EXERCISE APPARATUS WITH DIFFERENTIAL ARM RESISTANCE ASSEMBLY

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ABSTRACT

The present invention relates to exercise apparatuses having
a resistance assembly which utilizes a compression spring in
combination with a differential resistance arm to regulate the
amount of resistance provided to the user for use in exercise.
The resistance assembly of the present invention utilizes a
compression spring, gas shock, or other known resistance
mechanisms. The differential resistance arm is provided in
connection with the compression spring to regulate the
amount of resistance provided for use during exercise. The
differential resistance arm includes a differential contact
surface which has a substantially curved configuration. The
curved configuration maintains a linear increase/decrease in
resistance subsequent to input from a user increasing or
decreasing the resistance.
EXERCISE APPARATUS WITH DIFFERENTIAL ARM RESISTANCE ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS


BACKGROUND OF THE INVENTION

[0002] 1. The Field of the Invention
[0003] The present invention relates to exercise apparatuses. In more particular, the present invention relates to exercise devices utilizing a compression spring and differential resistance arm for providing variable resistance for use during exercise.
[0004] 2. The Relevant Technology
[0005] In recent years, there has been a trend towards the use of exercise equipment, whether it is at a gym or at home. Although gym exercise equipment provides many benefits to an exercising user, it is typically expensive to become a member of the gym and usually time consuming and inconvenient to exercise at the gym. Many individuals are turning to home exercise equipment to obtain the health benefits associated with daily exercising.
[0006] Although home exercise equipment is more convenient to use, in many instances the devices are cumbersome and difficult to use. For instance, many multi-gym exercise devices use free weights or other heavy weights to provide resistance during an exercise regime. These weights make positioning and subsequent movement of the exercise device difficult. Typically, once a multi-gym device has been set-up in one position, it will remain there for a significant amount of time without being moved. When the device is to be moved, the owner must spend a long period of time to dismantle the device, move the parts to the new position within the home, and reassemble the exercise device. Additionally, use of such a multi-gym device requires the user to settle at a significant amount of space within the user’s home. This reduces the livable space within the home and typically requires that an area of the home be dedicated to the performance of exercise regimes.
[0007] Typical exercise devices use weights to provide resistance to an exercising user. The selection of weights may be difficult to achieve before and during an exercise regime. Additionally, selection of a particular resistance is limited to the incremental weights provided with the exercise device. For instance, the adjustability of the exercise device to a particular weight is often limited by the minimum numerical weight value of the weights included with the exercise device.

[0008] In addition to the above, the adjustability of the exercise device limits the usability of the exercise device. Many exercise devices require removal of pins and repositioning of weights to vary the resistance applied to an exercising user. This may be time consuming and difficult to achieve depending the particular configuration of the exercise device. Over time, there is a likelihood that the pins associated with the exercise device will become lost, thereby preventing a user exercising using the exercise device.

[0009] Some exercise devices attempt to overcome the limitations associated with the use of heavy weights to provide resistance to an exercising user. These exercising devices may utilize a flexible arm or rod that provides resistance as a user exercises. However, such flexible arms can take more than the desired amount of space, can require manual manipulation, or can be otherwise cumbersome to use efficiently.

BRIEF SUMMARY OF THE INVENTION

[0010] The present invention relates to exercise apparatuses. More particularly, the present invention relates to exercise apparatuses having a resistance assembly which utilizes a compression spring in combination with a differential resistance arm to regulate the amount of resistance provided to the user for use in exercise. The resistance assembly of the present invention utilizes a compression spring, gas shock, or other known resistance mechanisms including, but not limited to, resilient bands, compressible foam members, or the like. The differential resistance arm is provided in connection with the compression spring to regulate the amount of resistance provided for use during exercise. The differential resistance arm includes a differential contact surface which has a substantially curved configuration. The curved configuration maintains a linear increase/decrease in resistance subsequent to input from a user increasing or decreasing the resistance.

[0011] According to one embodiment of the present invention, a lead screw and lead screw motor are provided in connection with the differential resistance arm. A linkage arm is secured to the lead screw utilizing a threaded coupler. In response to a request from a user to increase or decrease the amount of resistance provided from the resistance assembly, the lead screw motor turns the lead screw changing the position of the threaded coupler along the length of the differential resistance arm. The differential resistance arm provides a mechanical advantage such that when the position of the threaded coupler is moved along the length of the differential resistance arm the mechanical advantage of the differential resistance arm is increased or decreased to change the amount of resistance experienced by the user during exercise.

[0012] The configuration of the differential resistance arm and linkage arm allows the compression spring to be compressed in a substantially linear manner without requiring rotation or pivoting of any portion of the compression spring. This provides a fluid and reliable motion of the
compression spring which limits breakage or other stresses on the compression spring during exercise. The differential contact surface of the differential resistance arm provides for effective and continuous contact between the threaded coupler and the differential resistance arm when the threaded coupler is positioned at a variety of positions along the differential contact surface of the differential resistance arm. As a result, a reliable, efficient, and compact resistance assembly can be provided in connection with the exercise device.

