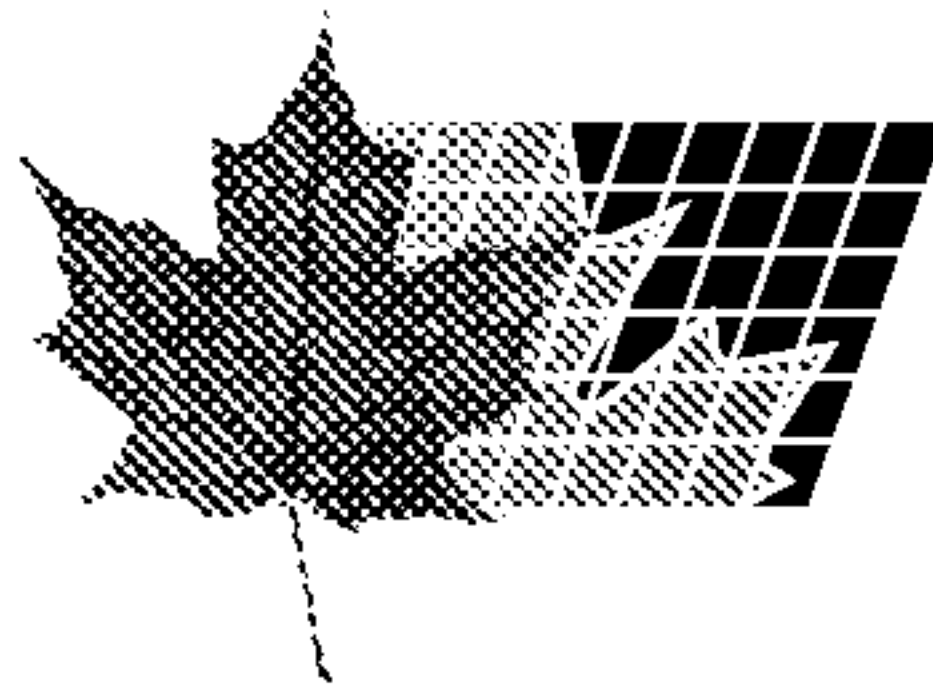




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(72) Davenport, Bruce, CA

(72) McArthur, James A., CA

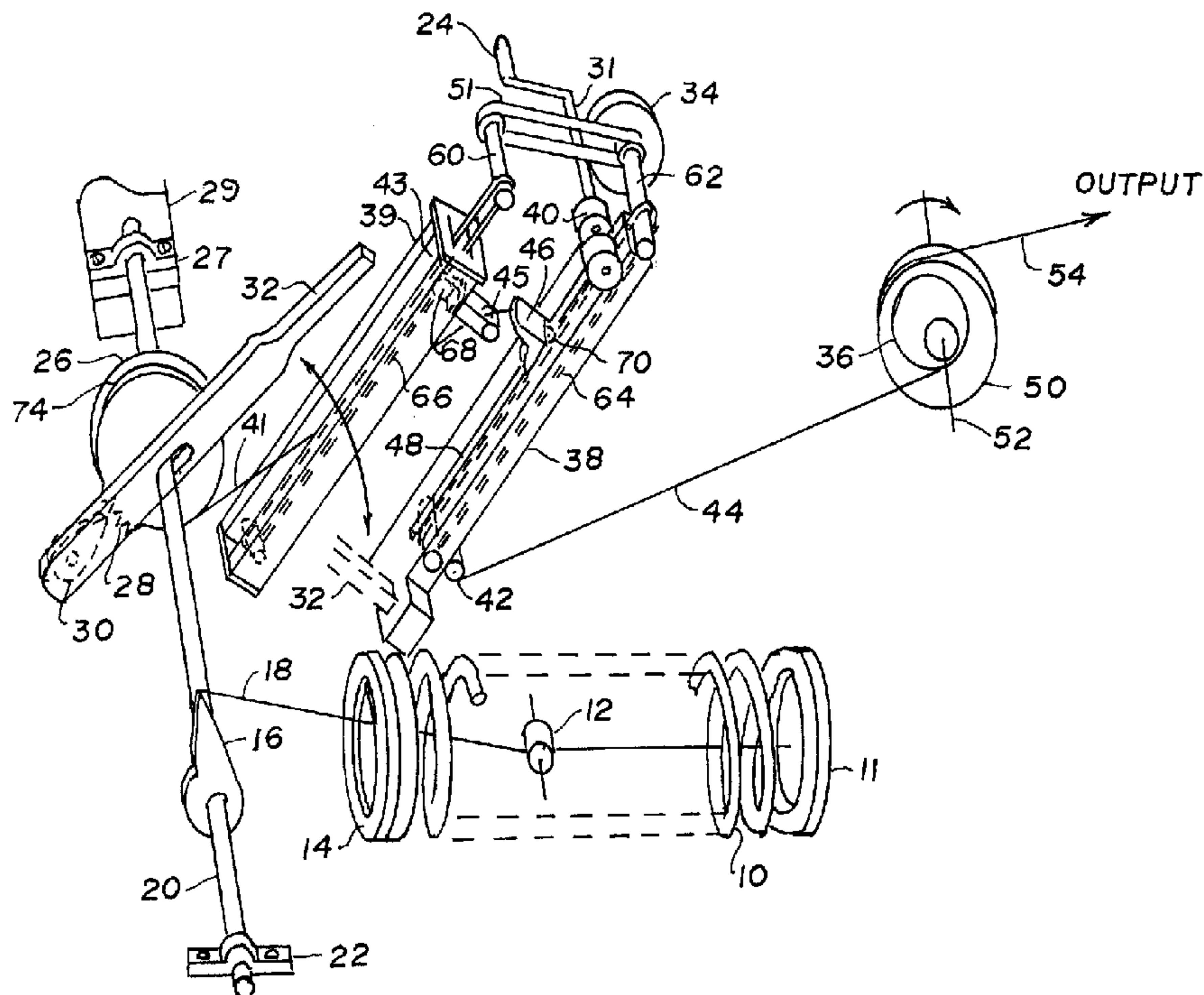
(73) MEDEX SYSTEMS INTERNATIONAL INC., CA

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(54) **DISPOSITIF DE CHARGE CONSTANTE POUR APPAREIL
D'EXERCICES**

(54) **CONSTANT FORCE LOAD FOR AN EXERCISING APPARATUS**



(57) A constant force load for use in an exercising apparatus. The load includes a frame, an energy storage unit coupled to the frame and capable of exerting a force on an external element when storing energy therein, a cam for making the force transmitted from that exerted by the energy storage means constant, and force transmission means for changing the constant transmitted force. The load further includes an output force modifying assembly for making the output force constant.

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ABSTRACT

A constant force load for use in an exercising apparatus. The load includes a frame, an energy storage unit coupled to the frame and capable of exerting a force on an external element when storing energy therein, a cam for making the force transmitted from that exerted by the energy storage means constant, and force transmission means for changing the constant transmitted force. The load further includes an output force modifying assembly for making the output force constant.

CONSTANT FORCE LOAD FOR AN EXERCISING APPARATUS**BACKGROUND**

5 The present invention relates to a constant force load for use in exercising apparatus.

Most conventional exercise machines use weights and the force of gravity to provide a load to the muscles of a user. Our bodies can easily minimize the beneficial effects on the muscles of such a load by simply providing it with a large initial acceleration or impulse and then largely controlling the movement thereafter without applying a force sufficient to benefit the muscles through much of the range of movement of the exercise. The basic reason for being able to move the weights in this manner is due to the fact that the kinetic energy imparted to the weights by the initial impulse lessens the force required to move the weight through the remaining part of the exercise. Consequently, studies have shown that when using weights in combination with the force of gravity as the muscle load, one must load the muscle to at least 80% of its capacity in order to effectively exercise the non-elastic component of that muscle and gain both strength and muscle size.

Accordingly, it is an object of the invention to provide a load having a high acceleration capability. It is a further object of the invention to provide an adjustable load which, once adjusted, provides a constant force.

