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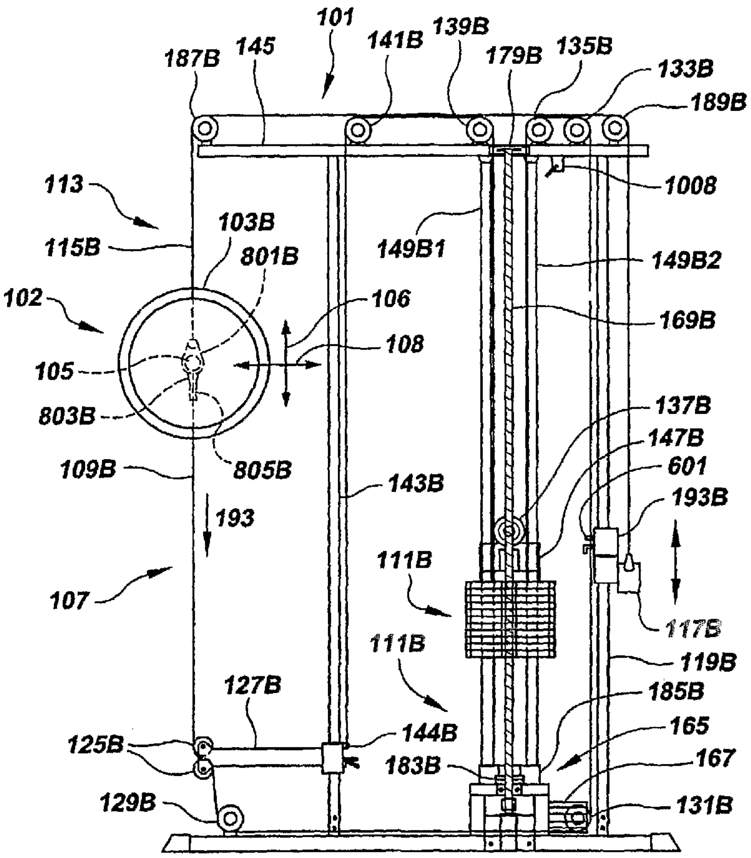
(54) **Title:** COMBINATION FREE AND STACK-WEIGHT FITNESS APPARATUS



(57) Abstract: A combined free and stack-weight fitness apparatus (101) utilizes a combination of free weights (103A, 103B) and stack-weight assemblies (111A, 111B) to provide multi-mode fitness training. The total training resistance is a combination of free-weight resistance and stack-weight resistance transmitted to the barbell by cables (109A, 109B). A pair of overhead cables (115A, 115B), attached to a barbell (102), provide vertical support until a substantial portion of the weight on the barbell is borne by the operator.

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Combination Free And Stack-Weight Fitness Apparatus

Background of the Invention

Field of the Invention

The present invention relates to the field of fitness equipment and, more particularly, to a fitness equipment utilizing both free-weights and stack-weights.

Description of the Related Art

Despite the variety of exercise and muscle-building equipment and activities available, free-weight lifting continues to be the workout method of choice for many athletes. Free-weight lifting allows unrestrained motion during lifting, closely approximating application of human strength in many recreation and sporting activities. Selection of weights utilized in free-weight lifting is highly repeatable as compared to machines employing levers, cams, and resistance elements such as springs and hydraulic or pneumatic cylinders. Also, free-weights provide uniform resistance unaffected by wear of mechanical parts and other components.

One disadvantage limiting use of free-weights is the need for one or more spotters, especially in strength regimens that push the strength and endurance limits of the user. These regimens are most effective when the user continues repetitions until he or she is unable to lift the weight. This is a safety concern if spotters are not immediately available since the user may be unable to safely lift the weight to a support device. Even when spotters are available, they may not recognize an unsafe condition, or, their response may not be quick enough to prevent injury.

Another limitation of free-weight equipment is the time required to add or remove free-weights to the free-weight assembly. The free-weight retainers such as clips or clamps must be physically removed from each side in the case of a conventional free-weight bar in order to add or remove weights, followed by re-installation of the clips or clamps.

Stack-weight fitness apparatus, on the other hand, provides a quick method to change the amount of desired weight by withdrawal or insertion of a pin in the bottom weight of a desired stack. The freedom of motion of stack-weight apparatus is limited unless cables are used, and even then no overhead support is provided.

US patents 6,293,892, 6,379,287, and 6,537,182, hereby incorporated as references, make a significant step forward in disclosing free-weight apparatus incorporating weight-responsive engagement assemblies which engage or disengage free-weight support from a frame. This apparatus also provides self-spotting of dumbbells and allows motion of free-weight ends independent of each other.

