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(54) Supplemental resistance assembly for resisting motion of an exercise device

(57) An exercise apparatus for a user. The exercise apparatus includes a frame, a crank system coupled to the frame, a pivotal linkage pendulum system, a foot member and first and second directional resistance systems. The crank system includes one or more crank members. The pivotal linkage pendulum system comprises at least a first link member. The first link member is coupled to the crank system through at least a first pivot point. The first pivot point of the first link member is configured to move in a path during use. The foot member is coupled to the at least one first link member. The first and second directional resistance systems are each coupled to the crank system. The first direction is different from the second direction.

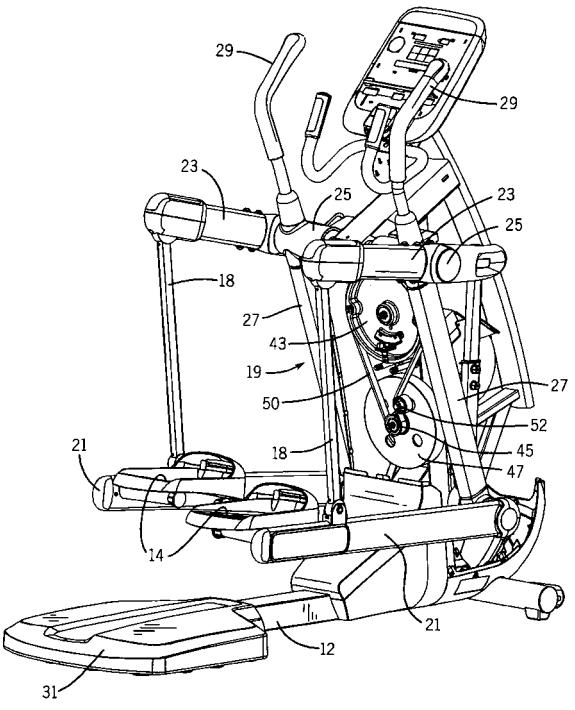

FIG. 4

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Description

RELATED APPLICATIONS

[0001] This application is related to U.S. Patent Application No. ____ titled "End of Travel Stops for An Exercise Device" filed concurrently herewith and assigned to the same assignee as the present application.

FIELD OF THE INVENTION

[0002] The present invention relates to exercise equipment.

BACKGROUND OF THE INVENTION

[0003] The benefits of regular aerobic exercise have been well established and accepted. However, due to time constraints, inclement weather, and other reasons, many people are prevented from aerobic activities such as walking, jogging, running, and swimming. As a result, a variety of exercise equipment has been developed for aerobic activity.

[0004] From their humble beginnings as free weights and bicycles mounted on wooden platforms, exercise equipment such as stationary bicycles, treadmills, elliptical fitness trainers, stair climbers, and the like have grown increasingly sophisticated. However, the very advantage of the exercise equipment referenced above - the ability to use such equipment conveniently, in a relatively confined space, and in inclement weather - results in exercise devices that can be relatively monotonous to use. It is well known that the more stimulating and enjoyable the experience of exercising is to a user, the longer and more frequently that user will exercise. Unfortunately, many users find spending long hours doing repetitive forms of stationary exercise hard work and boring, sometimes so much so that the exercise equipment is abandoned in favor of more entertaining activity.

[0005] One type of exercise machine addresses the repetition of movement of the user by enabling the user to exercise without requiring a predetermined motion thereby gaining the desirable result of increasing mobility and freedom of movement, while minimizing boredom. Examples of such user defined motion fitness equipment can include pendulum motion-type exercise apparatus. Such user defined motion fitness equipment allow the user to control the foot path rather than the machine guiding the foot such as current elliptical machines, stepping machines and stationary cycles. One benefit user defined motion fitness equipment is that the user is able to control the stride length and overall foot motion to fit their needs, such as to replicate running, walking, or stepping. Another benefit is that the user can change between such motions whenever desired using a single exercise device.

[0006] However, existing user defined motion fitness equipment, such as pendulum motion-type exercise apparatus, have drawbacks. Existing user defined motion fitness equipment typically include only a single resistance system that is configured to inhibit or resist motion of the exercise device foot pads in a single direction, typically a generally vertical direction. The freedom of motion in the fore and aft direction that provides the horizontal motion of the foot of the user is typically un-resisted.

[0007] It has been found that having un-resisted free travel in the fore and aft directions of such user defined motion fitness equipment provides too much freedom for a user. The result of this excessive freedom is a foot path that can be unpredictable as well as often uncontrollable by the user. For example, a user could be attempting to execute a climbing or stepping motion only to have the foot path change involuntarily to a backward kidney bean shaped motion. Such unintended motion can frustrate the user, and even increase the risk of injury.

[0008] Accordingly, a continuing need exists for an exercise device that provides a user with a variety of smooth natural available exercise paths or foot motions, exercises a relatively large number of muscles through a large range of motion, and provides such foot motions in a safe and stable manner. There is also a need for an exercise device that enables the user to exercise muscles in a smooth natural manner over a large range of motion, without applying undesirable impact loads to the user's joints. It would be desirable for such an exercise device to be configured for convenient use in a relatively confined space even in inclement weather. Further, a continuing need also exists for an exercise device that provides a variety of user defined unique engaging motions and is fun to use. It would be desirable for such an exercise device to provide available resistance in more than one general direction, such as resisted free travel in the fore and aft directions, without detracting from the unique engaging motion.

SUMMARY OF THE INVENTION

[0009] The present invention provides an exercise apparatus for a user. The exercise apparatus includes a frame, a crank system coupled to the frame, a pivotal linkage pendulum system, a foot member and first and second directional resistance systems. The crank system includes one or more crank members. The pivotal linkage pendulum system comprises at least a first link member. The first link member is coupled to the crank system through at least a first pivot point. The first pivot point of the first link member is configured to move in a path during use. The foot member is coupled to the at least one first link member. The first and second directional resistance systems are each coupled to the crank system. The first direction is different from the second direction.

[0010] According to a principal aspect of a preferred form of the invention, a resistance system for an exercise apparatus that has both a horizontal and a vertical motion component. The resistance system includes a foot member, a vertical resistance system and a horizontal resist-

ance system. The vertical and horizontal resistance systems are each coupled to the foot member. The horizontal resistance system provides resistance to the foot member that varies from 0.5 pounds of force at zero generally horizontal velocity to a maximum resistance at full generally horizontal velocity.

[0011] According to a principal aspect of a preferred form of the invention, a resistance system for an exercise apparatus that has both a horizontal and a vertical motion component. The resistance system includes a foot member, a variable vertical resistance system and a variable horizontal resistance system. The vertical and horizontal resistance systems are each coupled to the foot member. The horizontal resistance system provides a resistance within the range of about 0.5 pounds to about 15.0 pounds in the fore and aft direction.

[0012] According to a principal aspect of a preferred form of the invention, a resistance system for an exercise apparatus that has both a horizontal and a vertical motion component. The resistance system includes a foot member, a vertical resistance system and a horizontal resistance system. The vertical and horizontal resistance systems are each coupled to the foot member. The horizontal resistance system provides constant resistance within the range of about 0.5 pounds to about 15.0 pounds.

