

[54] EXERCISING DEVICE

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[58] Field of Search 73/379, 380, 381, 141;
272/57, 72, 79, 80, 81, 82, 83; 60/54.5

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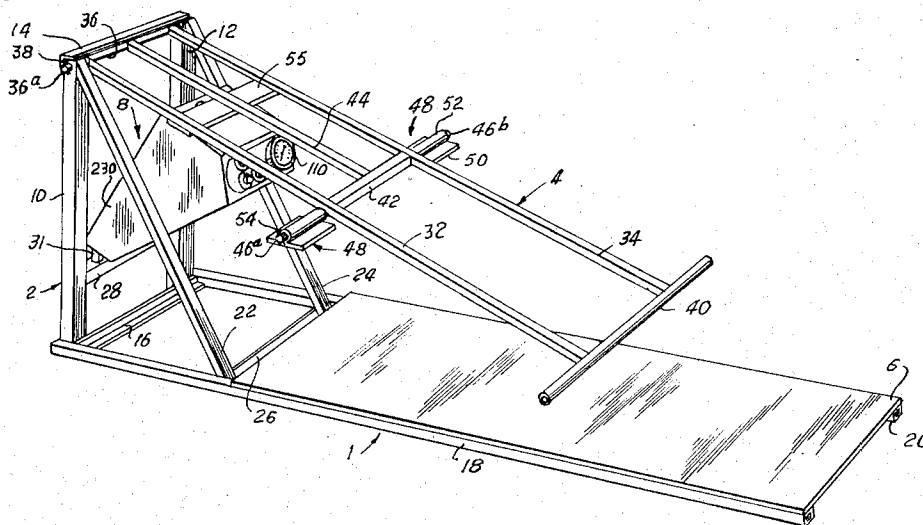
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[57]

ABSTRACT

An exercising device comprising a handle pivotally mounted on a frame with a hydraulic system connected to the handle to exert a regulated force restraining movement of the handle. The hydraulic system comprises a hydraulic cylinder, a reservoir, a valve arranged to prevent movement of the handle until a force of predetermined regulated magnitude is exerted on the handle, and a second valve arranged to control the rate of movement of the handle when a force exceeding the predetermined magnitude is exerted thereon. A calibrated gauge indicates the magnitude of force exerted at various points on the handle.

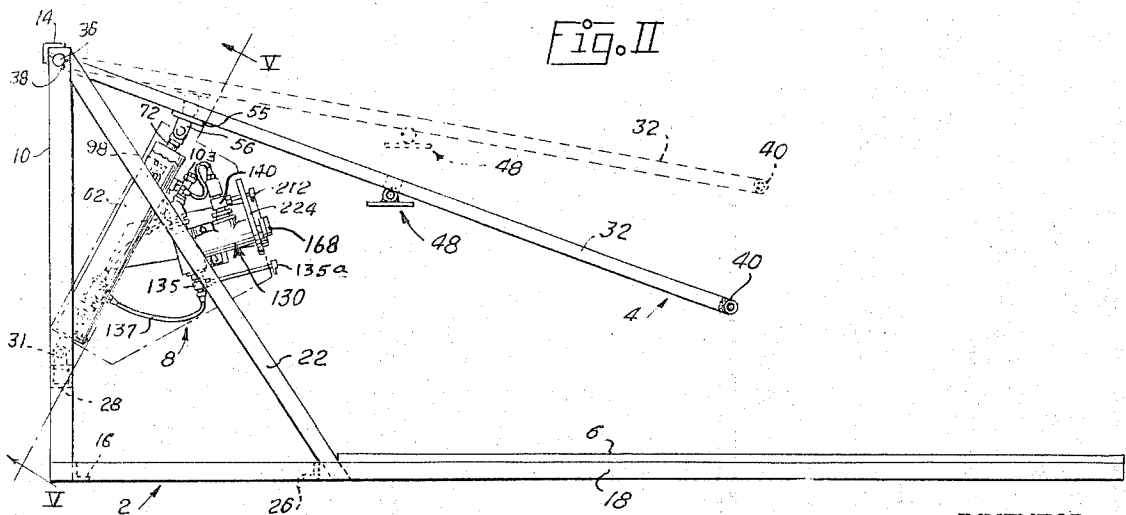
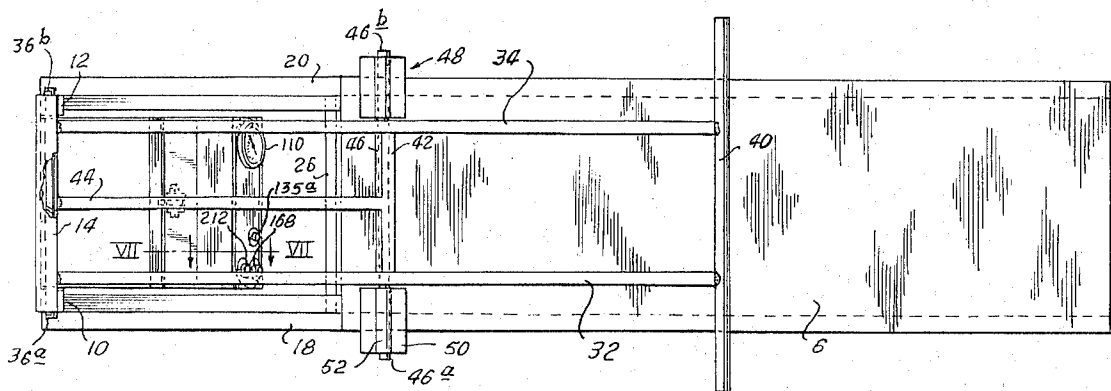
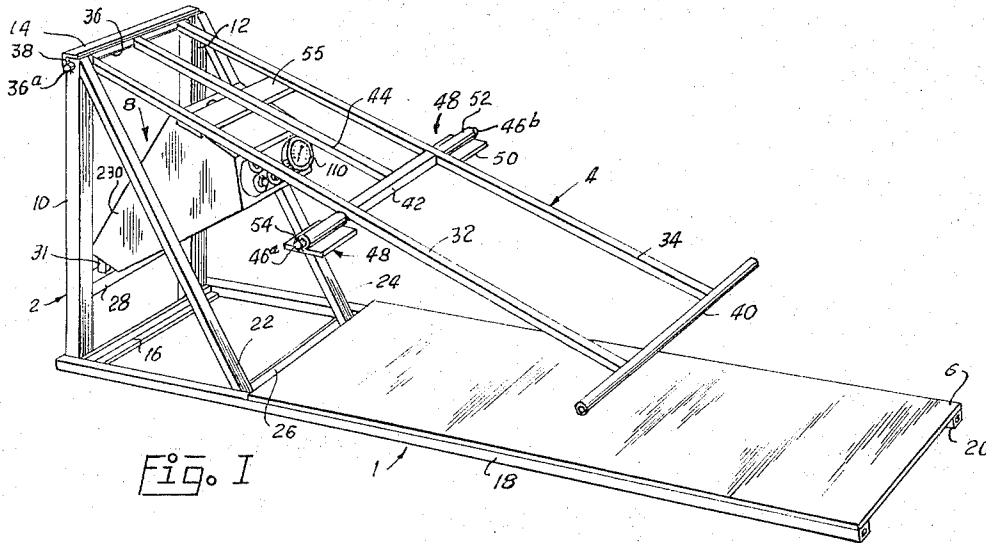
19 Claims, 11 Drawing Figures



