# Everything you wanted to know about patents

# Intellectual property

**Product of the mind: idea, invention, artistic expression, name, business process, chemical formula, ...**

## Copyright

- For written materials, images, software
- Lasts for 50+ years
- “(c) 2001 by myName” (not required, but helps)

## Trademark

- Register with USPTO (TM, R) (not required, but helps)
- Bottom line: does it confuse the customer?

## Trade secret

- Retains value because IP is kept secret
- Must make reasonable efforts to keep it secret (non-disclosure agreements, …)

# Patent

- **Grants inventor a limited term monopoly**
- **Invention must be disclosed**
- **Gives inventor right to exclude others from "make, use or sell"**
- **It's up to the inventor to protect the patent**
- **20 years from filing date**
- **You have 1 year to file after publicly disclosing the invention (0 years in Europe)**

# Patent requirements

- **New**
- **Useful**
- **Non-obvious**

- **Can be reduced to practice (made)**
- **Is not a perpetual motion machine**

# Tour of a patent

- **Front page**
  - **Inventor, Assignee, File date, Class, References, Abstract, Drawing**
- **Drawings**
- **Specification**
  - **Background, Summary of invention, detailed description**
- **Claims**

US005476441A

# United States Patent [19]

**Durfee et al.**

[11] **Patent Number: 5,476,441**

[45] **Date of Patent: Dec. 19, 1995**

[54] **CONTROLLED-BRAKE ORTHOSIS**

[75] Inventors: **William Durfee**, Medford; **Michael Goldfarb**, Belmont, both of Mass.

[73] Assignee: **Massachusetts Institute of Technology**, Cambridge, Mass.

[21] Appl. No.: **129,920**

[22] Filed: **Sep. 30, 1993**

[51] **Int. Cl.**[6] ..... **A61F 5/00**

[52] **U.S. Cl.** ..... **602/23**; 607/49; 602/16; 434/112; 623/24; 623/44

[58] **Field of Search** ..... 602/5, 16, 19, 602/23, 26; 434/112; 623/24, 44, 45; 601/5, 33–35; 607/48, 49

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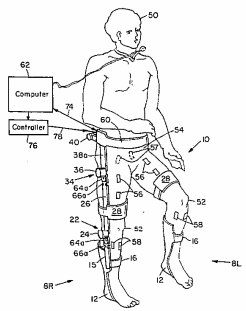
*Primary Examiner*—Linda C. M. Dvorak

*Attorney, Agent, or Firm*—Hamilton, Brooks, Smith & Reynolds

[57] **ABSTRACT**

A controlled-brake orthosis for providing controlled limb movement includes a stimulator for stimulating an individual's leg muscles which causes the legs to move. An orthosis worn on the legs to support the legs include lower links rotatably coupled to upper links with lower rotatable joints. Brackets are rotatably coupled to the upper links with upper rotatable joints. The joints are located adjacent to the hip and knee joints of the individual and brakes are coupled to the joints for controlling the rotation of the joints. By controlling the stimulator and brakes with a computer, movement of the legs can be controlled to produce walking.

**28 Claims, 4 Drawing Sheets**



[54] **CONTROLLED-BRAKE ORTHOSIS**

[75] Inventors: **William Durfee**, Medford; **Michael Goldfarb**, Belmont, both of Mass.

[73] Assignee: **Massachusetts Institute of Technology**, Cambridge, Mass.