[0013] An exercise device in accordance with the principles of the present invention provides for smooth natural action, exercises a relatively large number of muscles through a large range of motion, and provides for safety and stability. An exercise device in accordance with the principles of the present invention enables the user to exercise muscles in a smooth natural manner over a large range of motion, without applying undesirable impact loads to the user's joints. An exercise device in accordance with the principles of the present invention is configured for convenient use in a relatively confined space even in inclement weather. An exercise device in accordance with the principles of the present invention provides a unique engaging motion and is fun to use. An exercise device in accordance with the principles of the present invention provides resisted free travel in the fore and aft directions of user defined motion fitness equipment without detracting from the unique engaging motion.

[0014] This invention will become more fully understood from the following detailed description, taken in conjunction with the accompanying drawings described herein below, and wherein like reference numerals refer to like parts.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Figure 1 is a front perspective view of an exercise device in accordance with the principles of the present invention.

[0016] Figure 2 is a front perspective view of the exercise device of FIG. 1 with a shroud removed.

[0017] Figure 3 is a detailed front perspective view of a portion of the exercise device of FIG. 1.

[0018] Figure 4 is a rear perspective view of the exercise device of FIG. 2.

[0019] Figure 5 is a graph of the non-linear profile of the stop point of the exercise device of FIG. 1.

[0020] Figure 6 is a detailed rear elevated view of a portion of the exercise device of FIG. 1.

[0021] Figure 7 is a detailed rear perspective view of another portion of the exercise device of FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

[0022] While an exemplary embodiment of the invention has been illustrated and described, it will be appreciated that various changes can be made therein without departing from the spirit and scope of the invention.

[0023] FIGS. 1-7 illustrates an example embodiment of an exercise or fitness device suitable for use with the present invention. While the example embodiment described herein is a pendulum motion-type exercise device, the principles of the present invention apply to other fitness devices, particularly those in which the user is relatively mobile.

[0024] Referring to FIG. 1, a perspective view of an embodiment of a pendulum motion-type exercise device 10 is seen. A frame 12 is provided that can include a basic supporting framework. The frame 12 can be any structure that provides support for one or more components of the exercise device 10. A pair of footpads 14 is provided on which the user stands. In one embodiment, a rear support base or platform 31 can be provided connected to the frame 12 that provides further support to the exercise device 10 and acts as a step-up to the footpads 14.

[0025] Left and right pivoting linkage pendulum systems 15 are provided. The discussion below will focus on the right pivoting linkage pendulum system 15. However, the description is applicable to the left pivoting linkage pendulum system 15 as well. In one embodiment, the linkage pendulum system 15 includes a lower and upper generally horizontal links 21 and 23, a rear link member 18, a forward generally vertical link 27, and a pivot shaft 25 (or a spindle). Although the lower and upper generally horizontal links 21 and 23, and the forward generally vertical link 27 incorporate the terms horizontal and vertical, these terms are intended to refer to the general orientation of these links at an at rest position and their position may vary by as much as 25 degrees from horizontal or vertical. The lower and upper horizontal links 21 and 23, and the forward vertical link 27 will not always lie in a horizontal plane or a vertical plane, respectively. Rather, their positions will remain at or near the respective horizontal or vertical planes during use or while in a rest position.

[0026] The footpad 14 is coupled to a rear portion of the lower horizontal link 21. The lower horizontal link 21 serves as a footlink linking the footpad 14 to the remaining portions of the pendulum system 15. The lower horizontal

link 21 swings or oscillates, but remains generally at or near horizontal, during use. The horizontal link 21 is coupled near its rear end to a lower end of the rear link member 18 and is pivotally coupled at its forward end to the lower end of the forward vertical link 27. The rear link member 18 upwardly extends from its pivotal coupling with the lower horizontal link 21 in a generally vertical direction. The coupling of the rear link member 18 and the lower horizontal link 21 can occur adjacent a forward portion of the footpad 14. The upper end of the rear link member 18 is pivotally coupled to a rear portion of the upper horizontal link 23. The upper horizontal link 23 extends generally horizontally and maintains a position that is generally parallel with the lower horizontal link 21 during use. A central region of the upper horizontal member 23 is pivotally coupled to the pivot shaft 25, and a forward end of the upper horizontal member 23 is pivotally coupled to an upper end of a vertical resistance link 30. The pivot shaft 25 is directly coupled to the frame 12. The pivotal coupling of the central region of the upper horizontal member 23 to the pivot shaft 25 enables the rear portion of the upper horizontal member 23 (a cantilevered end region of the upper horizontal member 23) to be raised upward or downward during use thereby allowing for more pronounced available vertical motion to the exercise device 10 during use. The forward vertical link 27 extends upward, generally vertically, from its coupling at its lower end to the forward end of the lower horizontal link 21. The forward vertical link 27 is pivotally coupled to the frame 12 at the pivot shaft 25. The forward vertical link 27 and the upper horizontal link 23 are configured to independently pivot about the pivot shaft 25. Thus, the rear link member 18, the lower and upper horizontal links 21 and 23, the forward vertical link 27, and the pivot shaft 25 comprise the pivotal linkage pendulum system 15.

[0027] Additionally, the resistance systems of the present Application are referred to in terms of vertical and horizontal resistance systems. The terms vertical and horizontal, in context of the resistance systems, are used in association with an embodiment of the invention, and the invention is not limited to resistance systems that are directed to vertical and horizontal movements only. Rather, the present Application relates to first and second resistance systems, or primary and supplemental resistance systems. The orientation or application of the first and second resistance systems is not limited to vertical and horizontal application only. The present invention involves the application of a second or supplemental resistance system to improve the operation of an exercise device and is not limited to a specific orientation for the second or supplemental resistance application.

[0028] A swing arm 29 can be provided by extending the forward vertical link 27 above the pivot shaft 25 a predetermined amount. The length and configuration of the swing arm 29 can be varied to match a desired motion and/or feel during use. An aesthetic shroud 33 can partially cover the exercise device 10.

[0029] In use, the pivotal linkage pendulum system 15 and the remaining components of the exercise device, enable the user to increase or decrease the stride length or stride of the exercise device as desired. As the user increases his or her stride length or tries to increase his or her cadence, the potential for the foot of the user to disengage, slide or slip from, the footpad 14 increases. Thus, in one embodiment the footpads 14 can be provided with a foot securement member. The foot securement member can be a toe clip 16, a strap or other foot coupling apparatus. Toe clips will be discussed in more detail; however, the discussion is also applicable to other forms of foot securement members. The toe clips 16 can be fixedly or removably connected to the foot pads 14. In another embodiment, the toe clip 16 can be integrally formed with the foot pad 14. The toe clips 16 enable a user to easily and removably secure his or her foot on the footpad 14 while inhibiting forward movement or forward slippage of the user's foot during use. Accordingly, the toe clips 16 not only properly secure the user's feet with the exercise device 10, but the toe clips 16 also enable the user to readily impart a forward force onto the footpad 14 with the toe clip 16. In some configurations, the toe clips 14 can also enable the user to readily impart an upward force onto the toe clip 16 and foot pad 14 assembly. The user therefore can drive his or her foot forward and even upward without experiencing foot slippage. Additionally, by enabling the user to utilize these additional movements, additional large muscle group involvement as well as the smaller stabilizer muscle groups are engaged throughout the exercise resulting in higher aerobic training effect. A still further benefit of the use of the toe clips is that more muscles can be exercised throughout the full range of motion rather than just during flexion or just during extension.

