

EXERCISE MACHINES

This invention relates to exercise machines for resistance or strength training, in one aspect it relates to a rotary torso exercise machine and in another aspect it relates to multiple muscle cardiovascular exercise machines, incorporating rotary torso exercise; primarily, but not exclusively, for home use.

BACKGROUND

Cardiovascular exercise is also known as aerobic exercise wherein oxygen gets continuously delivered by the heart at an increased rate to muscles. It involves the large muscles like those of the legs and helps to make the heart and lungs stronger; it can also lower blood pressure and burn calories, helping to lose weight.

To give a heart a proper workout requires a certain intensity of cardiovascular exercise, often monitored by measuring heart rate. Everyone has a resting heart rate, which is the heart beat rate while resting. Everyone also has a maximum heart rate, which is the maximum amount of times a heart can beat in a given time, usually measured in beats per minute. A 'target heart rate zone' is a range of heart rate that is considered to be the best rate to give a good heart workout; this range is between 50% and 85% of maximum heart rate.

Machines are known which are designed to exercise specific muscle groups and include:

Machine Name	Muscle Group
Rotary Torso	Abdominal external oblique muscle
Chest Press/Seated Row	Pectoralis major and minor Triceps brachii Anterior deltoid
Butterfly/Rear Deltoid	Pectoralis Trapezius
Abdominal crunch /Lower Back	Rectus abdominis Erector spinae
Shoulder Press/Lat. Pull	Deltoid Lattisimus dorsi
Leg Extension/Leg Curl	Quatricep femoris Posterior thigh muscles (hamstring)

Machines that provide bidirectional resistance (preferably hydraulic or pneumatic) enable opposed muscle groups to be exercised at the same time using a reciprocal (push/pull) motion.

- 5 Machines are also known that exercise combinations of muscle groups.

One type has differing exercise stations distributed about the machine and has a cable and pulley system acting on a variable weight stack. Each station has fitments connected to the weight stack via the cable and pulley system and designed co-operate with a particular part of a user's body; thereby to enable the user to exercise a given muscle against the weight stack.

- 10 This weight resistive machine only provides a unidirectional resistance proportional to the weight and inertia of the weights being pulled.

Another type of exercise machine uses oppositely acting pairs of adjustable telescopic hydraulic struts to provide bidirectional resistance modules for some torso and leg muscle group exercises. The user remains seated in the same position (station) to access the muscle exercise modules. Telescopic hydraulic struts have the advantage of providing resistance proportional to the rate at which the strut is compressed/expanded; at slow rates the resistance is essentially constant and suits exercises to build muscle strength and mass (hypertrophy) and the resistance increases at fast rates to train for cardio endurance.

- 15 One example of this type of machine is the Edge Fitness Extreme Combo Multi gym that provides three exercise modules, arranged to be operable from a single station, for the pectoralis and trapezius (upper back), quadriceps femoris and posterior thigh muscles (hamstring), deltoid and latissimus dorsi muscle groups.

- 20 Another hydraulic multiple exercise machine also provides three exercise modules, arranged to be operable from a single station, for the quadriceps femoris and posterior thigh muscles (hamstring), deltoid and latissimus dorsi and butterfly and rear deltoid muscle groups.

The femoris and posterior thigh are the largest muscles and for effective cardiovascular exercise it is essential to include these muscles.

PRIOR ART

Document WO 2008/152627 A2 (18 December 2008 – KLEINMAN) discloses:

“In a first aspect the invention is a hydraulic exercise machine for allowing a user to perform a plurality of exercises. The exercise machine of the invention is characterized in that the pressure release mechanism is a mechanical mechanism that allows the cable to be drawn from the exercise machine with a predetermined minimum resistance, independent of the speed at which the cable is drawn out from the exercise machine. Some embodiments of the hydraulic exercise machine are adapted to allow the user to do only concentric (positive) work and other embodiments are adapted to allow the user to do either concentric (positive) work or eccentric (negative) work. The invention is also an apparatus comprising the hydraulic exercise machine. The exercise apparatus of the invention may comprising an exercise bench for the user to sit or lie thereon when performing an exercise and a platform upon which the exercise machine and the exercise bench are affixed.” [Abstract]

The described machine relies on a pull cable connection to a rotary hydraulic pump, a hydraulic engine or a linear hydraulic pump; the user adjusts position and pull cable attachment point to depending on the muscle to be exercised.