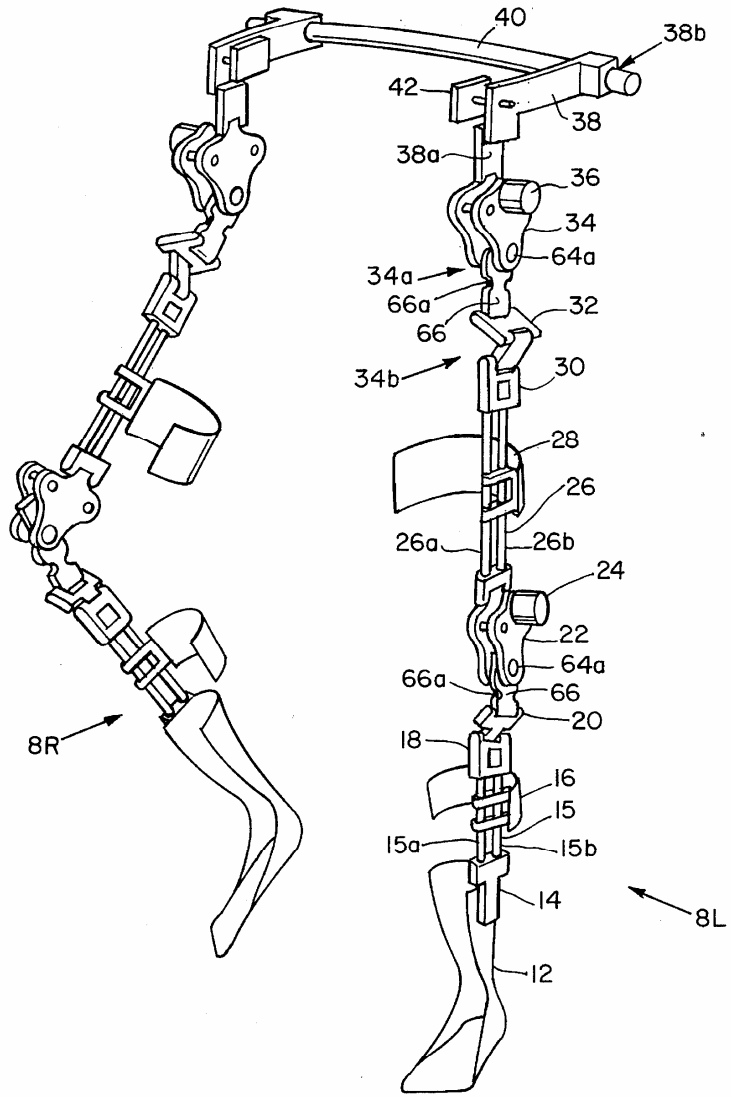
[21] Appl. No.: **129,920**

[22] Filed: **Sep. 30, 1993**

[51] **Int. Cl.**[6] ..... **A61F 5/00**

[52] **U.S. Cl.** ..... **602/23**; 607/49; 602/16; 434/112; 623/24; 623/44

[58] **Field of Search** ..... 602/5, 16, 19, 602/23, 26; 434/112; 623/24, 44, 45; 601/5, 33–35; 607/48, 49


40
38b
42
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38a
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34
64a
34a
66a
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32
34b
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26a
26b
24
22
64a
66a
66
20
18
16
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15a
15b
14
8L
12
8R

FIG. 2

# CONTROLLED-BRAKE ORTHOSIS

## BACKGROUND

Functional electrical stimulation (FES) is a method of restoring functional gait (walking) to paralyzed individuals. In FES, certain leg muscles are stimulated with an electrical stimulator. Electrical signals produced by the electrical stimulator are conveyed to the leg muscles by electrodes. The electrodes can either be placed directly on the skin of the individual over the muscles or implanted within the muscles. Depending upon the individual's condition, a single leg or both legs can be stimulated. By controlling the electrical signals provided to the leg muscles with a computer, walking can be produced.

In some current FES systems, the individual initiates the stimulation of leg muscles by hand actuated switches. In the case of a hemiplegic (paralysis of one side of the body) where one leg is functional, a switch can be manipulated to initiate intermittent stimulation and movement of the paralyzed leg in tandem with the functional leg to enable the individual to walk. In the case of a paraplegic, the left and right leg muscles can be alternately stimulated to produce walking by manipulating switches.

## SUMMARY OF THE INVENTION

A problem with FES systems of this kind is that the individual must use his/her hands to activate the switches and therefore, the hands cannot be used for other purposes. Additionally, the electrically stimulated muscles are quickly fatigued which limits the distance an individual can walk. Furthermore, the limb trajectories of stimulated legs are not controllable which results in an unnatural gait.

Accordingly, there is a need for a system which enables paralyzed individuals to walk without becoming rapidly fatigued and with a more normal gait than currently obtainable with current FES systems. Additionally, there is a need for this system to be non-manually actuated.

The present invention provides a controlled-brake orthosis system for providing controlled movement of a limb, such as, a leg or an arm. The system includes a stimulator for stimulating a limb muscle to cause the limb to move. An orthosis worn on the limb supports the limb and includes a lower link rotatably coupled to an upper link by a lower rotatable joint. A lower brake is coupled to the lower joint for controlling the rotation of the lower joint to assist the muscle in providing controlled movement of the limb.

In preferred embodiments, the limb is a leg and the controlled brake orthosis further includes a bracket rotatably coupled to the upper link by an upper rotatable joint to provide additional freedom of movement for the limb. An upper brake is coupled to the upper joint for controlling the rotation of the upper joint to further assist the muscle in providing controlled movement of the limb. The upper joint has two degrees of freedom of rotation and is adjacent to the hip joint of the individual while the lower joint has one degree of freedom of rotation and is adjacent to the knee joint. A control algorithm is computed by a computer. The brakes and the stimulator are controlled by the computer. Sensors located adjacent to the joints sense and provide the computer with the rotational position of the joints.

