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(54) **Pendulum striding exercise apparatus**

Pendelschreittrainingsvorrichtung

Appareil pendulaire pour exercise de marche

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(56) References cited:
US-A- 5 653 662
US-A- 5 876 307
US-A- 5 897 463
US-A- 6 083 143
US-A1- 2002 198 083

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Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates generally to an exercise apparatus. Certain embodiments relate to exercise apparatus that may allow exercise such as simulated walking, striding, jogging, and/or climbing.

2. Description of Related Art

[0002] Exercise devices have been in use for years. Some typical exercise devices that simulate walking, jogging, or climbing includes cross country ski machines, stair climbing machines, elliptical motion machines, and pendulum motion machines.

[0003] In many exercise apparatus, the user's foot is constrained during exercise to patterns that may not accurately represent the typical path and/or position of a foot during walking and/or jogging. For example, cross country ski machines may not allow a user to lift the front of his/her foot above a flat plane defined by the top of the pedal or footpad. Elliptical machines may provide inertia that assists in changing directions of the foot pedals, which may make the exercise smoother and more comfortable. Elliptical machines may, however, constrain a user's foot to the mechanically defined elliptical path of the footpads or foot pedals. The elliptical path may be too long for shorter users or too short for taller users. Thus, an elliptical apparatus may not accommodate a variety of users. In addition, a jogging stride is longer than a walking stride so a fixed stride length apparatus may not optimally simulate several different types of exercise activities.

[0004] Pendulum motion exercise apparatus may allow variable stride length. The user's feet, however, may be constrained to follow the same arcuate path in both forward and rearward motion. Such motion may not accurately simulate a walking, striding, jogging, or climbing motion.

[0005] Certain pendulum motion exercise apparatus may have a fixed pendulum length. A fixed pendulum length may not allow for foot lift or vertical amplitude in the motion of the foot, and thus, may not provide naturally accommodating foot motion. Other pendulum motion exercise apparatus may have relatively short pendulum lengths that may not properly accommodate the path of motion of the foot or legs of the human body.

[0006] Reference is made to U S patent 6,083,143, which discloses an exercise machine comprising a frame, an eccentric race together carried by the frame, a motion bar of which an upper pivot point is coupled to the eccentric race, a foot receiving element attached to the motion bar, such that a user can move the foot receiving element to and fro in a generally horizontal sense while the user's foot moves through a closed path of fixed geometry, to cause the eccentric race to undergo complete revolutions and the upper pivot point to move in a circular path in use, and a flywheel coupled to the eccentric race to be rotated as the eccentric race rotates.

SUMMARY

[0007] According to the invention, there is provided an exercise apparatus, comprising: a frame configured such that at least a portion of the apparatus remains substantially stationary during use; a crank system coupled to the frame, wherein the crank system comprises one or more crank members; a pivotal linkage pendulum system comprising one or more link members and a movable member coupled to the one or more link members, wherein an upper pivot point of at least one of the link members which one link member acts as a pendulum, is coupled to the crank system through a movable member, and wherein the upper pivot point of the link member is configured to move in a path during use and is coupled to a portion of the movable member, the portion being configured to move in a back and forth path of motion; a foot member coupled to a lower pivot point of one or more of the link members, wherein the foot member comprises a footpad, wherein a path of motion of the footpad comprises at least some vertical amplitude, wherein a horizontal amplitude of the path of motion of the footpad is controlled by a user and determined by an amount of force applied by a user to the footpad, wherein a vertical amplitude of the path of motion of the footpad is controlled by a vertical amplitude of the path of the upper pivot point, wherein a distance between the footpad and the upper pivot point of the link member configured to move in the closed path is greater than 1 foot (0.30m); and a brake/inertia device coupled to the crank system.

[0008] An exercise apparatus to be described includes a frame. The frame includes at least a portion that remains substantially stationary during use. A crank system is coupled to the frame. The crank system includes one or more crank members. A brake/inertia device is coupled to the crank system. The exercise apparatus includes a pivotal linkage pendulum system. The pivotal linkage pendulum system is coupled to the crank system. A pivotal linkage pendulum system includes one or more link members. An upper pivot point of a link member is coupled to the crank system.

[0009] The upper pivot point of the link member is coupled to the crank system through a movable member. The upper pivot point of the link member moves in a path during use. A foot member is coupled to at least one of the link members. In some embodiments, the foot member may be coupled to a lower pivot point of at least one of the link members. The foot member may include a footpad.

[0010] The pivotal linkage pendulum system includes a movable member. The movable member is coupled to one or more link members. An upper pivot point of at least one of the link members is coupled to a portion of

the movable member. In certain embodiments, the upper pivot point of the at least one of the link members is at an upper end of the link member. The portion of the movable member moves in a back and forth path of motion. In some embodiments, the portion of the movable member may move in a closed path of motion.

[0011] In an embodiment, a movable member is coupled to and at least partially supported by the frame at or near a first end of the movable member. The movable member may be coupled to and at least partially supported by the crank system at or near a second end of the movable member. The portion of the movable member coupled to the upper pivot point of the at least one of the link members may be between the first end and the second end of the movable member. In some embodiments, the portion of the movable member coupled to the upper pivot point of the at least one of the link members is near the second end of the movable member.

[0012] In certain embodiments, an upper pivot point of at least one of the link members may be coupled to the crank system such that the upper pivot point of the link member moves in a closed path. A foot member is coupled to one or more of the link members. The foot member includes a footpad. In certain embodiments, a majority of a path of motion of the footpad is below the closed path. In some embodiments, substantially all of a path of motion of the footpad is below the closed path.

[0013] In certain embodiments, a distance between a footpad and an upper pivot point of a link member that moves in a path (e.g., a closed path or a back and forth path) is at least about 3 times the length of at least one crank member. In some embodiments, a distance between a footpad and an upper pivot point of a link member that moves in a path (e.g., a closed path or a back and forth path) is at least about 3 times a vertical amplitude of a path of motion of the footpad. In certain embodiments, a hip of a majority of users of the apparatus is positioned near at least a portion of the path of motion of an upper pivot point of a link member.

[0014] In certain embodiments, a majority of the path of an upper pivot point of a link member is positioned in front of a footpad plane when the footpad is at a center of its path of motion. The footpad plane may be located at a center of a footpad. In certain embodiments, a majority of a crank system is positioned in front of a footpad plane when the footpad is at a center of its path of motion. In some embodiments, a majority of the crank system is positioned near a footpad plane when the footpad is at a center of its path of motion. In some embodiments, a majority of the crank system is positioned behind a footpad plane when the footpad is at a center of its path of motion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Advantages of the present invention may become apparent to those skilled in the art with the benefit of the following detailed description, given by way of example, and upon reference to the accompanying drawings in which:

FIG. 1 depicts an embodiment of a human leg moving through a walking, striding, jogging, or climbing motion.

FIG. 1A depicts embodiments of paths of a user's foot moving through a walking, striding, jogging, or climbing motion.

FIG. 2 depicts an embodiment of a linkage system with a relatively long pendulum length compared to a crank radius.

FIG. 3 depicts an embodiment of a linkage system with a relatively short pendulum length compared to a crank radius.

FIG. 4 depicts a side view of an embodiment of an exercise apparatus.

FIG. 5 depicts a path that a user's foot may follow during exercise using an embodiment of an exercise apparatus.

FIG. 6 depicts a side view of an embodiment of an exercise apparatus.

FIG. 7 depicts a side view of an embodiment of an exercise apparatus.

FIG. 8 depicts a side view of an embodiment of an exercise apparatus.

FIG. 9 depicts a top view of an embodiment of an exercise apparatus.

FIG. 10 depicts a side view of an embodiment of an exercise apparatus.

FIG. 10A depicts a side view of an embodiment of an exercise apparatus.

FIG. 11 depicts a side view of an embodiment of an exercise apparatus.

FIG. 11A depicts a side view of an embodiment of an exercise apparatus.

FIG. 12 depicts a side view of an embodiment of an exercise apparatus.

FIG. 13 depicts a side view of an embodiment of an exercise apparatus.

FIG. 14 depicts a side view of an embodiment of an exercise apparatus.

FIG. 15 depicts a side view of an embodiment of an exercise apparatus.

FIG. 16 depicts a side view of an embodiment of an exercise apparatus.

FIG. 16A depicts a side view of an embodiment of an exercise apparatus.

FIG. 17 depicts a side view of an embodiment of an exercise apparatus.

FIG. 18 depicts a side view of an embodiment of an exercise apparatus.

FIG. 19 depicts a side view of an embodiment of an exercise apparatus.

FIG. 20 depicts examples of embodiments of back and forth paths of motion.

FIG. 21 depicts examples of embodiments of closed paths of motion.

[0016] While the invention is susceptible to various modifications and alternative forms within the scope of the appended claims, specific embodiments thereof are shown by way of example in the drawings and may herein be described in detail. The drawings may not be to scale. It should be understood, however, that the drawings and detailed description thereto are not intended to limit the invention to the particular form disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the scope of the present invention as defined by the appended claims.

DETAILED DESCRIPTION

[0017] In the context of this patent, the term "coupled" means either a direct connection or an indirect connection, (e.g., one or more intervening connections) between one or more objects or components. The phrase "directly attached" means a direct connection between objects or components. The term "support" means a first element, directly or indirectly, locates or positions a second element by pushing or pulling on the second element. The first element may be directly attached or coupled to the second element when providing support. The first element may be in compression while pushing or in tension while pulling on the second element.

[0018] The term "path" means any type of path that an object (e.g., a foot, a footpad, a link member, a movable member, or a coupling) or a point in space may undertake during motion. For example, a path may include a closed path or a back and forth path.

[0019] A "back and forth path of motion" means motion along a curved or straight line with two end points. The back and forth motion moves along the same line but in opposite directions. Back and forth motion may be substantially horizontal motion, substantially vertical motion, or a combination of horizontal motion and vertical motion. Examples of back and forth paths of motion are depicted in FIG. 20.

[0020] A "closed path of motion" means motion along a continuous path that encloses an area. A closed path of motion has no end points. A closed path of motion may have many different shapes. The shape of a closed path may depend on the generating linkage mechanism. For example, a closed path may be an orbital path, an elliptical path, a saddle-shaped path, an asymmetrical path (e.g., a closed path with a smaller radius of curvature on one side of the path as compared to the other side), or an ovate or egg-shaped path. In some embodiments, a closed path may be elliptical, orbital, or oblong. Examples of closed paths of motion are depicted in FIG. 21.

[0021] The term "pendulum" means a body suspended from a pivoting point so that it swings back and forth. The term "amplitude" means the magnitude or extent of movement from a specified location (e.g., a starting position or an equilibrium position).

[0022] The phrase "average height user" means a user that has a height near an average human height. Mean height for males is about 5'9" (1.75m) and mean height for females is about 5'4.5" (1.64m) (data from U.S. Department of Health and Human Services). Thus, an average height user may be defined as a user with a height of about 5'6" (1.68m) or 5'7" (1.70m). An exemplary image of an average height user is used in one or more of the drawings described herein. A "majority of users" may have a height between about 5' (1.52m) and about 6'4" (1.93m). For the purposes of this patent, "a hip of an average height user" refers to a location of the hip of an average height user and "a hip of a majority of users" refers to a location of the hip of a majority of users. Users with similar heights may, however, have different torso and/or leg lengths that vary the position of each user's hip relative to other parts (e.g., the feet) of the user's body. Thus, there may be variations in the location of a user's hip between individuals.

[0023] FIG. 1 depicts an embodiment of a human leg moving through a walking, striding, jogging, or climbing motion. Leg 80, when fully extended, may act as a pendulum. Hip joint 82 may be a top of the pendulum about which leg 80 moves. Articulation of the ankle and knee joints results in closed path 84 of the foot with a foot lift. FIG. 1A depicts several embodiments of closed path 84 that a user's foot may move through using an exercise apparatus as described herein. Path 84 has a vertical amplitude "h" at a center of the path. Path 84 may have several different shapes due to variations in a horizontal amplitude of the path, as shown in FIG. 1A. The vertical amplitude "h", however, remains substantially the same for the various embodiments of path 84 for an exercise apparatus with a fixed geometry. At or near walking or jogging speeds, "h" may be a relatively small percentage of extended leg length "L". Thus, a mechanical system that more accurately accommodates the natural path of motion of a user's leg and foot may include a pendulum system having a pendulum length that is relatively long compared to vertical amplitude "h".

[0024] A vertical amplitude of a foot path of motion may be defined by a geometry of a crank system (e.g., a crank radius) and a linkage system (e.g., a pivotal linkage pendulum system). FIG. 2 depicts an embodiment of a linkage system with a relatively long pendulum length compared to a crank radius. FIG. 3 depicts an embodiment of a linkage system with a relatively short pendulum length compared to a crank radius. As shown in FIG. 2, pendulum angle 86 is relatively small with pendulum length "P" relatively long compared to crank radius 88. A resultant horizontal force as a user steps on a foot member (e.g., a foot pedal) is equal to the stepping force multiplied by the tangent of pendulum angle 86. A resultant horizontal force in the embodiment depicted in FIG. 2 may be a relatively small portion (e.g., approximately 10%) of the stepping force. In FIG. 3, pendulum length "P" is relatively short compared to crank radius 88. A resultant horizontal force in the embodiment depicted in FIG. 3 may be a relatively large portion (e.g., approximately 100%) of the stepping force. Therefore, an exer-

cise apparatus with a relatively long pendulum length "P" compared to crank radius 88 (e.g., a pendulum length at least about 3 times the crank radius) may provide a smaller resultant horizontal force. Thus, such an exercise apparatus may provide a smoother, a more comfortable, and a more accommodating motion for a user of the apparatus.