[0030] FIG. 2 shows the pendulum motion-type exercise device 10 with the shroud 33 removed. The upper end of the vertical resistance link 30 is pivotally coupled to and extends generally vertically and downward from the forward end of the upper horizontal link 23. At an end opposite the upper horizontal link 23, the vertical resistance link 30 is connected to a generally vertical resistance system 17.

[0031] The vertical resistance system 17 can comprise a crank member 32 having a first end that is pivotally coupled to a lower end of the vertical resistance link 30. A second end of the crank member 32 is coupled to a shaft 35. During use, the back and forth motion of the lower horizontal link 21, the rear link member 18, and the forward vertical link 27 typically includes at least some vertical component that causes the upper horizontal link 23 to pivot about its pivotal coupling to the pivot shaft 25. This pivotal movement causes the forward end of the upper horizontal link 23 to oscillate upward and downward. Further, when the user imparts a downward force onto the foot pad 14, or an upward force onto the toe clip 16, these forces also cause the upper horizontal member 23 to pivot or oscillate about its pivotal coupling to the pivot shaft 25. This pivotal motion also contributes to the

upward and downward oscillating motion of the forward end of the upper horizontal member 23. The shaft 35 and the pivot shaft 25 each connect the left and right pivoting linkage pendulum systems 15, and the shaft 35 connects the left and right crank members 32 causes the left and right upper horizontal links 23 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). The crank member 32 is connected to a pulley system 34, which includes an electronically controlled generator mounted to the frame 12. The pulley system 34 can be preferably operatively connected to a step-up pulley, a flywheel, and a generator system for applying a braking or retarding force, as known in the art. Alternatively, braking or retarding forces can be applied using other mechanisms, such as for example an eddy current system, an alternator, friction brakes, fluid resistance, etc. Thus, a vertical resistance is applied to the upper horizontal link 23 by means of the crank member 32 and the vertical resistance system 17.

[0032] The back and forth (fore and aft) path of motion of the exercise device 10 also has a horizontal component, which has not been addressed in the prior art. Thus, an advantage of the exercise device of the present invention is that it provides for horizontal resistance (a second or supplemental resistance). In particular, the present invention provides a horizontal resistance system 19 (a second or supplemental resistance system). Referring to FIG. 3, a close-up of the pivot shaft 25, the upper horizontal link 23, and the vertical resistance link 30 of the exercise device 10 is seen. A supplemental resistance link 41 is provided pivotally coupled to the pivot shaft 25 by a rocker link 60 which outwardly extends from the pivot shaft 25. The rocker link 60 pivots in coordination with the pivoting movement of the forward vertical link 27 about the pivot shaft 25. At an end of the supplemental resistance link 41 opposite the pivot shaft 25, the supplemental resistance link 41 is connected to the horizontal resistance system 19.

[0033] The horizontal resistance system 19 can comprise a horizontal resistance pulley 43. The horizontal resistance pulley 43 is pivotally coupled to the supplemental resistance link 41 opposite the pivot shaft 25. The supplemental resistance link 41 is pivotally connected to the horizontal resistance pulley 43 near the outer periphery of the horizontal resistance pulley 43; thus the horizontal resistance pulley 43 acts as a crank member pivotally connecting the supplemental resistance link 41 and the horizontal resistance system 19.

[0034] Referring to FIGS. 4 and 6, the horizontal resistance pulley 43 also acts to provided resistance to the horizontal resistance system. The horizontal resistance pulley 43 is connected to a step-up pulley 45 and a flywheel 47 via a belt 50. Tension on the belt 50 can be maintained via an idler gear 52. In one embodiment, the flywheel 47 can be a rotating metallic flywheel and resistance can be provided by an eddy current brake 49 (seen in FIGS. 6 and 7). The horizontal resistance pulley 43 does not fully rotate; instead, the horizontal resistance pulley 43 rotates through an arch which is determined by the length of the stride of the user. Thus, if the user takes a short stride length, the total rotation of the arch of the horizontal resistance pulley 43 is relatively minimal; if the user takes a long stride length, the total rotation of the arch is relatively significant. By subjecting the rotating horizontal resistance pulley 43 to a means of resistance, the user is subjected to horizontal resistance in the fore and aft motions. In addition, the right and left footpads 14 are synchronized about 180 degrees out of phase by the horizontal resistance pulley 43, the supplemental resistance links 41 and the pivot shaft 25. This synchronization results allow for foot motion that simulates climbing, walking, jogging or running to be achieved. In an alternative embodiment, the right and left footpads 14 can be synchronized by a rocker link or other forms of couplings. In other embodiments, the right and left footpads and the right and left linkage pendulum systems can operate independent of each other or in a non-synchronous manner. In an alternative embodiment, a linear type resistance system can be used in place of the horizontal resistance pulley and related components. The link between the left and right footpads and the left and right linkage pendulum systems can also be accomplished with compliance between the left and right providing a loose or flexible coupling between left and right motions. Also, the movement of the left and right linkage pendulum systems can be configured in a phased operating arrangement.

[0035] The horizontal resistance system 19 of the present invention preferably provides adequate resistance to assist in stable foot motion, but not so much resistance as to make the fore and aft motion unnatural. Excessive resistance in the fore and/or aft directions can cause the foot path to distort in a vertical direction creating an unnatural foot path. In other instances, increased resistance in a fore and/or aft direction can make operation of the exercise device unsustainable for some users. In one embodiment, the level of resistance at the foot pad or the foot of the user in the fore and aft direction is within the range of about 0.5 pounds of force to about 15 pounds of force. The level of resistance can be variable within this range or constant value within this range. The variable resistance can be user adjustable, programmed, time-dependent, or vary based upon other parameters. In another alternative embodiment, the level of resistance at the foot pad or the foot of the user in the fore and aft direction is within the range of about 2.0 pounds of force to about 10.0 pounds of force. The variable resistance can be configured to vary based upon the velocity of the fore and aft motion of the foot pads or the linkage pendulum systems, or the variable resistance can vary based upon user selection, user programs or time or other parameters. The variation in resistance can be obtained by effectively starting and stopping the rotating metallic flywheel 47 of the eddy current brake 49 for fore to aft or aft to fore motions. The metal flywheel

47 is exposed to a magnetic field produced by permanent or electromagnets, generating eddy currents in the wheels. The magnetic interaction between the applied field and the eddy currents acts to slow the metal flywheel 47. The faster the metal flywheel 47 spins, the stronger the effect, meaning the effective horizontal resistance changes for zero force (at zero rotational velocity) to a maximum force at full rotational velocity. A variable resistance can be obtained through linear dampers (magnetic particle shock absorbers), pneumatic or hydraulic shock absorbers, or other non-constant resistance assemblies. Variability of resistance can also be provided by the start and stop of an inertial mass such as a larger flywheel without the need for additional resistance. A constant resistance can be obtained by utilizing a rotating constant torque brake (magnetic particle rotating brake) or other form of friction resistance.

[0036] In another embodiment, an electronic controlled horizontal resistance brake can be provided. Use of an electronic controlled horizontal resistance brake allows for pre-determined variations in the resistance throughout the stride, a constant resistance throughout the stride or an overall variability on the effective resistance to assist in interval training. The range of usable resistance at the foot in the fore and aft directions was found to be about 0.5 to about 15 pounds. In another embodiment, a linear resistance system can be provided.