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SHEET 1 OF 4



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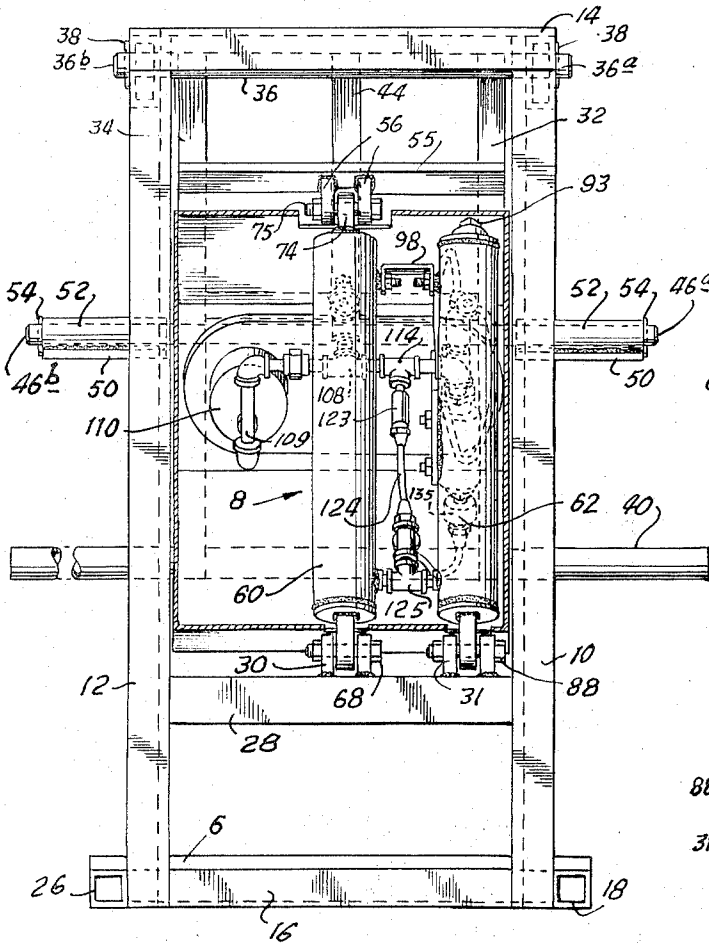


Fig. IV

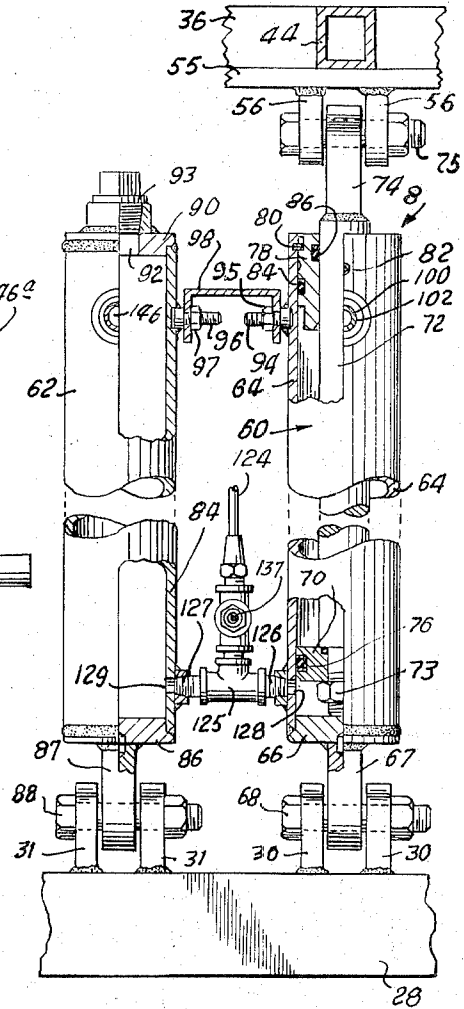


Fig. V

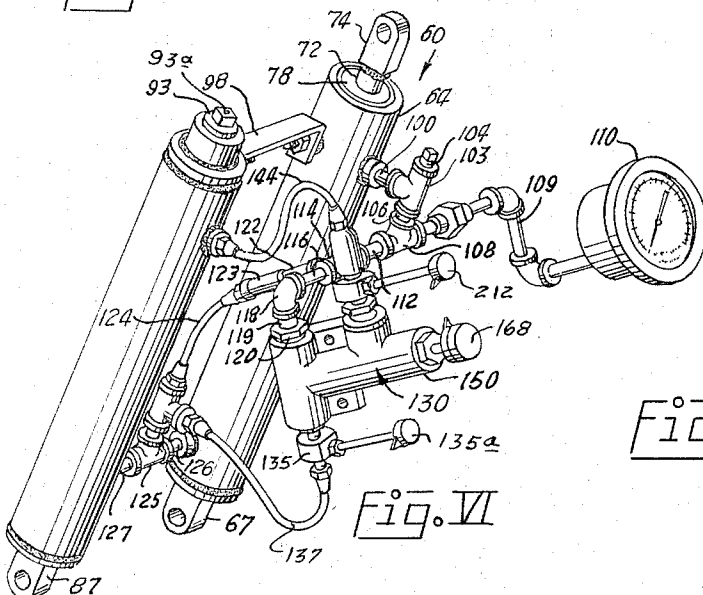
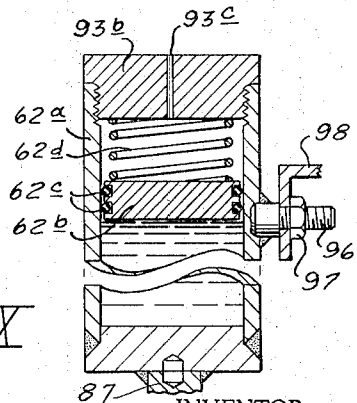