[0025] The pendulum motion exercise apparatus includes a brake/inertia system or device. Brake/inertia systems receive energy, store energy, and deliver energy in an exercise apparatus. For example, a brake/inertia system receives energy as a user steps downward at the beginning of a stride. The brake/inertia system stores the received energy. The stored energy may be delivered back to the exercise apparatus or the user to assist in lifting a linkage assembly or a portion of a linkage assembly (e.g., a foot member) over the top of a step or a stride. This energy transfer assists in providing a more natural and a more comfortable walking, striding, jogging, and/or climbing motion for a user of an exercise apparatus.

[0026] In certain embodiments, an exercise apparatus includes a brake/inertia system and provide for a foot path of motion in which a vertical amplitude of the foot path of motion is relatively small compared to a pendulum length of the foot path of motion. Such an exercise apparatus may provide more natural, smoother, more comfortable, and more accommodating function and path of motion for a user of the exercise apparatus.

[0027] FIG. 4 depicts a side view of an embodiment of an exercise apparatus. Frame 100 includes a basic supporting framework and an upper stalk. Frame 100 may be any structure that provides support for one or more components of an exercise apparatus. All or a portion of frame 100 remains substantially stationary during use. For example, all or a portion of frame 100 may remain substantially stationary relative to a floor on which the exercise apparatus is used. "Stationary" generally means that an object (or a portion of the object) has little or no movement during use. For example, an exercise apparatus would be "stationary" if the apparatus is operated in one location (in contrast to a movable exercise apparatus such as an ordinary bicycle); even if the apparatus wobbles or vibrates during use.

[0028] Foot members 122 may have footpads 124 or any other surface on which a user may stand. Footpad 124 is typically any surface or location on which a user's foot resides during use of an exercise apparatus (e.g., the footpad may be a pad or a pedal on which the user's foot resides during use). Footpad 124 may be a portion of foot member 122. Footpad plane 125 is a plane that intercepts footpad 124 at a right angle approximately near a center of the footpad, as shown in FIG. 4. Footpad plane 125, as depicted in FIG. 4, may be used in any of the embodiments and drawings described herein.

[0029] Link members 152a, 152b, 152c, 152d are components of a multibar linkage system (e.g., a pivotal linkage pendulum system). The pivotal linkage pendulum system, may include one or more pendulum members (e.g., link members 152a, 152b, 152c, 152d), foot members (e.g., foot members 122), and footpads (e.g., footpads 124). The pivotal linkage pendulum system includes left and right portions that are mirror images of each other. The left and right portions of a pivotal linkage pendulum system may move in opposition to each other. In one arrangement, link members 152a, 152d are coupled to (e.g., pivotally coupled to) foot members 122. Link members 152a are coupled to (e.g., pivotally coupled to) frame 100 at point 130. Link members 152a are supported by frame 100 at point 130. Point 130 is a location on frame 100 that includes an elongated axis perpendicular to the plane of FIG. 4 (i.e., the axis projects in or out of the two dimensional plane depicted in FIG. 4) for coupling members (e.g., link members 152a) to the frame. For example, point 130 may be a location with an axis or a shaft that couples the frame to broth right and left side link member. Link members 152a support an end of foot members 122 coupled to the link members. Link members 152d may also support foot members 122. Foot members 122 are coupled to a lower end of a pivotal linkage pendulum system. For example, foot members 122 are coupled to link members 152d, which are in a lower end of the pivotal linkage pendulum system.

[0030] Link member 152c is coupled to and supported by movable member 104 at point 132. An "upper pivot point" of link member 152c is coupled to movable member 104 at point 132. The upper end of link member 152c may be the upper pivot point coupled to moveable member 104 at point 132. Alternatively, another portion of link member 152c may be coupled to movable member 104 at point 132 (e.g., the upper pivot point on the link member may be near the upper end of the link member). Point 132 is a location that includes an elongated axis perpendicular to the plane of FIG. 4 (i.e., the axis projects in or out of the two dimensional plane depicted in FIG. 4) for coupling two or more members together (e.g., link members 152c and movable members 104). For example, point 132 may be a location with an axis or a shaft that couples a right side movable member to a right side link member. A similar point or location may be on a left side of the exercise apparatus for coupling a left side movable member to a left side link member.

[0031] Link member 152c acts as a pendulum moving about an upper pivot point of the link member, which is coupled to movable member 104. The upper pivot point of link member 152c represents a top of the pendulum. Thus, link member 152c acts as a pendulum supported by movable member 104 at point 132, which is the point of coupling between the movable member and the upper pivot point of the link member.

[0032] Movable member 104 is a member of the pivotal linkage pendulum system. Movable members 104 may be motion generating members. Movable members 104 are supported by frame 100 at point 130. Movable members 104 rotate or pivot abut point 130. Crank members 114 engage movable members 104 with rollers 106. Dur-

ing use, as crank members 114 rotate, the crank members displace movable members 104 and cause an end of the movable members to move in a back and forth path of motion at point 132 centered about point 130, which is approximately represented by arrow 134 in FIG. 4. The back and forth path of motion of movable member 104 causes the upper pivot point of link member 152c coupled to the movable member at point 132 to move in a back and forth path of motion. The back and forth path of motion of the upper pivot point of link member 152c includes at least some vertical component. A hip of a majority of users may be positioned near at least a portion of the back and forth path of motion of the upper pivot points of link members 152c. A hip of an average height user may be positioned near at least a portion of the back and forth path of motion of the upper pivot points of link members 152c. An exercise apparatus with movable members that move in a back and forth path of motion may be easier to use and learn than certain other exercise apparatus because there is no preferred direction of movement for the movable members, as there may for an exercise apparatus with movable members that move in a closed path of motion.

[0033] Crank members 114 cause right and left movable members 104 to move in opposition to each other (i.e., the right movable member moves downwards as the left movable member moves upwards, and vice versa). Crank members 114 are each coupled to pulley device 116. Pulley device 116 is coupled to brake/inertia device 118 by belt 120. Thus, rotation of pulley device 116 causes rotation of brake/inertia device 118.

[0034] The "crank system" may include, in a generic case, crank member 114 coupled (either directly attached or indirectly attached) to pulley device 116. The crank system may be formed from other types of devices that generally convert reciprocation or motion of a member to rotation. For example, a crank system may include a ring (e.g., a metal ring) supported by one or more rollers. Another example is a crank system with multiple crank members. A crank drive may include one or more intermediate components between the crank member and the pulley (e.g., an axle or connectors). The crank system is directly attached to frame 100, but the crank system may instead be indirectly coupled to frame 100 with one or more components coupling the crank system to the frame. A majority of a crank system may be positioned in front of footpad plane 125 when footpad 124 is at a center of its path of motion, as depicted in the embodiment of FIG. 4. A majority of a crank system may be positioned near footpad plane 125 when footpad 124 is at a center of its path of motion, as depicted in the embodiment of FIG. 11. A majority of a crank system may be positioned behind footpad plane 125 when footpad 124 is at a center of its path of motion, as depicted in the embodiment of FIG. 7.

[0035] The brake/inertia device (e. g., brake/inertia device 118) provides a load to affect the intensity of a cardiovascular workout. The brake/inertia device includes an energy-storing member (e.g., a flywheel) that is coupled to a linkage or crank system to increase inertia of the system. In some embodiments, the brake/inertia device may provide for a variable load. The brake/inertia device stores energy provided by a user during a portion of an exercise motion and then provides at least a portion of such stored energy back to the user during another portion of the exercise motion.

[0036] As shown in FIG. 4, movable member 104 is straight and foot member 122 is bent. However, movable members 104 and/or foot members 122 may be straight, bent in one or more places, and/or curved. Movable member 104 and/or foot members 122 may be made of a solid or unitary construction. Alternatively, movable member 104 and/or foot members 122 may include multiple components coupled or fastened to achieve a desired performance. Similarly, arm link members 108 and/or other link members may be straight, bent, or curved. Arm link members 108 and/or other link members may be unitary or may include multiple components.

[0037] As the user ascends the exercise apparatus, the user stands on footpads 124 and initiates a walking, striding, jogging, or climbing motion. The weight of the user on footpads 124 combined with motion of the footpads and foot members 122 causes a force to be transmitted to movable members 104. This transmitted force causes rotation of crank members 114, pulley device 116, and brake/inertia device 118. As movable members 104 move, footpads 124 alternately rise and fall. This rising and falling path of motion simulates the rising and falling motion of a foot of a user during actual walking, striding, jogging, or climbing.

[0038] As a user steps downward at a front of a step or stride, a force is transmitted through the pivotal linkage pendulum system to brake/inertia device 118. Brake/inertia device 118 receives and stores at least some of this transmitted energy. Brake/inertia device delivers at least some of the stored energy back to the exercise apparatus to assist in lifting the pivotal linkage pendulum system over the top of a step or a stride.

[0039] Arm link members 108 are coupled to link members 152a. Arm link members 108 may be included as a portion of link members 152a (i.e., arm link members 108 and link members 152a are made of a unitary construction). Arm link members 108 may include handles or other devices that may be grasped by a user of the exercise apparatus.

[0040] The right and left portions of a pivotal linkage pendulum system are cross coupled. Cross coupling causes the right and left portions to move in opposition. As shown in FIG. 4, a cross coupling system includes belt 182, pulley 186r, a mirror image pulley on a left side of the exercise apparatus, and idler pulleys 184u and 1841. Idler pulleys 184u and 1841 are coupled to pulley 186r and its mirror image pulley by belt 182. Pulley 186r and its mirror image pulley are directly attached (e.g., rigidly attached) to link members 152a. Belt 182 is a continuous belt that causes pulley 186r and its mirror image

pulley to rotate in direct opposition to one another so that the right and left side portions of the pivotal linkage pendulum system are cross coupled.

[0041] FIG. 5 depicts a closed path that a footpad (i.e., a user's foot) follows during exercise using an embodiment of an exercise apparatus (e.g., the embodiment depicted in FIG. 4). A vertical amplitude "h" of the path may be determined by a geometry of the crank system (e.g., a length of a crank member) and/or a geometry of the pivotal linkage pendulum system. The geometry of the crank system and/or the geometry of the pivotal linkage pendulum system determines a vertical amplitude of the back and forth path of motion of movable member 104, depicted in FIG. 4. The back and forth path of motion of movable member 104 causes the upper pivot point of link member 152c to move in a back and forth path of motion. This back and forth path of motion includes at least some vertical component. The vertical amplitude of the back and forth path of motion of the upper pivot point of link member 152c determines the vertical amplitude "h" of the path of footpad 124. The vertical amplitude "h" of the path of a footpad (e.g., footpad 124) may be similar in magnitude to a vertical amplitude of a back and forth path of motion of an upper pivot point of a link member (e.g., link member 152c). The vertical amplitude of the back and forth path of motion of an upper pivot point of a link member (e.g., link member 152c) may be similar in magnitude to a length of a crank member (e.g., crank member 114). Thus, a vertical amplitude "h" of the path of a footpad (e.g., footpad 124) may be similar in magnitude to a length of a crank member (e.g., crank member 114).

[0042] In FIG. 5, a horizontal amplitude "d" of the path is determined by an amount of force applied by a user to a footpad. A user may undertake an arcuate, substantially vertical climbing motion by limiting the horizontal amplitude of the path. A vertical climbing motion may be approximated when a vertical amplitude of a path of motion of a footpad is greater than a horizontal amplitude of the path of motion of the footpad. In certain embodiments, a user may be allowed to "instantaneously" or "dynamically" adjust his/her stride length (e.g., a horizontal amplitude of a path). The user is essentially allowed to instantaneously or dynamically change his/her stride length by imparting variable forces to foot members 122 or footpads 124, depicted in FIG. 4. The user may selectively impart forces that vary the stride length and allow more accurate simulation of a walking, striding, jogging, and/or climbing motion.

[0043] An exercise apparatus may have a pendulum length that is relatively long compared to a vertical amplitude of a path of motion of a footpad (e.g., footpad 124 depicted in FIG. 4) or to a length of a crank member (e.g., crank member 114 depicted in FIG. 4). In certain embodiments, a pendulum length may approximate the length of a majority of users' legs. For example, a pendulum length may be within about 10% of the length of a majority of users legs. The pendulum length may approximate the length of an average height user's legs. A footpad may be located at or near an end of a pendulum member (e.g., at or near an end of a link member such as link member 152c). Thus, a distance between a footpad (e.g., footpad 124) and a top of a pendulum (e.g., the upper pivot point of link member 152c (i.e., point 132) depicted in FIG. 4) may be representative of a pendulum length of an apparatus.