[0037] Accordingly, the present invention provides a user with a variety of smooth natural available exercise paths or foot motions, exercises a relatively large number of muscles through a large range of motion, and provides such foot motions in a safe and stable manner. The present invention also provides an exercise device having available resistance in more than one general direction, such as resisted free travel in the fore and aft directions, without detracting from the unique engaging motion of the exercise device.

[0038] In addition to resistance on the vertical and horizontal movement, the movement of the pivotal linkage pendulum system 15 of the exercise device 10 also includes one or more stops for when the footpad 14 comes to the limit of the exercise device, also referred to as an end of travel stop. In general, if an end of travel stop is too abrupt, an unsatisfactory jerking will occur to the user; indeed, if this stop is too abrupt and the user is utilizing a fast stride rate, the potential for injury to the user can increase. Accordingly, a need exists for an exercise device having a natural feeling end of travel stop. Applicants have determined that it is preferred that the end of travel have a two-stage linear stiffness profile or a non-linear stiffness profile.

[0039] This profile is graphed in FIG. 5. In FIG. 5, force in pounds is set forth on the vertical axis and travel in inches is set forth on the vertical axis. It is seen that as the travel increases the force in pounds is initially relatively flat, thereby providing the user with a gentle indication of the end of travel. Then, the force in pounds increases rapidly as the pre-determined stop point is approached. The softer initial contact can also provide a turn-around push for the user, as well as a smooth non-forceful signal that the end of travel is approaching.

[0040] One embodiment for achieving a two-stage linear or a non-linear stiffness profile is a single bumper that provides a non-linear profile starting off relatively soft at initial contact, then producing an increase in stiffness at a pre-determined stop point. Referring back to FIG. 3, in one embodiment, the rocker link 60 includes stop tab 61 configured to engage a first bumper 57. The first bumper 57 serves as an end of travel stop that provides a highly stiff cushion and a rather abrupt stop when the stop tab 61 fully engages the first bumper 57. As part of the left and right pivoting linkage pendulum systems 15, the exercise device 10 also includes left and right rocker links 61, supplemental resistance links 41 and first bumpers 57.

[0041] Referring to FIGS. 6 and 7, in another embodiment, at least a pair of separate second bumpers 62, 64 can be utilized alone, or in combination with the first bumpers 57. In this embodiment, each of the second bumper 62 and 64 is configured to be relatively soft for the initial contact as the end of travel is approached and then becomes relatively stiff, or increasingly stiff, as the actual end of travel is approached. The bumpers 62 and 64 provide the end of travel stops in the fore and aft directions, respectively. The first bumper 57, and the second bumpers 62 and 64 are preferably formed of an elastic material such as a polyester elastomer. Alternatively, the first and/or second bumpers can be formed of other materials such as, for example, butyl rubber, polyurethane, other elastomers, or combinations thereof. The elastic properties of the second bumpers 62 and 64 enable the bumpers to provide a gentle push to the user as the user reverses directions at the end of travel position. The gentle push improves the feel and comfort of the exercise device 10 and makes the exercise device more enjoyable to use. In combination, the second bumpers 62 and 64 and the first bumpers 57 provide an optimal two stage end of travel stop configuration for an exercise device in both the fore direction and the aft direction. The second bumpers 62 and 64 provide the initial soft end of travel indication that non-linearly increases if travel continues in the stop direction, and the first bumpers 57 provide the abrupt stop to ensure that the maximum travel of the exercise device is not exceeded, and the exercise device is not damaged, while minimizing the negative impact or feel to the user.

[0042] To provide for the at least two second bumpers 62 and 64, in one embodiment, a bumper bracket 66 can be provided extending over the horizontal resistance pulley 43. The bumper bracket 66 contains two contact surfaces 72, 74 adapted to contact and bear against the second bumpers 62 and 64. The second bumpers 62 and 64 are held in brackets 82, 84 contained on the horizontal resistance pulley 43. Thus, as the horizontal resistance pulley 43 comes to the limit of the exercise device 10 as rotating through the arch determined by the length of the

stride of the user, one of the second bumpers 62 and 64 held on the horizontal resistance pulley 43 contacts the corresponding contact surface 72 and 74.

[0043] Alternatively, the first bumper 57 can be provided with the non-linear response such that initial contact by the stop tab 61 is soft providing a gentle indication of the end of stop, then the first bumper 57 can be configured to have a non-linear increase in resistance if and when the stop tab 61 continues to engage the first bumper 57 and continues to bear against the first bumper 57. Both the single bumper and the dual bumper methods provide a unique feel that is crucial to a user defined motion exercise device. By correctly selecting the initial stiffness, the user does not sense the foot motion is approaching the end of travel, but instead senses a resistance that begins to urge the foot into the opposite direction. While the user defined motion exercise device allows for significantly longer stride lengths than most of the current exercise devices, the end of travel "push" tends to help the user to maintain a smooth and rhythmical motion required to achieve highly aerobic workout even while striding out to a maximum stride length.

[0044] While the invention has been described with specific embodiments, other alternatives, modifications and variations will be apparent to those skilled in the art. As previously described, while the example embodiment depicts a pendulum striding exercise device, the principles of the present invention apply to any other fitness devices, particularly those in which the user is relatively mobile, including but not limited to rowing machines, elliptical exercise machines, stepping machines, cross-country skiing machines, pendulous exercise devices, and the like. Accordingly, it will be intended to include all such alternatives, modifications and variations set forth within the spirit and scope of the appended claims.

Claims

1. An exercise apparatus for a user comprising:

a frame;
a crank system coupled to the frame, the crank system comprises one or more crank members;
a pivotal linkage pendulum system comprising at least a first link member, the first link member coupled to the crank system through at least a first pivot point, and the first pivot point of the first link member configured to move in a path during use;
a foot member coupled to the at least one first link member;
a first directional resistance system coupled to the crank system; and
a second directional resistance system coupled to the crank system,

wherein the first direction is different from the second direction.

2. The exercise apparatus of claim 1, wherein the first directional resistance system is a generally vertical resistance system, and wherein the second directional resistance system is a generally horizontal resistance system.

3. The exercise apparatus of claim 1, wherein the second resistance system comprises a system for applying a braking or retarding force to the movement of the pivotal linkage pendulum system.

4. The exercise apparatus of claim 3, wherein the system for applying a braking or retarding force comprises an eddy current brake.

5. The exercise apparatus of claim 2, wherein the horizontal resistance system provides resistance at the foot member varying from zero force at zero velocity to a maximum force at full velocity.

6. The exercise apparatus of claim 2, wherein the horizontal resistance system provides constant resistance.

7. The exercise apparatus of claim 2, wherein the horizontal resistance system provides resistance to the foot member in the fore and aft directions from about 0.5 to about 15.0 pounds.

8. The exercise apparatus of claim 7, wherein the horizontal resistance system provides resistance to the foot member in the fore and aft directions from about 2.0 to about 10.0 pounds.

9. The exercise apparatus of claim 1, wherein the at least a first link member comprises at least the first link member and a second link member, wherein the pivot point of the first link member is an upper pivot point, and wherein the second link member is coupled to the frame.

10. The exercise apparatus of claim 1 further comprising a footpad coupled to the foot member, the footpad provided with a forward securement member.

11. The exercise apparatus of claim 10, wherein the forward securement member is a toe clip.

12. The exercise apparatus of claim 2, wherein the foot member is configured to move in a user defined motion, and wherein the user defined motion has a vertical component and a horizontal component.

