TIBIALIS ANTERIOR STRENGTH
TRAINING MACHINE

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ABSTRACT

A strength training machine for exercising the muscles of the lower leg that lift the foot toward the body, namely the tibialis anterior. The machine includes a frame that supports a seat and either one or two foot positioning devices, such that a seated user can insert his or her feet into the positioning device(s). The positioning device(s) are rotatably supported by the frame with an axis of rotation that approximately intersects the location of the ankles when the feet are inserted into the positioning device(s). A cam, cable, and pulley system connect each positioning device to weights, thereby providing resistance to ankle dorsiflexion.
Fig. 13
BACKGROUND OF THE INVENTION

[0004] 1. Field of the Invention

[0005] This invention relates to a strength training machine for exercising the muscles on the front of the lower leg that lift the foot toward the body.

[0006] 2. Description of the Related Art

[0007] Overall physical fitness is achieved by exercising all the major muscles of the body. It is especially important to exercise antagonistic muscles, ones that oppose one another. Exercising a muscle continuously while neglecting its antagonist often leads to strength and postural imbalances. Also, the neglected muscle has an increased susceptibility to injury. A muscle particularly subject to these concerns is the tibialis anterior.

[0008] The tibialis anterior muscle is located on the front of each lower leg just lateral to the shin bone. It is responsible for dorsiflexion, which is when the foot pivots at the ankle toward the body. Other muscles of the lower leg contribute to dorsiflexion as well, but the tibialis anterior is the most powerful. During the swing phase of human gait, it lifts the foot clear of the ground to prevent tripping. It also controls the lowering of the foot immediately after the heel strikes the ground, thereby dampening impact.

[0009] The calf muscles act antagonistically to the tibialis anterior, meaning they induce the opposite motion. This opposite motion is known as planar flexion, in which the foot pivots at the ankle away from the body. An exercise regimen that includes strength training for the calf should also include strength training for the tibialis anterior to ensure muscular balance. Strength training machines for the calf are commonly found in fitness centers, while those for the tibialis anterior are unfortunately rarely present.

[0010] An isolation exercise is one where movement is restricted to one joint and one muscle group. This technique is appropriately applied to the tibialis anterior when only ankle joint rotation is permitted and only dorsiflexion is resisted. The machine axis of rotation should be closely aligned with the ankle axis of rotation. If these mechanical and anatomical axes do not closely match, the ankle joint is able to translate relative to the machine axis. Consequently, other muscles and joint motions may aid in this translation of the ankle. This has the undesired effect of reducing the tibialis anterior contribution to the exercise and thereby diminishing the strengthening benefit for the tibialis anterior. The present invention includes unique structural features that provide better strength training isolation for the tibialis anterior than any of the related art machines.

[0011] U.S. Pat. No. 2,542,074, issued to William Bierman on Feb. 20, 1951, shows an exercising apparatus for the carpel-tarsal joints which allows for limited strength training of the tibialis anterior muscles. The Bierman machine is intended for rehabilitation of paralyzed patients while they are lying down. The device is intended for resistance levels insufficient to meet the strength training demands of athletes. Further, the foot support of the apparatus lacks an axis of rotation that goes through the foot near the ankle to appropriately isolate the tibialis anterior.

[0012] U.S. Pat. No. 3,120,954, issued to Chris J. Apostol on Feb. 11, 1964, shows an exercise machine that allows for strength training of the tibialis anterior muscles. The Apostol machine lacks any support for the bottom of the foot while exercising the tibialis anterior muscles. This may result in ankle instability and poor isolation of the tibialis anterior.

[0013] U.S. Pat. No. 3,863,916, issued to Vance Allen Cline on Feb. 4, 1975, shows an exercise machine that allows for strength training of the tibialis anterior muscles. The Cline machine lacks an integral seat, forcing the user to provide seating which may not be dimensionally appropriate for the machine. Further, the swing arms of the device lack an axis of rotation that goes through the foot near the ankle to appropriately isolate the tibialis anterior muscle.

[0014] U.S. Pat. No. 4,236,712, issued to Lloyd J. Lambert, Jr. on Dec. 2, 1980, shows an exercise machine for the calf muscles. The Lambert machine is designed to resist the motion of planar flexion and is therefore not appropriate for strength training of the tibialis anterior.

[0015] U.S. Pat. No. 4,591,149, issued to Daniel R. Godfrey on May 27, 1986, shows an exercise machine that allows for strength training of the tibialis anterior muscles. The bar lifted by the foot in the Godfrey machine moves linearly rather than rotationally. Thus, the bar moves relative to the tops of the feet, which may result in discomfort for the user. The Godfrey device lacks an axis of rotation that goes through the foot near the ankle to appropriately isolate the tibialis anterior. Further, the device requires manual loading of weights which can be cumbersome and inconvenient for the user.

[0016] U.S. Pat. No. 4,807,874, issued to Lloyd R. Little on Feb. 28, 1989, shows an exercise machine that allows for strength training of the tibialis anterior muscles. As claimed, it is a combination device for both dorsiflexion and plantar flexion resistance with separate stations for each exercise. In a practical sense, the dual use of the machine would be wasted since most people would not feel comfortable exercising shoulder to shoulder with another person. Not only would the Little machine be more costly to manufacture since it is two machines in one, plantar flexion machines for the calf muscles are commonplace and it is highly likely that fitness centers would already have one. A standalone machine for the tibialis anterior is more practical. Furthermore, the Little device contains an unnecessary apparatus for adjusting the range of motion of the machine, whereas the adjustable seat can be used to alter the orientation of the user’s lower legs and thus match the ankle range of motion to the machine range of motion. The Little machine utilizes a strapping system for fixing the feet, which causes inconvenience by requiring the user to bend down and adjust straps for each foot. The present invention includes an alternative method that avoids this.