[0044] The distance between a footpad (e.g., footpad 124) and a top of a pendulum (e.g., the upper pivot point of link member 152c) is at least 3 times a vertical amplitude of a path of motion of the footpad. The distance between a footpad (e.g., footpad 124) and a top of a pendulum (e.g., the upper pivot point of link member 152c) may be at least 4 times, or at least 5 times, a vertical amplitude of a path of motion of the footpad. The distance between a footpad (e.g., footpad 124) and a top of a pendulum (e.g., the upper pivot point of link member 152c) may be at least 3 times a length of a crank member (e.g., crank member 114). The distance between a footpad (e.g., footpad 124) and a top of a pendulum (e.g., the upper pivot point of link member 152c) may be at least 4 times, or at least 5 times, a length of a crank member (e.g., crank member 114).

[0045] The distance between a footpad (e.g., footpad 124) and a top of a pendulum (e.g., the upper pivot point of link member 152c) may be greater than about 2 feet (0.61m). The distance between a footpad (e.g., footpad 124) and a top of a pendulum (e.g., the upper pivot point of link member 152c) may be greater than about 1 foot (0.30m), or greater than about 1 ½ feet (0.46m). In certain embodiments, the distance between a footpad (e.g., footpad 124) and a top of a pendulum (e.g., the upper pivot point of link member 152c) is between about 1 foot (0.30m) and about 5 feet (1.52m), or between about 2 feet (0.61m) and about 4 feet (1.22m).

[0046] FIG. 6 depicts a side view of an embodiment of an exercise apparatus. Right side link member 152R and left side link member 152L are coupled to (e.g., pivotally coupled to) right side sprocket 162R and a corresponding left side sprocket, respectively. Link member 152R and left side link member 152L is coupled to right side sprocket 162R and a corresponding left side sprocket at right side offset point 164R and left side offset point 164L, respectively. Right side offset point 164R and left side offset point 164L are 180° out of phase so that as right link member 152R rises, left link member 152L falls, and vice versa. Link members 152R, 152L act as pendulums with a top of the pendulums being located at right side offset point 164R and left side offset point 164L, respectively.

[0047] Sprocket 162R is coupled to sprocket 166R by chain 168R. Left side sprockets are coupled accordingly. Sprocket 166R and a corresponding left side sprocket are coupled to brake/inertia device 118 using belt 120. Belt 120 is coupled to an axle or shaft of sprocket 166R and its corresponding left side sprocket. In some alternative arrangements, devices may be used to operate

similarly to sprocket 162, sprocket 166, and chain 168. For example, a pulley and belt system operate similarly to sprocket 162, sprocket 166, and chain 168.

[0048] In an embodiment, as a user ascends the exercise apparatus, the user stands on footpads 124R, 124L and initiates a walking, striding, or jogging motion. The weight of the user on footpads 124R, 124L combined with motion of the footpads and link members 152R, 152L causes a force to be transmitted to sprocket 162R and its corresponding left side sprocket. This transmitted force causes rotation of sprocket 162R and its corresponding left side sprocket. The rotation of sprocket 162R and its corresponding left side sprocket cause a rising and falling path of motion of footpads 124R, 124L. This rising and falling path of motion simulates the rising and falling motion of a foot of a user during actual walling, striding, or jogging. The rotation of sprocket 162R and its corresponding left side sprocket cause rotation of sprocket 166R, its corresponding left side sprocket, and brake/inertia device 118. A hip of a majority of users may be positioned near at least a portion of the path of motion of the sprocket 162R and its corresponding left side sprocket.

[0049] Right and left link members 152R, 152L are cross coupled using belt 182 and idler pulleys 184. Right and left link members 152R, 152L are coupled to belt 182 so that the right and left link members move in opposition to each other. Belt 182 is supported and guided by idler pulleys 184.

[0050] FIG. 7 depicts a side view of an embodiment of an exercise apparatus. Link members 190 are coupled to (e.g., pivotally coupled to) foot members 122. Link members 190 are coupled to (e.g., pivotally coupled to) frame 100 at point 130. Link members 190 are supported by frame 100 at point 130 and support an end of foot members 122 coupled to the link members. Foot members 122 are coupled to link members 152 at a lower pivot point (e.g., a lower end) of the link members. Instead, a lower pivot point of link members 152 may be at another portion of the link members (e.g., a portion near a lower end of the link members). Link members 152 support an end of foot members 122 opposite from link members 190. Link members 152 are members of a pivotal linkage pendulum system (e.g., pendulum members). The embodiments, pivotal linkage pendulum system may include one or more pendulum members (e.g., link members 152), foot members (e.g., foot members 122), and footpads (e.g., footpads 124). A pivotal linkage pendulum system includes left and right portions that are mirror images of each other. The left and right portions of a pivotal linkage pendulum system may move in opposition to each other.

[0051] Link members 152 are coupled to (e.g., pivotally coupled to) crank members 114 at upper pivot points of the link members (e.g., points 132). Link members 152 act as pendulums with a top of the pendulums being located at points 132. During use, as crank members 114 rotate, the crank members displace link members 152. Crank members 114 cause right and left link members 152 to move in opposition to each other. Crank members 114 are coupled to pulley device 116. Pulley device 116 is coupled to brake/inertia device 118 by belt 120. Thus, rotation of pulley device 116 causes rotation of brake/inertia device 118.

[0052] As a user ascends the exercise apparatus, the user stands on footpads 124 and initiate a walking, striding, or jogging motion. The weight of the user on footpads 124 combined with motion of the footpads and foot members 122 causes a force to be transmitted to crank members 114 through link members. 152. This transmitted force causes rotation of crank members 114, pulley device 116, and brake/inertia device 118. As crank members 114, pulley device 116, and brake/inertia device 118 rotate, the upper pivot points of link members 152 coupled to the crank members move in a closed path (e.g., an orbital path approximately represented by arrow 216 in FIG. 7). This closed path motion causes footpads 124 to rise and fall as foot members 122 move forwards and backwards during exercise. The rising and falling path of motion of footpads 124 simulates the rising and falling motion of a foot of a user during actual walking, striding, or jogging.

[0053] A majority of a path of motion of footpad 124 is below the closed path of motion of the ends of link members 152 coupled to crank members 114. In some arrangements, substantially all of a path of motion of footpad 124 is below the closed path of motion of the ends of link members 152 coupled to crank members 114. A hip of a majority of users may be positioned near at least a portion of the closed path of motion of the upper pivot points of link members 152 coupled to crank members 114. A user's foot follows a path similar to the path shown in FIG. 5 during exercise.

[0054] As a user steps downward at a front of a step or stride, a force is transmitted through the pivotal linkage pendulum system to brake/inertia device 118. Brake/inertia device 118 receives and stores at least some of this transmitted energy. Brake/inertia device delivers at least some of the stored energy back to the exercise apparatus to assist in lifting the pivotal linkage pendulum system over the top of a step or a stride.

[0055] As shown in FIG. 7, arm link members 108 are coupled to link members 190. Again, as shown, arm link members 108 may be included as a portion of link members 190 (e.g., arm link members 108 and link members 190 are made of a unitary construction). Arm link members 108 may include handles or other devices that may be grasped by a user of the exercise apparatus.

[0056] The right and left portions of a pivotal linkage pendulum system may be cross coupled. Cross coupling causes the right and left portions to move in opposition. As shown in FIG. 7, a cross coupling system includes belt 182, pulley 186r, a mirror image pulley on a left side of the exercise apparatus, and idler pulleys 184u and 1841. Idler pulleys 184u and 1841 are coupled to pulley 186r and its mirror image pulley by belt 182. Pulley 186r

and its mirror image pulley are directly attached (e.g., rigidly attached) to link members 190. Belt 182 is a continuous belt that causes pulley 186r and its mirror image pulley to rotate in direct opposition to one another so that the right and left side portions of the pivotal linkage pendulum system are cross coupled.

[0057] The exercise apparatus (e.g., the exercise apparatus shown in FIG. 7) is constructed in a compact and economical manner. An exercise apparatus with a pendulum arm (e.g., link member 152) that is relatively long compared to a crank member (e.g., crank member 114) allows the placement of a crank system in an elevated position. As shown in FIG. 7, crank member 114, pulley device 116, belt 120, and brake/inertia device 118 are placed in an elevated position. Elevating the crank system allows for a relatively long user stride compared to a length of the exercise apparatus because the user's feet may move back and forth into an area below the crank system, as represented by hatched area 191. A user's stride length would be shortened if a crank system were placed in a lowered position (e.g., by shortening a length of a pendulum arm (e.g., link member 152)) so that the crank system inhibits or restricts the user's stride. A longer stride length may be obtained with a crank system placed in a lowered position, but only by substantially increasing an overall length of the exercise apparatus. Thus, an exercise apparatus with a relatively long pendulum arm compared to a relatively short crank member allows longer stride lengths to be obtained in a more compact and economical exercise apparatus.

[0058] FIG. 8 depicts a side view of another embodiment of the exercise apparatus. FIG. 9 depicts a top view of the embodiment depicted in FIG. 8. Foot members 122 are coupled to link members 152, link members 190, link members 192, and movable members 104. Foot members 122, link members 152, link members 190, link members 192, and movable members 104 are members of a pivotal linkage pendulum system.

[0059] Link members 152 are coupled to and supported by movable members 104. An upper pivot point of link member 152 is coupled to movable member 104 at point 132. Link member 152 acts as a pendulum with a top of the pendulum being located at point 132. Movable members 104 are motion generating members. Movable members 104 are supported by frame 100 at point 130. Movable members 104 rotate or pivot about point 130.

[0060] Crank members 114 engage movable members 104 through link members 192 and slider assembly 168. The crank system (e.g., crank members 114 and pulley device 116) provides at least some support to movable members 104 and the pivotal linkage pendulum system (e.g., link members 152) through link members 192. During use, as crank members 114 rotate, the crank members displace movable members 104 and cause an end of the movable members to move in a back and forth path of motion centered about point 130, as approximately represented by arrow 134 in FIG. 8. The back and forth path of motion of movable members 104 causes the upper pivot points of link members 152 to move in a back and forth path of motion. This back and forth path of motion has at least some vertical component. A hip of a majority of users maybe positioned near at least a portion of the back and forth path of motion of the upper pivot points of link members 152.

[0061] Crank members 114 clause right and left movable members 104 to move in opposition to each other (i.e., the right movable member moves downwards as the left movable member moves upwards, and vice versa). Crank members 114 are coupled to pulley device 116. Pulley device 116 is coupled to brake/inertia device 118 by belt 120. Thus, rotation of pulley device 116 causes rotation of brake/inertia device 118.

[0062] In an embodiment, as a user ascends the exercise apparatus, the user stands on footpads 124 and initiates a walking, striding, jogging, or climbing motion. The weight of the user on footpads 124 combined with motion of the footpads and foot members 122 causes a force to be transmitted to movable members 104. This transmitted force causes rotation of crank members 114, pulley device 116, and brake/inertia device 118. As movable members 104 move, footpads 124 alternately rise and fall. This rising and falling path of motion simulates the rising and falling motion of a foot of a user daring actual walking, striding, jogging, or climbing. A user's foot follows a path similar to the path shown in FIG. 5 during exercise.

[0063] As a user steps downward at a front of a step or stride, a force is transmitted through the pivotal linkage pendulum system to brake/inertia device 118. Brake/inertia device 118 receives and stores at least some of this transmitted energy. Brake/inertia device 118 delivers at least some of the stored energy back to the exercise apparatus to assist in lifting the pivotal linkage pendulum system over the top of a step or a stride.

[0064] Arm link members 108 are coupled to link members 190. Arm link members 108 may be included as a portion of link members 190 (i.e., arm link members 108 and link members 190 are made of a unitary construction). Arm link members 108 may include handles or other devices that may be grasped by a user of the exercise apparatus. Arm link members 108 may move in an arcuate pattern during use.

[0065] Left and right arm link members 108 are cross coupled. Cross coupling causes the right and left portions of the exercise apparatus to move in opposition to each other. Elements 194 are coupled (e.g., rigidly attached) to arm link members 108 through tubes 196. Thus, each element 194 moves in unison with each respective arm link member 108 (e.g., the right element 194 may move in unison with the right arm link member 108). Connectors 198 couple each of elements 194 (e.g., the right and left elements) to rocker arm 200. Connectors 198 may be connector rods. Rocker arm 200 is pivotally coupled to an upper portion of frame 100 at point 202. As arm link members 108 move, connectors 198 cause rocking motion of rocker arm 200. This rocking motion causes the

right and left arm link members to move in opposition to each other (i.e., the rocking motion may cross couple the left and right arm link members).

[0066] During use of the apparatus depicted in FIGS. 8 and 9, slider assembly 168 is located at a fixed position along movable member 104 so that the slider assembly moves along with the movable member at the fixed position. In certain exercise apparatuses, slider assembly 168 is movable back and forth (i.e., adjustable) along a length of moveable member 104. The moving of the location of slider assembly 168 along a length of movable member 104 allows the slider assembly to be selectively positioned along the length of the movable member to determine a vertical amplitude of the path of motion of foot members 122 and/or footpads 124. Thus, adjusting the position of slider assembly 168 allows for varying the vertical amplitude of the path of motion of foot members 122 and/or footpads 124. Adjusting the position of slider assembly 168 varies the vertical amplitude of the path of motion of foot members 122 and/or footpads 124 by adjusting the geometry of the pivotal linkage pendulum system. For example, a vertical amplitude of a path, such as the path shown in FIG. 5, may be adjusted by adjusting a position of slider assembly 168, thus adjusting the vertical amplitude of the path of motion of foot members 122 and/or footpads 124.