In another preferred embodiment, the controlled-brake orthosis includes a stimulator for stimulating a first muscle of a first limb and a second muscle of a second limb to cause the first and second limbs to move.



A first orthosis portion is worn on the first limb to support the first limb. The first orthosis portion includes a lower link rotatably coupled to an upper link by a lower rotatable joint. A lower brake is coupled to the lower joint for controlling the rotation of the lower joint to assist the muscle of the first limb in providing controlled movement of the first limb. A bracket is rotatably coupled to the upper link by an upper rotatable joint to provide additional freedom of movement for the first limb. An upper brake is coupled to the upper joint for controlling the rotation of the upper joint to further assist the muscle of the first limb in providing controlled movement of the first limb.

A second orthosis portion is worn on the second limb to support the second limb. The second orthosis portion includes a lower link rotatably coupled to an upper link by a lower rotatable joint. A lower brake is coupled to the lower joint and controls the rotation of the lower joint to assist the muscle of the second limb in providing controlled movement of the second limb. A bracket is rotatably coupled to the upper link by an upper rotatable joint to provide additional freedom of movement for the second limb. An upper brake is coupled to the upper joint for controlling the rotation of the upper joint to further assist the muscle of the second limb in providing controlled movement of the second limb. A coupling rod is secured to the first orthosis portion bracket and the second orthosis portion bracket to couple the first and second orthosis portions together. The lower joints have one degree of freedom and are located adjacent the knee joints of the individual while the upper joints have two degrees of freedom of rotation and are located adjacent the hip joints. A control algorithm is computed by a computer. The brakes and the stimulator are controlled by the computer. Sensors located adjacent to the joints sense and provide the computer with the rotational position of the joints. By alternating controlled movement between the first and second limbs, walking is produced.

The present invention controlled-brake orthosis allows paralyzed individuals to walk over long distances without becoming quickly fatigued and with a more natural gait than previously obtainable with current FES systems. The present invention also may be voice-activated to give the individual the use of his/her hands while walking.

## BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of preferred embodiments of the drawings in which like reference characters refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

FIG. **1** is a perspective view of an individual wearing the present invention controlled-brake orthosis.

FIG. **2** is a perspective view of the right and left orthosis portions.

FIG. **3** is a detailed view of the upper joint.

FIG. **4** is a flow chart of the algorithm used for controlling the brakes and stimulator.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1**, controlled-brake orthosis **10** is worn about the legs and waist of a paralyzed individual **50** to support the legs. Controlled-brake orthosis **10** includes a right orthosis

loads. This simplifies the requirement to align upper joints **34** with the anatomical hip joints **54** and also lightens the structure since no compressive buckling loads are present. The length of the links of orthosis **10** and body attachment points is adjustable to fit male and female subjects within orthosis **10** who fall within a reasonable size range. When fitted to a subject, the brace is aligned first at the ankle, then the knee, and finally the hip.

In the preferred embodiment, the majority of the components of orthosis **10** are carbon composite components. However, other suitable materials can be used such as aluminum or chromium alloy tubing. Additionally, a mixture of components of various materials may be employed.

FIG. **3** shows upper joint **34** in more detail. Flexion-extension damping torques in sub-joint **34*a*** are controlled by a upper brake **36**. Upper brake **36** is a magnetic particle friction brake which is a lightweight mechanical component whose shaft resistive torque is proportional to the applied current. In preferred embodiments, the upper brake **36** can resist a continuous torque of 1.8 N-m. The brake torque is preferably scaled up through a 16:1 rotary transmission based on an Evoloid gear set. The Evoloid gears form a single-stage, high-ratio, back-drivable transmission that is in a much smaller and lighter package than the equivalent single or multi-stage spur gear transmission. The transmission output is coupled to the regions of orthosis portions **8R** and **8L** below sub-joint **34*a*** through a member **66** on which a strain-gauge bridge **66*a*** is mounted for monitoring the hip flexion-extension torques supported by the orthosis. A precision potentiometer **64*a*** is mounted inside the gear shaft **64** to sense joint position which is used to determine rotational speed. Potentiometer **64*a*** and strain-gauge bridge **66*a*** are connected to computer **62** via cable **74**.