Document WO 2010/109383 A1 (30 September 2011 – KONINKLIJKE PHILIPS ELECTRONICS N.V.) discloses:

“A method comprising monitoring a physiological characteristic of a user performing a physical activity in connection with an interactive program; and adjusting one or parameters of the program based on the monitored physiological characteristic.” [Abstract]

Document CA 2,103,013 A1 (12 November 1993 – BRIAN KOCHAN) discloses an exercise machine which exercises the user’s upper body by providing for an arm movement in a plane substantially parallel to the ground and rotating around an axis parallel to the user’s spine. The user rotates a handle attached to a pair of cantilevered bars extending from a rotatable shaft located in front of the user. The handle is free to pivot and move in a linear radial direction during rotation.

Document US5094449 (STEARNS) discloses apparatus for abdominal exercises, including crunch, sway and twist. Variable resistance is provided by weights 22 which act in one direction only. Arm handles 64 and elbow pad members 344, 346 are attached to a crunch frame 310 that is rotatable about side-to-side horizontal axis 300 carried by sway frame

members 266, 268, 270 that are rotatable about front-back horizontal axis 200 carried by twist frame 68 rotatable about vertical axis 100.

STATEMENT OF INVENTION

According to an aspect of the present invention, there is provided an exercise machine comprising: i) a seat; ii) resistance means; iii) an operating member constrained to move in a generally horizontal arc about a generally vertical axis against resistance provided by the resistance means and in a generally vertical arc about a generally horizontal axis against resistance provided by the resistance means; thereby to provide rotational reciprocal movement for both rotary torso and abdominal crunch exercises; wherein: a) the generally vertical axis passes through or near a rear edge zone of the seat; b) the generally horizontal axis is positioned forwardly of the generally vertical rotational axis; and iv) a frame and at least five exercise modules, wherein each module comprises: a) a carrier pivoted to the frame, b) bidirectional fluidic resistance means acting between the carrier and another carrier or the frame, and c) an operating member attached to the carrier; which operating member is appropriately shaped to be operated by a user by means of the muscle group to be exercised.

Resistance can be frictional, elastic or fluidic; such as provided by friction pads, elastic rubber bands, coil springs or pneumatic or hydraulic struts respectively.

An embodiment of the exercise machine comprises separate exercising modules arranged and configured to respectively exercise torso and major muscle groups against bidirectional fluidic resistance; the muscle group exercising modules being disposed to be actuated by a user from a single position sitting on the seat.

In an embodiment, the exercising modules comprise:

- i) a rotary torso module wherein a handlebar is arranged to be movable in a generally horizontal arc about a generally vertical axis against bidirectional fluidic resistance;

- ii) an abdominal crunch module wherein a handlebar is arranged to be movable in a generally vertical arc about a generally horizontal axis against bidirectional fluidic resistance;
 - iii) a chest press/seated row module wherein a pair of handles are each arranged to be movable in a generally vertical arc about a generally horizontal axis against bidirectional fluidic resistance, the arms may be separately moveable;
 - iv) a shoulder press/lat. pull module wherein a handlebar is rotatable in a generally vertical plane against bidirectional fluidic resistance;
- and,
- v) a leg extension and curl module wherein a leg-bar is rotatable in generally vertical arc about a generally horizontal axis against bidirectional fluidic resistance.