[0067] In certain embodiments, movement (e.g., sliding movement) of slider assembly 168 may be controllable For example, servomotor 170 and lead screw 172 may be used to control the movement of slider assembly 168. Servomotor 170 and lead screw 172 are electrically coupled to controlled 174. Controller 174 is used to control servomotor 170 and to control a position of slider assembly 168. Controller 174 may include user-operated controls and/or a display for the user of the apparatus. A user may adjust a vertical amplitude of the user's stride by using controller 174 to activate servomotor 170. Activation of servomotor 170 rotates lead screw 172, which repositions slider assembly 168 along a length of movable member 104 and adjusts a vertical amplitude of the user's stride.

[0068] Spring 204 is coupled to slider assembly 168 and link member 192. Spring 204 is used to assist in startup of an exercise if crank member .114 is in either a top dead center position or a bottom dead center position. Spring 204 exerts a greater force on one side (e.g., the left side or the right side) of the apparatus to displace crank member 114 slightly off either a top dead center position or a bottom dead center position.

[0069] FIG. 10 depicts an alternate embodiment of a cross coupling system that may be used in the embodiment depicted in FIGS. 8 and 9. Pulley 186r and its mirror image pulley may be coupled to idler pulleys 184F, 184R with belt 182 so that the pulleys and the idler pulleys work in conjunction with each other. Belt 182 is a continuous belt that is affixed to pulley 186r and its mirror image pulley. Pulley 186r and its mirror image pulley are rigidly coupled to link members 190. Belt 182 causes pulley 186r and its mirror image pulley to rotate in direct opposition to each other to cross couple the right and the left sides of the pivotal linkage pendulum system. Idler pulleys 184F, 184R may be drive pulleys with overrunning clutches in their hubs. Overrunning clutches cause unidirectional rotation of shaft 188 when idler pulleys 184F, 184R oscillate. A bi-directional brake may be coupled to idler pulleys 184F, 184R so that overrunning clutches are not needed. A bi-directional brake may be, for example, a friction disc brake, a band brake, or an electromechanical brake.

[0070] In certain embodiments, pulley device 206 is coupled to shaft 188. Belt 208 couples pulley device 206 to brake/inertia device 210. Brake/inertia device 210 is a second brake/inertia device on the exercise apparatus. Brake/iulertia device 210 receives and stores energy from horizontal motion of foot members 122. Brake/inertia device 210 resists horizontal motion of foot members 122.

[0071] In some embodiments, arm link members 108 are coupled to link members 152, as shown in PIG. 10A. Thus, arm link members 108 extend a length of link members 152. The upper pivot point of link members 152 is coupled to movable member 104 at point 132. As shown, arm link members 108 may be included as a portion of link members 152 (i.e., arm link members, 108 and link members 152 are made of a unitary construction). Arm link members 108 may include handles or other devices that may be grasped by a user of the exercise apparatus.

[0072] FIGS. 11-17 depict schematic representations of various embodiments of exercise apparatus that may allow motion of a user's feet similar to motion allowed by the embodiments depicted in FIGS. 4, and 6-10. Several embodiments are depicted herein as schematics to simplify discussion of pertinent features. Such depictions may not include one or more features that may be present in a fully functioning exercise apparatus. For example, only the right side foot member, right side footpad, right side movable member, right side link member right side arm link member, and/or other right side selected components of the apparatus are shown. In some embodiments, no pulley, belt, and/or brake/inertia system is shown. In some embodiments, no right and left side cross coupling system is shown. One or more members in an apparatus may be straight, may be curved, may be unitary, or may be composed of multiple pieces.

[0073] FIG. 11 depicts a side view of an embodiment of an exercise apparatus. Slider assembly 168 is positioned on movable member 104. Movable member 104 is coupled to point 130 and extends towards a rear end of frame 100. Link member 152 is coupled to movable member 104 at a location between point 130 and slider assembly 168 on the movable member. Link member 152 is coupled to movable member 104 at point 132, which is at or near slider assembly 168, as shown in FIG. 11A. An upper pivot point of link member 152 is coupled to movable member 104 at point 132. Link member 152 acts as a pendulum with a fop of the pendulum being

located at point 132. The embodiment depicted in FIGS. 11 and 11A operate similarly to the embodiment depicted in FUGS. 8 and 9. In the embodiments depicted in FIGS. 11 and 11A, link member 192 pushes movable member 104 upward to lift link, member 152 and foot member 122 rather than pulling downwards to lift the link member and the foot member. Movable member 104 is supported by the crank system through link 192 and slider assembly 168 and supported by the frame at point 130. Providing support to movable member 104 at these two locations provides structural support both in front of and behind a user that stands on footpad 124.. In such an exercise apparatus, bearings or other coupling components located at, for example, point 130 and/or the coupling between link member 192 and movable member 104 are subject to lighter loads than found in other embodiments of exercise apparatus in which large loads are placed on couplings in the apparatus. Thus, less expensive bearings or other coupling components may be used for certain exercise apparatus embodiments such as those depicted in FIGS. 11 and 11A.

[0074] FIG. 12 depicts a side view of another embodiment of an exercise apparatus. Link member 152 is coupled to an end of movable member 104. An upper pivot point of link member 152 is coupled to movable member 104 at point 132. Link member 152 acts as a pendulum with a top of the pendulum being located at point 132. Movable member 104 is directly attached to crank member 114 at a forward end of the movable member. Movable member 104 is coupled to support link member 212. Support link member 212 is pivotally coupled to frame 100 at point 214. Support link member 212 constrains the motion of movable member 104. Motion of crank member 114 causes an end of movable member 104 opposite the coupling to the crank member to move in a closed path (e.g., an orbital path) of motion in space, which is approximately represented by arrow 216. This closed path of motion is controlled by a geometry of the crank system, a geometry of the pivotal linkage pendulum system, and/or a position of slider assembly 168 along movable member 104. A majority of a path of motion of footpad 124 may be below this closed path of motion. Substantially all of a path of motion of footpad 124 may be below this closed path of motion. A hip of a majority of users may be positioned near at least a portion of the closed path of motion.

[0075] FIG. 13 depicts a side view of a still further embodiment of an exercise apparatus. Link member 152 is coupled to movable member 104 at point 132. An upper pivot point of link member 152 is coupled to movable member 104 at point 132. Link member 152 acts as a pendulum with a top of the pendulum being located at point 132. Link member 152 is coupled to and provides at least some support to member 218. Member 218 is supported by wheel 220, which engages the base of frame 100. A portion of member 218 moves in a back and forth path of motion along frame 100. A hip of a majority of users may be positioned near at least a portion of the back and forth path of motion at point 132. Member 218 is pivotally coupled to foot member 122. Member 218 and wheel 220 may provide at least some support for a user's weight on foot member 122.

[0076] FIG. 14 depicts a side view of an additional embodiment of an exercise apparatus. Link member 152 is coupled to movable member 104 at point 134. An upper pivot point of link member 152 is coupled to movable member 104 at point 134. Link member 152 acts as a pendulum with a top of the pendulum being located at point 132. Movable, member 104 is directly attached to crank member 114 at a forward end of the movable member. Movable member 104 is supported by and translates along an upper portion of frame 100. Link member 190 is coupled to an upper portion of frame 100 at point 130. Wheel 220 is coupled to slider assembly 168. Thus, wheel 220 is coupled to movable member 104 at a position determined by a position of slider assembly 168. Wheel 220 engages an upper portion of frame 100 to allow movable member 104 to translate along the upper portion of the frame. Motion of crank member 114 causes an end of movable member 104 opposite the coupling to the crank member to move in a closed path (e.g., an orbital path) of motion in space approximately represented by arrow 216. This closed path of motion is controlled by a geometry of the crank system, a geometry of the pivotal linkage pendulum system, and/or a position of slider assembly 168 along movable member 104. A majority of a path of motion of footpad 124 may be below this closed path of motion. Substantially all of a path of motion of footpad 124 may be below this closed path of motion. A hip of a majority of users may be positioned near at least a portion of the closed path of motion.

[0077] FIG. 15 depicts a side view of a further embodiment of an exercise apparatus. Member 218 is coupled to crank member 114 at one end and wheel 220 at another end. Wheel 220 engages the base of frame 100 and support member 218. Member 218 is pivotally coupled to link member 152 at point 132. An upper pivot point of link member 152 is coupled to member 218 at point 132. Link member 152 may act as a pendulum with a top of the pendulum being located at point 132. As crank member 114 rotates, point 132 moves in a closed path (e.g., an orbital path) of motion in space approximately represented by arrow 216. A majority of a path of motion of footpad 124 is below this closed path of motion. Substantially all of a path of motion of footpad 124 is below this closed path of motion. A hip of a majority of users may be positioned near at least a portion of the closed path of motion.

[0078] FIG. 16 depicts a side view of another embodiment of an exercise apparatus. Link member 190 is pivotally coupled to crank member 114 at point 132. An upper pivot point of link member 190 is coupled to crank member 114 at point 132. Link member 190 acts as a pendulum with a top of the pendulum being located at point 132. Foot member 122 is pivotally coupled to link member 190 at or near a front end of the foot member.

Link member 152 is pivotally coupled to foot member 122 at point 224. Link member 152 is slidably coupled to foot member 122 using slider assembly 168, as shown in FIG. 16A. Link member 152 is coupled to frame 100 at point 130. An upper pivot point of link member 152 is coupled to frame 100 at point 130. Link member 152 acts as a pendulum with a top of the pendulum being located at point 130. In the embodiments shown in PIGS. 16 and 16A, as crank member 114 rotates, the crank member causes the front end of foot member 122 to rise and fall. Thus, footpads 124 may rise and fall as crank member 114 rotates.

[0079] FIG. 17 depicts a side view of another embodiment of an exercise apparatus. Link member 152 is coupled to movable member 104 at point 132. An upper pivot point of link member 152 is coupled to movable member 104 at point 132. Link member 152 acts as a pendulum with a top of the pendulum being located at point 132. Link member 152 is coupled to foot member 122 at or near a rear end of the foot member. Movable member 104, link member 192, and the crank system are located at or near a rear of the exercise apparatus. Movable member 104 is pivotally coupled to frame 100 at point 226. Movable member 104 rotates or pivots about point 226. The embodiment depicted in FIG. 17 operates similarly to the embodiment depicted in FIGS. 8 and 9.

[0080] FIG. 18 depicts a side view of a further embodiment of an exercise apparatus. Foot member 122 is coupled to link member 152, link member 190, link member 192, and movable member 104. Foot member 122, link member 152, link member 190, link member 192, and movable member 104 are members of a pivotal linkage pendulum system.

[0081] Link member 152 is supported by movable member 104. Link member 152 is coupled to movable member 104 at point 132. An upper pivot point of link member 152 is coupled to movable member 104 at point 132. Link member 152 acts as a pendulum with a top of the pendulum being located at point 132. Movable member 104 is an angled, member, as shown in FIG. 18. Movable member 104 is coupled to and supported by frame 100 at point 136. Movable member 104 is coupled to crank members 114. During use, as crank member 114 rotates, the crank member displaces movable member 104 and causes an end of the movable member to move in a back and forth motion at point 132. The back and forth path of motion of movable member 104 at point 132 causes an upper pivot point of link member 152 to move in a back and forth path of motion. A hip of a majority of users may be positioned near at least a portion of the back and forth path of motion.

[0082] FIG. 19 depicts a side view of a still further embodiment of an exercise apparatus. Movable member 104 moves up and down a vertical portion of frame 100. For example, movable member 104 slidably or rollably engages the vertical portion of frame 100. Link member 152 is coupled to movable member 104 at point 132. An upper pivot point of link member 152 is coupled to movable ember 104 at point 132. Link member 152 acts as a pendulum with a top of the pendulum being located at point 132. Movable member 104 is coupled to crank member 114 through link member 192. During use, as crank member 114 rotates, the crank member displaces movable member 104 and causes an end of the movable member to move up and down along a vertical portion of frame 100. The up and down motion of movable member 104 is a linear back and forth motion approximately represented by arrow 134. The linear back and forth path of motion of movable member 104 at point 132 causes an upper pivot point of link member 152 to move in a linear back ' and forth path of motion A hip of a majority of users may be positioned near at least a portion of the year back and forth path of motion.

[0083] Further modifications and alternative embodiments of various aspects of the invention within the scope of the appended claims will be apparent to those skilled in the art in view of this description. Accordingly, this description is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the general manner of carrying out the invention. It is to be understood that the forms of the invention .. shown and described herein are to be taken as the presently preferred embodiments. Elements and materials may be substituted for those illustrated and described herein, parts and processes may be reversed, and certain features of the invention may be utilized independently, all as would be apparent to one skilled in the art aster having the benefit of this description of the invention. Changes may be made in the elements described herein without departing from the scope of the Invention as defined in the following claims.