[0017] U.S. Pat. No. 4,883,270, issued to Henry H Maag on Nov. 28, 1989, shows a strength training machine for the tibialis anterior muscles. As claimed, the device incorporates rigid seating and no method for users of different size to match their ankle range of motion to the machine range of
motion. Further, the Maag device does not allow independent motion of each ankle necessary to ensure each foot is applying equal amounts of resistance.

[0018] U.S. Pat. No. 5,833,535, issued to Ron D. Williams on Nov. 10, 1998, shows a strength training machine for the tibialis anterior muscles. The exercise bar in the Williams machine spans both feet and therefore does not allow independent motion of each ankle necessary to ensure each foot is applying equal amounts of resistance. This flaw may result in unbalanced conditioning of each leg’s tibialis anterior muscle. Further, the Williams machine lacks an axis of rotation that goes through the foot near the ankle to appropriately isolate the tibialis anterior. The Williams machine contains an unnecessary lever system that raises the exercise bar so that the user can position his or her feet. The purpose of the lever in the Williams machine can be accomplished by the adjustable seating that allows a user to match the starting position of the feet with that required by the machine.

[0019] U.S. Pat. No. 6,277,057, issued to Craig Hayden on Aug. 21, 2001, and U.S. Pat. No. 6,283,897, issued to Blair R. Patton on Sep. 4, 2001, show ankle conditioning devices that allow for limited strength training of the tibialis anterior muscles. The two devices employ piston-cylinders and elastomeric bands, respectively, for resistance, making changes in resistance inconvenient, especially since the user would have to reach to ground level to make such changes. Each apparatus incorporates one foot platform, limiting exercise to one foot at a time. Further, the foot platforms of the Hayden and Patton devices each lack an axis of rotation that goes through the foot near the ankle to appropriately isolate the tibialis anterior muscle.

[0020] U.S. Pat. No. 6,421,935, issued to Michael D. Burtlett on Jul. 23, 2002, shows a therapeutic rocking shoe that provides limited strength training for the tibialis anterior muscles. The device uses body weight for resistance and therefore may provide inappropriate resistance for certain users. Further, the resistance cannot be readily altered to provide the intensity level of strength training demanded by athletes.

[0021] In conclusion, no single prior art exercise device for the tibialis anterior has the combined benefit of properly isolating the tibialis anterior muscles to limit compensating use of other muscles, providing a means to ensure equal resistance to both feet, providing a means to seat and position different users, and including measured resistance levels that are convenient to alter. None of the above patents is seen to describe the present invention as claimed.

[0022] Accordingly, it is a principal object of the invention to provide a strength training machine for exercising the tibialis anterior muscle, which is the primary dorsiflexor for the ankle.

[0023] It is another object of the invention to provide a strength training machine for exercising the tibialis anterior muscle, wherein the resistance experienced during the exercised can be known to the user and easily modified by the user.

[0024] It is a further object of the invention to provide a strength training machine for exercising the tibialis anterior that includes means for users of different size to comfortably and adjustably positions themselves to effectively perform the exercise.

[0025] It is an object of the invention to provide a strength training machine for exercising the tibialis anterior that includes elements and arrangements familiar to fitness equipment manufacturers, so that production of such a strength training machine would be inexpensive and result in a desirable product that is dependable and successful in accomplishing its intended purposes.

[0026] These and other objects of the present invention will become readily apparent upon further review of the following specifications and drawings.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0027] In the drawings, closely related parts have the same reference number but different alphabetic suffixes. The positioning of a user as shown for the first embodiment of the present invention should be assumed to be similar to the positioning of a user for the second and third embodiments of the present invention.

[0028] FIG. 1 is an isometric view showing a person using the first embodiment of the present invention with just the primary assemblies referenced.

[0029] FIG. 2 is an isometric view of the unoccupied first embodiment of the present invention.

[0030] FIG. 3 is an isometric view of the exercise assembly that interfaces with a user’s feet in the first embodiment of the present invention.

[0031] FIG. 4 is an isometric view of the seating assembly that positions a user’s body in the first embodiment of the present invention.

[0032] FIG. 5 is an isometric view of the weight stack assembly that provides resistance to motion of a user’s feet in the first embodiment of the present invention.

[0033] FIG. 6 is an isometric view of the second embodiment of the present invention.

[0034] FIG. 7 is an isometric view of the second embodiment of the present invention.

[0035] FIG. 8 is an isometric view of the second embodiment of the present invention.

[0036] FIG. 9 is an isometric view of the second embodiment of the present invention.

[0037] FIG. 10 is an isometric view of the third embodiment of the present invention.

[0038] FIG. 11 is an isometric view of the third embodiment of the present invention.

[0039] FIG. 12 is an isometric view of the third embodiment of the present invention.
FIG. 13 is an isometric view of the weight stack assembly of the third embodiment of the present invention.