According to one embodiment of the present invention a guide and guide slot are provided in connection with the compression spring. The guide, guide slot, and compression spring are mounted on a compression spring securement frame member. When the compression spring is in operation, the compression spring securement frame member, the guide, and guide slot maintain smooth, continuous, and linear movement of the compression spring as the compression spring is compressed. According to another embodiment of the present invention, a cable and pulley is provided to utilize resistance from the resistance member and convey the resistance to the user for use in exercise. In one embodiment, a plurality of pulleys are positioned at one end of the differential resistance arm and a plurality of pulleys are positioned on the frame of the resistance assembly. A cable is threaded from the pulleys on the differential resistance arm to the pulleys on the frame. Additionally, the cable of the cable and pulley system extends from the resistance assembly to a position on the exercise device. The cable is connected to a handle, or other grasping member allowing the user to utilize the resistance from the compression spring during an exercise routine. Resistance from the resistance member is conveyed to the differential resistance arm utilizing the linkage arm. As a result, the cable and pulley system links directly to the differential resistance arm to utilize such resistance from the resistance member and convey the resistance to the user.

According to one embodiment of the present invention, additional resistance can be added by the user to the resistance assembly. Additional compression springs can be added to an external connection point on the housing of the resistance assembly to add such additional resistance. In another embodiment, a different type of resistance such as a resilient band, or other known resistance member can be utilized. In the embodiment, the additional resistance compression springs are engaged by an external portion of the guide. Movement of the differential resistance arm during exercise compresses both the compression spring internal to the resistance assembly and the ancillary compression spring or springs added by the user. As will be appreciated by those skilled in the art, a variety of types and configuration of exercise mechanisms such as lat towers, weight benches, squat towers, leg press, or preacher curl mechanisms can be utilized.

These and other objects and features of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

To further clarify the above and other advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It is appreciated that these drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

FIG. 1 is a perspective view of an exercise apparatus according to the present invention.

FIG. 2 is a rear perspective view of the resistance assembly in connection to the exercise apparatus.

FIG. 3 is perspective view of the resistance assembly illustrating the differential resistance arm.

FIG. 4 is a side cutaway view of the resistance assembly illustrating the guide which maintains linear compression of the compression spring.

FIG. 5A is a side view illustrating the differential resistance arm, compression spring, and linkage arm.

FIG. 5B is a side view of the differential resistance arm in which the resistance assembly has been actuated.

FIG. 6A is a side view of the differential resistance arm in which the threaded coupler is in a minimum resistance position and the differential resistance arm is in a relaxed state.

FIG. 6B illustrates the threaded coupler in a minimum resistance position in which the differential resistance arm is in an actuated position.

FIG. 7A illustrates the threaded coupler in a maximum resistance position in which the differential resistance arm is in a relaxed position.

FIG. 7B illustrates the threaded coupler in a maximum resistance position in which the differential resistance arm is in an actuated position.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to an exercise device having a resistance assembly which utilizes a differential resistance arm and a compression spring to provide resistance for use in exercise. Additionally, the present invention relates to a user interface for use with the differential resistance arm. The user interface allows the user to select an amount of resistance to be utilized during exercise. The user interface subsequently controls application of the resistance through the full range of motion according to a user selected routine, including automatically setting amounts of resistance, numbers of sets and repetitions of particular exercises, and combinations of exercises to be performed. In this manner, the exercise apparatus of the present invention provides a user with controllable resistances, while providing the user with a range of motion that is greater than the amount that the differential resistance arm or compression spring is displaced during the exercise.

FIG. 1 illustrates an exercise device 10 according to one aspect of the present invention. Exercise device 10 provides a mechanism for allowing a user to undertake aerobic and anaerobic exercises in a home or institutional
gym setting. Exercise device 10 provides a mechanism for allowing a user to undertake a variety of types and configurations of exercises without needing an exercising partner to assist in the management of the resistance apparatuses during exercise. In the illustrated embodiment, exercise device 10 includes a frame 11, a resistance assembly 12, a cable and pulley system 18, and user interface 17. The exercise device 10 also includes a squat apparatus 19, a leg exercising mechanism 16, a lat tower 14, and a bench 39 that will be discussed in more detail hereinafter. As will be appreciated by those skilled in the art, a variety of types and combinations of components can be utilized with exercise apparatus without departing from the scope and spirit of the present invention.

Frame 11 provides a structure upon which other components of exercise device 10 are positioned. Additionally, support frame 11 provides stability to exercise device 10 to provide a safe exercise environment. Resistance assembly 12 is positioned adjacent to frame 11. Resistance assembly 12 includes a differential resistance arm 61 and a compression spring 78 (see FIG. 2). The compression spring 78 provides resistance for use during exercise. The differential resistance arm 61 regulates the amount of resistance provided to the user in connection with compression spring 78.

User interface 17 is linked to resistance assembly 12. User interface 17 allows a user to select an amount of resistance to be used in exercise without having to manually adjust components of the system. User interface 17 allows the user to increase or decrease the amount of resistance experienced during exercise. In one embodiment user interface 17 includes a plurality of preprogrammed exercise routines that can be selected by the user. A description of a user interface or electronic weight selector system for use with the exercise device of the present invention is provided in U.S. patent application Ser. No. 10/968,250, filed Oct. 19, 2004, and entitled “Exercise Device with Single Resilient Elongate Rod and Weight Selector Controller,” the entire contents of which are hereby incorporated by reference.