Claims

1. An exercise apparatus, comprising:

a frame (100) configured such that at least a portion of the apparatus remains substantially stationary during use;

a crank system coupled to the frame, wherein the crank system comprises one or more crank members (114);

a pivotal linkage pendulum system comprising one or more link members (152) and a movable member (104) coupled to the one or more link members, wherein an upper pivot point (132) of at least one of the link members (152) which one link member (152c) acts as a pendulum, is coupled to the crank system through said movable member (104), and wherein the upper H pivot point (132) of the link member (152c) is configured to move in a path during use and is coupled to a portion of the movable member, the portion being configured to move in a back and forth path of motion;

a foot member (122) coupled to a lower pivot point of one or more of the link members, wherein the foot member comprises a footpad (124), wherein a path of motion of the footpad comprises at least some vertical amplitude, wherein a horizontal amplitude of the path of motion of the footpad is controlled by a user and determined by an amount of force applied by a user to the footpad, wherein a vertical amplitude of the path of motion of the footpad is controlled by a vertical amplitude of the path of the upper pivot point, wherein a distance between the footpad and the upper pivot point of the link member configured to move in the closed path is greater than 1 foot (0.30m); and
a brake/inertia device (118) coupled to the crank system.

2. The apparatus of claim 1, wherein a majority of the path of motion of the footpad (124) is below the path of the upper pivot point (132) during use.

3. The apparatus of any one of claims 1-2, wherein substantially all of the path of motion of the footpad (124) is below the path of the upper pivot point (130, 132) during use.

4. The apparatus of any one of claims 1-3, wherein the one link member (152c) is directly attached to the crank system.

5. The apparatus of any one of claims 1-4, wherein at least one of the link members (152) is coupled to and at least partially supported by the frame (100).

6. The apparatus of any one of claims 1-5, wherein the upper pivot point (132) of the one link member (152c) is at an upper end of that one link member (152c).

7. The apparatus of any one of claims 1-6, wherein the foot member (122) is coupled to a lower end of the pivotal linkage pendulum system.

8. The apparatus of any one of claims 1-7, wherein the path of the upper pivot point (132) comprises a closed path.

9. The apparatus of any one of claims 1-7, wherein the path of the upper pivot point (132) comprises a back and forth path of motion.

10. The apparatus of any one of claims 1-9, wherein the geometry of the pivotal linkage pendulum system and the crank system can be varied to vary amplitude of the substantially vertical motion of the footpad (124).

11. The apparatus of any one of claims 1-10, wherein the distance between the footpad (124) and the upper pivot point (132) is approximately a length of a leg of an average height user of the apparatus.

12. The apparatus of any one of claims 1-11, wherein a distance between the footpad (124) and the upper pivot point (132) is at least about 3 times the amplitude of the substantially vertical motion of the footpad (124).

13. The apparatus of any one of claims 1-12, wherein the apparatus comprises a left foot member (122) and a right foot member (122), and wherein the left foot member and the right foot member are cross coupled.

14. The apparatus of any one of claims 1-13, further comprising a further brake/inertia device (210) coupled to the foot members (122), wherein the brake/inertia device (210) is configured to resist horizontal motion of the footpads (124).

15. The apparatus of any preceding claim, wherein said distance between the footpad and the upper pivot point of the link member configured to move in the closed path is greater than 2 feet (0.61m) and less than 5 feet (1.52m).

Patentansprüche

1. Trainingsvorrichtung, umfassend:

einen Rahmen (100), der ausgebildet ist, so dass zumindest ein Teil des Rahmens während der Verwendung im Wesentlichen stationär verbleibt,
ein Hebelsystem, das mit dem Rahmen verbunden ist, wobei das Hebelsystem eines oder mehrere Hebelelemente (114) umfasst,
ein drehbares Verbindungspendelsystem, das eines oder mehrere Verbindungselemente (152) und ein bewegliches Element (104), das mit dem einen oder mehreren Verbindungselementen verbunden ist, umfasst, wobei ein oberer Anlenkpunkt (132) von zumindest einem der Verbindungselemente (152), das als Pendel wirkt, mit dem Hebelsystem über das bewegliche Element (104) verbunden ist, und wobei der obere Anlenkpunkt (132) des Verbindungselementes (152c) ausgebildet ist, um sich auf einer Bahn während der Verwendung zu bewegen und mit einem Abschnitt des beweglichen Elementes verbunden ist, wobei der Abschnitt ausgebildet ist, um sich auf einer Bewegungsbahn vor und zurück zu bewegen,
ein Fußelement (122), das mit einem unteren Anlenkpunkt von einem oder mehreren der Ver-

bindungselemente verbunden ist, wobei das Fußelement einen Fußbelag (124) umfasst, wobei ein Bewegungspfad des Fußbelages zumindest eine vertikale Amplitude umfasst, wobei eine horizontale Amplitude des Bewegungspfades des Fußbelages durch einen Benutzer gesteuert wird und durch einen von einem Benutzer an den Fußbelag angelegten Kraftbetrag bestimmt wird, wobei eine vertikale Amplitude des Bewegungspfades des Fußbelages durch eine vertikale Amplitude des Pfades des oberen Anlenkpunktes gesteuert wird, wobei ein Abstand zwischen dem Fußbelag und dem oberen Anlenkpunkt des Verbindungselementes, das sich auf der geschlossenen Bahn bewegt, größer als ein Fuß (0,30m) ist, und
eine Brems-/Trägheitseinrichtung (118) mit dem Hebelsystem verbunden ist.

2. Vorrichtung nach Anspruch 1, bei der sich während der Benutzung ein Großteil der Bewegungsbahn des Fußbelags (124) unter der Bahn des oberen Anlenkpunktes (132) befindet.

3. Vorrichtung nach einem der Ansprüche 1 bis 2, bei der sich während der Benutzung im Wesentlichen die gesamte Bewegungsbahn des Fußbelags (124) unter der Bahn der oberen Anlenkpunktes (130, 132) befindet.

4. Vorrichtung nach einem der Ansprüche 1 bis 3, bei der das eine Verbindungselement (152c) direkt mit dem Hebelsystem verbunden ist.

5. Vorrichtung nach einem der Ansprüche 1 bis 4, bei der zumindest eines der Verbindungselemente (152) mit dem Rahmen (100) verbunden ist und zumindest teilweise von dem Rahmen (100) gestützt wird.

6. Vorrichtung nach einem der Ansprüche 1 bis 5, bei der der obere Anlenkpunkt (132) des einen Verbindungselementes (152c) ein oberes Ende des einen Verbindungselementes (152c) ist.

7. Vorrichtung nach einem der Ansprüche 1 bis 6, bei der das Fußelement (122) mit einem unteren Ende des drehbaren Verbindungspendelsystems verbunden ist.

8. Vorrichtung nach einem der Ansprüche 1 bis 7, bei der die Bahn des oberen Anlenkpunktes (132) eine geschlossene Bahn umfasst.

9. Vorrichtung nach einem der Ansprüche 1 bis 7, bei der die Bahn des oberen Anlenkpunktes (132) eine vor- und zurückgehende Bewegungsbahn umfasst.

10. Vorrichtung nach einem der Ansprüche 1 bis 9, bei der die Geometrie des drehbaren Verbindungspendelsystems und des Hebelsystems verändert werden kann, um die Amplitude der im Wesentlichen vertikalen Bewegung des Fußbelages (124) zu verändern.

11. Vorrichtung nach einem der Ansprüche 1 bis 10, bei der der Abstand zwischen dem Fußbelag (124) und dem oberen Anlenkpunkt (132) ungefähr einer Länge eines Beines einer durchschnittlichen Benutzergröße der Vorrichtung entspricht.

12. Vorrichtung nach einem der Ansprüche 1 bis 11, bei der ein Abstand zwischen dem Fußbelag (124) und dem oberen Anlenkpunkt (132) zumindest dreimal der Amplitude der im Wesentlichen vertikalen Bewegung des Fußbelages (124) entspricht.

13. Vorrichtung nach einem der Ansprüche 1 bis 12, bei der die Vorrichtung eines linkes Fußelement (122) und ein rechtes Fußelement (122) umfasst und bei der das linke Fußelement und das rechte Fußelement kreuzweise verbunden sind.

14. Vorrichtung nach einem der Ansprüche 1 bis 13, ferner aufweisend eine weitere Brems-/Trägheitseinrichtung (210), die mit den Fußelementen (122) verbunden ist, wobei die Brems-/Trägheitseinrichtung (210) ausgebildet ist, um einer horizontalen Bewegung des Fußbelages (124) Widerstand zu leisten.

15. Vorrichtung nach einem vorhergehenden Anspruch, bei der der Abstand zwischen dem Fußbelag und dem oberen Anlenkpunkt des Verbindungselementes, das ausgebildet ist, um sich auf der geschlossenen Bahn zu bewegen, größer als 2 Fuß (0,61m) und geringer als 5 Fuß (1,52m) ist.

Revendications

1. Appareil pour exercice, comprenant:

un cadre (100) configuré de telle sorte qu'au moins une partie de l'appareil demeure essentiellement stationnaire durant l'utilisation;
un système de vilebrequin couplé au cadre, dans lequel le système de vilebrequin comprend un ou plusieurs organes (114) de vilebrequin;
un système pendulaire pivotant de liaison comprenant un ou plusieurs organes de liaison (152) et un organe mobile (104) couplé au un ou plusieurs organes de liaison, où un point (132) de pivotement supérieur d'au moins l'un des organes de liaison (152) lequel organe de liaison (152c) agit comme un pendule, est couplé au système de vilebrequin à travers ledit organe

mobile (104), et dans lequel le point (132) de pivotement supérieur de l'organe de liaison (152c) est configuré de manière à se déplacer dans un chemin durant l'utilisation et est couplé à une partie de l'organe mobile, la partie étant configurée de manière à se déplacer dans un chemin de mouvement en va-et-vient;
un organe pour pied (122) couplé à un point de pivotement inférieur de l'un ou plusieurs des organes de liaison, où l'organe pour pied comprend un support pour pied (124), où un chemin de mouvement du support pour pied comprend au moins une certaine amplitude verticale, où une amplitude horizontale du chemin de mouvement du support pour pied est commandée par un utilisateur et déterminée par une quantité de force appliquée par un utilisateur au support pour pied, où une amplitude verticale du chemin de mouvement du support pour pied est commandée par une amplitude verticale du chemin du point de pivotement supérieur, où une distance entre le support pour pied et le point de pivotement supérieur de l'organe de liaison configuré pour se déplacer dans le chemin fermé est supérieure à 0,30 m (1 pied); et
un dispositif de frein/inertie (118) couplé au système de vilebrequin.

2. Appareil de la revendication 1, dans lequel une grande partie du chemin de mouvement du support pour pied (124) se trouve sous le chemin du point (132) de pivotement supérieur durant l'utilisation.

3. Appareil de l'une quelconque des revendications 1-2, dans lequel essentiellement la totalité du chemin de mouvement du support pour pied (124) se trouve sous le chemin du point (130, 132) de pivotement supérieur durant l'utilisation.

4. Appareil de l'une quelconque des revendications 1-3, dans lequel l'organe de liaison (152c) est fixé directement au système de vilebrequin.

5. Appareil de l'une quelconque des revendications 1-4, dans lequel au moins l'un des organes de liaison (152c) est couplé à et au moins partiellement soutenu par le cadre (100).

6. Appareil de l'une quelconque des revendications 1-5, dans lequel le point (132) de pivotement supérieur de l'organe de liaison (152c) se trouve au niveau d'une extrémité supérieure de cet organe de liaison (152c).

7. Appareil de l'une quelconque des revendications 1-6, dans lequel l'organe pour pied (122) est couplé à une extrémité inférieure du système pendulaire pivotant de liaison.

8. Appareil de l'une quelconque des revendications 1-7, dans lequel le chemin du point (132) de pivotement supérieur comprend un chemin fermé.

9. Appareil de l'une quelconque des revendications 1-7, dans lequel le chemin du point (132) de pivotement supérieur comprend un chemin de mouvement en va-et-vient.

10. Appareil de l'une quelconque des revendications 1-9, dans lequel la géométrie du système pendulaire pivotant de liaison et du système de vilebrequin peut être modifiée afin de faire varier l'amplitude du mouvement essentiellement vertical du support pour pied (124).

11. Appareil de l'une quelconque des revendications 1-10, dans lequel la distance entre le support pour pied (124) et le point (132) de pivotement supérieur est approximativement une longueur d'une jambe d'un utilisateur de taille moyenne de l'appareil.

12. Appareil de l'une quelconque des revendications 1-11, dans lequel une distance entre le support pour pied (124) et le point (132) de pivotement supérieur est au moins environ 3 fois l'amplitude du mouvement essentiellement vertical du support pour pied (124).

13. Appareil de l'une quelconque des revendications 1-12, dans lequel l'appareil comprend un organe pour pied gauche (122) et un organe pour pied droit (122), et où l'organe pour pied gauche et l'organe pour pied droit sont couplés de manière transversale.

14. Appareil de l'une quelconque des revendications 1-13, comprenant en plus un dispositif de frein/d'inertie (210) supplémentaire couplé aux organes pour pied (122), où le dispositif de frein/d'inertie (210) est configuré de manière à résister à un mouvement horizontal des supports pour pied (124).

15. Appareil de l'une des revendications précédentes, dans lequel ladite distance entre le support pour pied et le point de pivotement supérieur de l'organe de liaison configuré de manière à se déplacer dans le chemin fermé est supérieure à 0,61 m (2 pieds) et inférieure à 1,52 m (5 pieds).