Fig. VI

Fig. IX



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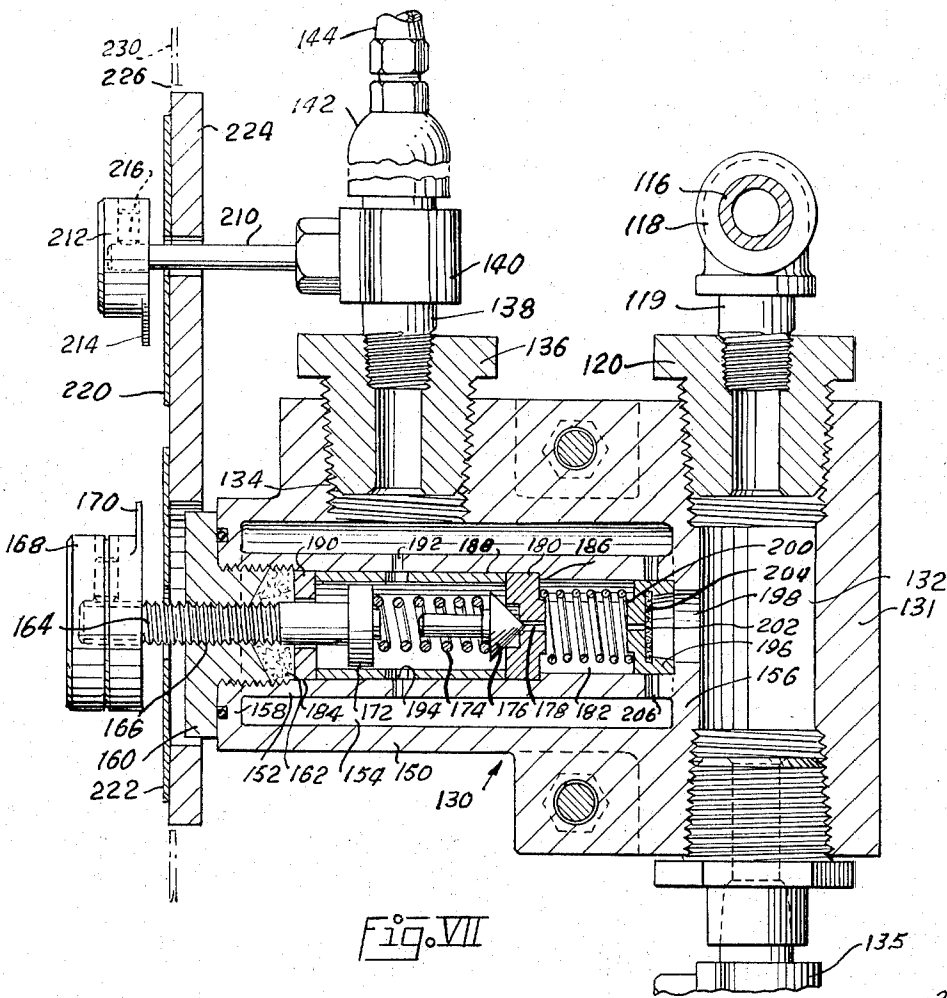


Fig. VII

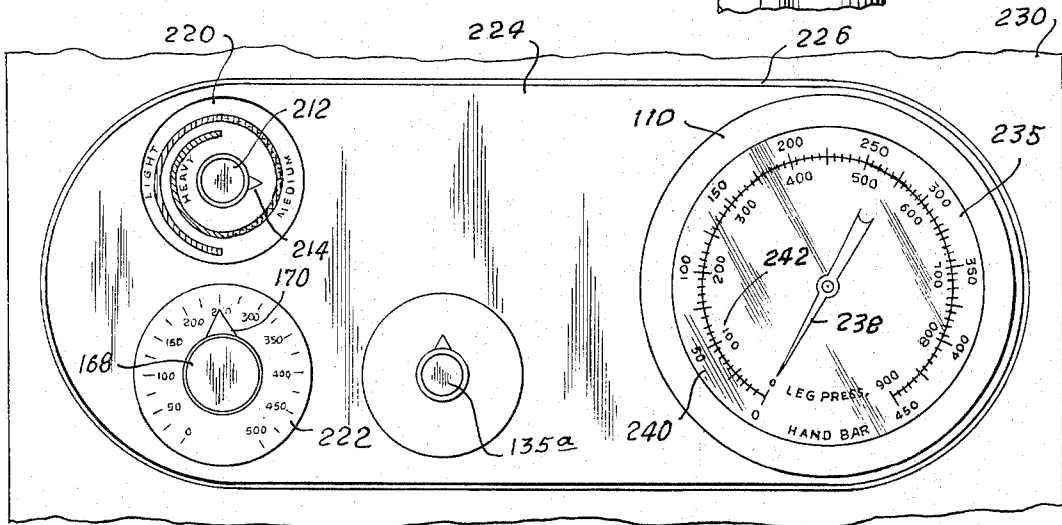
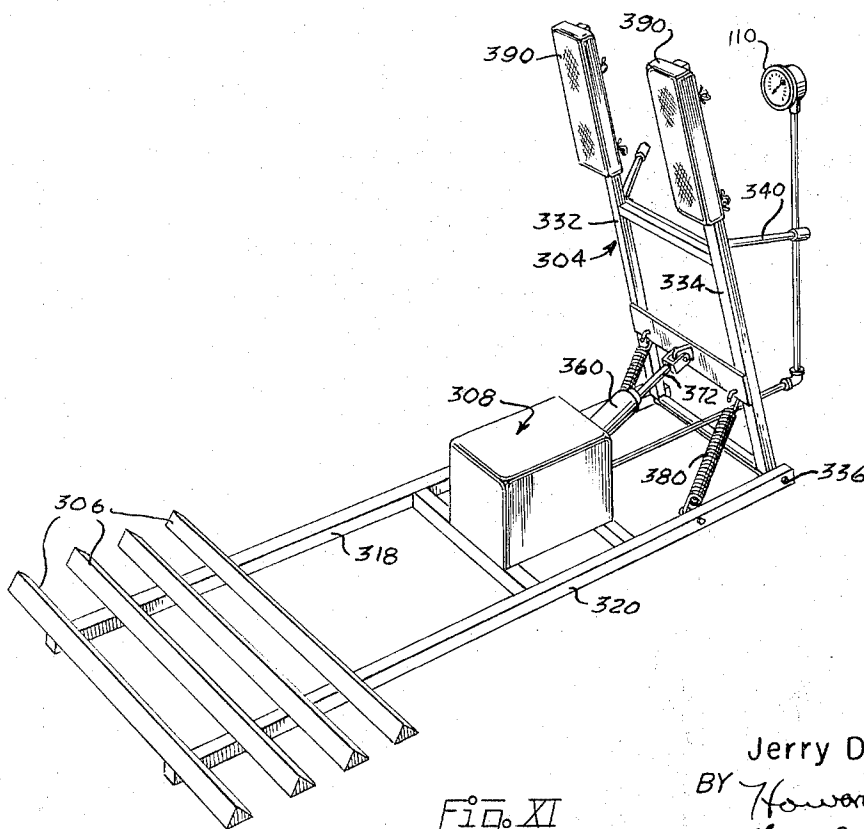
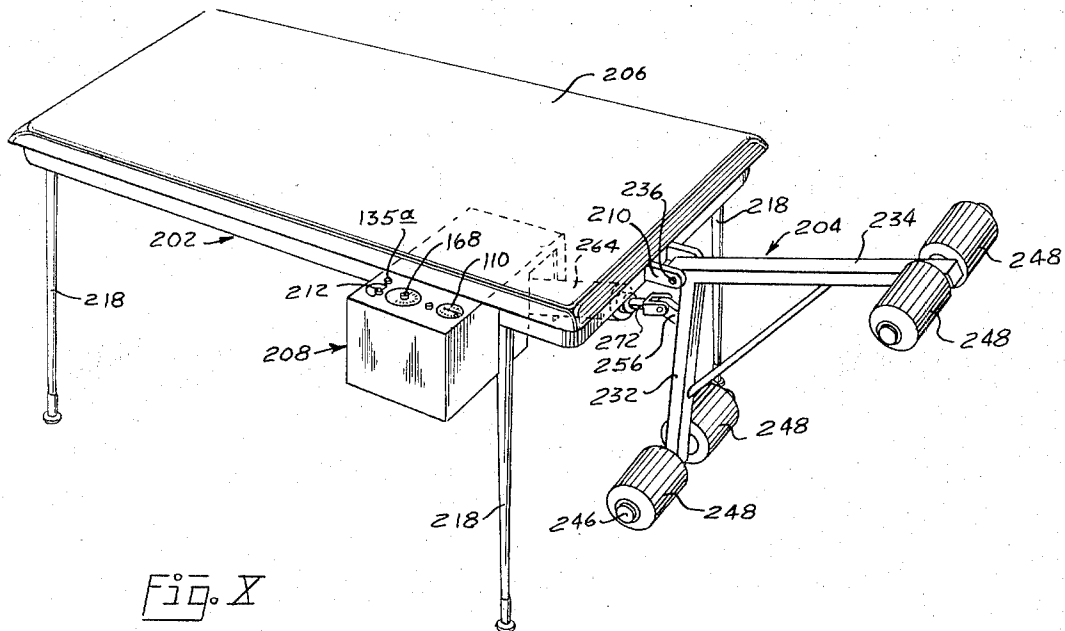