DETAILED DESCRIPTION

FIGS. 1-5—First Embodiment

[0042] The first embodiment of the present invention illustrated in FIGS. 1-5 is a strength training machine 20, which includes an exercise frame 22, a positioning device 24a for a user’s left foot, a positioning device 24b for a user’s right foot, a seating frame 26, an adjustable seat 28, an adjustable backrest 30, and a weight stack frame 32. Exercise frame 22 is fixedly attached to one end of seating frame 26, while weight stack frame 32 is fixedly attached to the opposite end of seating frame 26. Positioning devices 24a and 24b are rotatably supported by exercise frame 22. Adjustable seat 28 and adjustable backrest 30 are slidably supported by seating frame 26.

[0043] Exercise frame 22 consists of two parallel members 34 and 36 supporting a plate 38. Member 34 includes two bolt holes 40 that allow attachment of exercise frame 22 to seating frame 26. Four inclined members 42a, 42b, 42c, and 42d extend from plate 38. Four bracing members 44a, 44b, 44c, and 44d more rigidly fix inclined members 42a, 42b, 42c, and 42d respectively. Inclined members 42a, 42b, 42c, and 42d support bearing units 46a, 46b, 46c, and 46d respectively.

[0044] Positioning device 24a for the left foot includes two plates 52a and 52b that are fixedly attached to opposite sides of a foot plate 54a. A forefoot bar 56a is rotatably supported by side plates 52a and 52b. Forefoot bar 56a has a cushioned covering 58a. Two coaxial pivot shafts 48a and 50a are fixedly attached to side plates 52a and 52b respectively. Pivot shafts 48a and 50a are rotatably supported by bearing units 46a and 46b respectively. A cam 60a is fixedly attached to pivot shaft 50a. One end of a cable 62 is fixed to cam 60a. Along a portion of the periphery of cam 60a is a groove 64a that ensures cable 62 tracks along the periphery of cam 60a as positioning device 24a rotates.

[0045] Positioning device 24b for the left foot includes two plates 52c and 52d that are fixedly attached to opposite sides of a foot plate 54b. A forefoot bar 56b is rotatably supported by side plates 52c and 52d. Forefoot bar 56b has a cushioning covering 58b. Two coaxial pivot shafts 48b and 50b are fixedly attached to side plates 52c and 52d respectively. Pivot shafts 48b and 50b are rotatably supported by bearing units 46c and 46d respectively. A cam 60b is fixedly attached to pivot shaft 50b. The other end of cable 62 is fixed to cam 60b. Along a portion of the outer rim of cam 60b is a groove 64b that ensures cable 62 tracks along the periphery of cam 60b as positioning device 24b rotates.

[0046] Seating frame 26 has two collinear horizontal members 66 and 68, separated by a vertical guide 70. Horizontal member 66 has a bolt plate 72 fixedly attached to its end, allowing attachment of seating frame 26 to exercise frame 22. A vertical spacer 74 projects from the end of horizontal member 68. Another horizontal member 76 is fixedly attached between vertical space 74 and vertical guide 70. Two bolt plates 78 and 80 are fixedly attached to horizontal members 68 and 76 respectively. Bolt plates 78 and 80 allow attachment of seating frame 26 to weight stack frame 32. A vertical member 82 projects from horizontal member 76. A horizontal guide 84 is fixedly attached to vertical member 82. An inclined member 86 projects from horizontal guide 84. A bolt plate 88 is fixedly attached to inclined member 86. Bolt plate 88 allows further attachment of seating frame 26 to weight stack frame 32.

[0047] Adjustable seat 28 consists of a cushioned surface 90 fixedly attached to a selector insert 92. A knob 94 is attached to a spring loaded pin (not shown). A housing 96 for the pin is fixedly attached to vertical guide 70. The spring loaded pin attached to knob 94 passes through the wall of vertical guide 70 and engages with one of several holes 98 distributed along the length of selector insert 92.

[0048] Adjustable back rest 30 consists of a cushioned surface 100 fixedly attached to a selector insert 102. A knob 104 is attached to a spring loaded pin (not shown). A housing 106 for the pin is fixedly attached to horizontal guide 84. The spring loaded pin attached to knob 104 passes through the wall of horizontal guide 84 and engages with one of several holes 108 distributed along the length of selector insert 100.

[0049] Weight stack frame 32 consists of a base member 108, two upright members 110a and 110b that project from base member 108, and a top member 112 that extends across upright members 110a and 110b. Base member 108 includes two bolt holes 114 for attachment of bolt plate 78. Top member 112 includes two bolt holes 116 for attachment of bolt plate 88. Top member 112 also includes two openings 118 for passage of cable 62. An intermediate member 120 extends between upright members 110a and 110b at a height intermediate to base member 108 and top member 112. Intermediate member 120 includes two bolt holes 122 for attachment of bolt plate 80. Intermediate member 120 supports a stack of weight plates 124 when weight plates 124 are at rest. Two guide rods 126a and 126b extend between top member 112 and intermediate member 120. Guide rods 126a and 126b pass through weight plates 124 and confine weight plates 124 to vertical displacement only. Guide rods 126a and 126b also pass through bumpers 128a and 128b located beneath weight plates 124 to dampen the impact of weight plates 124 during the exercise.

[0050] Each weight plate 124 has a central hole aligned with similar holes in all other weight plates 124. Thus when weight plates 124 are stacked atop one another, a vertical passage is formed through all weight plates 124. A selector rod 130 fits through the vertical passage of weight plates 124. The bottom of each weight plate 124 has a horizontal channel 132. Each channel 132 intersects the vertical passage through which selector rod 130 fits. Selector rod 130 includes a plurality of holes (not shown) distributed along its length, each of which corresponds to a channel 132 when weight plates 124 are at rest. A selector pin 134 is inserted through a channel 132 and engaged in the corresponding hole in selector rod 130 to select which weight plates 124 are to be lifted during the exercise.