13. The exercise apparatus of claim 12, wherein the user defined motion can be altered by the user as

desired.

14. The exercise apparatus of claim 1, wherein the pivotal linkage pendulum system comprises a corresponding pair of four or more bar linkages.

15. The exercise apparatus of claim 1, further comprising a step-up base, and wherein at least a portion of the base is positioned beneath at least a portion of the foot member.

17. The exercise apparatus of claim 1, wherein the pivotal linkage pendulum system includes a swing arm for engaging the upper body of the user.

18. The exercise apparatus of claim 3, wherein the system for applying a braking or retarding force comprises at least one of a resistance pulley and a rocker link.

19. The exercise apparatus of claim 17, wherein the resistance pulley has an available operating motion that is less than a complete revolution.

20. A resistance system for an exercise apparatus that has both a horizontal and a vertical motion component, comprising:

a foot member;
a vertical variable resistance system coupled to the foot member; and
a horizontal variable resistance system coupled to the foot member, the horizontal resistance system providing resistance to the foot member varying from 0.5 pounds of force at a generally horizontal velocity of zero to a maximum resistance at a full generally horizontal velocity.

21. The resistance system of claim 20, wherein the horizontal resistance system comprises a system for applying a braking or retarding force to the movement of the pivotal linkage pendulum system.

22. The resistance system of claim 21, wherein the system for applying a braking or retarding force comprises an eddy current brake.

23. The resistance system of claim 20, wherein the horizontal resistance system provides resistance to the foot member in the fore and aft directions from about 0.5 pounds of force to about 15.0 pounds of force.

24. The resistance system of claim 20, wherein the horizontal resistance system provides resistance to the foot member in the fore and aft directions from about 2.0 pounds of force to about 10.0 pounds of force.

25. The resistance system of claim 20 further comprising a footpad coupled to the foot member, the footpad provided with a forward securement member.

26. The resistance system of claim 25, wherein the forward securement member is a toe clip.

27. The resistance system of claim 20, wherein the vertical resistance system comprises a system for applying a braking or retarding force.

28. A resistance system for an exercise apparatus that has both a horizontal and a vertical motion component, comprising:

a foot member;
a variable vertical resistance system coupled to the foot member; and
a variable horizontal resistance system coupled to the foot member, the horizontal resistance system providing a user selectable resistance within the range of about 0.5 pounds of force to about 15.0 pounds in the fore and aft direction.

29. The resistance system of claim 28, wherein the resistance of the horizontal resistance system is within the range of about 2.0 to about 10.0 pounds.

30. The resistance system of claim 28, wherein the horizontal resistance system comprises a system for applying a braking or retarding force to the movement of the pivotal linkage pendulum system.

31. The resistance system of claim 30, wherein the system for applying a braking or retarding force comprises an eddy current brake.

32. The resistance system of claim 28 further comprising a footpad coupled to the foot member, the footpad provided with a forward securement member.

33. The resistance system of claim 32, wherein the forward securement member is a toe clip.

34. The resistance system of claim 28, wherein the vertical resistance system comprises a system for applying a braking or retarding force.

35. A resistance system for an exercise apparatus that has both a horizontal and a vertical motion component, comprising:

a foot member;
a vertical variable resistance system coupled to the foot member; and
a horizontal resistance system coupled to the

foot member, the horizontal resistance system providing constant resistance within the range of about 0.05 pounds of force to about 15.0 pounds of force.

36. The resistance system of claim 35, wherein the constant resistance of the horizontal resistance system is within the range of about 2.0 to about 10.0 pounds.

37. The resistance system of claim 35, wherein the horizontal resistance system comprises a system for applying a braking or retarding force to the movement of the pivotal linkage pendulum system.

38. The resistance system of claim 37, wherein the system for applying a braking or retarding force comprises an eddy current brake.

39. The resistance system of claim 35 further comprising a footpad coupled to the foot member, the footpad provided with a forward securement member.

40. The resistance system of claim 39, wherein the forward securement member is a toe clip.

41. The resistance system of claim 35, wherein the vertical resistance system comprises a system for applying a braking or retarding force.