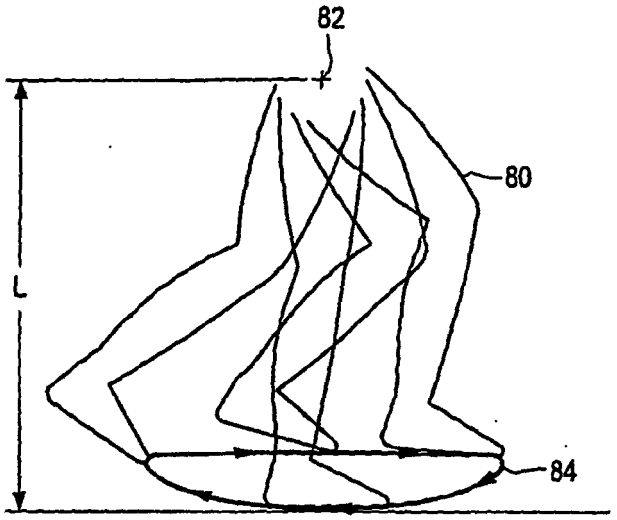


FIG. 1

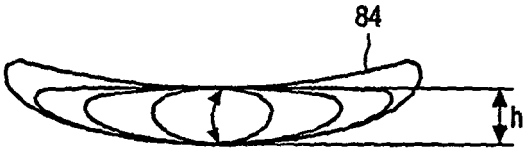


FIG. 1A

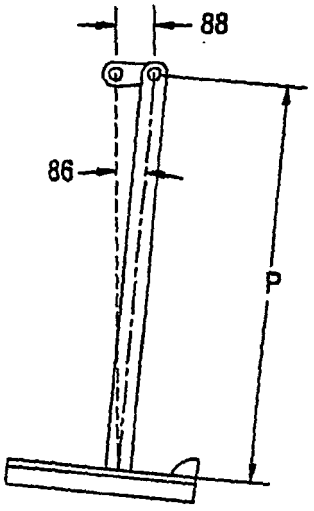


FIG. 2

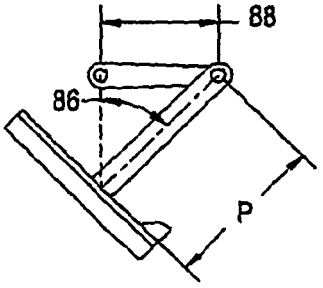
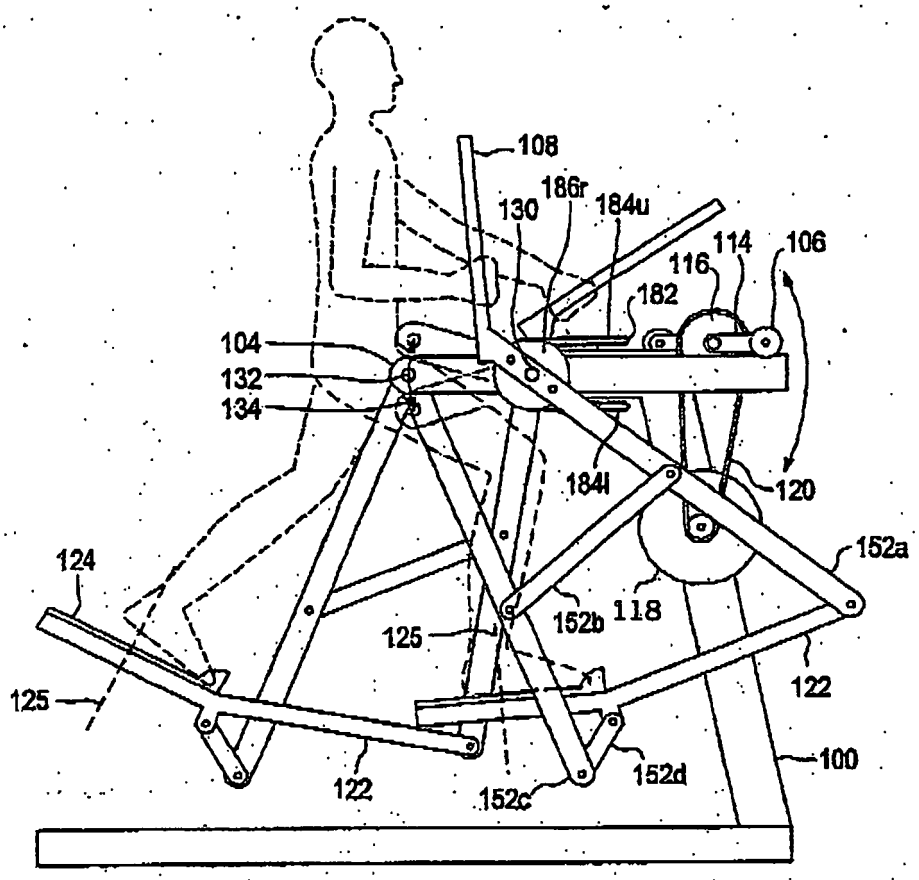


FIG. 3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152a
152b
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125
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125
122
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152d
152c

FIG. 4

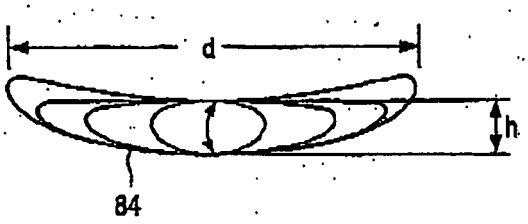
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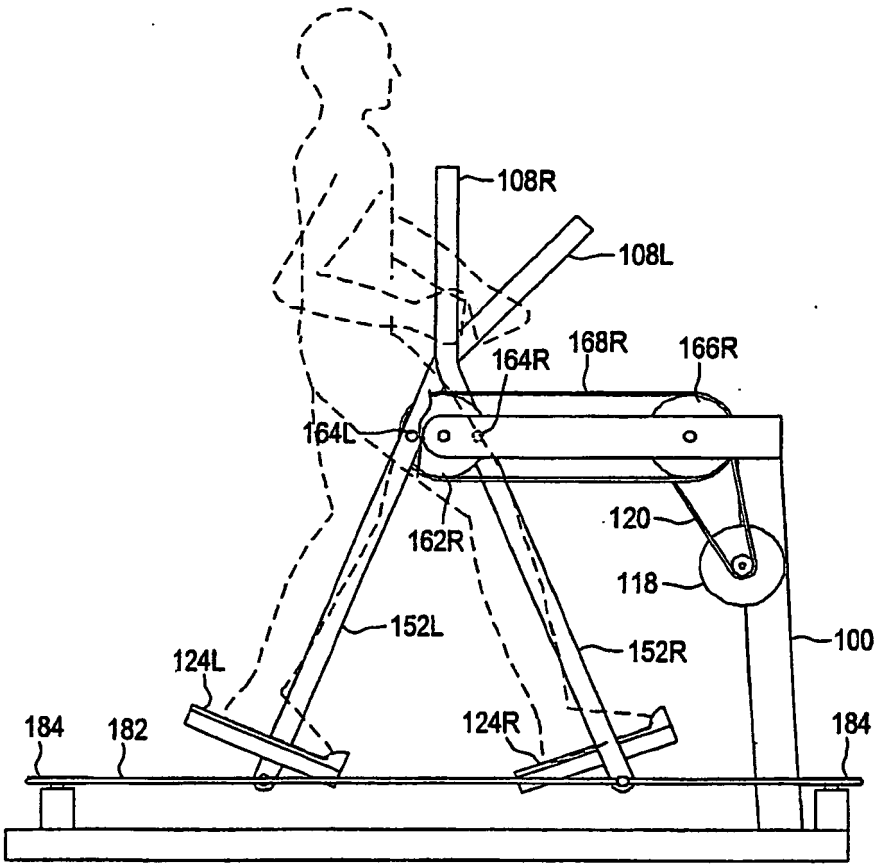
FIG. 5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152L
152R
124L
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184
182
184

FIG. 6

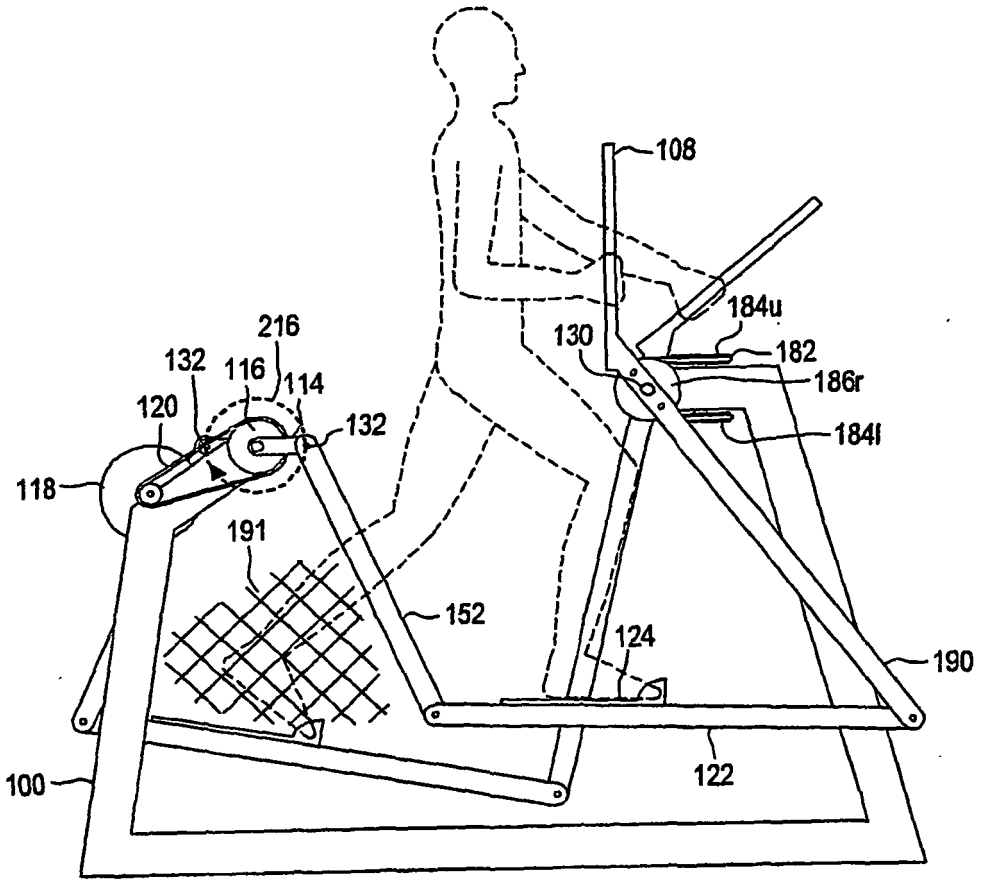
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FIG. 7

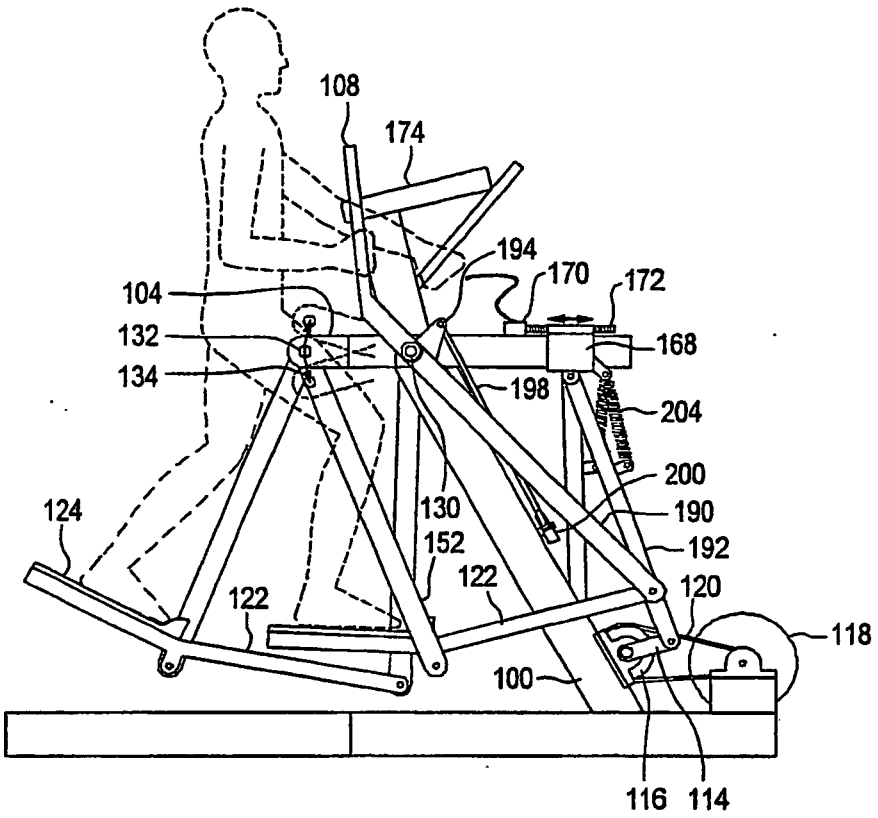
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FIG. 8