[0051] A pulley 136 is rotatably supported above selector rod 130. The middle of cable 62 wraps around the underside of pulley 136 to exert a lifting force on selected weight plates 124 during the exercise. Pulley 136 ensures equal tension is created in the two pathways of cable 62 that are routed back to cams 60a and 60b. Two pulleys 138a and 138b are rotatably supported above top member 112. Pulleys 138a and 138b function to route the two pathways of cable 62 downward after each pathway of cable 62 passes through openings 118 in top member 112. Two pulleys 140a and 140b are rotatably supported between base member 108 and intermediate member 120. Pulleys 140a and 140b function
to direct the two pathways of the cable 62 horizontally toward cams 60a and 60b of positioning devices 24a and 24b respectively.

**Operation of the First Embodiment**

[0052] The first embodiment illustrated in FIGS. 1-5 is a strength training machine 20 which is intended for exercising the tibialis anterior muscles on each leg. Contraction of the tibialis anterior muscle causes the foot to dorsiflex about the ankle, bringing it toward the body. A force applied to the top of the forefoot tends to cause it to plantar flex about the ankle, in which it rotates away from the body. Therefore, the tibialis anterior muscle must contract to counteract such a force and create dorsiflexion necessary to complete the exercise.

[0053] The user positions himself or herself by sitting on seat 28 and against backrest 30. Seat 28 and backrest 30 may be slidably adjusted to accommodate the user’s size by disengaging their respective spring pins and then reengaging them into different holes 98 and 107 respectively arranged along selector inserts 92 and 102 respectively. The user inserts the feet into positioning devices 24a and 24b, resting the heels on foot plates 54a and 54b with the forefeet under forefoot bars 56a and 56b. The user aligns the ankles of the feet in close proximity to the common axis of pivot shafts 48a, 48b, 48c, and 48d. This alignment is made possible for a range of foot sizes by means of compressible cushions 58a and 58b that cover forefoot bars 56a and 56b respectively. Vertical adjustment of seat 28 allows the user to keep the thighs in contact for greater comfort; however, this is not necessary as long as the feet can reach positioning devices 24a and 24b. Horizontal adjustment of backrest 30 determines the horizontal distance of the user’s torso from pivot shafts 48a, 48b, 48c, and 48d. In order to maintain the positioning of the feet inside positioning devices 24a and 24b after an increase in horizontal distance of the torso from the axis of rotation of pivot shafts 48a, 48b, 48c, and 48d, the angle of inclination of the lower legs must decrease. This is desirable in that it maximizes the plantar flexed starting position of the feet at the beginning of the exercise, ensuring ample range of motion when the exercise is performed. The horizontal distance may be decreased if necessary to ease insertion of the feet into positioning devices 24a and 24b.

[0054] To perform the exercise, the user first selects a resistance level from weight plates 124. The user then dorsiflexes his or her feet about the ankle, exerting lifting force against cushions 58a and 58b and thereby causing rotation of positioning devices 24a and 24b. This results in uptake of cable 62 along the periphery of cam 60a and 60b. For this to be possible, each tibialis anterior muscle must generate sufficient force to counter the resistance from selected weight plates 124 routed through the pulley and cable system to each cam 60a and 60b. The configuration of the pulley and cable system gives each positioning device 24a and 24b a mechanical advantage of two. This means each positioning device 24a and 24b receives one half the resistance selected from weight plates 124. Likewise, each leg’s tibialis anterior muscle provides equal effort to lift selected weight plates 124, thereby ensuring balanced muscular conditioning. This configuration provides the user with the option to lift and return positioning devices 24a and 24b in succession or in unison.

**FIGS. 6-9—Second Embodiment**

[0055] The second embodiment illustrated in FIGS. 6-9 is a strength training machine 220, which includes an exercise frame 222, a positioning device 224a for the left foot, a positioning device 224b for the right foot, a seating frame 226, an adjustable seat 228, an adjustable backrest 230, and a weight stack frame 232. Weight stack frame 232 is fixedly attached to one end of exercise frame 222, while seating frame 226 is fixedly attached to the opposite end of exercise frame 222. Adjustable seat 228 and adjustable backrest 230 are slidably supported by seating frame 226.

[0056] Exercise frame 222 consists of parallel members 234 and 236 supporting a plate 238. Member 234 includes bolt holes 240 on each end that allow attachment of exercise frame 222 to weight stack frame 232. Member 236 includes two bolt holes 242 that allow attachment of exercise frame 222 to seating frame 226. Four inclined members 244a, 244b, 244c, and 244d extend from plate 238. Four bracing members 246a, 246b, 246c, and 246d more rigidly fix inclined members 244a, 244b, 244c, and 244d respectively. Inclined members 244a, 244b, 244c, and 244d support bearing units 248a, 248b, 248c, and 248d respectively. Two inclined members 250a and 250b extend from the ends of parallel member 236 toward weight stack frame 232. Two bolt plates 252a and 252b are fixedly attached to inclined members 250a and 250b respectively. Bolt plates 252a and 252b allow further attachment of exercise frame 222 to weight stack frame 232.