Fig. VIII

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EXERCISING DEVICE

BACKGROUND OF INVENTION

Heretofore, the most commonly used exercising device for muscle development was the bar-bell which comprised a bar with weights on opposite ends thereof. The weight of the bar-bell could be varied by adding or removing weights from the ends of the bar.

One of the major users of bar-bells and other exercising devices has been educational institutions which generally have required physical education courses for all students and voluntary athletic programs for those who wish to participate. The exercising devices heretofore developed, particularly bar-bells, present numerous short comings which greatly reduce the effectiveness of the devices in large physical education classes.

To obtain maximum benefit from weight lifting while spending a minimum of time in a session, research reveals that it is desirable to exert maximum force against a fixed resistance for isometric contraction of muscles until the muscles begin to tire and then move through the resisting force for concentric or eccentric contraction of the muscles. No exercising device heretofore developed has had the capability of providing such exercise while providing an indication of the magnitude of force exerted against the fixed and moving resistances.

Indication of the magnitude of force exerted makes progress in lifting capability readily apparent to the student. This is of great psychological importance and tends to instill ambition and determination in a student which are mandatory for an effective physical education program. Exercising devices heretofore developed generally indicated whether or not a specific force could be exerted.

In a relatively large class, for example, fifty students, a major portion of the allotted class period, usually fifty minutes, is consumed changing weights on the bar-bells. If each student is to obtain maximum benefit from a weight lifting program the correct weight for each student for each exercise must be used. Because of the wide range of lifting capability of the students the use of the proper weight is seldom practical employing exercise devices heretofore developed.

Safety is another major difficulty encountered in using bar-bells because of the ever present danger of the student "loosing," a weight causing the bar-bell to fall. An average athlete in a body building program works with three hundred pounds or more of weight.

Exercises are generally conducted in repetitions. Fixed weight exercising devices do not allow the lifting of all of the weight which a particular student is capable of lifting through each of a given number of repetitions. As the muscles tire, the lifting capability decreases.

Bar-bells and other fixed weight devices are expensive and require racks, stands and benches for performing various exercises. A wooden platform is usually required to prevent damage to floors.

Exercising devices heretofore developed require an excessive amount of storage space.

Because of the noise resulting from dropping of weights on the floor or other suitable support means, weight rooms in educational institutions have had to be far removed from other classrooms to minimize the noise level.

Versatility is another major shortcoming of exercising devices heretofore developed, most of said devices being constructed specifically for one or more exercises and often requiring two assistants to help in placing weights, as for example, on the shoulders.

SUMMARY OF INVENTION

I have developed an exercising device which eliminates the deficiencies hereinbefore enumerated in exercising devices. The resistive force may be quickly adjusted by merely rotating the stem of a control device and a direct read out gauge informs the user the exact magnitude of the resistive force exerted through any number of repetitions. The device is inexpensive to construct, and occupies minimum space while in use and in storage.

The exercising device which I have developed comprises an actuating member pivotally connected to a frame with a gripper bar on one end of the actuating member, and foot supports intermediate opposite ends of the actuating member providing a single versatile exercise device upon which most weight lifting exercises may be realistically simulated without changing weights and racks.

A regulated restraining force is applied to the actuating members through a fluid system which is arranged to provide finger-tip control of the magnitude of the restraining force and of the rate of movement of the actuating member to provide maximum benefit of the exercising device. A specially constructed control valve provides precise regulation of the magnitude of the force restraining movement of the actuating member and a restrictor connected in series with the regulating device in the fluid system provides a control for varying the rate of movement of the actuating member when a force exceeding the magnitude of force required for initial movement is applied to the actuating member.

A pressure gauge indicates the magnitude of force exerted by the user whether or not he is able to overcome the pre-set force required to initiate and maintain movement of the actuating member. The fluid system applies a restraining force substantially equal to the force exerted on the actuating member and indicates the magnitude of the force even though the magnitude of force exceeds that required to initiate and maintain movement, thus providing a device for isokinetic exercising. The restraining force varies automatically as the applied force varies over the full range of movement.

The exercising device is quite useful as a testing apparatus because the force exerted is indicated for each repetition of an exercise thus eliminating the possibility that the user will expend his energy unsuccessfully attempting to lift a weight which is too heavy or will tire himself lifting weights which are too light while working up to his limit, which will be substantially reduced after several repetitions. Heretofore, the average weight lifter had no way of determining how much force he was capable of exerting at each point over a full range of movement because the only way to gain such knowledge was by trial and error over a long period of time.

Two modified forms of the exercise device for therapeutic applications and for testing and developing muscles used for the specific movements of blocking and tackling used in football drills are illustrated and described herein.

A primary object of the present invention is to provide an exercising device in which the restrictive force may be quickly and accurately varied with a minimum of effort.

Another object of the invention is to provide an exercise device capable of allowing the user to exert maximum force which he is capable of exerting, the exercise device indicating the magnitude of exerted force, through any number of repetitions and at each leverage point of the body of the user as the resistive force is acted on through the full range of movement.

Another object of the invention is to provide an exercise machine which is completely safe to use making it impossible for a user to injure himself by dropping weights.

A further object of the invention is to provide an exercising device which is highly versatile allowing the user to perform numerous exercises employing the exercising device without the necessity of time consuming and exhausting modification of the structure to perform several different exercises.

A further object of the invention is to provide an exercising device which is capable of measuring and reacting to short and sharp explosive efforts of the user.

