EXERCISE APPARATUS CAPABLE OF CALCULATING STRIDE LENGTH

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ABSTRACT

An exercise apparatus including a drive mechanism including a first pedal and a second pedal each operable between a first position and a second position. At least one shaft in communication with the first pedal and the second pedal such that movement of either of the first or second pedal results in rotation of the shaft. At least one brake having a rotational input for receiving the shaft. An encoder capable of generating electrical pulses in response to the rotations of the rotational input of the at least one brake. A first sensor capable of sensing a position of at least the first pedal by providing an electrical signal indicating the first pedal is passing the position of the sensor. A controller in electrical communication with the encoder and the sensor wherein the controller counts the electrical pulses received from the encoder between the electrical signals received from the sensor and calculates a stride length. A user interface may display the stride length. The first pedal and the second pedal may be dependent or independent. A second sensor may be provided such that a first sensor senses a position of the first pedal and the second sensor a position of the second pedal. The controller may calculate a stride length for each of the first pedal and the second pedal.
300 Sense Pedal Crossing Sensor

Count Pulses From Encoder

Pedal Crossing Sensor ?

No

Yes

Determine Total Number of Rotations

Calculate Stride Length

Fig. 6
EXERCISE APPARATUS CAPABLE OF CALCULATING STRIDE LENGTH

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Application No. 61/871,268 filed Aug. 28, 2013, herein incorporated by reference in its entirety for all purposes.

FIELD OF THE INVENTION

[0002] The present invention relates generally to exercise equipment and more specifically to calculations or measurements generated by an exercise device as feedback to the user.

BACKGROUND OF THE INVENTION

[0003] Many different designs of equipment exist for the purpose of physical exercise and physical therapy. Many of these designs include a frame supporting a drive mechanism operable by the user by manually actuating levers, cranks or commonly pedals. In many such devices the amount of energy expended by the user or other parameters is measured or calculated in various ways and displayed. This is done so as to provide feedback to the user to allow the user to gauge the intensity or duration of the workout. A need exists for an exercise device capable of calculating the stride length of the user.

[0004] In many exercise devices, the energy expended is calculated based upon the number of times a pedal or pedals pass a point. In many such cases, it is assumed that the user actuates the pedal or pedals through the maximum or substantially the maximum available motion of the pedals in calculating the energy expended. However, if the user manipulates the pedals on a very short motion but just so that the pedal passes the point where the step is registered, the exercise device may fail to accurately measure the true energy expended by the user. A need therefore exists for an exercise device which calculates stride length so as to provide additional feedback to the user.

SUMMARY OF THE INVENTION

[0005] An exercise apparatus including a drive mechanism including at least a first pedal and most preferably a second pedal each operable between a first position and a second position. At least one shaft in communication with the first pedal and the second pedal such that movement of either of the first or second pedal results in rotation of the shaft. The drive mechanism further includes at least one brake having a rotational input for receiving the shaft. The at least one shaft being in communication with the rotational input of at least one brake such that the brake is capable of resisting the rotation of the shaft.

[0006] An encoder is provided capable of generating electrical pulses in response to the rotations of the rotational input of the at least one brake. A first sensor is provided capable of sensing a position of at least the first pedal by providing an electrical signal indicating the first pedal is passing the position of the sensor. A controller is provided and is in electrical communication with the encoder and the sensor wherein the controller counts the electrical pulses received from the encoder between the electrical signals received from the sensor and calculates a stride length.

[0007] The exercise apparatus preferably further includes a frame such that the drive mechanism is supported from the frame. A seat may also be supported from the frame. The drive mechanism may be operated recumbently by a user seated on the seat. The seat may be spaced from the drive mechanism in a preferred embodiment so as to provide step-through space between the seat and the drive mechanism.

[0008] In one preferred embodiment, the first pedal and the second pedal may be dependent. In a second preferred embodiment the first pedal and the second pedal are independent.

[0009] The exercise apparatus may also include a speed increasing mechanism between the shaft and the brake. The rotational input is a speed increasing mechanism in a preferred embodiment.