Exercise device 10 also includes a squat apparatus 19, leg exercising mechanism 16, lat tower 14, and bench 39. Squat apparatus 19 is coupled to an upright support member 22 of support frame 11. Squat apparatus 19 allows a user to utilize resistance from resistance assembly 12 to perform squat exercise routines. Bench 39 is also coupled to frame 11. Bench 39 provides a surface on which a user can sit or lay to perform certain exercise routines including the bench press, seated flies, bench curls, and the like. In the illustrated embodiment, bench 39 is slideable along a portion of frame 11. Leg exercising mechanism 16 is coupled to frame 11 at a distal portion of support frame 11. Leg exercising mechanism 16 allows the user to utilize resistance from the resistance assembly 12 to perform a variety of exercises including the bicep curl, quadriceps lift, hamstring curl, and a variety of other types and configurations of exercises.

Lat tower 14 is also coupled to frame 11. Lat tower 14 allows a user to perform lat pull down and other exercises. As will be appreciated by those skilled in the art, a variety of types and configurations of exercise machines can be utilized without departing from the scope and spirit of the present invention. For example, in one embodiment an exercise machine does not include all of the illustrated components, such as lat tower or bicep/quadriceps exerciser.

As previously discussed, frame 11 provides support for other components of exercise device 10. Frame 11 includes a base 20, upright support 22, and leg lever support 48. Base 20 is coupled to the lower portion of upright support member 22. Base 20 provides lateral stability to exercise device 10 to provide a stable exercising environment. Additionally, base 20 provides a deck on which various exercises can be performed by a user such as squat routines, standing lat pull downs, and the like. Base 20 provides a surface allowing a user to rest his/her feet thereon thereby allowing a user to perform certain exercise routines such as squats, and other standing or sitting exercise routines. In the illustrated embodiment, base 20 includes a textured upper surface which minimizes slippage of a user’s feet on base 20 during exercise routines.

Base 20 further includes one or more wheels 24. Wheels 24 are positioned on the portion of base 20 opposite riser bench 39. Wheels 24 provide a structural support member as well as a mechanism for moving exercise device 10. The ability to move exercise device 10 utilizing rollers 166 can be particularly beneficial when exercise device 10 is in a folded storage position. This allows a user to move exercise device 10 to a closet, room corner, or other desired storage location when exercise device 10 is not in use. In one embodiment, wheels 24 include a first and second wheel positioned on opposite lateral sides of base 20.

Upright support member 22 is coupled to base 20 and the horizontal support member of bench 39. Upright support member 22 provides a structure on which other components of the exercise machine can be affixed. For example, in the illustrated embodiment, resistance assembly 12, user interface 17, a squat apparatus 19, and a lat tower 14 are positioned on or next to upright support member 22. As will be appreciated by those skilled in the art, a variety of types and configurations of frame 11 can be utilized without departing from the scope and spirit of the present invention. For example, in one embodiment, a plurality of leg supports are utilized. In an alternative embodiment, the other components of exercise device are connected to a secondary component instead of to upright support member. In an alternative embodiment, distal components of frame include a support structure for a bench that is a separate stand alone component from upright support member and base.

Cable and pulley system 18 allows a user to utilize resistance from resistance assembly 12 during exercise. Cable and pulley system 18 includes a primary cable 30a, secondary cables 30b, c, tertiary cable 30d, handles 31a, b, and pulley stations 32a, b. In the illustrated embodiment, primary cable 30a is threaded from the left side of exercise device 10, through resistance assembly 12, to the rights side of exercise device 10. Primary cable 30a conveys resistance from resistance assembly 12 to a location where it can be utilized by the user. Primary cable 30a is threaded to pulley stations 32a, b to provide smooth and efficient movement of primary cable 30a. In one embodiment, handles 31a, b are configured to be affixed directly to the ends of primary cable 30a.

Secondary cables 30b, c can be affixed directly to the ends of primary cable 30a to allow a user to conduct additional exercise routines. For example, secondary cables 30b, c allow the user to perform lat pull down and other
exercises that require additional cable length. Tertiary cable 30d connects primary cable 30a to other components of the exercise device such as leg exercising mechanism 16 and seat member 38 (so as to perform seated rows).

Bench 39 provides a surface on which a user can rest to perform exercise routines. Bench 39 includes a seat member 38, a back rest 40. In the illustrated embodiment, seat member 38 includes a padded surface. Seat member 38 is slidably coupled to horizontal support member of the frame 11 allowing a user to perform seated rows and similar exercise devices. Back rest 40 is pivotally coupled to seat member 38. Back rest 40 provides a mechanism for supporting a user’s back in either a sitting or inclined position during exercise routines such as bench press, pectoral fly, and the like. Pivotal coupling between seat member 38 and back rest 40 allows back rest 40 to be placed in a variety of positions and at a variety of angles relative to seat member 38. In one embodiment, back support 40 is removable from seat member 38 permitting a user to conduct certain exercises, such as seated rows, and/or place exercise apparatus in a folded position.

In one embodiment, the base of seat member includes a plurality of roller wheels (not shown) positioned relative to horizontal support member of frame 11 to allow seat member 38 to slide relative to horizontal support member of frame 11. The seat member 38 also includes a locking pin providing a mechanism for securing a desired bench position.

Lat tower 14 is positioned on the upper end of upright support member 22. Lat tower 14 includes a support arm which provides displacement from upright component support member 22 to allow a user to conduct a lat pull down exercises with a lat bar. Pulleys are positioned at a desired lateral location to enable exercise with the lat bar. As will be appreciated by those skilled in the art, a variety of types and configurations of lat towers can be utilized without departing from the scope and spirit of the present invention.