A further object of the invention is to provide an exercise device of inexpensive construction which occupies minimum space while in use and in storage.

A still further object of the invention is to provide an exercise device which provides regulated restraining force, independent of the force of gravity, being capable of operation at zero gravity.

A still further object of the invention is to provide an exercising device for therapeutic applications which exerts a variable restraining force equal to the force applied through the full range of movement of a part of the human body, without exerting a force along an arm or leg which would tend to separate a joint.

A still further object of the invention is to provide an exercise device which is portable, making the device easily movable between a place of storage and a place of use and thus conserves space.

Other and further objects of the invention will become apparent upon referring to the detailed description hereinafter following and to the drawings annexed hereto.

DESCRIPTION OF THE DRAWINGS

Drawings of a preferred embodiment of the invention are annexed hereto so that the invention may be better and more fully understood, in which:

FIG. I is a perspective view of the exercise device;

FIG. II is a top plan view;

FIG. III is a side elevational view;

FIG. IV is an elevational view of the back-end of the exercise device with parts broken away to more clearly illustrate the details of construction;

FIG. V is a cross-sectional view taken along line V—V of FIG. III;

FIG. VI is a perspective view of the fluid system employed in the exercise device;

FIG. VII is an enlarged cross-sectional view taken substantially along line VII—VII of FIG. II;

FIG. VIII is an enlarged fragmentary elevational view of the control panel of the exercise device;

FIG. IX is a cross-sectional view of a modified form of the reservoir;

FIG. X is a perspective view of a modified form of the exercising device particularly adapted for exercising the knee; and,

FIG. XI is a modified form of the invention particularly adapted for football player exercises.

Numeral references are employed to designate like parts throughout the various parts of the drawings.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. I of the drawing the numeral 1 generally designates an exercise device comprising a frame 2 having actuating means 4 pivotally connected thereto, a platform 6 and actuated means 8 pivotally connected between the frame 2 and the actuating means 4.

Frame 2 is constructed of any suitable material and is comprised of spaced up-right stanchions 10 and 12, having an upper cross member 14 and a lower cross member 16 rigidly secured to the upper and lower ends thereof, with spaced base members 18 and 20 extending outwardly therefrom.

Brace members 22 and 24 extend diagonally from the upper end of stanchions 10 and 12 outwardly and have lower ends welded or otherwise rigidly secured to base members 18 and 20.

Suitable braces 26 extend transversely between spaced members 18 and 20 and are welded or otherwise rigidly secured thereto to provide desired structural strength and rigidity to the frame 2.

Suitable anchor means, such as member 28, is rigidly secured between stanchions 10 and 12 and actuated means 8 is pivotally mounted on lugs 30 and 31, intermediate opposite ends thereof.

Actuating means 4 comprises elongated members 32 and 34 rigidly secured in spaced apart relation to axle 36, opposite ends 36a and 36b of said axle 36 being rotatably secured in an upper portion of stanchions 10 and 12. Suitable means such as keys 38 are provided to prevent disengagement of opposite ends of axle 36 from apertures through stanchions 10 and 12.

A gripper bar 40 is welded or otherwise rigidly secured to the outer ends of members 32 and 34 and is preferably circular in cross-section to facilitate gripping same with the hands.

Suitable reinforcing, such as transverse member 42 and longitudinal member 44, are provided to assure that actuating member 4 has sufficient strength and rigidity.

A shaft 46 is welded or otherwise rigidly secured intermediate opposite ends of members 32 and 34 and the ends 46a and 46b of said shaft extend outwardly from opposite sides of the actuating means 4 and have suitable foot supports or pedals 48 pivotally secured thereto. Pedals 48 comprise plates 50 rigidly secured to tubular members 52 secured about the outer ends 46a and 46b of shaft 46. Suitable means, such as keys 54, is provided to prevent disengagement of pedals 48 from the ends of shaft 46.

Member 55 is welded or otherwise rigidly secured to members 32, 34 and 44 and has lugs 56 extended downwardly from the lower side thereof to which the upper end of actuated means 8 is pivotally connected.

Actuated means 8 comprises a fluid circuit including a pump, such as cylinder assembly 60; reservoir assembly 62; and suitable conduits and valves connected

therebetween to control the flow of fluid through the pump to regulate the resisting force and rate of movement of bar 40 and pedals 48 on actuating means 4.

Cylinder assembly 60 comprises a hollow tubular member 64 having a plate 66 welded or otherwise rigidly secured across the lower end thereof with an ear 67 pivotally secured by a bolt 68 to lugs 30 secured to anchor member 28. A piston 70, secured to piston rod 72, is slidably disposed through hollow tubular member 64. The upper end of rod 72 has an ear 74 rigidly secured thereto and is pivotally connected by a bolt 75 to lugs 56 which are secured to member 55 on actuating means 4 as hereinbefore described.

Suitable means, such as O-ring seal 76, is provided to prevent leakage of fluid around piston 70. A suitable cylinder head 78 is secured in the upper end of tubular member 64 and is secured therein by a retaining ring 80 and set screws 82. O-ring seals 84 and 86 are provided to prevent leakage of fluid from the upper end of the tubular member 64.

Reservoir assembly 62 comprises a tubular member 84 having a plate 86 welded or otherwise rigidly secured to the lower end thereof. An ear 87, extending downwardly therefrom, is pivotally secured to a bolt 88, extending through apertures, in lugs 31 which are welded or otherwise rigidly secured to anchor member 28 of frame 2. The upper end of tubular member 84 has a plate 90 welded or otherwise rigidly secured thereacross, said plate 90 having a passage 92 extending therethrough being normally closed by a threaded fill plug 93, having a breather passage 93a extending therethrough.

Tubular members 64 and 84 have bolts 94 and 96, respectively, welded thereto, said bolts extending through apertures in bracket 98 and being secured thereto by nuts 95 and 97, respectively.

A modified form of the reservoir is illustrated in FIG. IX of the drawings. Reservoir assembly 62a has a piston 62b slidably disposed therein with suitable sealing means, such as O-rings 62c, disposed about the outer edge thereof. Suitable means, such as spring 62d, urges piston 62b downwardly into engagement with the upper surface of fluid in the reservoir 62a. Spring 62d preferably is not strong enough to exert an appreciable force through the fluid to materially affect the fluid pressure. A fill cap 93b, having a breather passage 93c extending therethrough, is threadedly engaged with the upper end of reservoir assembly 62a. It should be readily apparent that piston 62b allows the entire fluid system described herein to be sealed from the atmosphere. The function of piston 62b and spring 62d is to provide means for automatically varying the volume of reservoir 62a and consequently the volume of the fluid system to compensate for the volume of piston rod 72 which moves in and out of fluid in cylinder 60.

Referring to FIGS. V and VI of the drawing, tubular member 64 of cylinder assembly 60 has a conduit 100 threadedly secured in aperture 102 in the upper end of said tubular member above piston 70 and the other end of said conduit is threadedly secured in a suitable fitting, such as tee 103 having a bleed plug 104 threadedly secured in an opening therein and a conduit 106 connecting said fitting to fitting 108.