We have found that essentially continuously exercising all the major muscle groups by pulling and pushing unidirectional resistive modules using opposed muscles in each group to be particularly beneficial because:

- a) cardiovascular exercise is distributed between all the major muscle groups which enables cardiovascular exercise to continue even though one particular muscle pair tires;
- b) an exercise program using a machine in accordance with embodiments of the present invention provides balanced exercise for all the major muscle groups.

An exercise machine in accordance with embodiments of the invention also provides more complete muscular strengthening, overcomes user boredom associated with repetitive exercise of one muscle group needed to obtain the requisite target heart rate (burn) and is more compact than known home gym machines.

The previously described known hydraulic multiple exercise machines are limited to a reduced number of major muscle groups. Exercising all the major muscle groups using prior art apparatus requires a minimum of four different exercise stations.

An embodiment of the present invention comprises a frame and five exercise modules, each module comprising a carrier pivoted to the frame, bidirectional fluidic resistance means acting between the carrier and the frame or another carrier and an operating member attached to the carrier; each operating member being appropriately shaped to be operated by a user by means of the muscle group to be exercised. The operating member may be a handlebar, handles or leg-bars.

Unlike the above-described three module exercise machines, an exercise machine in accordance with this embodiment of the present invention uniquely combines five exercise modules, respectively for the pectoralis major and minor/triceps brachii/anterior deltoid, pectoralis/trapezius, rectus abdominis/erector spinae, deltoid/lattissimus dorsi, quadriceps femoris/posterior thigh muscles (hamstring) muscle groups, in the one machine. The bidirectional resistance and the pivoted carriers enables each major muscle to be exercised against a specific resistance tailored to the muscle and enables the muscles of a given muscle groups to be exercised in opposition. Exercise modules can be operated separately or in combination.

In another embodiment a computer-controlled display is provided.

The above and further features of the present invention are illustrated, by way of example, in the Drawings wherein:

- 5 Fig. 1 is a front elevation illustrating rotary torso and abdominal crunch modules for an exercise machine in accordance with an embodiment of the present invention;
- Fig. 2 is a plan corresponding to Fig. 1;
- Fig. 3 corresponds to Fig. 1 with the rotary torso module turned left;
- Fig. 4 corresponds to Fig. 2 with the rotary torso module turned left;
- 10 Fig. 5 corresponds to Fig. 1 with the rotary torso module turned right;
- Fig. 6 corresponds to Fig. 2 with the rotary torso module turned right;
- Fig. 7 is a side elevation of the exercise machine of Fig. 1, with the abdominal crunch module in a starting position;
- Fig. 8 corresponds to Fig. 7 but with the abdominal crunch module in a middle position;
- 15 Fig. 9 corresponds to Fig. 7 but with the abdominal crunch module in a final position;
- Fig. 10 is a side elevation of a combined exercise machine having rotary torso, abdominal crunch, chest press/seated row, shoulder press/lat. pull and a leg extension and curl modules in accordance with a further embodiment of the present invention;
- 20 Fig. 11 is the opposed side elevation of the exercise machine of Fig. 10;
- Fig. 12 is a front elevation of the exercise machine of Fig. 10;
- Fig. 13 is a rear elevation of the exercise machine of Fig. 10;
- 25 Fig. 14 is a plan of the exercise machine of Fig. 10;
- and,

Fig. 15 is an underplan of the exercise machine of Fig. 10.

An exercise machine is shown by Figs 1 to 9 to comprise a leaf-shaped base 10 with an upwardly-extending, rectilinear framework 12. A vertical pillar 14 is mounted to the top of the frame and carries a seat 16 which is fixed in use for a given user; although the pillar 14
5 may be height adjustable e.g. to suit different users. A J-shaped upright 18 has a collar 20 at the bottom of the upright that carries a shaft 22 journaled in the framework 12; behind seat pillar 14. The rotational axis of the shaft 22 therefore extends generally vertically through the rear edge zone of the seat 16. The upright 18 extends rearward and then vertically upwardly behind seat 16 and carries a horizontal cross-member 24. Arms 26 and 28 project forwardly
10 respectively from each end of the cross-member, beyond the axis of the shaft 22; one arm 26 also extends rearwardly and downwardly at 30.