A squat apparatus 19 is secured to upright support member 22 to allow a user to conduct squat exercises on exercise device 10. Squat apparatus 19 is slidably coupled to upright support member 22. A user conducts a squat routine by raising and lowering squat apparatus 19. Squat apparatus 19 includes back support 52 and hand grip assemblies 54a, 54b. Back support 52 contacts a user’s back during exercise while providing support and cushioning to forces exerted by the user against squat apparatus 19. Hand grip assemblies 54a, 54b are grasped by the user during exercise to raise and lower squat apparatus 50.

In preparation for conducting a squat exercise routine, back rest 40 is disconnected from seat member 38 and removed from the horizontal support member of frame 11. This allows the user to straddle the horizontal support member of frame 11 with the user’s feet being positioned on base 20. The user then raises and lowers squat apparatus 19 by grasping hand grip assemblies 54a, 54b while the user’s back contacts back rest 52. As will be appreciated by those skilled in the art, a variety of types and configurations of squat apparatuses can be utilized to conduct a squat routine without departing from the scope and spirit of the present invention. The configuration and angle of squat apparatus 50 on upright support member 22 ensures smooth and predictable movement during a squat routine.

A leg exercising machine 16 utilized in connection with the resistance assembly 12. Leg exercising machine 16 is coupled to leg lever support 48. Leg exercising machine 16 includes a leg lever 44 and an arm curl lever 50. Leg lever 44 allows a user to conduct exercise routines relating to the quadriceps and other leg muscles. Arm curl lever 50 allows the user to conduct exercise routines related to the biceps and other muscles of the user’s body. A preacher curl 42 is provided to allow the user to rest and/or position portions of his/her body during use of leg lever 44 and/or arm curl lever 50.

FIG. 2 is a rear perspective view of exercise device 10 illustrating resistance assembly 12 according to one embodiment of the present invention. In the illustrated embodiment, pulley station 32b is shown in greater detail. Pulley station 32b is utilized in connection with primary cable 30a. Primary cable 30a includes a clip 56 positioned at its terminal end and a stop 58 positioned adjacent its terminal end. In the illustrated embodiment, pulley station 32b includes a pulley 60. Pulley 60 is configured to be pivotal relative to frame 11 to allow the user to exercise at a variety of different angles and positions relative to pulley station 32b.

Resistance assembly 12 is operatively linked to frame 11 to allow a user to utilize resistance from resistance assembly 12 for use in exercise. In the illustrated embodiment, resistance assembly 12 is positioned perpendicularly relative to frame 11. By being positioned perpendicularly relative to exercise frame 11, resistance assembly 12 provides an overall more compact and efficient storage design to exercise device 10. The overall lateral dimension of resistance assembly 12 is essentially the same width as base 20 of frame 11. As a result, when a user folds the seat portion of exercise device 10 can easily be rolled into a corner so as not to interfere with normal daily activities.

In the illustrated embodiment, resistance assembly 12 includes a differential resistance arm 61 which operates in connection with compression spring 78 to provide differential resistance to a user during exercise. Differential resistance arm 61 pivotally coupled to resistance assembly frame 62. As a user retracts the ends of primary cable (not shown) differential resistance arm 61 is pivoted. In the illustrated embodiment, differential resistance arm 61 includes a differential contact surface 63. Differential contact surface 63 allows the system to control the amount of resistance provided during exercise while maintaining contact with a threaded coupler 76.

Resistance assembly frame 62 surrounds most of the components of resistance assembly frame 62. Resistance assembly frame 62 provides support for the other components of resistance assembly 12. Resistance assembly frame 62 also provides a base for securing and ensuring proper operation of compression spring 78.

A plurality of pulleys are provided in connection with resistance assembly 12. The plurality of pulleys facilitate proper operation of resistance assembly 12 while allowing the user to utilize resistance from resistance assembly 12 during exercise. In the illustrated embodiment, resistance arm pulleys 66a-ν are connected to the free end of differential resistance arm 61. Frame pulleys 66a-ν are secured to resistance assembly frame 62. Transition pulleys 68a-ν are provided at a variety of locations relative to resistance...
assembly 12. Transition pulleys 68a-n facilitate the connection between primary cable 30a (not shown) and resistance assembly 12. During exercise, as a user retracts the primary cable of cable and pulley system 18, the primary cable pulls resistance arm pulley 64a-n toward frame pulley 66a-n.

[0049] As pulleys 64a-n are drawn toward pulleys 66a-n, the free end of differential resistance arm is displaced. This results in pivoting of differential resistance arm 61 causing actuation of compression spring 78. Compression spring 78 provides a counteracting force to movement of differential resistance arm 61. This counteracting force provides the resistance utilized by the user during exercise. In one embodiment, the amount of resistance provided by compression spring 78 is fixed. The differential resistance arm 61 utilizes the fixed amount of resistance from the compression spring 78 to provide variable resistance to the user. The user can add one or more ancillary compression springs 93a, b to increase the amount of resistance provided by the exercise device. In one embodiment, compression springs 78 provide a maximum of 220 pounds of resistance for use in exercise. The ancillary compression springs 93a, b add up to between 110 and 220 additional pounds of resistance providing a total of about 330 to 440 pounds of resistance. In the illustrated embodiment, the configuration of resistance arm pulley 64a-n and frame pulley 66a-n provides a compound pulley effect. As a result, a greater stroke length is provided to the primary cable during operation of exercise device 10. In other words, the amount of overall stroke length is greater than the total displacement of the free end of differential resistance arm 61.

