite 700
Washington, DC 20004

Tel: (202) 728-7034
Fax: (202) 842-7899
223723790 v1

Aretech LLC - Exhibit 1004, Page 00947

In the Claims:

Set forth below in ascending order, with status identifiers, is a complete listing of all claims currently under examination. Changes to any amended claims are indicated by [[double brackets]], ~~strikethrough~~ and /or underlining. This listing also reflects any cancellation and/or addition of claims. No new matter is added by these amendments.

1. (Previously Presented) 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. (Original) 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. (Original) 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.

Aretech LLC - Exhibit 1004, Page 00948

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

5. (Canceled)

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

7. (Original) The method of claim 6, wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill.

8. (Previously Presented) 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.

Aretech LLC - Exhibit 1004, Page 00949

9. (Original) The method of claim 8, wherein the first criterion is a rate of change in the length of the tether.

10. (Original) The method of claim 8, wherein the second criterion is a duration during which the length of the tether is changed.

11. (Original) The method of claim 10, wherein the second criterion is a minimum duration.

12. (Currently Amended) The method of claim 8, 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 ~~bodily~~ 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.

13. (Original) The method of claim 8, further comprising:

redefining the reference length of the tether in response to a change in the length of the tether that does not satisfy at least one of the first criterion or the second criterion.

14. (Original) A method of using a body weight support system to provide body weight support during gait training, the body weight support system including 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, the threshold length of the tether being associated with the user falling during the gait training;

defining a threshold number of falls during the gait training;

Aretech LLC - Exhibit 1004, Page 00950

providing a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls;

increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met; and

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

15. (Original) The method of claim 14, wherein the surface relative to which the user moves is a stationary surface.

16. (Original) The method of claim 15, wherein the body weight support system includes a drive assembly configured to movably 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.

17. (Original) The method of claim 14, wherein the surface relative to which the user moves is a moving surface included in a treadmill.

18. (Original) The method of claim 17, wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill.

19. (Original) The method of claim 14, wherein providing the predetermined amount of body weight support during the gait training as the user moves relative to the surface is in response to a length of the tether exceeding the threshold length of the tether.

20. (Original) The method of claim 14, wherein the reference length of the tether is a first reference length of the tether, the method further comprising:

Aretech LLC - Exhibit 1004, Page 00951

defining a second reference length of the tether in response to the threshold number of falls being met, the second reference length of the tether being shorter than the first reference length of the tether.

Aretech LLC - Exhibit 1004, Page 00952

AMENDMENTS

In the Drawings

Please amend the Drawings with Replacement Sheets 1-7 submitted herewith. No new matter is added by these amendments.

Aretech LLC - Exhibit 1004, Page 00953

PTO/AIA/80 (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

☒ Practitioners associated with Customer Number: **58249**

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

☒ The address associated with Customer Number: **58249**

OR

☐

Firm or Individual Name			
Address			
City			
Country			
Telephone		Email	

Assignee **Bioness Inc.**
25103 Rye Canyon Loop
Valencia, CA 91355

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/SB/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record
The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	[signature]	Date	9/1/16
Name	Todd Cushman	Telephone	661-362-4848
Title	CEO		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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136184448 v1

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PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

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Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

58249 7590 01/10/2020

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333	4706

TITLE OF INVENTION: METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	04/10/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
ATKINSON, GARRETT K	3784	482-139000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Cooley LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Bioness Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Valencia, CA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Michael D. Winternitz/ Date April 10, 2020

Typed or printed name Michael D. Winternitz Registration No. 73,102

Electronic Patent Application Fee Transmittal

Application Number:	15896731
Filing Date:	14-Feb-2018
Title of Invention:	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM
First Named Inventor/Applicant Name:	Keith MCBRIDE
Filer:	Michael D. Winternitz/Rebecca Phelan
Attorney Docket Number:	BION-051/12US 307799-2333