A cradle 32 has a crosspiece 34 with, at the ends thereof, an upwardly extending pair of arms 36 and a downwardly and forwardly extending pair of legs 38. The fore ends of legs 38 are journaled to the fore ends of arms 26, 28 to be rotatable in a vertical plane. The horizontal
15 rotational axis of the cradle 32 about the fore ends of the arms 26, 28 therefore lies forward of the generally vertical rotational axis of: the shaft 22, the upright 18 and the immediately attached structure. Cradle crosspiece 34 can, as shown in Figs. 1-7, rest on the top of upright 18.

A cross-piece links the free ends of cradle arms 36 and carries a head rest 40. A pair of hook-shaped handles 42 rise upwardly and then downwardly from each end of the cradle cross-piece.
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Vertical shaft 22 has a sprocket 44 (Figs 7-9) rotatable horizontally within the framework 12. A further sprocket 46 is journaled to the framework, forwards of and horizontally aligned with shaft sprocket 44. A roller chain, not shown, links the two sprockets. An opposed pair
25 of unidirectional hydraulic struts 48 are pivotally attached diametrically to gear wheel 46 with their cylinder ends pivotally attached to the base 10. The resistive force of each of the struts 48 is individually adjustable so that the effort required to move the upright 18 and attached structure in either rotational direction is separately adjustable.

An opposed pair of unidirectional hydraulic struts 50, 51 have respective piston rods 52, 53
30 pivoted to opposite ends of a crank 54 fixed to rotate with arm 38; the bodies of struts 50 and 51 are pivoted to the rear end of arm extension 30.

In use for rotary torso exercise, a user sits on the seat 16, grasps the handles 42 and alternately contracts abdominal external oblique muscles to swing the assembly 56, comprising J-shaped upright 18, horizontal cross-member 24, arms 26 and 28, cradle 32, arms 36 and legs 38, to rotate it in a horizontal arc about vertical shaft 22. This rotation is transferred by sprocket 44 and the roller chain to the further sprocket 46. Rotation of further sprocket 46 compresses one of the piston rods into the respective strut 48 against the resistance for which the strut has been adjusted. The other strut, being unidirectional, provides no resistance. Rotation of the assembly 56 in the other direction forces the other of the piston rods into the other respective strut 48 against the resistance for which that strut has been adjusted. A chest vest could be used instead of cradle 32; in known manner.

In use for abdominal crunch exercise, the user grasps and pulls down on the handles 42 by contracting rectus abdominis muscles. This rotates arms 36 in a vertical arc about the horizontal pivots between legs 38 and arms 26 to compress strut 51. Because the horizontal axis through these pivots lies somewhat above the user supporting upper surface of the seat 16 and forward of the generally vertical axis of the shaft 22, during an abdominal crunch and when straightening up again afterwards, the head/neck of a user is able to rest comfortably against the head rest 40 throughout the entire movement, while the cradle 32 and associated structure reciprocally pivots about this single horizontal axis. In use of the apparatus, when sitting upright, the s-shaped curve of the user's spine is centred generally about the axis of shaft 22. As the user bends forward into the crunch, the cervical and thoracic vertebrae rotate forwards and downwards to a slightly greater extent than the lumbar vertebrae, so that the lumbar curvature is reversed and the whole spine assumes a bow-shaped curve as the lowest point of the crunch is reached. It has been found that positioning the horizontal axis through the pivots between legs 38 and arms 26 forwardly of the shaft 22 rotational axis, allows the user to maintain comfortable contact with the head rest in the crook of the neck throughout the downward and then upward flexing motion of the spinal column during a crunch, despite the fact that the cradle 32 and its associated structure is movably mounted to the upright 18 and its associated structure along a simple single horizontal pivot axis. This mounting arrangement also leaves a clear space rearward of the upright 18, which advantageously can be used to accommodate further exercise modules as described below. As the user straightens up again out of the crunch, they contract their erector spinae muscles and push against the head rest 40 and/or push upwardly on the handles 42; this effort being resisted by

the independently adjustable strut 50. The resistance felt by the rectus abdominis and erector spinae muscles respectively may thus be independently tailored.