[0050] As will be appreciated by those skilled in the art, a variety of types and configurations of frame cable and pulley systems can be utilized without departing from the scope and spirit of the present invention. For example, in one embodiment a separate cable is provided to connect the frame pulleys and the resistance arm pulleys other than the primary cable. In another embodiment, a pulley system is utilized which does not provide a compounding effect as that illustrated in FIG. 2.

[0051] In the illustrated embodiment, a lead screw 70 and lead screw motor 72 are utilized in connection with differential resistance arm 61. Lead screw 70 allows the differential resistance arm 61 to utilize the fixed amount of resistance from compression spring 78 to provide varying amounts of resistance during exercise. A link arm 74 is coupled to lead screw 70 utilizing a threaded coupler 76. Link arm 74 couples differential resistance arm 61 to compression spring 78. As a result, when differential resistance arm 61 is moved, link arm 74 also exerts a force on compression spring 78. When the force exerted by differential resistance arm 61 and link arm 74 on compression spring 78 is sufficient, compression spring 78 is compressed.

[0052] Lead screw threadably interacts with threaded coupler 76 such that rotation of lead screw 70 changes the position of threaded coupler 76 relative to differential contact surface 63. Lead screw motor 72 causes rotation of lead screw 70 in a first direction to move threaded coupler 76 in a first direction to increase the resistance experienced by the user. Lead screw motor also causes rotation of lead screw 70 in the opposite direction to decrease the resistance experienced by the user. The position of threaded coupler 76 relative differential resistance arm 61 changes the mechanical advantage or disadvantage provided by differential resistance arm 61. When threaded coupler 76 is positioned closer to the free end of differential resistance arm 61 there is less mechanical advantage and thus a greater amount of resistance experienced by the user than when threaded coupler 76 is positioned closer to the pivoting end of differential resistance arm 61.

[0053] A lead screw pivot 73 is also shown. Lead screw pivot 73 allows the free end of lead screw 70 to pivot relative to the pivot point. Lead screw pivot 73 facilitates the continued contact between threaded coupler 76 and differential contact surface 63. The curved configuration of differential contact surface and the movement of the free end of lead screw 70 maintain contact between threaded coupler and differential contact surface even though link arm 74 has a fixed length.

[0054] Compression spring 78 is coupled to a compression spring securement frame member 80. Compression spring securement frame member 80 provides solid and reliable securement for mounting compression spring 78. Compression spring securement frame member 80 includes a guide slot 82. Guide slot 82 maintains a smooth and linear compression of compression spring 78. Linear compression of compression spring 78 ensures smooth and reliable operation of compression spring 78 during the life of exercise device 10.

[0055] Compression spring 78 includes a spring portion 84 and a compression arm 86. In the illustrated embodiment, spring portion 84 fixed and is positioned above compression arm 86 which is movable relative to spring portion 84. Compression arm 86 is compressed inside of spring portion 84 during operation. Compression arm 86 is secured to compression spring securement frame member 80 at slidable coupling 88. Spring portion 84 is secured to compression spring securement frame member 80 at fixed coupling 90. Slidable coupling 88 corresponds with guide slot 82. As a result, when the free end of differential resistance arm 61 rotates, force is exerted on link arm 74. Forces exerted on link arm 74 are related to compression spring 78 resulting in movement of compression arm 86 relative to spring portion 84. As the slidable coupling 88 begins to move, guide slot 82 ensures that movement of compression arm 86 in a substantially smooth and linear manner.

[0056] As will be appreciated by those skilled in the art, a variety of types and configurations of compression springs and resistance mechanisms can be utilized without departing from the scope and spirit of the present invention. For example, the spring portion can be positioned at the lower end of the compression spring and the compression arm can be positioned above the spring portion. In another embodiment, one or both of the couplings associated with the spring portion and the compression arm are pivotal. In another embodiment, the spring portion moves while the compression arm remains fixed.

[0057] In the illustrated embodiment, a repetition counter 92 is provided in connection with resistance assembly 12. Repetition counter 92 senses and provides an indication of the number repetitions that have been conducted by a user. Repetition counter 92 allows the user interface 17 (see FIG. 1) to indicate to the user the number of sets and repetitions that have been conducted as part of an exercise routine. Repetition counter 92 includes a spring and ribbon type
assembly which provides an indication of directional change which is configured to both identify smaller stroke length type repetitions and longer stroke length type repetitions. A complete description of repetition counter of the illustrated embodiment is disclosed in U.S. patent application No. 10/916,687 filed on Aug. 11, 2004 and entitled “Repetition Sensor in Exercise Equipment”, the entire description of which is incorporated herein by reference.

[0058] FIG. 3 is a perspective view of resistance assembly 12 according to one embodiment of the present invention. In the illustrated embodiment, the positioning of compression spring 78 relative to compression spring securement frame member 80 is more clearly illustrated. As previously discussed, compression spring 78 is secured to compression spring securement frame member 80 at fixed coupling 90 and slidable coupling 88. At fixed coupling 90, compression spring 78 is directly secured to compression spring securement frame member 80 utilizing a known securement apparatus. At slidable coupling 88, compression spring 78 is indirectly secured to compression spring securement 80 by being coupled to guide 100. Guide 100 is positioned primarily inside the channel created by the configuration of compression spring securement frame member 80. A hook extension is shown protruding axially from slot 99. The extension portion of guide 100 protruding from slot 99 is configured to engage an ancillary compression springs 93a-b depicted in FIG. 2. A securement flange 95 is positioned toward the top of compression spring securement frame member 80. Securement flange 95 is configured to accommodate a pin configured to secure ancillary compression springs 93a-b as depicted in FIG. 2.