Fitting 108 communicates through suitable piping 109 to a gauge 110 calibrated to indicate the magnitude of force applied to actuating member 4 as will be hereinafter more fully explained.

Fitting 108 is also connected through tube 112 to tee coupling 114 which is connected through tube 116, elbow 118, and tube 119 of nipple 120 threadedly secured in the inlet passage of pressure control device 130 as will be hereinafter more fully explained.

Coupling 114 is also connected through tube 122, check valve 123, and return line 124 to a suitable coupling 125 in fluid communication through conduits 126 and 127, respectively, with the inside of the lower ends of tubular members 64 and 84 through apertures 128 and 129.

Check valve 123 prevents the flow of fluids downwardly through return line 124 while allowing unrestricted flow upwardly from the lower ends of cylinder assembly 60 and reservoir assembly 62 through return line 124, coupling 114, coupling 112, 108, tube 106, fitting 103, tube 100 to the inside of tubular member 64 above piston 70.

Pressure regulating means, such as pressure relief valve 130, best illustrated in FIG. VII, comprises a body 131 having an inlet passage 132, into which nipple 120 is threadedly secured, and an outlet passage 134, having a nipple 136 threadedly secured therein in fluid communication through conduit 138 with a restrictor valve 140.

Restrictor valve 140 is connected through a suitable coupling 142 and tube 144 to an aperture 146 extending through an upper portion of the wall of tubular member 84 of reservoir assembly 62.

A valve 135, in bypass line 137, is in fluid communication with inlet passage 132 and return line 124. It should be readily apparent that when valve 135 is closed fluid is directed to passage 198 and plunger 196, as will be hereinafter more fully described. However, when valve 135 is open, pressure regulating device 130 is bypassed.

Pressure regulating device 130, FIG. VII, has an outer cylindrical wall 150 and an inner cylindrical wall 152 with an annular passage 154 disposed therebetween. Outlet passage 134 extends through outer wall 150 and is in fluid communication with annular passage 154. End walls 156 and 158 extend across and close opposite ends of annular passage 154 and connect outer wall 150 to inner wall 152. A stuffing nut 160 is threadedly secured in the outer end of the inner cylindrical tubular wall 152 to compressively engage packing 162 to prevent leakage of fluid around stem 164 which extends through threaded aperture 166 in stuffing nut 160. The outer end of stem 164 has a knob 168 and a pointer 170 rigidly secured thereto. The inner end of stem 164 has an enlarged portion 172 rigidly secured thereto in regulated pressure contact with spring 174 to urge same against conical valve member 176 which normally closes orifice 178 extending through orifice plate 180 which is disposed across passage 182 inside inner tubular wall 152. Passage 182 has an enlarged portion 184 in the outer end thereof forming a shoulder 186 against which orifice plate 180 is urged by hollow tubular member 188, washer 190 and packing 162.

Passages 192 extend through inner walls 152 and passages 194 extend through tubular member 188 connecting the inside of said tubular member 188 with annular passage 154 which is in turn in fluid communication with the outlet 134 of the pressure regulating device.

A plunger 196 is slidably disposed in passage 182 and is urged outwardly in sealing engagement about aper-

ture 198 which extends through wall 156 by a spring 200 which is disposed in abutting relation with orifice plate 180.

An orifice 202 covered by a screen 204 extends through plunger 196, said orifice 202 being smaller in diameter than the orifice 178 in orifice plate 180. The passage 182 between plunger 196 and orifice plate 180 forms a pressure chamber.

Apertures 206 extend through the inner ends of walls 152, said apertures being normally sealed by the outer edges of plunger 196.

Spring 174 is stiffer than spring 200. For fluid to flow from inlet passage 132 to outlet passage 134, the fluid pressure acting on plunger 196 must compress spring 200 thereby compressing fluid in passage 182 between plunger 196 and orifice plate 180. Fluid pressure through orifice 178 in orifice plate 180 exerts force on conical valve member 176 to compress spring 174. As valve member 176 is moved outwardly fluid in passage 182 flows through orifice 178, to outlet passage 134 through apertures 194 and 192 allowing plunger 196 to move into passage 182 a distance sufficient to allow fluid flow from inlet 132 through apertures 206, annular passage 154 to outlet passage 134.

Restrictor 140, secured to the outlet passage 134 of pressure regulating device 130 through conduit 138 and nipple 136, is of conventional design and has a variable passage extending therethrough, the size of said passage being regulated by rotating stem 210 having a knob 212 and pointer 214 rigidly secured thereto by a set screw 216.

Dials 220 and 222 are secured to a control panel 224 which extends through an opening 226 in the front of housing 230. The face of gauge 110 also extends through control panel 224.

Dial 220 is fixed to the control panel 224 adjacent pointer 214 on knob 212 secured to shaft 210 of restrictor valve 140. As best illustrated in FIG. VIII of the drawing, dial 220 is divided into three regions designated "light, medium and heavy." When pointer 214 is positioned at "light" on dial 220 restrictor valve 140 is opened to allow actuating means 4 to move rapidly. Positioning pointer 214 at "heavy" reduces the size of the passage through restrictor valve 140 and allows actuating means 4 to move slowly when force is exerted thereon.

Dial 222, adjacent pointer 170, is calibrated to indicate the magnitude of force which must be exerted on actuating means 4 to cause valve element 176 in control device 130 to open to allow fluid to flow from the upper end of cylinder 60 allowing actuating means 4 to move.

Pressure gage 110 has a dial face 235 upon which pointer 238 indicates the magnitude of force exerted at various locations on the actuating means. Outer calibrations 240 indicate the magnitude of force exerted upon gripper bar 40 while the inner calibrations 242 indicate the magnitude of force exerted on pedals 48. The calibration of dial face 235 is dictated by the mechanical advantage achieved by the relative position of the grip bar 40 and pedals 48. Empirical data may be utilized for calibration purposes by applying known forces at desired locations on the actuating means 4.

OPERATION

The operation and function of the device hereinbefore described is as follows:

The user, or an assistant, of the exercise device rotates knob 168 to the desired calibration on dial 222 to adjust pressure regulating device 130 to prevent the flow of fluid from cylinder 60 until a force of desired magnitude is applied to gripper bar 40. As illustrated in FIG. VIII of the drawing, pointer 170 is set at 250 pounds. Therefore conical valve element 176 will not compress spring 174 to open orifice 178 in orifice plate 180 until a force of 250 pounds has been applied to gripper bar 40, or 500 pounds to pedals 48. It should be readily apparent that the calibrations on dial 222 correspond to the magnitude of force registered on outer calibration 240 of dial 235 of gauge 110. Therefore, 250 pounds on dial 222 corresponds to 500 pounds on pedals 48 which is registered on inner calibrations 242 on dial 235.

The user then rotates knob 212 to position pointer 214 on the desired position on dial 220. Rotation of pointer 214 to the position marked light will allow actuating means 4 to move faster than if pointer 214 is positioned at "medium." Positioning pointer 214 at "heavy" causes actuating means 4 to move very slowly when a force in excess of that set on dial 222, for example 250 pounds in the drawing, is exerted. However, it should be noted that whether actuated means 4 is moving or not pointer 238 on gauge 110 registers the magnitude of force exerted on the actuating means.