A combined exercise machine is shown by Figs 10 to 16 to combine the rotary torso and abdominal crunch modules of the above-described embodiment shown by Figs 1 to 9 with
5 chest press/seated row, shoulder press/lat. pull and leg extension and curl modules.

A chest press/seated row module comprises a pair of generally vertical arms 58 each attached to horizontal axle 60 journaled to a vertical strut 62; bridging the front of frame 12 with base 10. There is a handle 64 at the top of each vertical arm 58. A pair of unidirectional hydraulic struts 66 have piston rods 68 pivoted to opposed cranks 70 pivoted to rotate with arms 58.

- 10 For use for chest presses, a user grasps and pushes on handles 64, at the ends of arms 58, contracting pectoralis major muscles whereupon the arms 58 pivot forwardly in a vertical arc about horizontal axle 60, to compress one of the hydraulic struts 66; the other of the struts providing no resistance.

- For use for seated rowing, a user grasps and pulls on handles 64 contracting minor/triceps
15 brachii/anterior deltoid muscles whereupon the arms 58 pivot rearwardly in a vertical arc about horizontal axle 60, to compress the other of the hydraulic struts 66; the one of the struts providing no resistance.

- Pivoting the arms independently and providing each with its own pair of unidirectional hydraulic struts having piston rods pivoted to opposed cranks pivoted to rotate with that arm,
20 would enable separate use of the arms, to provide independent resistance in either rotational direction.

- A shoulder press/lat. pull module comprises a serpentine, fixed, upwards extension 72, 74 at the rear of the framework 12. A frame 74 formed from opposed C-shaped side plates is fixed above extension 72. A rocker arm 87 (indicated in dotted lines in Fig. 10) lies within the
25 lower limb of the frame 74 and is pivotable about a horizontal axis 76. A handlebar 78, shaped like a bicycle drop handle bar, having grips 80 includes a circular mounting 82 that is pivoted at 88 horizontally to the top 84 of frame 74. A link rod 86 is pivoted at one end to the circular mounting and at the other end to one end of the rocker arm 87. The pistons of a pair of unidirectional, independently adjustable resistance, hydraulic struts 90, 92 are pivoted
30 to respective ends of the rocker arm 87, to either side of the pivot 76. The bodies of the hydraulic struts 90, 92 are pivoted to a rearwardly extending frame member 89.

In use for shoulder press exercise, the user grasps and pushes the handles 78 contracting deltoid muscles, the handlebar 78 rotating in a vertical arc upwards about horizontal axle 88 against the resistance of strut 92.

5 In use for lat. pull exercise, the user grasps and pulls the handles 78 contracting latisimus dorsi muscles, the handlebar 78 rotates in vertical arc about horizontal axle 88 downwards against the resistance of strut 90.

10 A leg extension and curl module comprises a swing arm 94 horizontally pivoted to the front of framework 12. Padded cross leg-bars 96 and 98 pivot horizontally with the forward end of swing arm 94 and a further padded cross leg-bar 100 is fixed horizontally across the front of framework 12. A bell crank 102 is horizontally pivoted to fixed upwards extension 72. A pushrod 104 is pivoted at one end to the swing arm 94 and at the other end to bell crank 102. A pair of unidirectional hydraulic struts 106 and 108 have piston rods 110 and 112 pivoted to opposed ends of bell crank 102 and the strut bodies are pivoted to the frame member 89.

15 In use for leg curl exercise, a user sits on seat 16 with knees hooked over crossbar 100 and ankles threaded between crossbars 96 and 98. Contracting the posterior thigh muscles (hamstring) rotates the lower leg about cross-bar 100 in a downwards vertical arc against cross-bar 98 and against the resistance of strut 108.