Despite the improvements offered in the aforementioned patents, there remains a need for improved self-spotting free-weight apparatus that further expand the fitness training variations provided by the apparatus.

Objects and Summary of the Invention

Therefore an object of the present invention is to provide fitness equipment combining free-weights and stack-weights to expand the types of fitness training available.

Another object of the present invention is to reduce time required to change the weights associated with free-weight training.

Another object of the present invention is to provide automatic support of a combined free-weight and stack-weight apparatus upon loss of control of the free-weight.

Another object of the present invention is to provide an apparatus providing a realistic pushing or "jamming" resistance-training mode.

Yet another object of the present invention is to provide a wide range of individual fitness training not available with barbell training.

Still another object of the present invention is to provide backup support for free-weight operation.

Yet another object of the present invention is to provide flexible fitness equipment that is reliable and reasonable in cost.

The fitness equipment of the present invention utilizes a combination of free-weights and stack-weights to increase the flexibility and capability of the apparatus. In the preferred embodiments the free-weight assembly, which may be a barbell-type component, is supported overhead by cable assemblies on either side of the barbell when not in use, or if the user is unable to maintain grip on the barbell. Two additional cables, connected to a pair of stack-weight assemblies, provide additional resistance from a direction determined by the position of an adjustable pulley assembly attached to the frame of the apparatus.

Normally the adjustable pulley assembly will be positioned so that the stack-weight cables connect to the free-weight assembly from below. The total resistance of the barbell is a combination of the resistance of the free-weight assembly and the resistance of the stack-weights. The resistance of the free-weight assembly is normally the weight of the barbell and any free-weights attached to it. In another mode, the combination of fixed overhead cable support and downward cable load from the stack-weight cables also allows pushing or “jamming” type training where the operator exerts a significant horizontal or near-horizontal training force.

In other types of weight training, the adjustable pulley assembly is positioned so that the stack-weight cables are positioned and attached from above the barbell, subtracting the force from the stack-weight assembly from that of the free-weight assembly. In this mode, the stack-weights can be adjusted to completely compensate the downward force of the free-weights, resulting in a nearly “zero” net weight on the barbell. Such a mode is useful in specialized training such as rehabilitation training. It is also possible to increase the stack-weight force sufficiently, or reduce the free-weight sufficiently so that the upward force from the weight stack is greater than the downward force from the free-weights. This arrangement results in “negative” training where the barbell must be “pulled” down against the normal direction of gravity.

In still other uses, the stack-weight cables are removed from the free-weight assembly allowing them to be used for independent arm or leg training using D-rings or dumbbells. The apparatus allows realistic free-weight training with improved safety and ease of weight changing.

The overhead support cables connect the barbell to a weight-responsive engagement assembly on each of two support columns. The weight-responsive engagement assemblies utilize a pawl biased toward engagement with one of a plurality of holes or openings in the support columns. A solenoid, energized when the user grips both of the grip actuators or sensors on the barbell, provide a disengagement bias on the engagement pawls. The disengagement bias is insufficient to withdrawal the pawls from the holes of the support columns until a significant (preferably most) of the weight of the barbell (and downward force from the stack-weights) is relieved by lifting of the free-weight assembly by the operator. An optional mode selector switch on the frame ensures that the barbell remains supported from above regardless of lift support during pushing or jamming modes or independent operation.

Retainer clamps on the barbell allow addition or removal of free-weights. Engagement of a pin between a selected weight and an engagement rod determines the number of stack-weights connected to the stack-weight cable. Optional adjustable stack-weight support brackets, positioned by a motor and lead screw drive, provide a convenient method to support all of the stack-weights and allow for quick and easy disengagement and re-engagement of stack-weights by pin removal and insertion. Manual or foot-switch operated stops on the support columns limit the motion of the weight-responsive engagement assemblies to define the lower most position attainable by the barbell.

Quick-disconnect fasteners connecting the lower cables to the barbell are removable and attachable to D-rings or barbells for individual arm or leg stack-weight training. Adjustable pulley assemblies, located below the barbell and adjustable in height, provide a means to adjust the stack-weight cable geometry.