[0059] FIG. 3 also illustrates transition pulleys 68a, b, c, d. Transition pulleys 68a, b, c, d are configured to facilitate the transition of the cable from exercise device 10 to the resistance assembly 12. In the illustrated embodiment, a single cable (primary cable 30a depicted in FIG. 1) is threaded from a right side of the exercise apparatus through the resistance assembly 12 to a left side of the exercise apparatus. By utilizing a single cable, the mechanical and stroke length benefits provided by the juxtaposition of pulleys 64a-n and 66a-n are realized on both the right and left sides of the exercise device.

[0060] In one embodiment, pulleys 68a-d allow the cable to be threaded through the resistance assembly 12 to other portions of the exercise device 10 so as to be grasped by the user. Pulley 68a is positioned on a support member toward the top of resistance assembly 12. Pulley 68b-c are positioned on a brace member 94 on the side of resistance assembly 12. Pulleys 68b-c are positioned at an angle facilitating the smooth transition to the left and right sides of the exercise device. Pulley 68d is positioned on the bottom of the resistance assembly 62. The cable is threaded from pulley 68a to pulleys 68a-n. As previously discussed, the cable is then threaded between pulleys 68a-n and 64a-n providing a compound pulley effect. From the last of pulleys 64a-n the cable is again threaded back to the last of pulleys 66a-n. From pulleys 66a-n the cable is then threaded to pulley 68d. From pulley 68d the cable extends to pulley 68c. From pulley 68c the cable is threaded to the left side of the exercise apparatus. The combination and juxtaposition of pulleys 64a-n, 66a-n, and 68a-d conveys resistance from resistance assembly 12 to the user in an effective and reliable manner.

[0061] FIG. 4 is a cutaway side view of resistance assembly 12 according to one embodiment of the present invention. In the illustrated embodiment, the threaded coupler 76 is positioned at mid-point on lead screw 70. The angle of lead screw 70 is affected by the position of threaded coupler 76 along the length of lead screw 70. Additionally, the angle of link arm 74 is affected by the position of threaded coupler 76 along the length of lead screw 70.

[0062] Link arm 74 is linked to a guide 100 at coupling 104. Guide 100 provides connection between link arm 74 and compression spring 78. In other words, guide 100 conveys resistance provided from compression spring 78 to link arm 74 and thus to differential resistance arm 61. Guide 100 includes upper guide wheel 102a and lower guide wheel 102b. Upper and lower guide wheels 102a-b are positioned integral to the channel created by the configuration of compression spring securement frame member 80. Upper and lower guide wheels 102a-b roll relative to compression spring securement frame member 80 providing smooth and reliable movement of guide 100. Because guide 100 is coupled to link arm 74 and compression spring 78, upper and guide wheels 102a-b also facilitate the smooth and reliable movement of link arm 74 and compression of compression spring 78. As previously discussed, at the lower end of guide 100 a hook member of guide 100 extends outward from compression spring securement frame member 80 so as to be optionally connected to ancillary compression springs 93a-b shown in FIG. 2.

[0063] FIG. 5A is a side view of resistance assembly 12 depicting differential resistance arm 61 in a relaxed position according to one embodiment of the present invention. In the illustrated embodiment, threaded coupler 76 is positioned at the mid-point on lead screw 70. As previously discussed, the position of threaded coupler 76 along the length of lead screw 70 affects the angle of link arm 74 and the amount of resistance experienced by the user during exercise. The system can increase or decrease the amount of resistance experienced by the user during exercise by rotating lead screw to change the position of threaded coupler 76 along the length of lead screw 70. When in the relaxed position, differential resistance arm 61 is positioned such that the free end of differential resistance arm 61 is positioned at its displacement closest to the bottom of resistance assembly frame 62. When differential resistance arm 61 is in a relaxed position, slidable coupling 88 and the bottom end compression spring 78 are positioned at the bottom of guide slot 82. Compression spring 78 is fully extended as no compressive forces are being exerted on compression spring 78.

[0064] In the illustrated embodiment, contact sensors 96a-b are depicted. Contact sensors 96a-b sense when threaded coupler 76 is at either the minimum or maximum resistance positions. When thread coupler contacts sensor 96a, the system is notified that threaded coupler 76 is at the minimum resistance position and that no further rotation of lead screw 70 toward the minimum resistance position is needed. When threaded coupler contacts sensor 96a, the system is notified that threaded coupler is at the maximum resistance position and no additional rotation of lead screw 70 in the maximum resistance direction is needed. In the illustrated embodiment, there is also shown a resistant member arm pivot 98.

[0065] FIG. 5B is a side view of resistance assembly 12 illustrating differential resistance arm 61 in an actuated
position. In the illustrated embodiment, differential resistance arm 61 is being pivoted about resistance arm pivot 98. Pivoting of differential resistance arm 61 about resistance arm pivot 98 results when a user exerts forces on the end of the primary cable. As the user exerts forces on the end of the primary cable, pulleys 64a-n are drawn in the direction of pulleys 66a-n. As pulleys 64a-n are drawn toward pulleys 66a-n, contact between differential contact surface 63 and threaded coupler 76 pushes link arm 74 in an upward direction.