[0010] A user interface may be in communication with the controller such that the stride length is displayed on the user interface. In a preferred arrangement, the user interface is in electrical communication with the controller such that stride length is displayed digitally or graphically on the user interface.

[0011] In a second preferred embodiment, the first sensor senses a position of the first pedal and a second sensor is included for sensing a position of the second pedal. In such an embodiment the controller calculates a stride length for each of the first pedal and the second pedal. A user interface may be in electrical communication with the controller such that the stride length of each of the first pedal and the second pedal are displayed on the user interface.

[0012] The invention contained herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processes and manufacturing techniques are omitted so as to not unnecessarily obscure the invention(s) disclosed and claimed herein. The examples used herein are intended merely to facilitate an understanding of ways in which the invention herein may be practiced and to further enable those of skill in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the claimed invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] FIG. 1 depicts the inventive step exerciser in its general environment.

[0014] FIG. 2 provides a left side view of one preferred embodiment of the step exerciser of FIG. 1.

[0015] FIG. 3 provides a left side view of the embodiment of FIG. 2 with exterior panels removed.

[0016] FIG. 4 provides an isometric view of the embodiment of FIG. 2 with exterior panels removed.

[0017] FIG. 5 provides one preferred embodiment for an electronic console as used on the step exerciser of FIG. 1.

[0018] FIG. 6 provides a flowchart of the method for calculating stride length of an exercise apparatus of the present disclosure.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Before describing the preferred embodiments of the present invention in detail, it is important to understand that the invention is not limited in its application to the details of the construction illustrated and the steps described herein. The invention is capable of other embodiments and of being
practiced or carried out in a variety of ways. It is to be understood that the phraseology and terminology employed herein is for the purpose of description and not limitation.

[0020] Referring now to the drawings, wherein like reference numerals indicated the same parts throughout the several views, the step exercise apparatus 10 of the present disclosure is shown in its general environment in FIGS. 1 and 2. In one preferred embodiment, exerciser 10 is a recumbent step exerciser comprising: a pair of pedal assemblies 12 and 14 which are alternatingly pushed down and away from the user 16; a pair of arm mechanisms 18 and 20 which are pulled toward the user 16; a seat 22 to support the user 16 during a workout; a frame 24 which generally supports exerciser 10; and display unit or console 26 which allows the user 16 to select a particular workout and to provide various information to the user, such as watts METS, heart rate, steps per minute, calories, steps taken, and, as will be described more fully below, stride length. Cover 28 protects internal components of exerciser 10 from dust, sweat, and other contaminants, as well as protecting people from internal moving parts and providing an aesthetically pleasing appearance. Many features described above are present in existing step exercisers such as the recumbent step exerciser described in U.S. Pat. No. 7,713, 176, which is incorporated by reference as if full set forth herein.

[0021] It should be noted that as described herein, terms of position, such as forward, rearward, left, right, etc., indicate position from the perspective of a user of the machine. These descriptions are for the purpose of clarity, explanation and exemplification and it is understood that they are in no way limiting.

[0022] While specific details of the operation of many of the features of exerciser 10 are not necessary to understand the present invention, for the sake of clarity and for the benefit of those not familiar with step exercisers, in general, and by way of example and not limitation, a brief description of the overall operation of exerciser 10 is provided. Pedal assemblies 12 and 14 are connected to frame 24 through a four-bar linkage assembly which controls articulation of the associated pedal. As best seen in FIG. 3, four-bar linkage assembly 30 comprises: crank 32; lower link 34; pedal support 36 connected to crank 32 and lower link 34 at pivots 42 and 44, respectively; and crank 32 and lower link 34 connect to frame 24 at pivots 38 and 40, respectively. Articulation of pedal 36 is achieved by the difference between the radius of arc followed by pivot 42 and the radius of arc followed by pivot 44. If the upper bar 46 is the same length as lower link 34, and the distance between pivots 38 and 40 is equal to the distance between pivots 42 and 44, pedal support 36 will remain parallel to frame support 50 throughout the pedal’s range of motion.