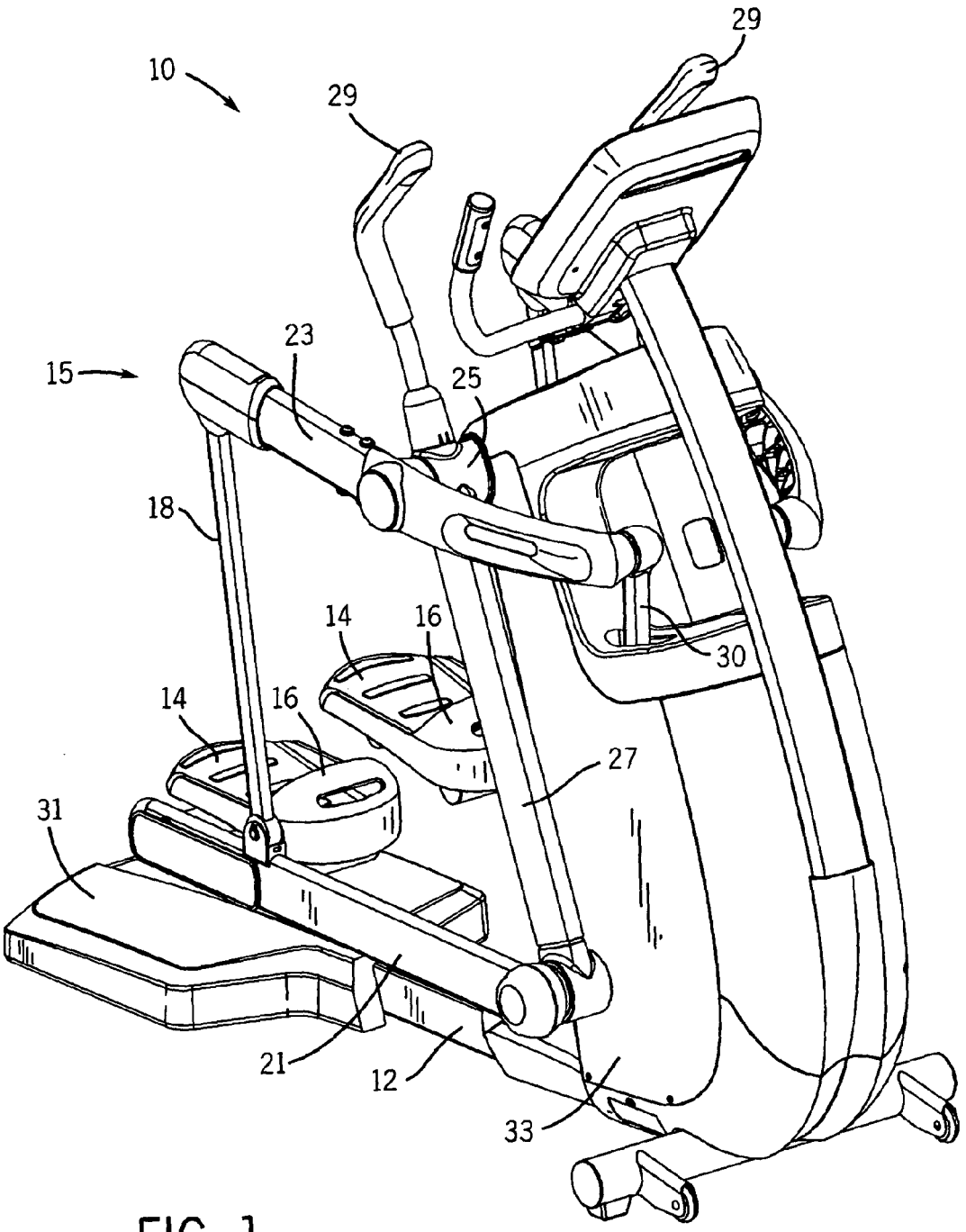


FIG. 1

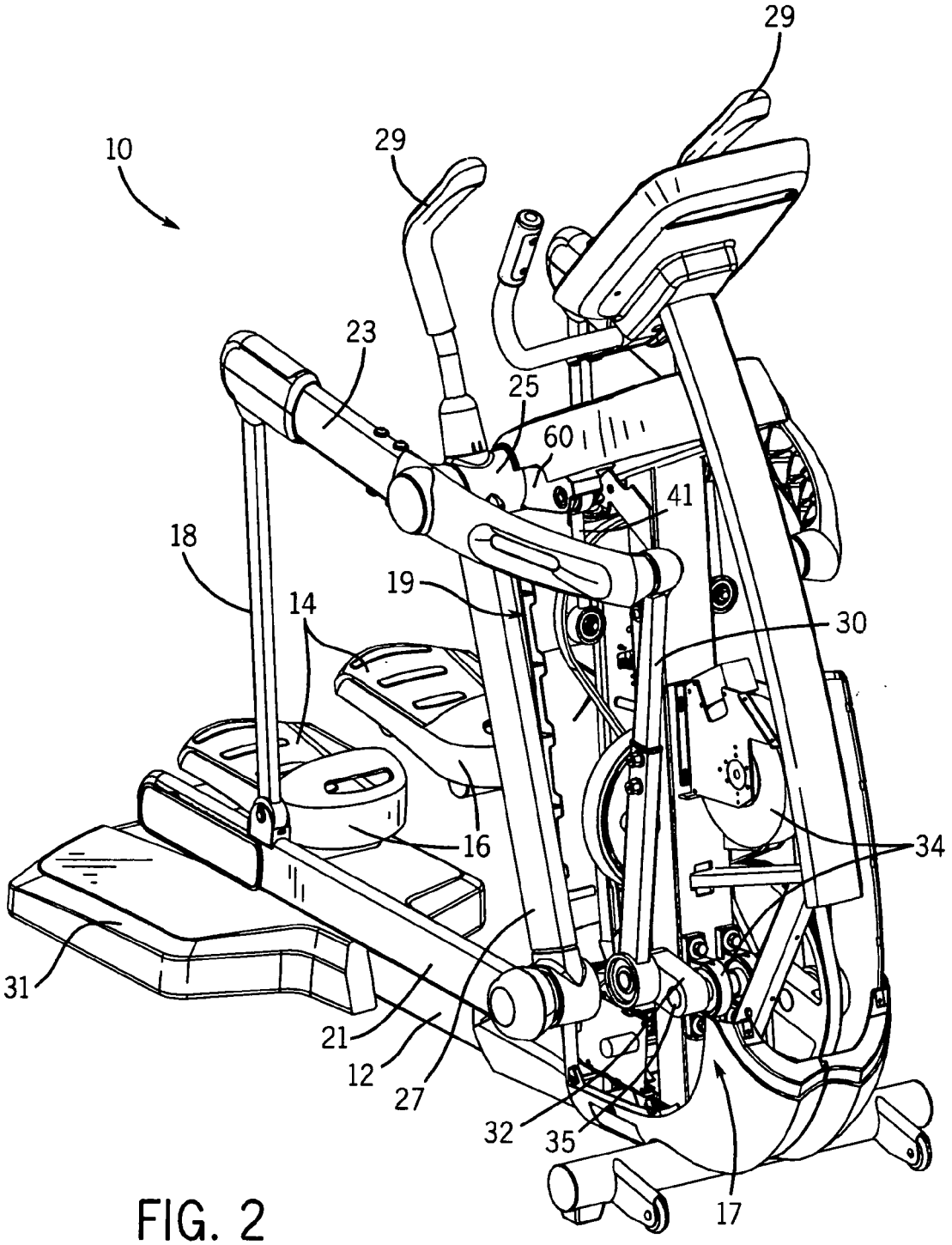


FIG. 2

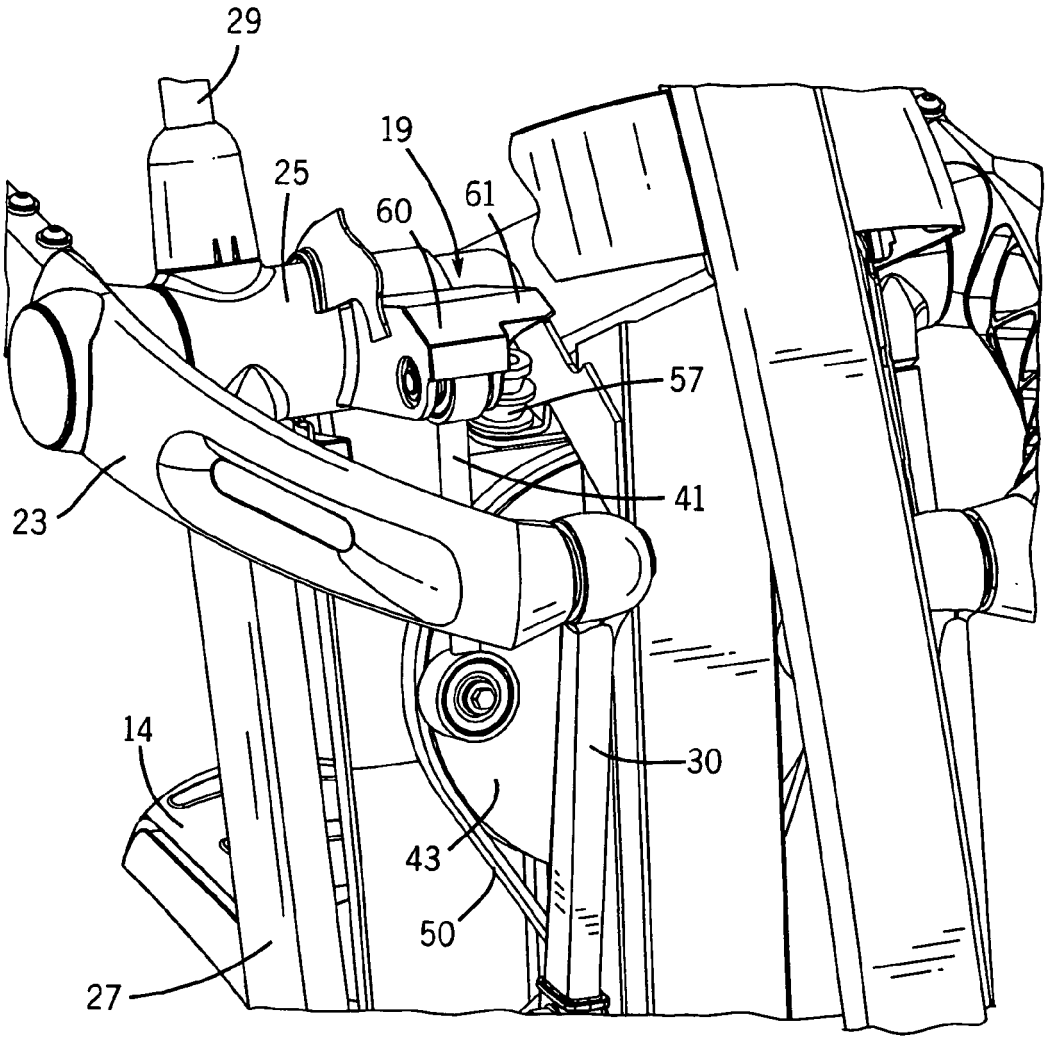


FIG. 3

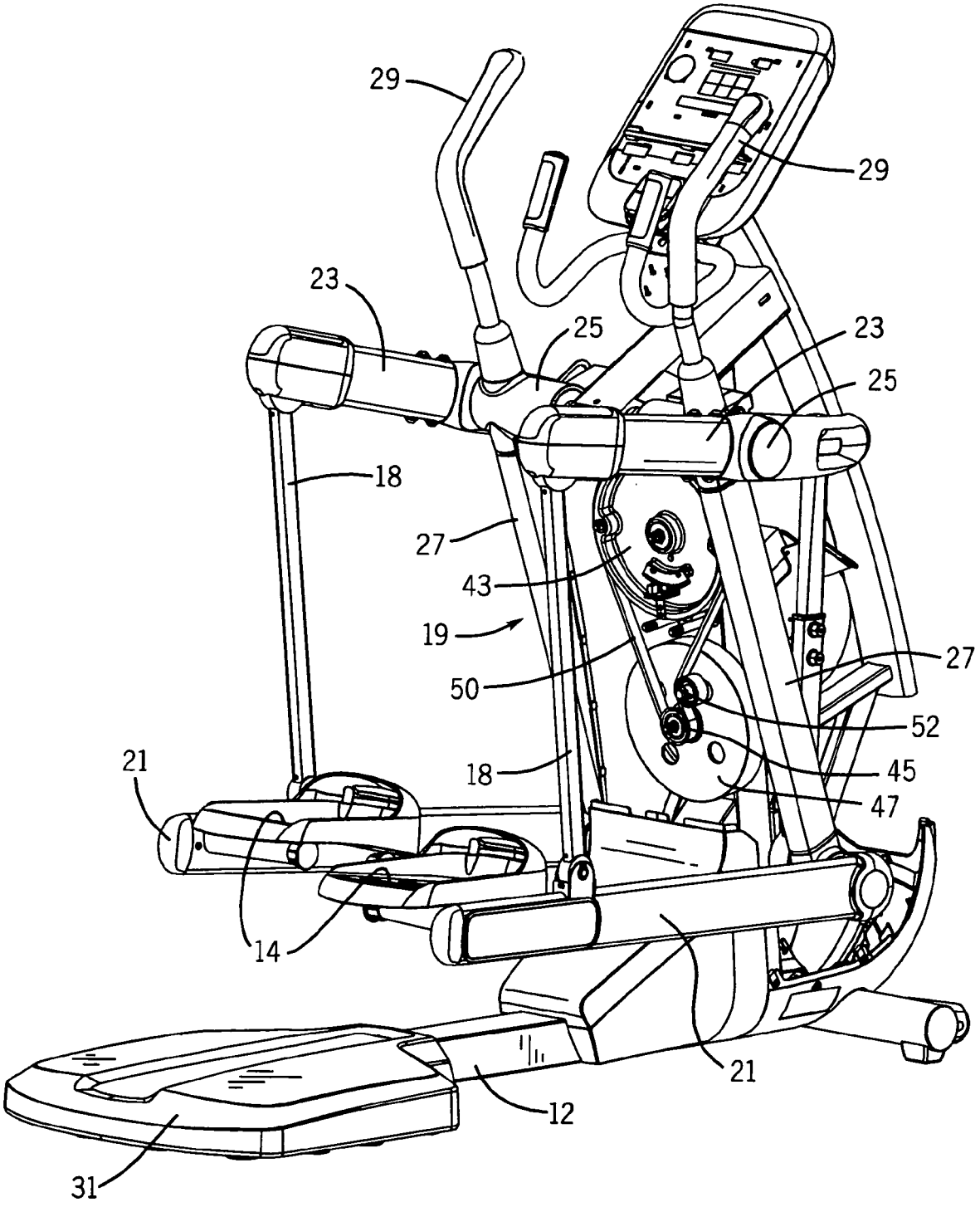


FIG. 4

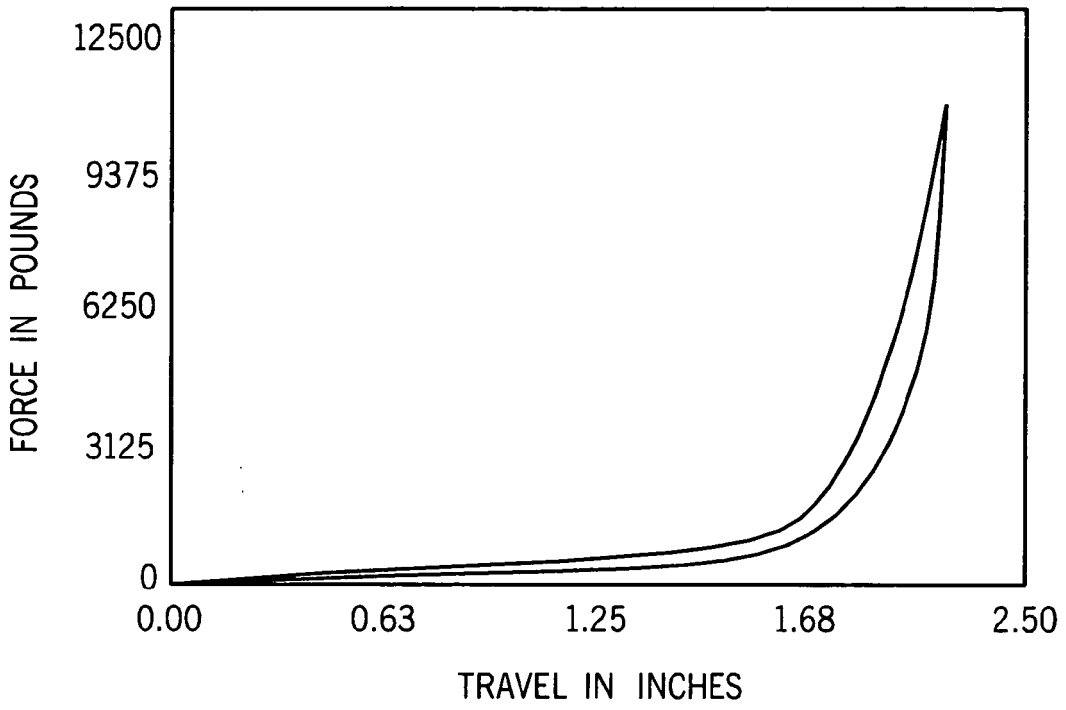