The gear housing consists of two aluminum support plates **68** and **70** connected by hollow tube standoffs **72** and the gear shaft **64**. The gear shaft **64** is preferably a thin-walled tube which maximizes the ratio of bending strength to weight and also encloses the potentiometer **64*a*** and strain-gauge bridge **66*a*** electronics for compact packaging.

Abduction-adduction motion is achieved through sub-joint **34*b*** which is a small three degree-of-freedom linkage **30** and **32** located at the lower portion of upper joint **34**. Because sub-joint **34*b*** cannot be aligned with the true center of rotation of the hip **54**, the linkage **30** and **32** ensures that the brace will follow the abduction motions of the hip **54**. The rotation of sub-joint **34*b*** is not controlled by upper brake **36** but the movement between the links **30** and **32** is limited to prevent excessive adduction or scissoring during gait.

Lower joints **22** are similar in construction to the flexion-extension mechanism of sub-joints **34*a***. Because lower joints **22** must support larger dissipative loads than sub-joints **34*a***, a more powerful magnetic particle brake is used which, for example, can resist a continuous torque of 2.8 N-M. However, the transmission design and sensor configuration are the same as those used in sub-joints **34*a***.

FIG. **4** is a flow chart depicting the algorithm for operating controlled-brake orthosis **10**. At step **100**, individual **50** is supported by both legs with the respective upper joints **34** (hip) and lower joints **22** (knee) in the locked position. Individual **50** will remain in this position until he/she decides to take a step as indicated in step **102**. Once individual **50** gives the command to take a step to computer **62**, one leg remains standing with upper joint **34** first being unlocked in step **103** and the gluteal muscles then being stimulated until there is full hip extension at which point upper joint **34** is locked as indicated in steps **104**, **106** and **108**. Simultaneously, the lower joint **22** and upper joint **34** of the other leg are unlocked in step **109** and the lower leg muscles are stimulated with electrodes **58** to swing the leg while the leg motion is guided with an upper brake **36** and a lower brake **24** in step **110**. When there is full hip flexion, upper joint **34** is locked as indicated in steps **112** and **114**. After locking upper joint **34**, the quadriceps (thigh muscles) are stimulated with electrodes **56** until there is full knee extension at which point lower joint **22** is locked as indicated in steps **116**, **118** and **120**. At this point, the process is back to the double support phase of step **100** in which the legs are in the reversed order from the previous double support phase and the process can then be repeated.

## EQUIVALENTS

While this invention has been particularly shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims. Although the present invention controlled-brake orthosis has been shown to be used in conjunction with two legs, the present invention may be used in conjunction with arms, a combination of arms or legs, or with a single limb. Additionally, the orthosis may be operated by hand switches instead of by voice activation.

What is claimed is:

**1**. A controlled brake orthosis for providing controlled limb movement comprising:

a stimulator for stimulating a muscle of a limb to cause the limb to move;

an orthosis capable of being worn on the limb comprising a lower link rotatably coupled to an upper link by a lower rotatable joint; and

a lower brake coupled to the lower joint for controlling the rotation of the lower joint to assist the muscle in providing controlled movement of the limb, the lower brake being a variable resistance brake;

a sensor coupled to the lower joint for providing a signal indicative of the rotational position of the lower joint; and

a computer responsive to the sensor signal for controlling the level of resistance provided by the lower brake throughout the rotation of the lower joint such that the lower brake is capable of guiding the movement of the limb by regulating power applied to the lower joint throughout the rotation of the lower joint, the computer also controlling the stimulator.

**2**. The orthosis of claim **1** further comprising:

a bracket rotatably coupled to the upper link by an upper rotatable joint;

an upper brake coupled to the upper joint for controlling the rotation of the upper joint to further assist the muscle in providing controlled movement of the limb.

**3**. The orthosis of claim **2** in which the upper and lower rotatable joints are positionable adjacent limb joints.

**4**. The orthosis of claim **2** in which the lower joint has one degree of freedom of rotation.

**5**. The orthosis of claim **2** in which the upper joint has two degrees of freedom of rotation.

**6**. The orthosis of claim **2** in which the computer controls the upper brake.

**7**. The orthosis of claim **6** further comprising sensors for

What is claimed is:

1. A controlled brake orthosis for providing controlled limb movement comprising:

a stimulator for stimulating a muscle of a limb to cause the limb to move;

an orthosis capable of being worn on the limb comprising a lower link rotatably coupled to an upper link by a lower rotatable joint; and

a lower brake coupled to the lower joint for controlling the rotation of the lower joint to assist the muscle in providing controlled movement of the limb, the lower brake being a variable resistance brake;

a sensor coupled to the lower joint for providing a signal indicative of the rotational position of the lower joint; and

a computer responsive to the sensor signal for controlling the level of resistance provided by the lower brake throughout the rotation of the lower joint such that the lower brake is capable of guiding the movement of the limb by regulating power applied to the lower joint throughout the rotation of the lower joint, the computer also controlling the stimulator.