[0066] As depicted in FIG. 4, the upper end of link arm 74 is connected to guide 100. As a result, as link arm 74 moves in an upward direction, guide 100 is also pushed in an upward direction. Because compression spring 78 is coupled to guide 100 at slidable coupling 88, movement of guide 100 results in movement of slidable coupling 88 in an upward direction. Movement of slidable coupling 88 forces compression arm inside spring portion 84. Movement of compression arm 86 into spring portion 84 provides the resistance that is utilized by the user during exercise.

[0067] In the illustrated embodiment, the positioning of the threaded coupler 76 along the length of lead screw 70 also dictates the amount of displacement of slidable coupling 88 during actuation of differential resistance arm 61. For example, where the threaded coupler 76 is positioned at midpoint along the lead screw, the slidable coupling 88 is not fully compressed when the differential resistance arm 61 is fully actuated. Subsequent to full actuation of differential resistance arm 61, when a user begins to relax the tension on the primary cable, the pressure in compression spring 78 begins to push the compression arm 86 out of spring portion 84. As compression arm 86 begins to push out of spring portion 84, slidable coupling 88 begins to be pushed in a downward direction. As slidable coupling 88 moves in a downward direction guide 100 is also moved in a downward direction. This allows link arm 74 and differential resistance arm to move downward to the relaxed position depicted in FIG. 5A.

[0068] FIG. 6A is a side view of resistance assembly 12 depicting differential resistance arm 61 in a relaxed state. In the illustrated embodiment, threaded coupler 76 is positioned at a minimum resistance position adjacent contact sensor 96a. In other words, when threaded coupler 76 is positioned adjacent resistance arm pivot member 98, differential resistance arm 61 provides a maximum amount of mechanical advantage. As a result, a minimum amount of tension on the cable is sufficient to cause compression of compression spring 78.

[0069] As can be seen in the illustrated embodiment, when threaded coupler 76 is positioned at its displacement closest to resistance member arm pivot 98, link arm 74 is positioned in a substantially vertical orientation. Due to the positioning of link arm 74 relative to compression spring securement member 80, much of link arm 74 is obscured by compression spring securement member 80. It can also be seen that when threaded coupler 76 is positioned at a displacement closest to resistance member arm pivot 98, lead screw 70 is pivoted about lead screw motor pivot 73 such that most or all of lead screw 70 is exposed above the profile of differential contact surface 63. As previously discussed, the curvilinear nature of differential contact surface 63 is configured to maintain contact between threaded coupler 76 and differential contact surface 63 notwithstanding the position of threaded coupler 76 along the length of lead screw 70.

[0070] FIG. 6B illustrates differential resistance arm 61 in an actuated configuration. In the illustrated embodiment, threaded coupler 76 is positioned at a displacement closest to resistance member arm pivot 98 as shown in FIG. 6A. When differential resistance arm 61 is actuated while threaded coupler 76 is at its displacement closest to the resistance member arm pivot 98, a large amount of displacement of differential resistance arm 61 results in a relatively small amount of depression of slidable coupling 88 and thus compression arm 86. The small amount of displacement is in large part due to the fact that when the free end of differential resistance arm 61 moves a large amount, the portion of differential resistance arm 61 adjacent resistance member pivot moves a relatively small distance. As a result of the relatively small amount of movement of threaded coupler 76 and thus link arm 74, guide 100 and slidable coupling 88 also move a relatively small amount. In other words, for every increment of movement of the cable, a very small amount of compression of compression spring 78 results. In one embodiment, a return spring is connected to either guide 100 or differential resistance arm 61 to facilitate return of differential resistance arm 61 to the relaxed position. The return spring can be helpful when the large amount of mechanical advantage resulting from the position of threaded coupler 76 is insufficient to facilitate the return the differential resistance arm 61 to the relaxed position.

[0071] FIG. 7A is a side view of resistance assembly 12 illustrating differential resistance arm 61 in which threaded coupler 76 is positioned at maximum resistance position at a displacement closest to the free end of differential resistance arm 61. In the illustrated embodiment, threaded coupler 76 has contact sensor 96a. Contact sensor 96a indicates that threaded coupler is at the maximum resistance position and that rotation of lead screw 70 should be stopped in the direction of increasing resistance. In the illustrated embodiment, the maximum resistance position of threaded coupler 76 positions link arm 74 at a fairly sharp angle relative to compression spring 78. Additionally the position of threaded coupler 76 along the length of differential resistance arm 61 results in little or no mechanical advantage in compressing compression spring 78.

[0072] The positioning of threaded coupler 76 results in a relatively sharp angle of lead screw 70 relative to differential contact surface 63. As a result, approximately half of lead screw 70 is obscured below the profile of differential contact surface 63. As a user begins to exert a force on the free end of differential resistance arm 61 to draw resistance arm pulleys 64a-n towards frame pulleys 66a-n, the angle of link arm 74 and the position of threaded coupler 76 along the length of differential resistance arm both increase the degree of resistance experienced by the user while exerting a force on the cable. In one embodiment, the amount of resistance experienced by the user when threaded coupler 76 is positioned in the maximum resistance position is approximately 220 pounds. When the threaded coupler is positioned in a minimum resistance position as depicted in FIG. 5A the amount of resistance experienced during exercise is 10 pounds or less.

[0073] FIG. 7B is a side view of resistance assembly 12 depicting differential resistance arm 61 when threaded cou-
pler 76 is positioned at the maximum resistance position as shown in FIG. 7A. In the illustrated embodiment, resistance arm pulleys 64a-n have been drawn adjacent frame pulleys 66a-n. Because threaded coupler 76 is positioned at its displacement furthest from resistance member arm pivot 98, actuation of differential resistance arm 61 results in a relatively large amount of displacement of link arm 74. The relatively large amount of displacement of link arm 74 results in a large amount of displacement of both guide 100 and slideable coupling 88. As a result compression arm 86 is drawn nearly entirely inside of spring portion 84.