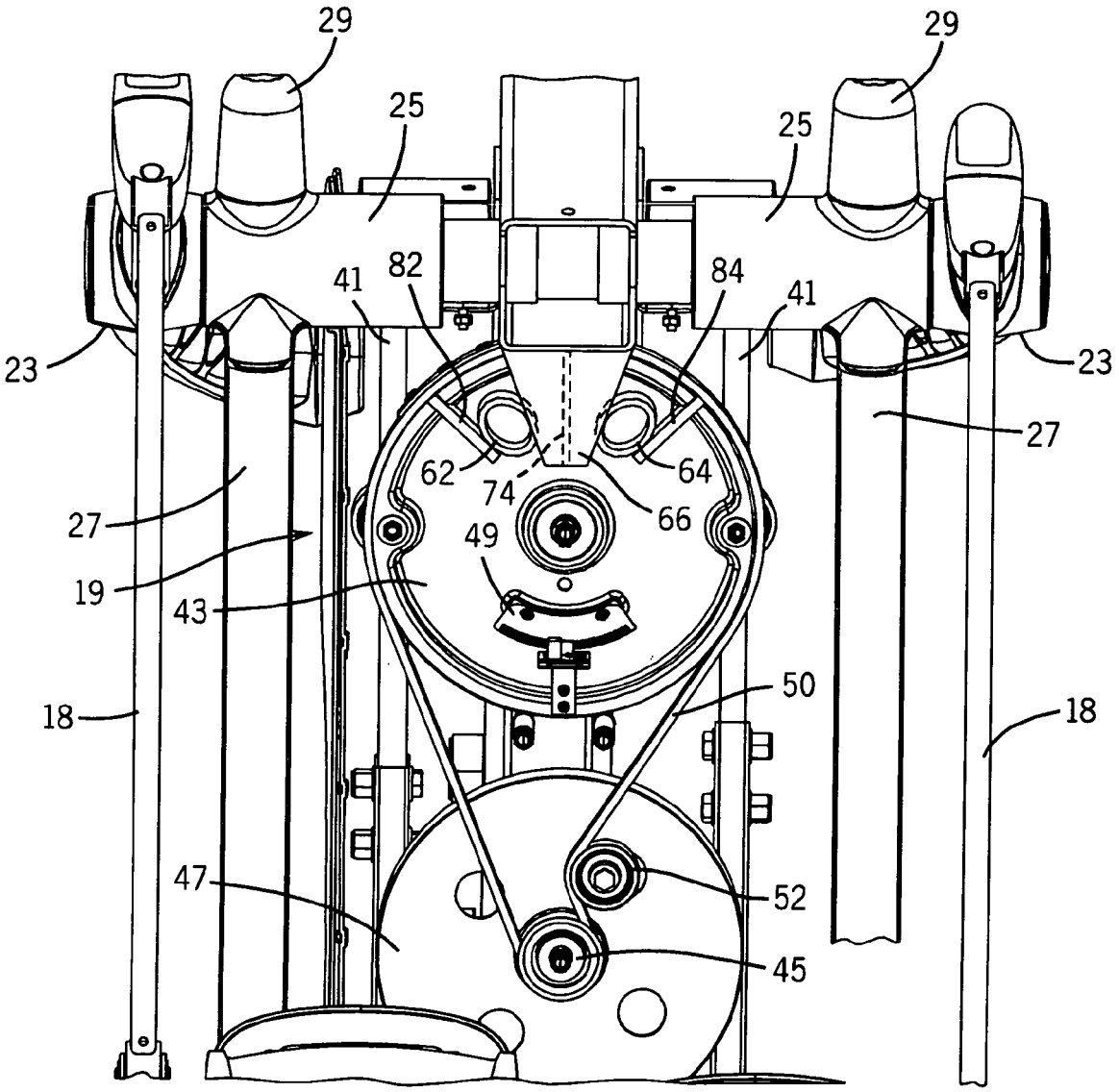

12500
9375
6250
3125
0
FORCE IN POUNDS
0.00
0.63
1.25
1.68
2.50
TRAVEL IN INCHES

FIG. 5


29
29
25
25
41
82
84
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27