2. The orthosis of claim 1 further comprising:

a bracket rotatably coupled to the upper link by an upper rotatable joint;

an upper brake coupled to the upper joint for controlling the rotation of the upper joint to further assist the muscle in providing controlled movement of the limb.

# Patent search

- **To get ideas**
- **To see if your idea infringes on prior art**

- **On-line: www.uspto.gov**
- **Search by keyword AND by class/subclass**
- **Online full text starts ~1972**

US006000000A

# United States Patent [19]

**Hawkins et al.**

[11] **Patent Number: 6,000,000**

[45] **Date of Patent: *Dec. 7, 1999**

[54] **EXTENDIBLE METHOD AND APPARATUS FOR SYNCHRONIZING MULTIPLE FILES ON TWO DIFFERENT COMPUTER SYSTEMS**

[75] Inventors: **Jeffrey C. Hawkins**, Redwood City; **Michael Albanese**, Los Gatos, both of Calif.

[73] Assignee: **3Com Corporation**, Santa Clara, Calif.

[ * ] Notice: This patent is subject to a terminal disclaimer.

[21] Appl. No.: **09/072,274**

[22] Filed: **May 4, 1998**

**Related U.S. Application Data**

[63] Continuation of application No. 08/542,055, Oct. 13, 1995, Pat. No. 5,884,323.

[51] **Int. Cl.**[6] ..... **G06F 17/30**

[52] **U.S. Cl.** ..... **707/201**

[58] **Field of Search** ..... 707/201

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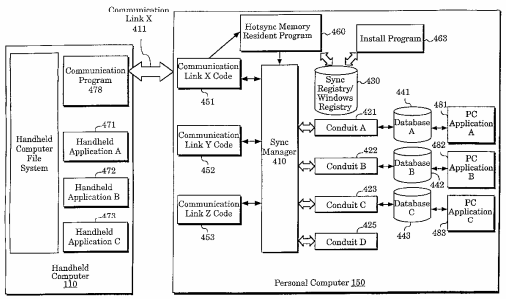
*Primary Examiner*—Richard L. Ellis

*Attorney, Agent, or Firm*—Blakely, Sokoloff, Taylor & Zafman LLP

[57] **ABSTRACT**

Many users of handheld computer systems maintain databases on the handheld computer systems. To share the information, it is desirable to have a simple method of sharing the information with personal computer systems. An easy to use extendible file synchronization system is introduced for sharing information between a handheld computer system and a personal computer system. The synchronization system is activated by a single button press. The synchronization system proceeds to synchronize data for several different applications that run on the handheld computer system and the personal computer system. If the user gets a new application for the handheld computer system and the personal computer system, then a new library of code is added for synchronizing the databases associate with the new application. The synchronization system automatically recognizes the new library of code and uses it during the next synchronization.

**27 Claims, 7 Drawing Sheets**




# Patent Number: 6,000,000

# Date of Patent: *Dec. 7, 1999

# United States Patent [19]

## Hawkins et al.

## [54] EXTENDIBLE METHOD AND APPARATUS FOR SYNCHRONIZING MULTIPLE FILES ON TWO DIFFERENT COMPUTER SYSTEMS

# Invention documentation

- **Essential if patent is challenged**
- **Keep a lab notebook!**
- **Provides proof of (1) conception (when you thought of the idea), and (2) reduction to practice (when you built it)**
- **Date each entry, use ink, cross out rather than erase**
- **Have two witnesses sign and date**

# So how much will it cost me and how long does it take?

- **File, wait 18 months, reject: $5-10K**
- **Revise, wait 6 months: $1-6K**
- **Issue fee: $1K**

**$10-15K, 2-3 years**

- **Lawsuits: $800K - millions**

# What if I do it  myself?

| | | |
|---|---|---|
| Filing fee | $ 380 | |
| Issue fee | $ 605 | |
| Maintenance, years 4-8 | $ 470 | |
| Maintenance, years 9-12 | $ 950 | |
| Maintenance, years 13-17 | $ 1,455 | |
| | | |
| Total | $ 3,860 | |

# Some patent resources

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- **D. Pressman, “Nolo’s Patents for Beginners”**