Setting pointers 170 and 214 as indicated in FIG. VIII of the drawing, the user then approaches gripper bar 40 or pedals 48 and assumes the starting position for a desired exercise in the same manner as in using bar-bells.

Assuming that the user desires to do the exercise commonly known as "leg press," the user either lies upon his back on platform 6 or upon a bench (not shown) positioned on platform 6 and positions his feet against plates 50 on pedals 48. He then pushes upwardly against pedals 48 while watching pointer 238 on gauge 110 which indicates the magnitude of force he is exerting on inner calibrations 242 on dial 235. Pedals 48 do not move upwardly until a force of 500 pounds has been applied. When the force of 500 pounds is reached, pedals 48 will begin to move upwardly as members 32 and 34 pivot with axle 36, pivotally mounted in the upper ends of stanchions 10 and 12, thereby moving piston rod 72 and piston 70 upwardly through hollow tubular member 64 of hydraulic cylinder 60.

Referring to FIG. VII of the drawing, it should be noted that fluid pressure exerted through the conduits from the upper end of cylinder assembly 60 is exerted through inlet passage 132, passage 198, plunger 196, passage 182 and through orifice 178 to the face of valve member 176. As the pressure reaches that corresponding to the preset magnitude of force set on pointer 170, valve member 176 is moved outwardly against spring 174 and fluid from passage 182 is discharged through orifice 178, passages 194 and 192 to annular passage 154 and out of the regulating device 130 through outlet passage 134. This allows plunger 196 to move against the force of spring 200 to open apertures 206 allowing fluid from inlet passage 132 to circulate through passage 198, passages 206, annular passage 154 and out of pressure regulating device 130 through outlet passage 134.

The position of pointer 214 on dial 220 determines the rate at which fluid flows from outlet passage 134 of

pressure regulating device 130 through restrictor valve 140.

Fluid passing through restrictor 140 passes through conduit 144 to reservoir assembly 62.

When the user has completed the exercise, he merely releases pedals 50 allowing actuating means 4 to move slowly downwardly by force of gravity thereby causing piston 70 to move downwardly through cylinder assembly 60 forcing fluid through aperture 128, return line 124, check valve 123 and ultimately back to the upper end of the cylinder assembly.

Weight lifting is a sport that demands short and sharp explosive efforts for overcoming maximum restraining forces. Football coaches particularly emphasize development of muscles employed for exploding into a resistive force and momentarily holding the resistive force for developing skills necessary for blocking and tackling. From the foregoing it should be readily apparent that the exercise device which I have developed may be employed to explode against a resistive force to overcome a resistive force of a magnitude exceeding that which could be held after exhausting an initial explosive effort. However, since actuating means 4 returns slowly to the position illustrated in FIGS. I through III of the drawing, there is no danger of the user loosing or dropping weights.

It should also be readily apparent that the exercise device hereinbefore described accomplishes the objects of the invention in that it is extremely versatile, light weight, easy to store and use, and very quiet in operation.

DESCRIPTION OF MODIFIED FORMS

Two modified forms of the exercising device are illustrated in FIGS. X and XI of the drawing.

Referring to FIG. X of the drawing, the numeral 204 generally designates actuating means comprising angularly disposed elongated members 232 and 234 pivotally connected by pin 236 to a frame 202 which comprises a table having legs 218 and a top 206 with lugs 210 secured thereto to which the actuating means 204 is pivotally connected.

Elongated member 232 has an ear 256 welded or otherwise rigidly secured thereto for supporting the end of piston rod 272 which is pivotally secured thereto.

Actuated means, generally designated by the numeral 208, is substantially the same as that illustrated in FIG. VI of the drawing, hereinbefore described. Actuated means 208 has a pressure gauge 110, a knob 168 for regulating the force required to initiate movement of actuating means 204, a knob 212 for controlling the rate of movement of actuating means 204, and a knob 135a which may be employed to bypass pressure regulating device 130.

The embodiment of the invention illustrated in FIG. X of the drawing operates in substantially the same manner as the apparatus hereinbefore described and illustrated in FIG. I of the drawing.

Elongated members 232 and 234 have axles 246 extending outwardly from the ends thereof with pairs of padded rollers 248 pivotally secured thereto.

The user sits on top 206 of the table 202 with his legs extending downwardly therefrom positioned inwardly adjacent one of the pair of padded rollers 248 on member 232. The controls are set as hereinbefore described. He then exerts a kicking motion with his foot to exert force against roller 248 causing elongated

members 232 and 234 to pivot about pin 236. This causes piston rod 272 to be extended as hereinbefore described.

It should be noted that since force is exerted through padded rollers 248, only a force perpendicular to the leg of the user will be exerted thereto. This is very important in therapeutic applications for rebuilding damaged muscles. Weighted shoes and the like heretofore employed for this purpose exerted only vertical forces which tended to separate the knee joint, often aggravating the injury. For therapeutic rehabilitations of damaged joints, carefully controlled magnitude and direction of force as well as the rate of movement of the member, such as the leg is critical.

Padded rollers 248 on elongated member 234 are normally employed for knee exercises. The user lies face down on the top 206 of table 202 with the back of his legs below roller 248. He then bends his legs while a controlled restraining force is exerted through the roller.

Rollers 248 may also be gripped with the hands while the user is on or off the table.

Referring to FIG. XI of the drawing, the actuating means is generally designated by the numeral 304 and the actuated means is generally designated by the numeral 308.

Actuating means 304 comprises elongated members 332 and 334 secured to axle 336 pivotally secured to elongated members 318 and 320. Actuated means 308 is substantially the same as that illustrated in FIG. VI of the drawing, hereinbefore described.

Piston rod 372 is pivotally secured to actuating means 304 and resilient means, such as springs 380, is secured between elongated base members 318 and 320 and actuating means 304, tending to push piston rod 372 into cylinder 360.

Shock absorbing means, such as pads 390, is disposed on elongated members 332 and 334, arranged to engage the shoulders of an athlete as he positions his feet against cross members 306 while grasping handlebars 340 on actuating means 304. As the user pushes against pads 390 with his shoulders, the force exerted thereagainst is indicated on gauge 110.

Having thus described my invention, I claim:

1. An exercise device comprising: a table; actuating means movable relative to the table; actuated means pivotally connected between the table and the actuating means; means associated with said actuated means to prevent movement of the actuating means in at least one direction from a first position to a second position until a force of predetermined magnitude is exerted on the actuating means; means to vary the magnitude of force required to move the actuating means; and means associated with the actuated means to control the rate of movement of the actuating means from the first position to the second position when a force exceeding the predetermined magnitude is exerted on the actuating means, said actuating means comprising, a first elongated member, a second elongated member angularly disposed relative to the first elongated member; and surfaces on said elongated member against which force may be applied.