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1000**

Electronic Acknowledgement Receipt

EFS ID:	39125095
Application Number:	15896731
International Application Number:	
Confirmation Number:	4706
Title of Invention:	METHODS AND APPARATUS FOR BODY WEIGHT SUPPORT SYSTEM
First Named Inventor/Applicant Name:	Keith MCBRIDE
Customer Number:	58249
Filer:	Michael D. Winternitz/Rebecca Phelan
Filer Authorized By:	Michael D. Winternitz
Attorney Docket Number:	BION-051/12US 307799-2333
Receipt Date:	10-APR-2020
Filing Date:	14-FEB-2018
Time Stamp:	14:21:30
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$1000
RAM confirmation Number	E202040E21500364
Deposit Account	501283
Authorized User	Rebecca Phelan

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		BION-051-12US-ResponseToNFCAPand312Amendment.pdf	447562 4b904dc1cce0488018d0a775f07d9b2b9365d4d5	yes	12

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Response to Pre-Exam Formalities Notice	10	12
	Applicant Arguments/Remarks Made in an Amendment	8	9
	Claims	3	7
	Drawings-other than black and white line drawings	2	2
	Amendment after Notice of Allowance (Rule 312)	1	1

Warnings:

Information:

2	Drawings-only black and white line drawings	BION-051-12US-ReplacementDrawings.pdf	414258 b83b5960f943106651355dfd4601405fff1fcaec	no	7

Warnings:

Information:

3		BION-051-12US-Power.pdf	387446 97ecca7710cb4cda5cb9815c7b0375159123e19b	yes	4

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Assignee showing of ownership per 37 CFR 3.73	2	4
	Power of Attorney	1	1

Warnings:

Information:					
4	Issue Fee Payment (PTO-85B)	BION-051-12US-IssueFee.pdf	198450 d847b6c16a533c146adf697a3ccb6f84275d790f	no	1
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	30484 9cff00db971aa7e308a5345c86d21fde5bbb9bc4	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	1478200	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

SCORE Placeholder Sheet for IFW Content

Application Number: 15896731 Document Date: 04/10/2020

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

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- USPTO employees may access SCORE content via DAV or via the SCORE web page.
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Form Revision Date: March 1, 2019

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United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333

CONFIRMATION NO. 4706

58249
COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

POA ACCEPTANCE LETTER

OC000000116175663

Date Mailed: 04/14/2020

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/10/2020.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/cgarner/

Aretech LLC - Exhibit 1004, Page 00962

PRINTER RUSH
(PTO ASSISTANCE)

Application: 15896731	**Examiner:** Atkinson	**GAU:** 3784
From:	**Location:** RTFM	**Creation Date:** 04/13/2020

Week Date: 1/13/2020

DOC CODE	DOC DATE	MISCELLANEOUS
☐ 1449		☐ Continuing Data
☐ IDS		☐ Foreign Priority
☐ CLM		☐ Document Legibility
☐ IIFW/FWCLM		☐ Fees
☐ SRFW		☐ Petition (TC)
☐ DRW		☐ Other
☐ OATH		
☒ 312	04/10/2020	
☐ SPEC		

[RUSH] Message:

Please respond to the 04/10/2020 a.na.

Thank you

[XRUSH] Response:

Initials: _____

Examiner: PUBS contact - James Leija, (703) 756-1197
NOTE: This form will be included as part of the official USPTO record with the response document coded as XRUSH.
REV: AUG 16

Aretech LLC - Exhibit 1004, Page 00963

To: zIPPatentDocketingMailboxUS@cooley.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 58249

Apr 14, 2020 04:13:22 AM

Dear PAIR Customer:

COOLEY LLP
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1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004
UNITED STATES

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Application	Document	Mailroom Date	Attorney Docket No.
15896731	N570	04/14/2020	BION-051/12US 307799-2333

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If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	02/14/2018	Keith MCBRIDE	BION-051/12US 307799-2333	4706

58249 7590 05/01/2020

COOLEY LLP
ATTN: IP Docketing Department
1299 Pennsylvania Avenue, NW
Suite 700
Washington, DC 20004