[0023] With further reference to FIG. 4, the movement of arm mechanisms 18 and 20 is coordinated with the movement of pedal assemblies 12 and 14, respectively. Arm mechanisms 18 and 20 include: outer bar 52; inner bar 54 telescopically received in outer bar 52; latch 56 to lock bar 54 relative to bar 52; grip assembly 58 located at the distal end of bar 54; bell crank 60 attached to frame 24 at pivot 64, having a first arm 62 attached proximate the forward end of bar 18 or 20 and a second arm pivotally attached to link 68. Thus, as best seen in FIG. 3, when the user pushes pedal assembly 30, crank 32 will rotate about pivot 38, lifting link 68 which in turn will lift arm 66 of bell crank 60, causing arm 62 to push bar 20 rearward towards the user. As pedal assembly 30 moves towards the user, the motion of bar 20 is reversed, away from the user.

[0024] With reference to FIG. 4, once a pedal 12 or 14 is pushed forward by the user, it is returned to its rearward position by movement of the opposite pedal. This is commonly referred to as a dependent system. The dependent system of exerciser 10 includes: pivot bar 70 pivotally attached to frame 24 at pivot 72; linkage 74 pivotally attached between left crank 60a and the left end of pivot bar 70; and linkage 74b pivotally attached between right crank 60b and the right end of pivot bar 70. Thus, upward movement of arm 66a, in response to pushing pedal assembly 14, will cause downward movement of arm 66b resulting in returning pedal 12 to its upward and rearward position, closer to the user. Pressing pedal 12 will similarly cause pedal 14 to return to its upward and rearward position.

[0025] In contrast, an independent system typically uses a spring associated with each pedal to return the pedal to its rearward position. As will be readily apparent to one of ordinary skill in the art, the present invention works equally well with either a dependent or an independent pedal system.

[0026] To provide resistance to movement of the pedals, step exerciser 10 includes a braking system driven by movement of the pedals and/or arms. Explanation will be made with regard to the left side of exerciser 10 with the understanding that the right side works in an identical manner. To harness energy from pedal movement, a belt 80 is attached to pedal assembly 30 at end 82 (FIG. 3). As best seen in FIG. 3, belt 80 then passes over driven sprocket 84 which is rotationally coupled to shaft 86 via overun clutch 88 such that clutch 88 engages shaft 86 as the pedal is pushed to turn shaft 86 in a clockwise direction as viewed in FIG. 4. Belt 80 then passes over idler pulley 90 and attaches to end 94 of spring 92. The opposite end 96 of spring 92 attaches to frame 24. As will be apparent to one of ordinary skill in the art, as a user pushes pedal 14, shaft 86 will be driven in a clockwise direction, as pedal 14 is pushed back to its upward position by the opposite pedal, spring 92 will pull the take up the slack in belt 80 and overun clutch 86 will disengage shaft 84 allowing driven pulley 82 to rotate freely in a counterclockwise direction. When pedal 12 is pushed, its associated driven pulley will likewise couple torque into shaft 86 in the same direction thus producing continuous rotation in shaft 84 as the user manipulates the pedals.

[0027] One feature of the present invention is that spring 92, and its counterpart on the right side, will tend to move the pedals 12 and 14 to a point where both springs are equally extended when the machine 10 is idle, centering the pedals. This serves a number of purposes, for example, with the arms and pedals in a centered position, access to the seat is not blocked when a user approaches the machine. Additionally, it is easier to properly adjust the position of seat 22 (FIG. 2) when the pedals and arms are centered so that the user doesn’t inadvertently adjust the seat where she or he is bumping into the limits of the movement at the top or bottom. Finally, the user will generally have his or her range of motion centered about the middle of the pedal range of motion.

[0028] Shaft 84 then drives speed increasing pulley 98, which in turn drives belt 100, which further drives the input 102 brake 104. In one preferred embodiment, brake 104 offers two braking modes, an eddy current mod for lower speeds and a generator mode for higher speeds. However, brake 104 is not so limited and a variety of options are available. By way of example and not limitation, brake 104 could
be an alternator, a generator, an eddy current brake, a magnetic particle brake, a friction brake, or the like. As will be apparent to one of ordinary skill in the art, the energy expended by the user will ultimately be dissipated into the environment as heat, a brake, of any style, simply provides a method for doing so. If a brake is chosen which produces electricity, a load resistor is wired across the output of the generator to produce heat.