20 In use for leg extension exercise, a user sits on seat 16 with knees hooked over crossbar 100 and ankles threaded between leg-bars 96 and 98. Contracting the quadricep femoris muscles rotates the lower leg about leg-bar 100 in an upwards vertical arc against leg-bar 96 and against the resistance of strut 106.

25 The exercise machine is also provided with a computer-controlled display 114. The computer is programmed to display a range of exercise routines, the routines at least specifying exercising modules to be used and exercise routine appropriate settings for the struts. A user physiological characteristic sensor, such as a blood pressure or pulse monitor, having a link to the computer-controlled display may be provided and the computer-controlled display is programmed to monitor the user physiological characteristic(s) and modify a displayed exercise routine in accordance therewith. For example, a blood pressure monitor could be linked for display of heart rate in relation to exercise intensity for particular exercises or
30 groups of exercises.

CLAIMS

1. An exercise machine comprising:

- i) a seat;
- ii) resistance means;
- iii) an operating member constrained to move in a generally horizontal arc about a generally vertical axis against resistance provided by the resistance means and in a generally vertical arc about a generally horizontal axis against resistance provided by the resistance means; thereby to provide rotational reciprocal movement for both rotary torso and abdominal crunch exercises;

wherein:

- a) the generally vertical axis passes through or near a rear edge zone of the seat;
- b) the generally horizontal axis is positioned forwardly of the generally vertical rotational axis; and
- iv) a frame and at least five exercise modules,

wherein each module comprises:

- a) a carrier pivoted to the frame,
 - b) bidirectional fluidic resistance means acting between the carrier and another carrier or the frame, and
 - c) an operating member attached to the carrier; which operating member is appropriately shaped to be operated by a user by means of the muscle group to be exercised.
2. An exercise machine as claimed in claim 1 comprising a rotary torso module, an abdominal crunch module, a chest press/seated row module, a shoulder press/lat. pull module, and a leg extension and curl module.
3. An exercise machine as claimed in claim 1 or claim 2, wherein the operating members comprise a handlebar, handles or a leg-bar.

4. An exercise machine as claimed in claim 2 wherein:
 - i) the rotary torso module comprises a handlebar constrained to be movable in the generally horizontal arc about the generally vertical axis against the bidirectional fluidic resistance;
 - ii) in the abdominal crunch module the handlebar is arranged to be movable in the generally vertical arc about the generally horizontal axis against the bidirectional fluidic resistance;
 - iii) in the chest press/seated row module a pair of handles are each arranged to be movable in a generally vertical arc about a generally horizontal axis against the bidirectional fluidic resistance;
 - iv) in the shoulder press/lat. pull module a further handlebar is movable in a generally vertical plane against the bidirectional fluidic resistance;
 - and,
 - v) in the leg extension and curl module a leg-bar is rotatable in generally vertical arc about a generally horizontal axis against the bidirectional fluidic resistance.
5. An exercise machine as claimed in any preceding claim, wherein bidirectional fluidic resistance is provided by adjustable hydraulic or pneumatic struts comprising the resistance means.
6. An exercise machine as claimed in claim 5, wherein the adjustable hydraulic or pneumatic struts comprise opposed, independently adjustable, unidirectional struts.
7. An exercise machine as claimed in claim 6, wherein the adjustable hydraulic or pneumatic struts comprise pairs of opposed, independently adjustable, unidirectional struts.
8. An exercise machine as claimed in any preceding claim and provided with a computer-controlled display.

9. An exercise machine as claimed in claim 8 as dependent upon claim 5, 6 or 7, wherein the computer is programmed to display a range of exercise routines, the routines at least specifying exercise modules to be used and exercise routine appropriate settings for the struts.
10. An exercise machine as claimed in claim 8 or claim 9, wherein a user physiological characteristic sensor is linked to the computer-controlled display and the computer-controlled display is programmed to monitor the user physiological characteristic and modify a displayed exercise routine in accordance therewith.