[0057] Positioning device 224a for the left foot includes two side plates 258a and 258b that are fixedly attached to opposite sides of a foot plate 260a. A footrest bar 262a is rotatably supported by side plates 258a and 258b. Footrest bar 262a has a cushioned covering 264a. Two coaxial pivot shafts 254a and 256a are fixedly attached to side plates 258a and 258b respectively. Pivot shafts 254a and 256a are rotatably supported by bearing units 248a and 248b respectively. A cam 266a is fixedly attached to pivot shaft 254a. One end of a cable 268a is fixed to cam 266a. Along a portion of the periphery of cam 266a is a groove 270a that ensures cable 268a tracks along the periphery of cam 266a as positioning device 224a rotates.

[0058] Positioning device 224b for the left foot includes two side plates 258c and 258d that are fixedly attached to opposite sides of a foot plate 260b. A footrest bar 262b is rotatably supported by side plates 258c and 258d. Footrest bar 262b has a cushioned covering 264b. Two coaxial pivot shafts 254b and 256b are fixedly attached to side plates 258c and 258d respectively. Pivot shafts 254b and 256b are rotatably supported by bearing units 248c and 248d respectively. A cam 266b is fixedly attached to pivot shaft 254b. One end of a cable 268b is fixed to cam 266b. Along a portion of the periphery of cam 266b is a groove 270b that ensures cable 268b tracks along the periphery of cam 266b as positioning device 224b rotates.

[0059] Seating frame 226 has two collinear horizontal members 270 and 272, separated by a vertical guide 274. Horizontal member 270 has a bolt plate 276 fixedly attached to its end, allowing attachment of seating frame 226 to exercise frame 222. A transverse member 278 is fixedly attached to horizontal member 272. A vertical member 280
projects from transverse member 278. Another horizontal member 282 is fixedly attached between vertical member 280 and vertical guide 274. A horizontal guide 284 is fixedly attached to vertical member 280.

[0060] Adjustable seat 228 consists of a cushioned surface 286 fixedly attached to a selector insert 288. A knob 290 is attached to a spring loaded pin (not shown). A housing 292 for the pin is fixedly attached to vertical guide 274. The spring loaded pin attached to knob 290 passes through the wall of vertical guide 274 and engages with one of several holes 294 distributed along the length of selector insert 288.

[0061] Adjustable back rest 230 consists of a cushioned surface 296 fixedly attached to a selector insert 298. A knob 300 is attached to a spring loaded pin (not shown). A housing 302 for the pin is fixedly attached to horizontal guide 284. The spring loaded pin attached to knob 300 passes through the wall of horizontal guide 284 and engages with one of several holes 303 distributed along the length of selector insert 298.

[0062] Weight stack frame 232 consists of a base member 304, two upright members 306a and 306b that project from base member 304, and a top member 308 that extends across upright members 306a and 306b. Base member 304 includes two bolt holes 310 that align with bolt holes 240 of member 234 for attachment of exercise frame 222. Upright members 306a and 306b each include a set of bolt holes 312a and 312b respectively for further attachment of bolt plates 252a and 252b respectively. Top member 308 includes two openings 314a and 314b for passage of cable 268a and 268b respectively. An intermediate member 316 extends between upright members 306a and 306b at a height intermediate to base member 304 and top member 308. Intermediate member 316 supports two stacks of weight plates 318a and 318b when weight plate 318a and 318b are at rest.

[0063] Two guide rods 320a and 320b extend between top member 308 and intermediate member 316. Guide rods 320a and 320b pass through weight plates 318a and confine the weight plates 318a to vertical displacement only. Guide rods 320a and 320b also pass through bumpers 322a and 322b located beneath weight plates 318a to dampen the impact of weight plates 318a during the exercise.

[0064] Two guide rods 320a and 320b extend between top member 308 and intermediate member 316. Guide rods 320a and 320b pass through weight plates 318b and confine weight plates 318b to vertical displacement only. Guide rods 320a and 320b also pass through bumpers 322c and 322d located beneath weight plates 318b to dampen the impact of weight plates 318b during the exercise.

[0065] Each weight plate 318a has a central hole aligned with similar holes in all the other weight plates 318a. Thus when weight plates 318a are stacked atop one another, a vertical passage is formed through all weight plates 318a. A selector rod 324a fits through the vertical passage of weight plates 318a. Each weight plate has a channel 326a formed in the bottom thereof. Each channel 326a intersects the vertical passage through which selector rod 324a fits. Selector rod 324a includes a plurality of holes (not shown) distributed along its length, each of which corresponds to a channel 326a when weight plates 318a are at rest. A selector pin 328a is inserted through a channel 326a and engaged in the corresponding hole in selector rod 324a to select weight plates 318a that are to be lifted during the exercise.

[0066] Each weight plate 318b has a central hole aligned with similar holes in all the other weight plates 318b. Thus when weight plates 318b are stacked atop one another, a vertical passage is formed through all weight plates 318b. A selector rod 324b fits through the vertical passage of weight plates 318b. Each weight plate has a channel 326b formed in the bottom thereof. Each channel 326b intersects the vertical passage through which selector rod 324b fits. Selector rod 324b includes a plurality of holes (not shown) distributed along its length, each of which corresponds to a channel 326b when weight plates 318b are at rest. A selector pin 328b is inserted through a channel 326b and engaged in the corresponding hole in selector rod 324b to select weight plates 318b that are to be lifted during the exercise.