Threaded coupler 76 is in contact with differential resistance arm 61 at a displacement furthest from resistance member arm pivot 98. As a result relatively little mechanical advantage has been provided by differential resistance arm 61. The relatively small amount of mechanical advantage provided by differential resistance arm 61 and the angle of link arm 74 relative to guide 100 and compression spring 78 results in a large amount of resistance being experienced by the user. As previously discussed, to move threaded coupler 76 from the minimum resistance position to the maximum resistance position, the lead screw motor 78 is actuated to rotate lead screw 70. The threaded interaction between lead screw 70 and threaded coupler 76 results in movement of the position of threaded coupler as lead screw 70 is rotated. To increase or decrease the amount of resistance during exercise, the user utilizes user interface 17 depicted in FIG. 1 to select an increase or decrease in the amount of resistance. The user interface provided in connection with exercise device 10 can include a variety of different types of functionality including preprogrammed exercise routines.

As will be appreciated by those skilled in the art, a variety of types and configurations of resistance assemblies can be utilized without departing from the scope and spirit of the present invention. For example, in one embodiment the positioning of the differential resistance arm and the compressions springs is varied from that which is depicted. In another embodiment, the link arm and the compression spring are pivotal to allow for proper operation of the differential resistance arm. In another embodiment, the compression spring interacts directly with the differential resistance arm to provide resistance for use in exercise.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. An exercise apparatus configured to provide resistance to allow a user to undertake aerobic and anaerobic exercise in a home or commercial gym setting, the exercise apparatus comprising:

   a frame providing support to the exercise apparatus;

   a resistance assembly operably linked to the frame, the resistance assembly comprising:

   a resistance member providing resistance for use in exercise;

   a lever arm utilizing resistance from the resistance member to provide variable amounts of resistance for use in exercise; and

   a connecting mechanism allowing the user to utilize resistance from the resistance assembly for use during exercise.

2. The exercise apparatus of claim 1, wherein the resistance member comprises a compression spring.

3. The exercise apparatus of claim 1, wherein the resistance member comprises a gas shock.

4. The exercise apparatus of claim 1, wherein the resistance member comprises a mechanism configured to provide resistance for use during exercise.

5. The exercise apparatus of claim 1, wherein the lever arm includes a differential contact surface.

6. The exercise apparatus of claim 1, wherein the connecting mechanism comprises a cable and pulley system.

7. An exercise apparatus configured to provide resistance to allow a user to undertake aerobic and anaerobic exercise in a home or commercial gym setting, the exercise apparatus comprising:

   a frame providing support to the exercise apparatus;

   a resistance assembly operably linked to the frame such that the resistance assembly is positioned perpendicular to the frame; the resistance assembly comprising:

   a differential resistance arm for regulating the amount of resistance provided by the resistance member;

   a resistance member providing an amount of resistance for use in exercise; and

   a cable and pulley system allowing the user to utilize resistance from the resistance assembly for use during exercise.

8. The exercise apparatus of claim 7, wherein the resistance member is linked to the differential resistance arm utilizing a link arm.

9. The exercise apparatus of claim 7, wherein resistance member comprises a compression spring.

10. The exercise apparatus of claim 9, wherein the compression spring is compressed in a linear motion.

11. The exercise apparatus of claim 7, further comprising a guide and guide slot to facilitate linear movement of the resistance member during exercise.

12. The exercise apparatus of claim 7, further comprising a lead screw for use with the differential resistance arm to control the amount of resistance provide to the user.

13. The exercise apparatus of claim 7, further comprising a user interface for controlling the amount of resistance provided to the user during exercise.

14. The exercise apparatus of claim 13, wherein the user interface includes one or more preprogrammed exercise routines that can be selected by a user.

15. An exercise apparatus configured to provide resistance to allow a user to undertake aerobic and anaerobic exercise in a home or commercial gym setting, the exercise apparatus comprising:

   a frame providing support to the exercise apparatus;

   a resistance assembly operably linked to the frame such that the resistance assembly is positioned perpendicular to the frame; the resistance assembly comprising:
a differential resistance arm having a differential contact surface for regulating the amount of resistance provided by the resistance member;
a compression spring providing an amount of resistance for use in exercise;
a linkage arm positioned between the compression spring and the differential resistance arm wherein the differential resistance arm, the resistance member, and the linkage arm allow linear movement of the resistance member during exercise; and
a connecting mechanism comprising a cable and pulley system allowing the user to utilize resistance from the resistance assembly during exercise.

16. The exercise apparatus of claim 15, further comprising a user interface for automatically controlling the amount of resistance provided by the resistance assembly.

17. The exercise apparatus of claim 16, further comprising a repetition sensor for detecting the number of repetitions conducted during exercise.

18. The exercise apparatus of claim 15, wherein the compression spring is secured such that compression of the spring is substantially linear in nature.

19. The exercise apparatus of claim 18, further comprising a lead screw for use with the differential resistance arm.

20. The exercise apparatus of claim 19, further comprising a threaded coupler adapted to secure the linkage arm to the lead screw, wherein the position of the threaded coupler along the length of the lead screw determines the amount of resistance experienced by the user during exercise.