Brief Description of the Drawings

These and other features, aspects and advantages of the present invention will become better understood with regard to the following description, appended claims and accompanying drawings where:

FIG. 1 is a front elevation drawing of the combination free and stack-weight fitness apparatus of the present invention showing a free-weight such as a barbell supported by overhead cables and two stack-weight assemblies connected to the barbell;

FIG. 2 is a side elevation drawing of the apparatus showing the overhead support cable assembly and its attachment to a weight-responsive engagement assembly on a support column, an adjustable pulley assembly for adjusting the geometry of the stack-weight cable assembly and the drive apparatus for the stack-weight height adjustment assembly;

FIG. 3 is a top view of the apparatus showing the drive components of the stack-weight adjustment assembly and the grip actuators mounted on the free-weight assembly.

FIG. 4 is a detail side elevation drawing of the apparatus showing the stack-weights in the lowered position and stack-weight adjustment assembly;

FIG. 5 is a detail side elevation of the weight-responsive engagement assembly slideably engaged to a support column showing pawl engagement with holes of the support column;

FIG. 6A is cross section drawing of a stop block of the apparatus disengaged from the support column to allow vertical adjustment of the stop block along the support column;

FIG. 6B is a cross section drawing of the spring-biased pin of the stop block of FIG. 6A engaged to a hole in the support column to lock the stop block on the support column and act as a stop for the weight-responsive engagement assembly;

FIG. 7 is a detail side elevation drawing of the adjustable pulley assembly showing engagement of a pin of the assembly to lock the pulley assembly in position on a support column;

FIG. 8 is a detail schematic drawing of a cable support collar providing mechanical connection between the overhead support cable assembly and the free-weight bar, and electrical connection between the grip actuators of the free-weight bar and the cable assembly, and the stack-weight cable attached to a bracket on the free-weight by a quick-release fastener;

FIG. 9A is a side elevation drawing of an operator exerting vertical lifts of the free-weight assembly with the stack-weight assemblies connected to the free-weight, the weight-engagement assemblies disengaged to allow unrestrained free-weight motion and the stop block defining the lowest position attainable by the free-weight assembly;

FIG. 9B is a side elevation drawing of an operator exerting pushing or "jamming" motion of the free-weight assembly with the weight-responsive engagement assembly providing locked-cable overhead support of the free-weight assembly by locking the support cable to the frame and the stack-weight assembly providing a pulling or restoring force on the free-weight assembly;

FIG. 9C is a side elevation drawing of an operator exerting independent withdrawal of D-rings attached to the stack-weight assemblies by their respective cables and quick-disconnect fasteners; and

FIG. 10 is an electrical schematic diagram of the control system of the combined free-weight and stack-weight assembly showing the series connection of the grip actuators requiring activation of both actuators to energize the solenoids of the weight-responsive engagement assembly solenoids, the mode selector switch, and the stack-weight adjustment toggle switch providing power to the respective up or down winding of the motor through respective limit switches.

Description of the Preferred Embodiments

The following is a description of the preferred embodiments of fitness apparatus combining free-weight and stack-weights to provide improved functionality and performance for weight-training equipment.

FIGS. 1, 2 and 3 show the front elevation, side elevation and top views respectively of embodiment 101 of the fitness apparatus. The apparatus provides at least two means of providing lift resistance; free-weight assembly or barbell 102 comprising free-weights 103A, 103B mountable on free-weight bar 105 and adjustable resistance means 107 comprising stack-weight cables 109A, 109B connected between bar 105 and stack-weight assemblies 111A, 111B. The apparatus also provides an overhead conditional support means 113 such as support cable assemblies 115A, 115B connected between bar 105 and weight-responsive engagement assemblies 117A, 117B engageable to support stands 119A, 119B of the frame 145.

Bar 105 of free-weight assembly 102 provides a means for an operator (not shown) to grasp and exert repetitive exercise motions to improve strength and conditioning. Bar

105 may be moved vertically as shown by arrows 106 or horizontally as shown by arrows 108. Bar 105 provides a means for conventional fitting, securing, and removing free-weights 103A, 103B by use of a releasable attachment means such as removable spring clamps 121A, 121B and collars 123A, 123B. Other means of attaching free-weights to bar 105 such as lock screw and threaded-bore collars may also be used.

Referring to FIG. 2, adjustable resistance means 107 provides resistance for bar 105 by routing stack-weight cable 109B connected to bar 105 through pulleys 125B of adjustable pulley assembly 127B and bottom resistance pulley 129B so that force on cable 109B from stack-weight assembly 111B provides a downward force in the direction of gravity in the supported condition shown. Stack-weight cable 109B is operatively engaged with pulley 137B of stack-weight assembly 111B through pulleys 125B, 129B, 131B, 133B and 135B. Pulleys 139B and 141B rout cable 109B to front column 143B of frame 145 via bracket 144B of adjustable pulley assembly 127B. Although right side components facing the apparatus are shown and described in this section, left side components, except where noted, are similar with similar functions.