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64
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18
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52
45

FIG. 6

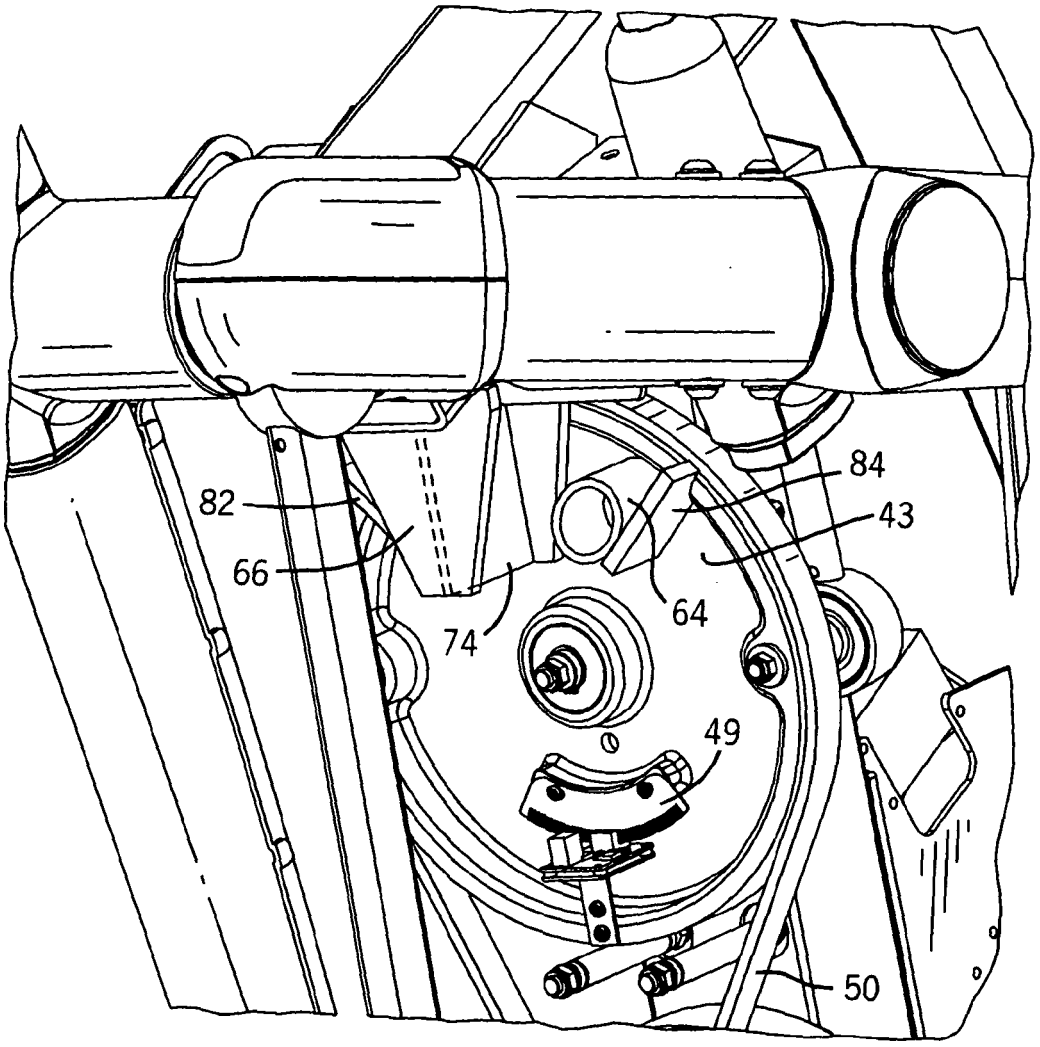

FIG. 7