2. The combination called for in claim 1 with the addition of an indicator operably connected to the actuated means to indicate the magnitude of force exerted on the actuating means.

3. The combination called for in claim 1 wherein the actuated means comprises a fluid pump having inlet and outlet ports, and conduit means in fluid communication with said ports; and the means to prevent movement of the actuated means comprises pressure control means in the conduit means to prevent fluid flow from the outlet port of the pump until a force of predetermined magnitude is exerted on the actuating means.

4. The combination called for in claim 3 with the addition of a fluid return line in fluid communication with the inlet and outlet ports of the pump; and a check valve in the return line arranged to permit fluid flow from the inlet port to the outlet port.

5. The combination called for in claim 1 wherein the actuated means is a pump; said pump having an outlet passage, and the means to control the rate of movement of the actuating means comprises a variable flow passage valve associated with the outlet passage of the pump.

6. The combination called for in claim 1 wherein the actuated means comprises a cylinder having a piston and piston rod slidably disposed therein; and with the addition of means for pivotally connecting the said piston rod to the actuating means; means for pivotally connecting the cylinder relative to the frame; and a pressure gauge in fluid communication with the inside of the cylinder.

7. An exercise device comprising: a frame; a cylinder; a piston slideably disposed in said cylinder; a piston rod secured to said piston extending outwardly from one end of said cylinder; means for pivotally securing the cylinder relative to the frame; an elongated member to apply force to the rod; means for pivotally securing the piston rod relative to the elongated member; means for pivotally connecting the elongated member to the frame; a conduit in fluid communication with the inside of said cylinder on one side of said piston; a pressure relief valve in said conduit constructed and arranged to prevent flow of fluid therethrough until a force of predetermined regulated magnitude is exerted on the piston; and a valve having a variable size flow passage therethrough in fluid communication with said pressure relief valve to regulate the rate of fluid flow through the pressure relief valve.

8. An exercise device comprising, a general frame; an elongated member; means to pivotally connect the elongated member to said frame; a cylinder; a piston slidably disposed in said cylinder; a piston rod attached to said piston and extending outwardly from one end of the cylinder; means for pivotally connecting the cylinder to the frame; means for pivotally connecting the piston rod to the elongated member; conduit means in fluid communication with the inside of the cylinder on opposite sides of the piston; valve means in the conduit; gripping means on the elongated member; foot support means on the elongated member between the gripping means and the means to pivotally connect the elongated member to the frame.

9. The combination called for in claim 8 with the addition of a pressure gauge in fluid communication with the inside of the cylinder.

10. The combination called for in claim 9 wherein the pressure gauge has an indicator; a first calibrated scale upon which the magnitude of force exerted on the gripping means is indicated; and a second calibrated scale upon which the magnitude of force exerted on the foot support means is indicated.

11. An exercise device comprising: a frame; a cylinder; a piston slideably disposed in said cylinder; a piston rod secured to said piston extending outwardly from one end of said cylinder; an upwardly extending member; means to pivotally secure the upwardly extending member relative to the frame; means to pivotally secure the piston rod to the upwardly extending member; shock absorbing means on the upwardly extending member; means to pivotally secure the cylinder to frame; a conduit in fluid communication with the inside of the cylinder on one side of said piston; a pressure relief valve in said conduit constructed and arranged to prevent flow of fluid therethrough until a force of predetermined magnitude is exerted on said piston; and a valve having a variable size flow passage therethrough in fluid communication with said pressure relief valve to regulate the rate of fluid flow through the pressure relief valve.

12. The combination called for in claim 11 with the addition of variable volume means in fluid communication with the conduit to compensate for the volume of piston rod moving in and out of cylinder.

13. The combination called for in claim 11 with the addition of a fluid reservoir in fluid communication with the inside of said cylinder on the opposite side of the piston from said conduit; and means to vary the volume of the reservoir to accommodate the volume of fluid displaced from the cylinder as the piston rod moves into the cylinder.

14. The combination called for in claim 11 with the addition of a bypass conduit in fluid communication with the inside of the cylinder on opposite sides of the piston; and a valve in the bypass conduit.

15. An exercise device comprising a general frame; an upwardly extending member having a lower end pivotally mounted on said frame; shock absorbing means on an upper portion of said upwardly extending member; gripper means on said upwardly extending member, said gripper means being positioned to support hands of a user having a shoulder in engagement with said shock absorbing means; means between the upwardly extending member and the frame to exert a resistive force substantially equal to the force applied to the shock absorbing members; and means to regulate the rate of movement of the shock absorbing means when a force is applied thereto.

16. An exercise device comprising, support means; an elongated member; means to pivotally connect an end of the elongated member to the support means; roller means rotatably secured to the other end of the elongated member; a hydraulic cylinder having a piston slidably disposed therein and a rod secured to said piston, said rod extending outwardly from an end of said cylinder; means to pivotally connect the cylinder and rod between the support and an intermediate portion of said elongated member; a pressure relief valve communicating with the inside of the cylinder on opposite sides of the piston; means to vary the pressure required to initiate fluid flow through the pressure relief valve from one side of the piston to the other; and a control valve having a variable flow passage in series with said pressure relief valve to control the rate of fluid flow from one side of the piston to the other.

17. The combination called for in claim 16 with the addition of second roller means on the elongated member disposed in spaced apart relation from the first named roller means.

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18. An exercise device comprising, a base; an upwardly extending member; at least one shoulder receiving pad secured to an upper end of the upwardly extending member; means to pivotally secure the lower end of the upwardly extending member to the base; a hydraulic cylinder having a piston slidably disposed therein and a rod connected to the piston and extending outwardly of the cylinder; means to pivotally connect the cylinder to the base; means to pivotally secure the rod to the upwardly extending member; and valve means communicating with the inside of the cylinder on opposite sides of the piston, said valve being adapted to control the flow of fluid from one side of the piston to the other.

19. An exercise device comprising a cylinder; a piston slidably disposed in said cylinder; a piston rod secured to said piston extending outwardly from one end of said cylinder; means associated with said piston rod to apply a force thereto; a conduit in fluid communication with the inside of said cylinder on one side of said piston rod; a pressure relief valve in said conduit constructed and arranged to prevent flow of fluid there-through until a force of predetermined regulated mag-

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nitude is exerted on the piston; and a valve having a variable size flow passage therethrough in fluid communication with said pressure relief valve to regulate rate of fluid flow through the pressure relief valve, wherein the pressure relief valve comprises a valve body having a passage therethrough and inlet and outlet ports in fluid communication with said passage; a plunger slidably disposed in the passage; said plunger being movable from a first position wherein the passage is closed to a second position allowing flow of fluid through the passage; an orifice plate having an orifice therethrough extending across said passage in spaced apart relation from said plunger, said plunger and said orifice plate forming a pressure chamber in said passage, said plunger being incapable of movement to its second position until pressure in the pressure chamber exceeds a predetermined value; means for blocking fluid flow through the orifice in the orifice plate; means for retracting the means for blocking fluid flow through the orifice in the orifice plate when fluid pressure in the pressure chamber exceeds a predetermined regulated value.

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