Referring in addition to FIG. 4 (shown with stack weight assembly 111B in the lowered position), pulley 137B, vertical guide 147B, guide rods 149B1, 149B2 and stack-weights 151B are conventional in that pulley 137B is engageable to a selected bottom stack-weight such as stack-weight 151B1 by an engagement rod 159B fixed to guide 147B. Pin 153B, inserted through a hole 155B of the selected weight engages a corresponding hole 157B of engagement rod 159B. Guide 147B provides a sliding fit with guide rods 149B1 and 149B2 and forms a mechanical connection between pulley 137B and engagement rod 159B. Holes 161B1 and 161B2 in stack-weights 151B provide a sliding fit with guide rods 149B1 and 149B2 and maintain alignment of stack-weights 151B. Holes 163B of weights 151B provide a sliding fit with engagement rod 159B.

Stack adjustment assembly 165B provides a means of raising and lowering the stack-weights to facilitate adjustment of the number of stack-weights 151B engaged to engagement rod 159B. Weight adjustment assembly 165B comprises motor 167 operably driving lead screws 169A, 169B via dual right-angle drive 171, drive shafts 173A, 173B, single right-angle drives 175A, 175B, and couplings 177A, 177B. Upper bearings 179A, 179B and lower bearings 181A, 181B rotateably support lead screws 169A, 169B. As best seen in FIGS. 1 and 4, lead screw follower 183A, 183B, mounted on stack-weight support brackets 185A, 185B engage respective lead screws 169A, 169B to position the support brackets 185A, 185B and stack-weights supported on the bracket to the desired height. Lead screw 169B is shown in fragmentary in FIG. 4 for clarity.

Positioning stack-weight support brackets 185A, 185B to the existing height of the engaged stack-weight permits removal of the respective engagement pin 153A, 153B without dropping the engaged weigh. Engagement pins 153A, and 153B may then be re-inserted in the new desired bottom stack-weight and the support brackets 185A, 185B lowered. Alternatively, the ends of stack-weight cables 109A, 109B attached to brackets 144A, 144B can be re-positioned by adjustment of adjustable pulley assemblies 127A, 127B height to temporarily lower the selected stack-weight assemblies for adjustment and then re-positioning.

Conditional support means 113 of the apparatus comprises a weight-responsive engagement assembly 117A, 117B that conditionally supports the weight of free-weight assembly 102 (and any downward force provided from adjustable resistance means 107) against gravity or external downward forces via cable assemblies 115A, 115B, and overhead pulleys 187A, 187B, and 189A, 189B. Weight-responsive engagement assemblies 117A, 117B engage one of a plurality of holes (505 of FIG. 5) in back of respective support columns 119A, 119B. Only column 119B is shown in FIG. 2, the other side is similar.

FIG. 5 is a side elevation detail drawing showing pawl 501 of pawl assembly 503 of weight engagement assembly 117B engaging hole 505A of column 119B. Armature 507 of solenoid 509B pulls downward on lever 511 of pawl assembly 503 to bias pawl 501 in a disengaged direction 513A. Solenoids 509A, 509B from each of the respective weight-responsive engagement assemblies 117A, 117B are energized from grip actuators or grip sensors 191A, 191B attached to weight bar 105 as shown in FIG. 8. Pawl assembly 503 pivots about pivot pin 515 to engage and disengage pawl 501 from the holes of column 119B as shown in the phantom lines. Helical spring 519, acting on lever 511, provides bias on pawl assembly 503 in the engaging direction 513B.

The disengagement bias of solenoid 509B is greater than the engagement bias provided by helical spring 519, but is selected to be insufficient to withdraw pawl 501 from hole 505A when the full weight of free-weight assembly 102 is acting in the direction of gravity, represented by force arrow 502. This is due to the shape of pawl 501 and friction with the upper portion of hole 505A when a significant upward force is provided to assembly 117B. Disengagement of pawl 501 from hole 505A requires lift support of a substantial (and preferably most or all) of the combined downward forces on free-weight assembly 102 resulting in reduction of force 502.