SUMMARY OF THE INVENTION

35 According to the invention there is provided a constant force load for use in an exercising apparatus. The load includes a frame, an energy storage unit coupled to the frame and capable of exerting a force on an

external element when storing energy therein, means for making the force transmitted from that exerted by the energy storage means constant, and force transmission means for changing the constant transmitted force.

5 Further included is an output force modifying means for making the output force constant.

Preferably, the energy storage unit may be a spring.

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Advantageously, the force transmission means is a lever having a pivot axis at one end, a point of output attachment proximate an end thereof remote from the pivot axis and a point of load attachment intermediate the
15 pivot axis and the point of output attachment. Means may be provided for making the connection to the point of load attachment substantially normal to the lever.

The distance from the pivot axis to the point
20 of load attachment to the lever may be adjustable and may preferably be infinitely adjustable.

The making means may be a cam rotatably mounted on the frame and shaped so as to provide a constant
25 output resistive load.

The aforesaid distance may be adjusted down to zero.

30 Other types of energy storage units may also be used such as an elastomeric mass or elastomeric bands or even weights. Utilizing a spring as the load minimizes the inertia or momentum in the apparatus and features a high acceleration so that a user's muscles are fully
35 loaded throughout the entire range of movement of an exercise.

A lever provides a simple and inexpensive but elegant means for achieving an adjustable mechanical advantage ranging continuously from zero up to unity.

5 The device provides a system for achieving an adjustable constant force adjustable in infinitely small steps from zero load up to a relatively high load value depending on the capacity of the spring. The device has a low inertia and high acceleration capability, with the
10 acceleration being higher the higher the constant force. No power is required to generate the resistance.

BRIEF DESCRIPTION OF THE DRAWINGS

15 The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as other features and advantages thereof, will be best understood by reference to the detailed description which follows, read in
20 conjunction with the accompanying drawings, wherein:

Figure 1 is a schematic perspective view of the lever force transmission assembly; and

25 Figure 2 is an elevation view of an alternative embodiment of the invention.

DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS

30 Referring to Figure 1 there is shown in perspective a lever force transmission assembly consisting of a large spring 10 as the source of resistance. The spring 10 is compressed by means of a cable 18 affixed at one end 11 of the spring 10. The
35 term cable is used but it is understood that any flexible line would do such as chain, rope, etc. The other end of cable 18 is attached to a cam 16 and passes through a central opening in fixed end 14 of spring 10. Fixed end

14 is attached to a frame 29. Cam 16 is affixed to shaft 20 which is rotatable in bushings 22 and 27 coupled at either end of the shaft 20. Idler pulley 12 ensures that cable 18 pulls perpendicularly to end 11 of spring 10.
5 Cam 16 is shaped so that the spring 10 and cam 16 combination produces a constant resistive torque when shaft 20 is rotated.

A flexible connector 41 is wound around pulley
10 26 which is rotatable around shaft 20. A torsion spring 74 has one end connected to pulley 26 and the other to shaft 20 biasing the pulley 26 in a direction so as to tension connector 41. Pulley 26 has a plurality of teeth 28 around a portion of a periphery thereof. A pawl 30
15 affixed to a long shaft 32 removably engages the teeth 28 as shaft 32 slides over shaft 20. Thus, as shaft 20 rotates, shaft 32 and pawl 30 also rotate. The distal end of shaft 32 abuts lever 38 when the latter is in its rest position, as shown in phantom, and causes pawl 30 to
20 disengage from teeth 28. Once disengaged, torsion spring 74 acting on pulley 26 causes the latter to rotate and take up any slack in flexible connector 41.

At its other end flexible connector 41 passes
25 over idler 45 and is affixed to lever bracket 46. Idler 45 is coupled to a drive chain 66 which causes it to slide along open track 43 of fixed member 39. Fixed member 39 has both ends affixed to a frame 29. Lever bracket 46 is attached at 70 to chain 64 driven along
30 track 48 by gear 62. Similarly, idler 45 is attached at 68 to chain 66 and is driven along slot 43 by gear 60 which drives chain 66. Worm gear 31 driven by crank 24 couples to gear 34. Gear 34 is coupled directly to gear 62 and is coupled by chain 51 to gear 60. The gear
35 ratios are such that operation of crank 24 serves to simultaneously drive chains 64 and 66 so that they track one another. Lever 38 pivots about rollers 40 the axis of which forms the axis of rotation of lever 38. Worm

gear 31 is axially aligned with rollers 40 so that pivoting of arm 38 does not require any movement of gear 31 and crank 24. Bracket 46 and idler 45 are movable through split rollers 40 to the axis of rotation of the
5 rollers 40 and the lever 38.