[0029] Turning next to FIG. 5, console 26 provides the user interface for recumbent step exerciser 10. Console 26 provides a plurality of buttons 200-208 to allow the user to adjust the resistance, enter data, and the like. Console 26 further includes LCD screen 212 to prompt the user for data, as well as provide work out details, such as the speed the user is climbing, steps climbed, calories burned, watts being produced, MET’s (metabolic rate), elapsed time, etc. In one preferred embodiment, screen 212 is a touch screen so that the user may be provided with various ways to input various information before, during, and after the workout, without cluttering console 26 with buttons which might only be active a few seconds during a workout session. Of particular interest, is the ability of console 26 to display stride length 214.

[0030] Returning to FIG. 3, to count steps taken, step exerciser 10 includes a sensor 110 on frame 24. Preferably, sensor 110 is a Hall effect sensor, reed switch, or other suitable sensor sensitive to magnetic fields. A magnet is then placed proximate position 112 on arm 34 such that as pedal 14 is pressed forward, the magnet on arm 34 will pass the sensor. The sensor is in communication with console 26 allowing it to count steps taken on the machine. It should be noted that, since the pedals are biased towards their mid-position when the machine is idle, sensor 110 can be placed where only slight movement from the idles position will count a step. Thus, regardless of how small of movements a user makes, steps will still be counted. It should also be noted that there are many locations on frame 24 where the sensor could be placed and where a corresponding magnet could be placed. For example, wherever arms 34 or 46 intersect a portion of frame 24, where arm 38 intersects frame 24, where pedal assembly 30 intersects frame 24, where are 66, etc. The only consideration being that either the sensor or magnet moves in response to pedal movement and passes near the corresponding element. Finally, while the preferred embodiment uses a magnetic sensor, the invention is not so limited, optical sensors could be used, mechanical switches, or any other known proximity sensor would be suitable.

[0031] As noted above, an important aspect of the present invention is the display of stride length. As discussed above, as a pedal (for the sake of discussion pedal 14) is pressed, belt 80 is drawn over driven pulley 80. As will be apparent to one of ordinary skill in the art, end 82 of belt 80 will move the same distance as pedal 14. Thus, shaft 24 will rotate an angle certain in response to any given amount of pedal movement determined by:

\[ \text{angle} = \frac{360}{\text{c}} \times \frac{\text{d}}{\text{c}} \]

where:

- \( \text{angle} \) is the angle of rotation of shaft 24;
- \( \text{d} \) is the distance traveled by a pedal;
- \( \text{c} \) is the circumference of driven pulley 84.

[0032] Since the relationship between the angular rotation of shaft 24, brake 102, and encoder (which also serves as an idler pulley) is fixed by the relative diameters of the pulley 98, the input 102, and encoder 120, measuring angular movement, of the brake or shaft 24 can be used to determine distance traveled by a pedal. Many methods are available to measure the rotations of either shaft, such as: a magnetic sensor mounted near the pulley and a magnet mounted to the pulley; an optical shaft encoder 120 (and may be referred to herein as a means for sensing angular movement); an eccentric washer placed outside the pulley to operate a mechanical switch, etc. For the purpose of this disclosure, all such methods are considered herein as to provide input to an encoder which, in turn, provide electrical pulses indicating rotations of either shaft to a controller. Stride length can then be calculated by counting rotations between step sensor activations as shown in flow chart 300 of FIG. 6.

[0037] By way of exemplification only, in the preferred embodiment, each revolution of the rotational input equals 2 inches of pedal travel. The total number of revolutions of the rotational input (in a given time period) times 2 inches equals the total distance traveled. The total distance traveled divided by the number of steps equals stride length. An average stride length is calculated by totaling the number of revolutions of the rotational input (for a given time) multiplied by 2 inches and divided by the total number of steps.