The shape and geometry of pawl assembly 503 and the strength characteristics of solenoid 509 require at least part, and preferably all, of the weight supported by the weight-responsive engagement assemblies 117A, 117B is borne by an operator before pawl 503 is able to disengage from hole 505A. The effective weight acting on the weight-responsive engagement assemblies will normally be the weight of free-weight assembly 102 (bar 105 and free-weights 103A, 103B) and downward force 193 resulting from stack-weight assembly 111A, 111B acting through cables 109A, 109B.

Weight-responsive engagement assemblies 117A, 111B improve safety of the apparatus by ensuring that all, or a substantial amount of the total downward forces acting on bar 105 of free-weight assembly 102 are supported by the operator before weight-responsive engagement assemblies 117A, 117B are disengaged from respective columns 119A, 119B. The weight of weight-responsive engagement assembly 117B is sufficient to allow downward movement of the assembly on column 119B when disengaged from support column 119B and the operator raises weight 102. Additional weight may be added to the assembly to prevent cable slackening during operation of the apparatus.

Holes 521B1, 521B2 retain tabs 523B1, 523B2 of guide bushings 525 and 527. Pin 529 of attachment block 531 attaches cable assembly115B to weight-responsive engagement assembly 117B. Construction and operation of weight-responsive engagement assembly 117A is similar.

Stop block 193B of FIG. 2 provides a back up means to provide support of free-weight assembly 102. Stop block 193B engages holes 505 of support column 119B to prevent upward movement of weight-responsive engagement assembly 117B beyond the set position of block 193B. This engagement to column 119B prevents downward motion of free-weight assembly 102 beyond the position set by stop block 193B.

FIG. 6A is an elevation cross sectional drawing of stop 193B and support column 119B. In this figure, adjustment bar 601 is depressed, for example by finger or hand pressure in direction 603, withdrawing pin 605 against spring 607 bias. In the withdrawn position, pin 605 does not engage holes such as holes 505 of column 119B, and stop 193B is free to move up and down along column 119B in vertical directions 609. In the preferred embodiments, stop 193B forms a sliding clearance with column 119B. Handgrip 611 provides surfaces for raising and lowering stop 193B and a reaction surface for insertion of bar 601 by a hand. A similar stop 193A on column 119A is not shown but is similar in construction and operation.

FIG. 6B is an elevation cross sectional drawing of stop 193B and column 119B with adjustment bar 601 released. Helical spring 607 biases cross bar 613, pin 605, and adjustment bar 601 in the direction of arrow 615. Upon alignment of a hole such as hole 505B in column 119B with pin 605, helical spring 607 biases pin 605 into hole 505B and fixes stop block 193B to support column 119B.

FIG. 7 is an elevation cross section drawing of adjustable pulley assembly 127B of FIG. 2. Pulley engagement block 701 slideably engages column 119B to allow vertical movement 702 of block 701 when pin 703 is disengaged from column 143B. In the normal position shown, helical spring 705 biases disengagement lever 707 towards the pin-engaged direction shown. When an operator moves disengagement lever 707 in the direction of arrow 709, lever portion 711 withdraws pin 703 from hole 713, releasing pulley assembly 127B for vertical adjustment. Pulley bracket 715 supports pulleys 125B from engagement block 701. Bracket 144B provides a means for adjusting the bottom position of stack-weight 111B via cable 109B, by changing the effective length of cable 109B. In other embodiments, bracket 144B is a separate adjustable bracket assembly positionable along one of the structural members of frame 145 such as column 143B.

FIG. 8 is a detail schematic diagram of cable attachment assembly 801B and bracket 803B on weight bar 105. Support cable attachment assembly 801B provides mechanical connection for cable assembly 115B to weight bar 105 and electrical connection for grip sensor 191B to cable 115B1. Stack-weight cable attachment bracket 803B provides mechanical connection between quick-release fastener 805B of stack-weight cable 109B and weight bar 105. In the preferred embodiments, cable assembly 115B is a dual cable assembly comprising two cables 115B1, 115B2. Two cables provide back-up reliability should a cable or connector fail. In the preferred embodiment, stack-weight cable assembly 109B, connected to quick-release fastener 805B comprises a single cable.

Support collar portion 802B comprises two crimp connectors 807B1, 807B2 for crimping the ends of the respective cables 115B1, 115B2 to form loops 809B1, 809B2 encircling weight bar 105. Inner collar 811B, fixed to bar 105 by setscrew 813, provides a means for electrical contact of a grip sensor such as a pressure sensitive switch or touch sensor 191B on bar 105. A brush 815 on inside collar 811B contacts slip ring 817 of support collar portion 802B to transfer an electrical signal from sensor 191B to cable 115B1.