[0067] A pulley 330a is rotatably supported above top member 308. Cable 268a is fixedly attached to selector rod 324a to exert a lifting force on weight plates 318a during the exercise. Cable 268a extends upward and passes through hole 314a, then wraps over pulley 330a. A pulley 332a is rotatably supported below intermediate member 316. Pulley 332a functions to direct the pathway of cable 268a horizontally toward cam 266a of positioning device 224a.

[0068] A pulley 330b is rotatably supported above top member 308. Cable 268b is fixedly attached to selector rod 324b to exert a lifting force on weight plates 318b during the exercise. Cable 268b extends upward and passes through hole 314b, then wraps over pulley 330b. A pulley 332b is rotatably supported below intermediate member 316. Pulley 332b functions to direct the pathway of cable 268b horizontally toward cam 266b of positioning device 224b.

Operation of the Second Embodiment

[0069] The second embodiment of the present invention illustrated in FIGS. 6-9 is a strength training machine 220 that a user operates in similar fashion to the strength training machine 20 of the first embodiment. The distinguishing feature strength training machine 220 has in comparison to the first embodiment is the presence of two stacks of weight plates 318a and 318b. The user must select the desired resistance for each positioning device 224a and 224b from each stack of weight plates 318a and 318b. Weight plates 318a operate exclusively with positioning device 224a and weight plates 318b operate exclusively with positioning device 224b. Simultaneous motion of positioning devices 224a and 224b in opposite directions is not detrimental to the exercise since they are not linked to a single weight source.

FIGS. 10-13—Third Embodiment

[0070] The third embodiment illustrated in FIGS. 10-13 is a strength training machine 420, which includes an exercise frame 422, a positioning device 424, a seating frame 426, an adjustable seat 428, an adjustable backrest 430, and a weight stack frame 432. Exercise frame 422 is fixedly attached to one end of seating frame 426, while weight stack frame 432 is fixedly attached to the side of seating frame 426. Adjustable seat 428 and adjustable backrest 430 are slidably supported by seating frame 426.

[0071] Exercise frame 422 consists of two parallel members 434 and 436 supporting a plate 438. Member 434 includes two bolt holes 440 that allow attachment of exercise frame 422 to seating frame 426. Three inclined members 442a, 442b, and 442c extend from plate 438. Three bracing members 444a, 444b, and 444c more rigidly fix inclined members 442a, 442b, and 442c respectively.
Inclined members 442a, 442b, and 442c support bearing units 446a, 446b, and 446c respectively.

Positioning device 424 includes two side plates 448a and 448b that are fixedly attached to opposite sides of a foot plate 450. A footrest bar 452 is rotatably supported by side plates 448a and 448b. Footrest bar 452 has a cushioned covering 454. Two coxial pivot shafts 456 and 458 are fixedly attached to side plates 448a and 448b respectively. Pivot shaft 456 is rotatably supported by bearing unit 446a. Pivot shaft 458 is rotatably supported by bearing units 446b and 446c. A cam 460 is fixedly attached to pivot shaft 458.

One end of a cable 462 is fixed to cam 460. Along a portion of the periphery of cam 460 is a groove 464 that enables cable 462 tracks along the periphery of cam 460 as positioning device 424 rotates.

Seating frame 426 has two collinear horizontal members 466 and 468, separated by a vertical guide 470. Horizontal member 466 has a bolt plate 471 fixedly attached to its end, allowing attachment of seating frame 426 to exercise frame 422. Another horizontal member 472 projects perpendicularly from horizontal member 468 and has a bolt plate 474 on its end. A vertical member 476 is fixedly attached to the end of horizontal member 468. Another horizontal member 478 is fixedly attached between vertical member 476 and vertical guide 470. A horizontal guide 480 is fixedly attached to vertical member 476. An additional horizontal member 482 projects perpendicularly from vertical member 476 and has a bolt plate 484 on its end.

Adjustable seat 428 consists of a cushioned surface 486 fixedly attached to a selector insert 488. A knob 490 is attached to a spring loaded pin (not shown). A housing 492 for the pin is fixedly attached to vertical guide 470. The spring loaded pin attached to knob 490 passes through the wall of vertical guide 470 and engages with holes 494 distributed along the length of selector insert 488.

Adjustable backrest 430 consists of a cushioned surface 496 fixedly attached to a selector insert 498. A knob 500 is attached to a spring loaded pin (not shown). A housing 502 for the pin is fixedly attached to horizontal guide 480. The spring loaded pin attached to knob 500 passes through the wall of horizontal guide 480 and engages with holes 504 distributed along the length of selector insert 488.

Weight stack frame 432 consists of a base member 506, two upright members 508 and 510 that project from base member 506, and a top member 512 that extends across the tops of upright members 508 and 510. Base member 506 includes two bolt holes 514 that allow for attachment of bolt plate 474. Upright member 510 includes two bolt holes 516 for attachment of bolt plate 474. Top member 512 includes an opening 518 for passage of cable 462. An intermediate member 520 extends between upright members 508 and 510 at a height intermediate to base member 506 and top member 512. Intermediate member 520 supports a stack of weights plates 522 when weight plates 522 are at rest.

Two guide rods 524a and 524b extend between top member 512 and intermediate member 520. Guide rods 524a and 524b pass through weight plates 522 and confine weight plates 522 to vertical displacement only. Guide rods 524a and 524b also pass through bumpers 526a and 526b located beneath weight plates 522 to dampen the impact of weight plates 522 during the exercise.