[0038] Alternatively, a tachometer can be used; if revolutions per minute is known, and time between steps is known, then rotational angle is simply revolutions per second times seconds per step. This is particularly useful where, as in the preferred embodiment, a generator is used to provide braking. The output voltage of the generator is proportional to the speed of the generator. Thus, by measuring the output voltage, an adequate speed of the brake may be determined and used by a microprocessor or controller to calculate stride length as detailed above.

[0039] It should be noted that where steps are sensed on a single pedal, the most accurate stride length would be determined by measuring a full cycle of the single pedal and dividing by two.

[0040] Thus, the present invention is well adapted to carry out the objects and attain the ends and advantages mentioned above as well as those inherent therein. While presently preferred embodiments have been described for purposes of this disclosure, numerous changes and modifications will be apparent to those skilled in the art. Such changes and modifications are encompassed within the spirit of this invention as defined by the appended claims.

What is claimed is:

1. An exercise apparatus including a drive mechanism, said drive mechanism comprising:
   - a first pedal and a second pedal;
   - at least one brake; said at least one brake having a rotational input; said first pedal and said second pedal each operable between a first position and a second position;
   - at least one shaft in communication with said first pedal and said second pedal such that movement of either of said first or second pedal between said first and second position results in rotation of said shaft;
   - said at least one shaft being in communication with said rotational input of said at least one brake such that at least one brake is capable of resisting the rotation of said at least one shaft;
   - an encoder for generating electrical pulses in response to the rotations of said rotational input;
a first sensor for sensing a position of at least said first pedal and providing an electrical signal indicating said at least said first pedal is passing said position; a controller in electrical communication with said encoder and said sensor wherein said controller counts said electrical pulses received from said encoder between said electrical signals received from said sensor and calculates a stride length.

2. The exercise apparatus of claim 1 further including a frame such that the drive mechanism is supported from said frame.

3. The exercise apparatus of claim 2 further including a seat supported from said frame such that said drive mechanism is operated recumbently by a user seated on said seat.

4. The exercise apparatus of claim 3 wherein said seat is spaced from said drive mechanism so as to provide step-through space between said seat and said drive mechanism.

5. The exercise apparatus of claim 3 wherein said first pedal and said second pedal are dependent.

6. The exercise apparatus of claim 1 further including a speed increasing mechanism between said shaft and said brake.

7. The exercise apparatus of claim 1 wherein said rotational input is a speed increasing mechanism.

8. The exercise apparatus of claim 1 further including a user interface in electrical communication with said controller such that said stride length is displayed on said user interface.

9. The exercise apparatus of claim 1 wherein said first pedal and said second pedal are dependent.

10. The exercise apparatus of claim 1 wherein said first sensor senses a position of said first pedal and further including a second sensor for sensing a position of said second pedal.

11. The exercise apparatus of claim 9 wherein said controller calculates a stride length for each of said first pedal and said second pedal.

12. The exercise apparatus of claim 10 further including a user interface in electrical communication with said controller such that said stride length of each of said first pedal and said second pedal are displayed on said user interface.

13. A method of calculating stride length on an exercise apparatus including at least one pedal in communication with a shaft, at least one brake capable of receiving a rotational input, an encoder in communication with the at least one brake, a sensor, and a controller in electrical communication with the encoder and the sensor, the method comprising: operating the at least one pedal between a first position and a second position so as to rotate the shaft; the at least one brake receiving and resisting the rotational input from the shaft; the encoder generating and sending a plurality of electrical pulses to the controller in response to the rotational input from the brake; the at least one sensor providing an electrical signal to the controller when the pedal passes a set position; the controller counting the electrical pulses received from the encoder between the electrical signals received for the sensor and calculating stride length.

14. The method of claim 13 further including displaying the calculated stride length on a user interface.

15. The method of claim 13 further including a second pedal and a second sensor such that said controller calculates the stride length of the second pedal.

16. The method of claim 15 further including displaying the stride length of the second pedal on a user interface.

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