An output cable 44 is affixed to a distal pivotal end of lever 38 at an attachment point 42 and at the other end is wound around an output cam 36. Cam 36
10 is affixed to pulley 50 and the output is taken on line 54 wound on pulley 50. Pulley 50 has a constant radius with respect to its center of rotation 52 and gears down the torque produced by cam 36. Cam 36 is shaped so that its radius to the point where it is contacted by cable 44
15 varies so as to compensate for the change in angle of lever 38 with respect to cable 44 and to a lesser extent for the change in angle between flexible connector 41 and lever 38.

20 Adjustment of the position of both idler 45 and lever bracket 46 by means of the worm gear 31, gear 34 and gears 60 and 62, causes the lever arm length for the resistive force from the spring 10 to change and, therefore, for the mechanical advantage of the lever 38
25 to change.

The assembly of Figure 1 can be used to replace a series of discrete weights commonly used on weight machines by providing a low-inertia, constant-torque
30 resistance. The load is adjustable from zero to a very large value depending on the spring characteristics. The torque resistance on pulley 50 is substantially constant as it is moved through its full range. Although a coil spring 10 is shown as a preferred load source, other load
35 sources such as a resilient mass, or even a large weight could be used.

Referring to Figure 2 there is shown an alternative embodiment of the invention which also employs a large coil spring 55 having an end plate 56 with a cable 57 attached centrally thereto. Cable 57
5 winds partially around pulley 58 and is attached to an end of cam 101. Cam 101 is shaped so that a constant tension in line 61 independent of the deflection of spring 55 is produced via pulley 59. Cable 61 winds partly around idler pulley 104 which is rotatably mounted
10 to slide mount 63 and attaches to mount 63. Mount 63 is positioned in a fixed lateral position relative to a first frame assembly 80. A pivotal arm 67 is pivotal about pivot 69 and has slots 65 which engage lower plate 75 of mount 63 when pivoting counterclockwise from the
15 rest position shown. Cable 81 is attached to a distal end of lever 67 at one end and at the other end is attached cam 71. Cam 71 is affixed to pulley 72 around which output line 83 is wound. Cam 71 compensates for the change in angle between cable 81 and lever 67 and to
20 a lesser extent for the change in angle between cable 61 and lever 67 as lever 67 pivots.

Lever 67, pulley 72 and cam 71 are all mounted on frame 73 while spring 55, pulley 59, cam 101 and mount
25 63 are all mounted on frame 80. Frame 73 is movable laterally with respect to frame 80 by means of a lead screw 96 passing through and rotatable with respect to frame 80 and threadedly registering with a threaded hole 98 in extension 97 of frame 73. As frame 73 moves to the
30 right lever 67 slides over plate 75 changing the distance between pivot 69 and mount 63.

Operationally, force applied to output line 83 causes cam 71 to tension line 81 and pivot lever 67.
35 Lever 67 acts on plate 75 of mount 63 and pivots the latter downwardly in a counterclockwise direction relative to pivot 69. Cable 61 is pulled downwardly rotating pulley 59 and, hence, cam 101, clockwise. Cable

57 is pulled to the right compressing spring 55. The action of cams 101 and 71 in compensating for spring deflection and changing angle between lever 67 and attached cables 61 and 81, respectively produces a
5 constant output load on line 83 which is infinitely, continuously adjustable.

Accordingly, while this invention has been described with reference to illustrative embodiments,
10 this description is not intended to be construed in a limiting sense. Various modifications of the illustrative embodiments, as well as other embodiments of the invention, will be apparent to persons skilled in the art upon reference to this description. It is therefore
15 contemplated that the appended claims will cover any such modifications or embodiments as fall within the true scope of the invention.