Each weight plate 522 has a central hole aligned with similar holes in all other weight plates 522. Thus when weight plates 522 are stacked atop one another, a vertical passage is formed through weight plates 522. A selector rod 528 fits through the vertical passage of weight plates 522. Each weight plate has a channel 530 formed in the bottom thereof. Each channel 530 intersects the vertical passage through which selector rod 528 fits. Selector rod 528 includes a plurality of holes (not shown) distributed along its length, each of which registers with a channel 530 when weight plates 522 are at rest. A selector pin 532 is inserted through a channel 530 and engaged in the corresponding hole in selector rod 528 to select plates 522 that are to be lifted during the exercise.

A pulley 534 is rotatably supported above top member 512. Cable 462 is fixedly attached to selector rod 528 to exert a lifting force on weight plates 522 during the exercise. Cable 462 extends upward and passes through opening 518, then is guided along pulley 534. Another pulley 536 is rotatably supported above top member 512. Pulley 536 functions to direct the pathway of cable 462 over the side of weight stack frame 432 and along upright 508. An additional pulley 538 is fixedly attached at the corner of upright 508 and base member 506. Pulley 538 functions to direct the pathway of cable 462 horizontally toward cam 460 of positioning device 424.

Operation of the Third Embodiment

The third embodiment of the present invention illustrated in FIGS. 10-13 is a strength training machine 420 that a user operates in similar fashion to the strength training machines 20 and 220 of the first and second embodiments respectively. The distinguishing feature strength training machine 420 has in comparison to the first and second embodiments is the presence of only one positioning device. To perform the exercise, both of the user’s feet are inserted into positioning device 424. While it is the opinion of the inventors that the first and second embodiments are functionally superior since they best ensure equal resistance to both feet, the simplified structure of the third embodiment would make it less expensive to manufacture.

Conclusion, Ramifications, and Scope

The present invention is the only piece of strength training equipment known to the applicants that is specifically intended for a user to perform exercises of the tibialis anterior muscles with the combined benefits of:

- properly isolating the tibialis anterior muscles to limit compensating use of other muscles;
- providing a means to ensure equal resistance to both feet;
- providing a means to seat and position different users with ease; and
- including measured resistance levels that are convenient to alter.

Although the description above contains much specificity, it should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. Those having ordinary skill in the art and access to the present teachings will recognize additional modifications, applications, and embodiments within the scope thereof.

It is therefore intended by the appended claims to cover any and all such applications, modifications and embodiments within the scope of the present invention.
What is claimed is:

1. A tibialis anterior strength training machine, said strength training machine comprising: a frame;
a seating apparatus attached to said frame;
two positioning devices for a user to insert the feet to perform the exercise;
means for rotatably supporting each of said positioning devices such that each of said positioning devices includes an axis of rotation that is approximately common to the ankle joint axes of a user when the feet are inserted into said positioning devices; and
means for providing a rotational resistance to said axis of rotation of said positioning devices.

2. The strength training machine according to claim 1, wherein said seating apparatus is located at a distance from said positioning devices.

3. The strength training machine according to claim 1, wherein said seating apparatus includes means for selectively adjusting the vertical and horizontal positioning of a user's hips supported by said seating apparatus, whereby a user may optimize the orientation of the legs relative to the orientation of said positioning devices while said positioning devices are at rest.

4. The strength training machine according to claim 1, wherein said means for rotatably supporting each of said positioning devices includes two coaxial pivot shafts fixedly attached to opposite sides of said positioning device such that the axis of said pivot shafts approximates the location of a user's ankle when the foot is inserted into said positioning device, said pivot shafts rotatably supported by said frame, whereby a user may rotate each of said positioning devices independently.

5. The strength training machine according to claim 1, wherein each said positioning device comprises:
a plate having sufficient size to provide a resting surface for the bottom of a user's heel;
two side walls fixedly attached to opposites edges of said plate, said side walls oriented perpendicularly to said plate; and
a bar supported between said side walls, said bar spaced apart from said plate, whereby a user can insert the forefoot between said bar and said plate.

6. The strength training machine according to claim 5, wherein said bar has a cushioning material attached thereto, whereby compression of said cushioning material allows further passage of the forefoot under said bar to allow users having various sized feet to align the ankle in close proximity to the axis of said pivot shafts.

7. The strength training machine according to claim 6, wherein said bar is rotatably supported by said side plates, whereby as a user inserts the forefoot under said bar while the forefoot it in contact with said cushioning material, said cushioning material and said bar rotate in unison to reduce the effort required for passage of the forefoot.