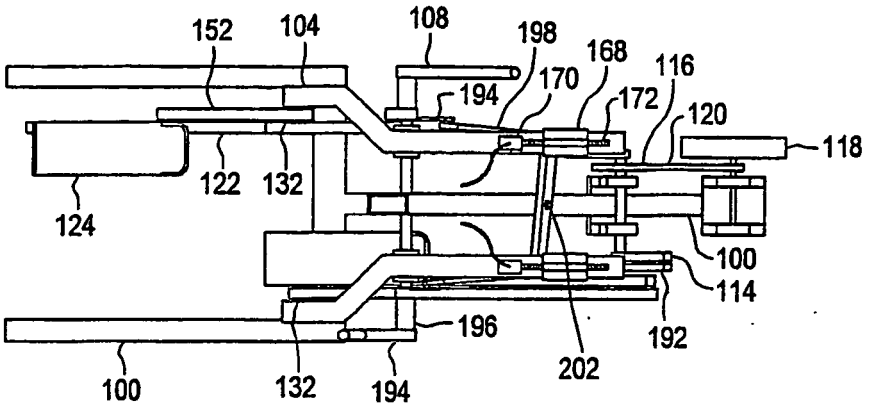
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FIG. 9

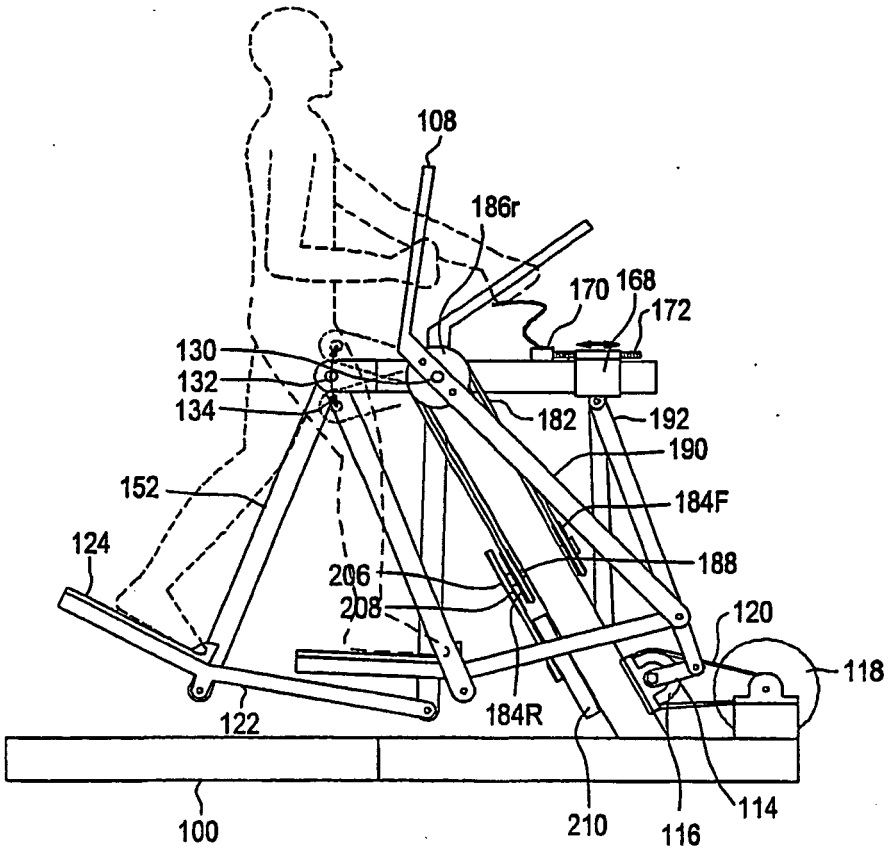
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FIG. 10

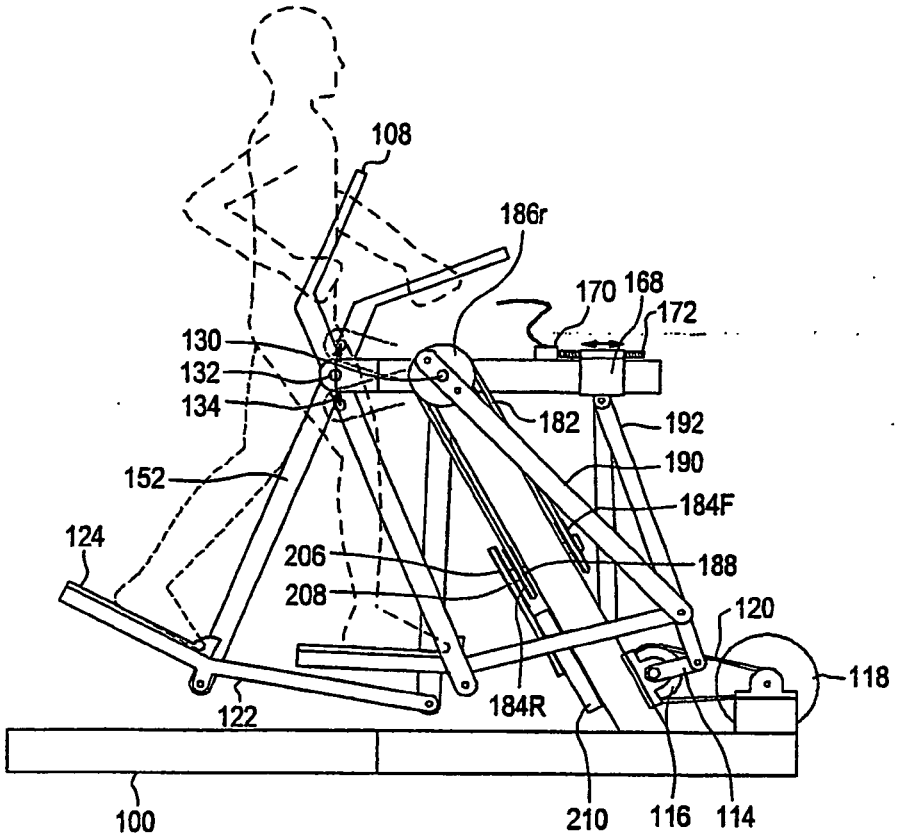
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FIG. 10A

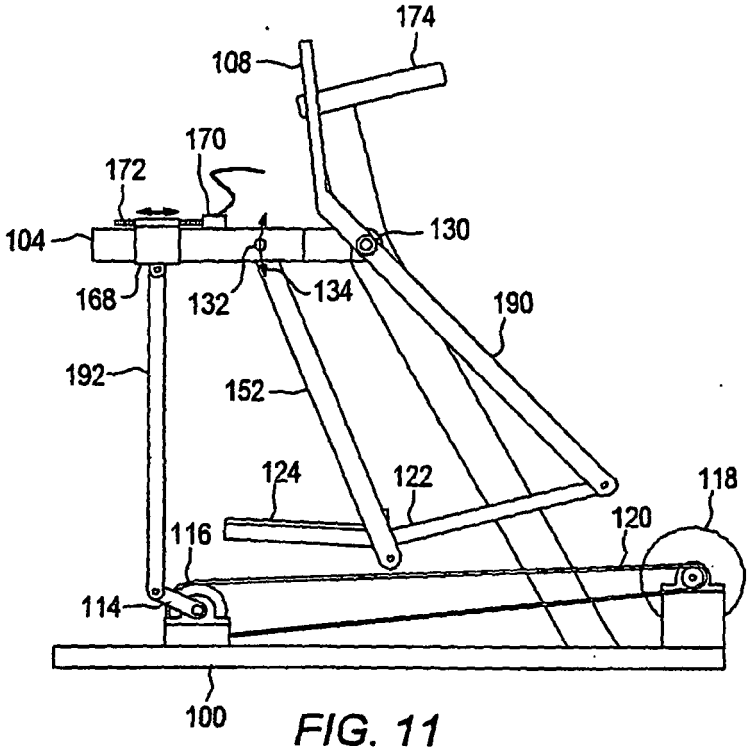

FIG. 11

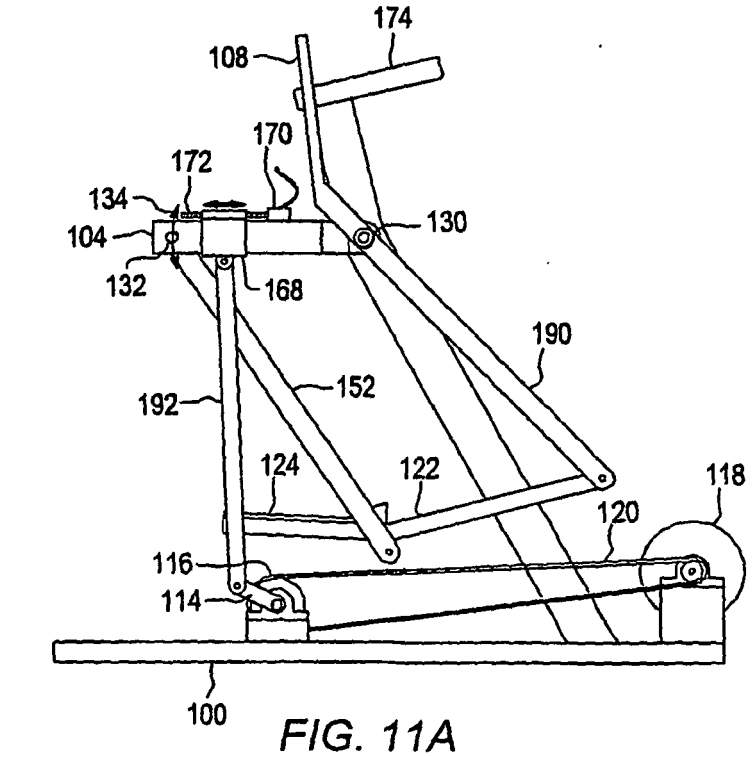

FIG. 11A

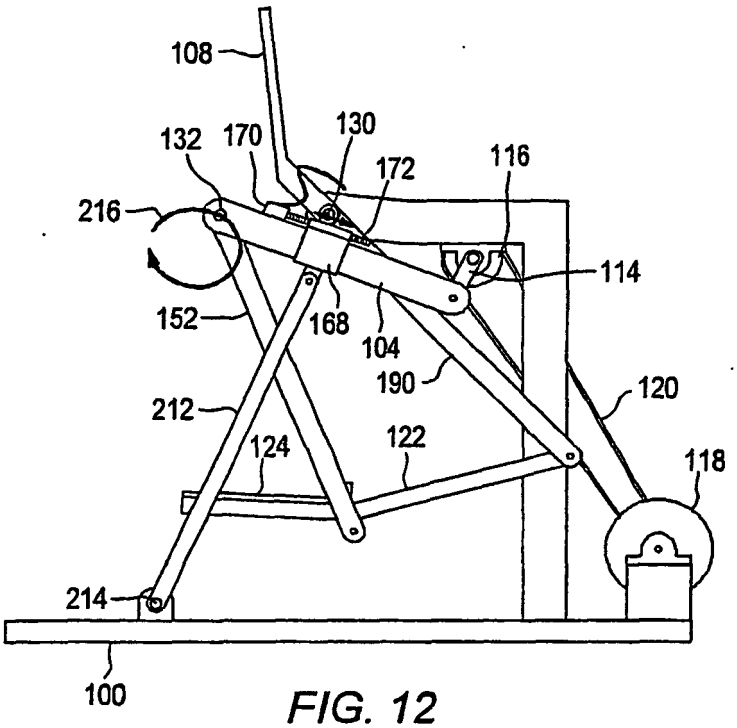
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FIG. 12

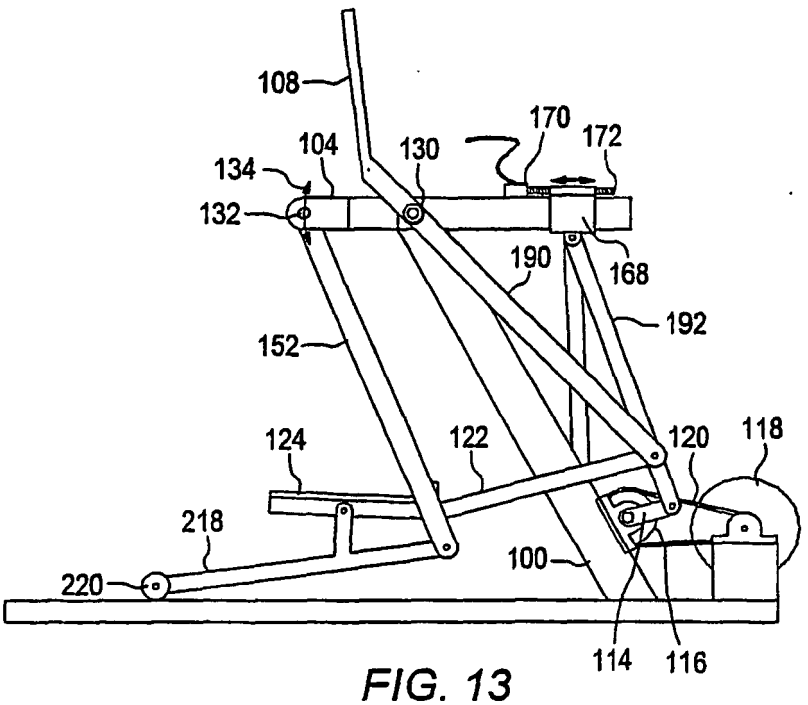
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FIG. 13