The embodiments of the invention in which an exclusive property of privilege is claimed are defined as follows:

1. A constant force load apparatus for an exercising device, comprising:
 - a) a frame;
 - b) a load coupled to said frame capable of exerting a force on an external element when storing energy therein which is due substantially to its elastic properties;
 - c) a cam means coupled to said frame having an input coupled to said load and an output which produces a constant force from that exerted by said load;
 - d) a force transmission means mounted on said frame and having an input coupled to an output of said cam means, and an output of said force transmission means operative to produce a force selectably changed to a multiple or fraction of that produced by said cam means; and
 - e) an output force modifying means coupled to said frame having an input coupled to said output of said force transmission means operative to produce a constant force from that produced by said force transmission means.
2. Apparatus according to claim 1, wherein said load is a spring.
3. Apparatus according to claim 1, wherein said force transmission means comprises a lever having a pivot axis at one end, a point of output attachment proximate an end thereof remote from said pivot axis and having a point of load attachment intermediate said pivot axis and said point of output attachment, and means for making the connection to said point of load attachment substantially normal to said lever at all operative positions of said lever.

4. Apparatus according to claim 3, wherein the distance from said pivot axis and said point of load attachment to said lever is adjustable.

5. Apparatus according to claim 1, wherein said cam means comprises a cam rotatably mounted on said frame and shaped so as to provide a constant output resistive load.
6. Apparatus according to claim 1, including means for adjusting the mechanical advantage of said force transmission means.
7. Apparatus according to claim 4, wherein said distance is continuously adjustable.
8. Apparatus according to claim 4, wherein said distance may be adjusted down to zero.
9. Apparatus according to claim 3, wherein said output force modifying means comprises an output cam coupled to said output attachment point of said lever, said output cam shaped so as to provide a constant output resistive load with changing deflection of said lever.
10. A constant force load apparatus for an exercising device, comprising:
 - a) a frame;
 - b) a spring coupled to said frame;
 - c) a lever pivotal about an axis proximate one end from a rest position and having an output attachment means proximate an end remote from said one end and a load attachment means coupled to said spring, said load attachment means being intermediate said one end and said remote end, said lever operative to change a resistive force provided by said spring by providing mechanical advantage;

(d) means for adjusting the distance between said load attachment means and an axis of said lever; and

(e) cam means for providing a constant resistive load independent of spring deflection and pivoting of said lever so as to provide a constant output resistive force;

(f) a flexible connector connected between said cam means and said load attachment means of said lever; and

(g) means for taking up slack in a cable due to changes in the position of said load attachment means automatically upon return of the lever to the rest position.

11. Apparatus according to claim 10, wherein said taking up means comprises a pulley journaled to a shaft and around which pulley said flexible connector is wound, a torsion spring biasing said pulley with respect to said shaft and a pawl arm mounted on said shaft and rotatable therewith and engaging a plurality of teeth on said pulley such that when moved to the rest position of said lever, said arm is moved so as to disengage from said pulley and allow the pulley to take up any slack in the flexible connector.

12. Apparatus according to claim 10, wherein said load attachment means is movable along the length of said lever.

13. Apparatus according to claim 10, wherein said cam means includes a cam coupled to said spring and shaped so as to compensate for the change in deflection force with deflection and make the output torque constant from said cam and spring in combination.

14. Apparatus according to claim 10, including an output cam, a flexible connector coupled at one end to the remote end of said lever and at the other to said output cam, and an output pulley coupled to said output cam and providing a constant output resistive force.

15. Apparatus according to claim 13, wherein said load attachment means includes a bracket attached to and movable along the length of said lever, a pulley mounted proximate said bracket and movable together with the bracket and positioned relative to said bracket such that the flexible connector between the bracket and the pulley is substantially perpendicular to said lever.

16. Apparatus according to claim 15, wherein said load attachment means includes an adjustment assembly coupled to both said bracket and said pulley and operative to cause both the bracket and the pulley to move in unison during adjustment.