EXAMINER	
ATKINSON, GARRETT K	

ART UNIT	PAPER NUMBER
3784	

NOTIFICATION DATE	DELIVERY MODE
05/01/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

zIPPatentDocketingMailboxUS@cooley.com

Response to Rule 312 Communication	Application No.	Applicant(s)	
	15/896,731	MCBRIDE et al.	
	Examiner	Art Unit	AIA (FITF) Status
	GARRETT K ATKINSON	3784	Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

1. ☑ The amendment filed on 10 April 2020 under 37 CFR 1.312 has been considered, and has been:

a) ☐ entered.

b) ☑ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.

Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

/GARRETT K ATKINSON/
Primary Examiner, Art Unit 3784

PRINTER RUSH
(PTO ASSISTANCE)

Application: 15896731	**Examiner:** Atkinson	**GAU:** 3784
From:	**Location:** RTFM	**Creation Date:** 04/13/2020

Week Date: 1/13/2020

DOC CODE	DOC DATE	MISCELLANEOUS
☐ 1449		☐ Continuing Data
☐ IDS		☐ Foreign Priority
☐ CLM		☐ Document Legibility
☐ IIFW/FWCLM		☐ Fees
☐ SRFW		☐ Petition (TC)
☐ DRW		☐ Other
☐ OATH		
☒ 312	04/10/2020	
☐ SPEC		

[RUSH] Message:

Please respond to the 04/10/2020 a.na.

Thank you

[XRUSH] Response:

The a.na has been entered.

Thank you.

/G.K.A/
Initials: _____

Examiner: PUBS contact - James Leija, (703) 756-1197
NOTE: This form will be included as part of the official USPTO record with the response document coded as XRUSH.
REV: AUG 16

Aretech LLC - Exhibit 1004, Page 00967

Application No.: 15/896,731 **Docket No.:** BION-051/12US 307799-2333

OK TO ENTER: /G.K.A/

In the Claims:

Set forth below in ascending order, with status identifiers, is a complete listing of all claims currently under examination. Changes to any amended claims are indicated by [[double brackets]], ~~strikethrough~~ and /or underlining. This listing also reflects any cancellation and/or addition of claims. No new matter is added by these amendments.

1. (Previously Presented) 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. (Original) 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. (Original) 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.

Aretech LLC - Exhibit 1004, Page 00968

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

5. (Canceled)

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

7. (Original) The method of claim 6, wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill.

8. (Previously Presented) 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.

9. (Original) The method of claim 8, wherein the first criterion is a rate of change in the length of the tether.

10. (Original) The method of claim 8, wherein the second criterion is a duration during which the length of the tether is changed.

11. (Original) The method of claim 10, wherein the second criterion is a minimum duration.

12. (Currently Amended) The method of claim 8, 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 ~~bodily~~ 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.

13. (Original) The method of claim 8, further comprising:

redefining the reference length of the tether in response to a change in the length of the tether that does not satisfy at least one of the first criterion or the second criterion.

14. (Original) A method of using a body weight support system to provide body weight support during gait training, the body weight support system including 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, the threshold length of the tether being associated with the user falling during the gait training;

defining a threshold number of falls during the gait training;

providing a predetermined amount of body weight support during the gait training as the user moves relative to a surface and the number of falls is less than the threshold number of falls;

increasing the predetermined amount of body weight support to be provided to the user during the gait training in response to the threshold number of falls being met; and

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

15. (Original) The method of claim 14, wherein the surface relative to which the user moves is a stationary surface.

16. (Original) The method of claim 15, wherein the body weight support system includes a drive assembly configured to movably 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.

17. (Original) The method of claim 14, wherein the surface relative to which the user moves is a moving surface included in a treadmill.

18. (Original) The method of claim 17, wherein displaying the data associated with the gait training on the display includes displaying data associated with an operating condition of the body weight support system and an operating condition of the treadmill.

19. (Original) The method of claim 14, wherein providing the predetermined amount of body weight support during the gait training as the user moves relative to the surface is in response to a length of the tether exceeding the threshold length of the tether.