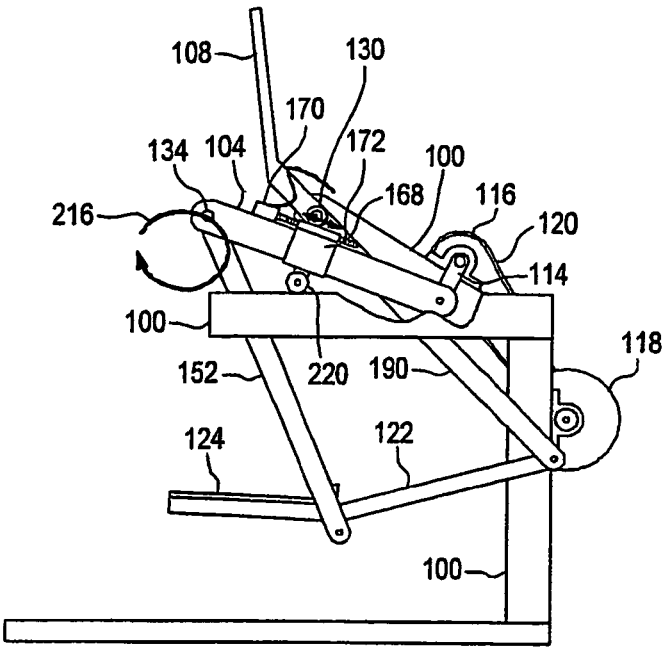
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FIG. 14

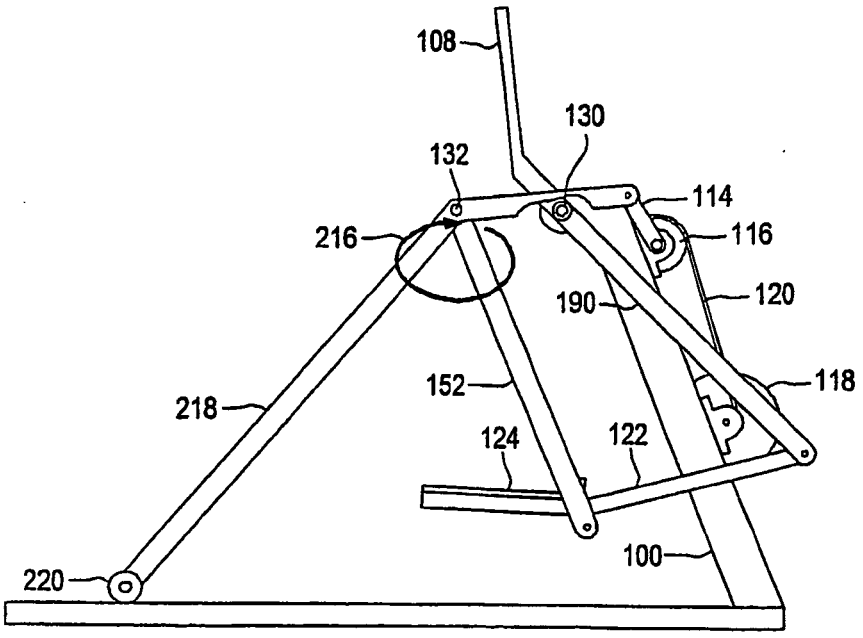
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FIG. 15

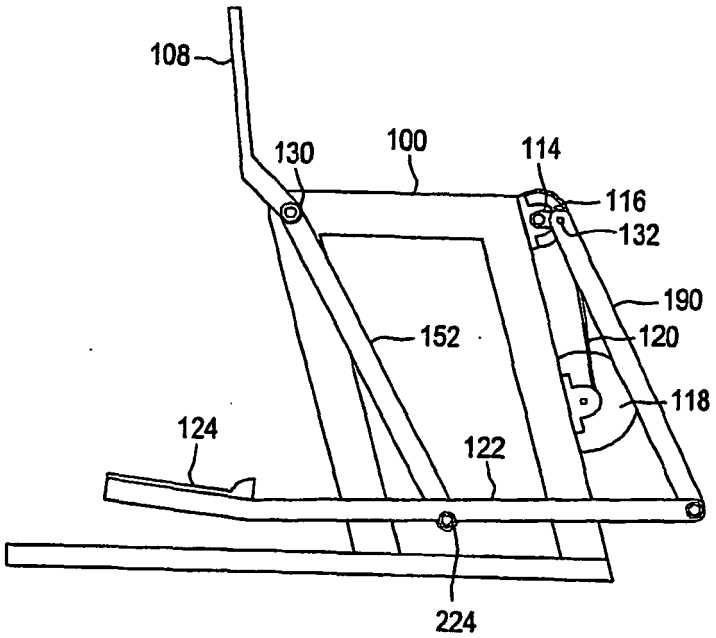

FIG. 16

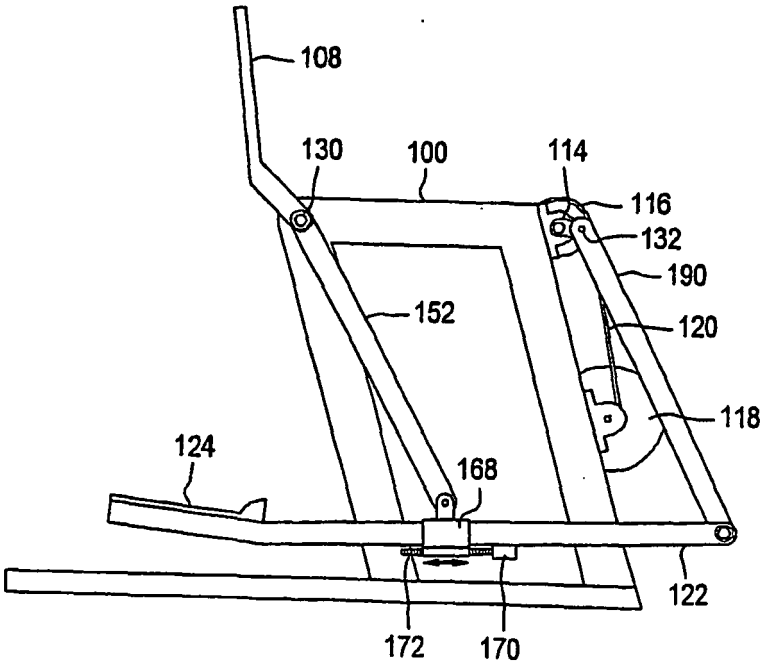

FIG. 16A

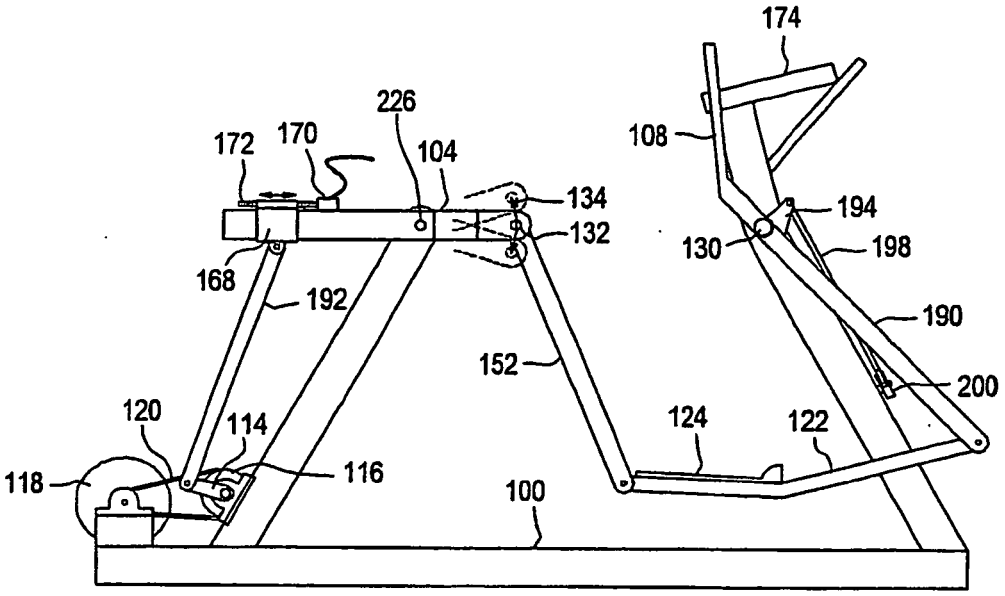
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FIG. 17

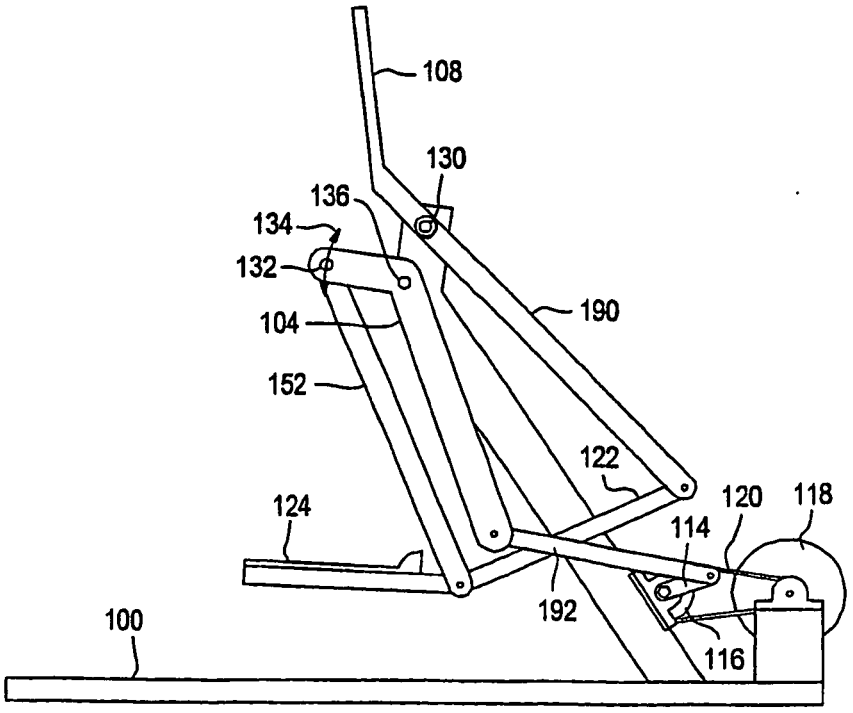
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FIG. 18

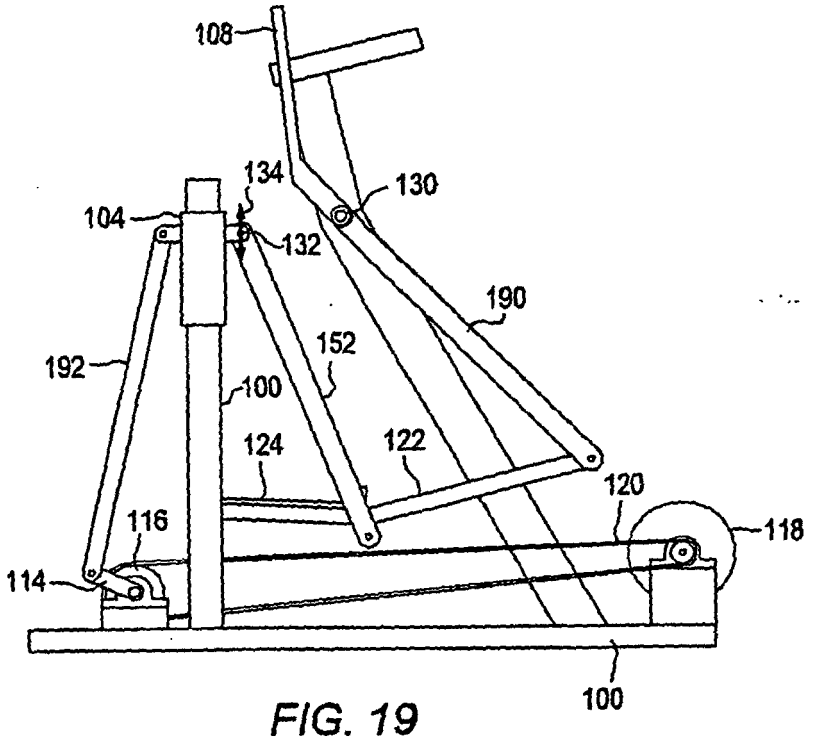

FIG. 19

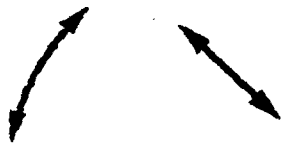

FIG. 20

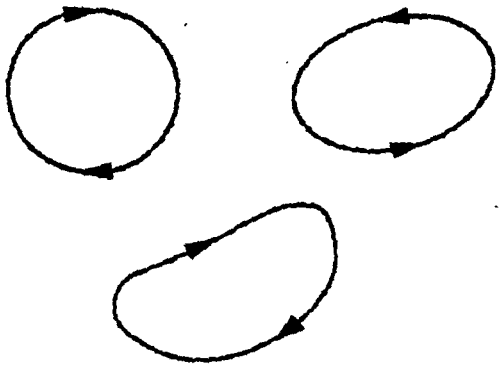

FIG. 21

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6083143 A **[0006]**