8. The strength training machine according to claim 1, wherein said means for providing a rotational resistance comprises:
a vertical stack of a plurality weight plates supported by said frame, each of said plates having a central hole such that when said plurality of weight plates are vertically stacked a vertical passage is formed throughout said vertical stack, each of said plurality of weight plates having a horizontal channel in the bottom thereof intersecting said vertical passage;
a lifter rod vertically positioned within said vertical passage, said lifter rod having a plurality of holes, a selected one of said plurality of holes being registrable with said channel of a selected one of said plurality of weight plates;
a selector pins engaged to said selected one of said plurality of holes, whereby when said lifter rod is lifted said selected one of said plurality of weight plates and all said plurality of weight plates above said selected one of said plurality of weight plates are lifted with said lifter rod;
a lifter pulley rotatably supported atop said lifter rod;
a cable have a middle and two ends, said middle of said cable routed around said lifter pulley;
at least one guide pulley supported by said frame, said cable being routed around said at least one guide pulley; and
two sets of at least one pulley supported by said frame, each of said sets of at least one pulley corresponding to one of said positioning devices, said cable being routed around said sets of at least one pulley; and
two cams having an outer perimeter, each of said cams corresponding to one of said positioning devices with said cam fixedly attached to one of said pivot shafts, each of said ends of said cable corresponding to one of said cams and fixedly attached thereto, whereby as the user rotates the ankle so that the feet move toward the body while the feet are inserted into a said positioning devices, more of said cable is taken up around said outer perimeter of said cam resulting in said lifter pulley and said weight being lifted with said lifter pulley distributing an equal resistance through said cable to each said cam.

9. The strength training machine according to claim 1, wherein said means for providing a rotational resistance comprises:
two vertical stacks of a plurality weight plates supported by said frame, each of said plates having a central hole such that when said plurality of weight plates are vertically stacked a vertical passage is formed throughout said vertical stack, each of said plurality of weight plates having a horizontal channel in the bottom thereof intersecting said vertical passage;
two lifter rods, each said lifter rod corresponding to one said vertical stack of a plurality weight plates, said lifter rod vertically positioned within said vertical passage, said lifter rod having a plurality of holes, a selected one of said plurality of holes being registrable with said channel of a selected one of said plurality of weight plates;
two selector pins, each said selector pin corresponding to one said vertical stack of a plurality weight plates, said selector pin engaged to said selected one of said plurality of holes, whereby when said lifter rod is lifted said selected one of said plurality of weight plates and all said plurality of weight plates above said selected one of said plurality of weight plates are lifted with said lifter rod;
two cables, each of said cables corresponding to one said lifter rod, each of said cables having a first end and second end, said first end of said cable being fixed to said lifter rod;
two sets of at least one pulley supported by said frame, each of said sets of pulleys corresponding to one of said cables, said cable being routed around said at least one pulley; and
two cams having an outer perimeter, each of said cams corresponding to one of said positioning devices with said cam fixedly attached to one of said pivot shafts, each of said cams corresponding to one of said cables, said second end of said cable being fixed to said cam, whereby as the user rotates the ankles so that the feet move toward the body while the feet are inserted into said positioning devices, more of said cables is taken up around said outer perimeters of each of said cams resulting in said stacks of a plurality weight plates being lifted.

10. A tibialis anterior strength training machine, said strength training machine comprising:
a frame;
a seating apparatus attached to said frame;
two positioning devices for a user to insert the feet to perform the exercise;
means for rotatably supporting each of said positioning devices by said frame;
means for users having various sizes of feet to adjustably insert the feet into said positioning devices such that the ankle joint axes are approximately common to the axis of rotation of said positioning devices; and
means for providing a rotational resistance to said positioning devices.

11. The tibialis anterior strength training machine according to claim 10, wherein said means for rotatably supporting each of said positioning devices includes two coaxial pivot shafts fixedly attached to opposite sides of said positioning device such that the axis of said pivot shafts approximates the location of a user’s ankle when the foot is inserted into said positioning device, said pivot shafts rotatably supported by said frame, whereby a user may rotate each of said positioning devices independently.

12. The strength training machine according to claim 10, wherein each said positioning device comprises:
a plate having sufficient size to provide a resting surface for the bottom of a user’s heel;
two side walls fixedly attached to opposites edges of said plate, said side walls oriented perpendicularly to said plate; and
a bar supported between said side walls, said bar spaced apart from said plate, whereby a user can insert the forefoot between said bar and said plate.

13. The strength training machine according to claim 12, wherein said means for users having various sizes of feet to adjustably insert each foot into each of said positioning devices comprises a cushioning material attached to said bar, whereby compression of said cushioning material allows further passage of the forefoot under said bar to allow the user to align the ankle in close proximity to the axis of said pivot shafts regardless of foot size.

14. A tibialis anterior strength training machine, said strength training machine comprising:
a frame;
a seating apparatus attached to said frame;
one positioning device for a user to insert the feet to perform the exercise;
means for rotatably supporting said positioning device by said frame;
means for users having various sizes of feet to adjustably insert the feet into said positioning device such that the ankle joint axes are approximately common to the axis of rotation of said positioning device; and
means for providing a rotational resistance to said positioning device.

15. The tibialis anterior strength training machine according to claim 14, wherein said means for rotatably supporting said positioning device includes two coaxial pivot shafts fixedly attached to opposite sides of said positioning device such that the axis of said pivot shafts approximates the location of a user’s ankles when the feet are inserted into said positioning device, said pivot shafts rotatably supported by said frame.

16. The strength training machine according to claim 14, wherein said positioning device comprises:
a plate having sufficient size to provide a resting surface for the bottom of a user’s heels;
two side walls fixedly attached to opposites edges of said plate, said side walls oriented perpendicularly to said plate; and
a bar supported between said side walls, said bar spaced apart from said plate, whereby a user can insert the forefoot between said bar and said plate.

17. The strength training machine according to claim 16, wherein said means for users having various sizes of feet to adjustably insert the feet into said positioning device comprises a cushioning material attached to said bar, whereby compression of said cushioning material allows further passage of the forefoot under said bar to allow the user to align the ankles in close proximity to the axis of said pivot shafts regardless of foot size.