20. (Original) The method of claim 14, wherein the reference length of the tether is a first reference length of the tether, the method further comprising:

defining a second reference length of the tether in response to the threshold number of falls being met, the second reference length of the tether being shorter than the first reference length of the tether.

To: zIPPatentDocketingMailboxUS@cooley.com,,
From: PAIR_eOfficeAction@uspto.gov
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Application	Document	Mailroom Date	Attorney Docket No.
15896731	N271	05/01/2020	BION-051/12US 307799-2333

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Notice of References Cited	Application/Control No. 15/896,731	Applicant(s)/Patent Under Reexamination MCBRIDE et al.	
	Examiner GARRETT K ATKINSON	Art Unit 3784	Page 2 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-9713439-B1	07-2017	Wu; Ming	A61B5/112	1/1
*	B	US-20060229167-A1	10-2006	Kram; Rodger	A63B21/00181	482/54
*	C	US-7998040-B2	08-2011	Kram; Rodger	A63B21/4015	482/124
*	D	US-20120018249-A1	01-2012	Mehr; Christian	A63B69/0064	182/5
*	E	US-20040143198-A1	07-2004	West, R. Gary	A61F5/0102	601/5
*	F	US-0229167-A	06-1880	~~Name not available~~ Morse	B60G11/02	267/39
*	G	US-0143198-A	09-1873	~~Name not available~~ Taylor	A41D1/14	2/211
*	H	US-0018249-A	09-1857	~~Name not available~~ Robertson	B41K3/08	101/110
*	I	US-7980856-B2	07-2011	Grabiner; Mark	A63B22/0292	434/258
*	J	US-20150320632-A1	11-2015	VALLERY; Heike	A61H3/008	482/69
*	K	US-9801775-B2	10-2017	Vallery; Heike	A61H3/008	1/1
*	L	US-20180055715-A1	03-2018	VALLERY; Heike	A61H3/008	1/1
*	M	US-20140206503-A1	07-2014	Stockmaster; James G.	A61H3/008	482/4

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O	Change(s) applied				
	P	to document,				
	Q	/S.B./				
	R	2/28/2020				
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/896,731	06/02/2020	10668316	BION-051/12US 307799-2333	4706

58249 7590 05/13/2020

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Washington, DC 20004

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 66 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Keith MCBRIDE, Ventura, CA;
Bioness Inc., Valencia, CA
Arkady GLUKHOVSKY, Valencia, CA;
Augustine SMITH, Santa Clarita, CA;

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Cc: PAIR_eOfficeAction@uspto.gov
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May 14, 2020 04:12:52 AM

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Application	Document	Mailroom Date	Attorney Docket No.
15896731	ISSUE.NTF	05/13/2020	BION-051/12US 307799-2333

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Virginia, Alexandria Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
	6/15/2022	Eastern District of Virginia, Alexandria Division

PLAINTIFF	DEFENDANT
BIONESS INC.	ARETECH, LLC

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	See Attachment A.		
2			
3			
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading		
	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1			
2			
3			
4			
5			

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

Attachment A to
Report on the Filing or Determination of an Action Regarding a Patent or Trademark

Bioness Inc. v. Aretech, LLC
United States District Court, Eastern District of Virginia
Alexandria Division

Patent or Trademark No.	Date of Patent or Trademark	Holder of Patent or Trademark
9,682,000	June 20, 2017	Bioness Inc.
9,839,569	December 12, 2017	Bioness Inc.
9,855,177	January 2, 2018	Bioness Inc.
10,219,960	March 5, 2019	Bioness Inc.
10,463,563	November 5, 2019	Bioness Inc.
10,537,486	January 21, 2020	Bioness Inc.
10,668,316	June 2, 2020	Bioness Inc.
11,246,780	February 15, 2022	Bioness Inc.
11,253,416	February 22, 2022	Bioness Inc.
11,324,651	May 10, 2022	Bioness Inc.