Inner collar 811B utilizes a drilled passage 819 for routing lead 821 of grip actuator or touch sensor 191B between inner setscrew 823 and outer setscrew 825. Helical spring 827 provides bias on brush 815 to make sliding electrical contact with slip ring 817 and provides electrical contact between inner setscrew 823 and brush 815. Spring clip 829 provides electrical contact between slip ring 817 of support collar 802B and cable 115B1 at crimp connector 807B1. Inner collar 811B and support collar 802B are made of a high-strength insulative material such as a high-strength plastic to ensure non-shorting contact between the electrical components of the assemblies.

Outer collar 831B is clamped to bar 105 by setscrew 833. Alternatively, the collars may be split collars and clamped to bar 105 by clamp screws and nuts such as clamp screw 835 and clamp nut 837 of inner collar 811B. The clamping arrangement retains support collar 802B and stack-weight cable attachment bracket 803B in the desired axial location on bar 105 while allowing partial rotation of bar 105 with respect to support collar 802B. Stop 835 of bar 105, engageable with a radial slot (not shown) in collar 802B, provides a means to limit rotation of bar 105 to positions retaining contact of touch sensor 191B with the hand of an user.

FIGS. 9A, 9B and 9C are side elevation drawings showing methods of use of free and stack-weight fitness apparatus 101. FIG. 9A shows use of the apparatus for lifting exercises against the combined downward force of free-weight assembly 102 and the downward force provided by stack-weight assemblies 111A, 111B transmitted by cables 109A, 109B (only right side components are shown in this view, left side components are similar). Support cables 115A, 115B, connected to weight-responsive engagement assemblies 117A, 117B provide overhead support of the combined downward force until released by the operator gripping grip sensors 191A, 191B and at least part of the downward force on free-weight assembly 102 counteracted by a lift force applied by the operator as previously described.

The desired lift point where stack-weights 111A, 111B provide lift resistance (or positioning for stack-weight adjustment) are determined by stack-weight assembly support bracket 185A, 185B positions adjusted by foot or toggle switch 1005 (FIGS. 3 and 10). Alternatively, adjustment of pulley assembly 127A, 127B along the respective support columns 119A, 119B adjust the position of stack-weight assemblies 111A, 111B. Activation of disengagement lever 707 and vertical adjustment of the respective pulley assemblies 127A, 127B retracts or withdraws the end of cables 109A, 109B at brackets 144A, 144B to position pulleys 137A, 137B and the respective stack-weight assemblies.

Pulley assemblies 127A, 127B may also be positioned above free-weight assembly 102 so that the force exerted by stack-weight cables 109A, 109B act upward and therefore counteract free-weights on free-weight assembly 102. It is possible to add stack-weights or reduce free-weights until little or no net weight remains on free-weight assembly 102. This position is useful, for example in rehabilitation therapy, when it is desirable to reduce the effective weight of free-weight assembly 102 while still retaining inertia in the system. In still other training, stack-weight force acting upward may exceed free-weights acting downward, resulting in "negative" weight training.

Stop blocks 193A, 193B define the lowest position of free-weight assembly 102. Both adjustment of free weights 103A, 103B on free-weight assembly 102 and engagement of the desired number of stack-weights 151A, 151B of stack-weight assemblies 111A, 111B as described earlier determine the total lift force required to lift free-weight assembly 102. For any static position of free-weight assembly 102, stack-weights 151A, 151B may be changed by raising stack-weight assembly support brackets 185A, 185B with toggle switch 1005 until brackets 185A, 185B support weights currently engaged to engagement rod 159A, 159B of FIG. 4. At that point, pins 153A, 153B may be removed and re-set for the desired stack-weight, and stack-weight assembly support brackets 185A, 185B lowered to the desired position by toggle switch 1005. Mode switch 1004 (FIGS. 3 and 10) is in its "normal" mode position, allowing disengagement of weight-responsive engagement assemblies 117A, 117B upon operator support of free-weight assembly 102.

FIG. 9B shows another method of use of apparatus 101 in a push or "jamming" mode. In this mode, vertical support of free-weight assembly is maintained either automatically (since little or no lift force is applied to free-weight assembly 102), or by placing the mode switch 1004 of FIG. 10 in the" jamming" (open) position. In this position, weight-responsive engagement assemblies 117A, 117B remain engaged to support columns 119A, 119B regardless of the operator gripping actuators of weight bar 105, or supporting the full weight of free-weight assembly 102. Stop blocks 193A, 193B provide additional protection from loss of vertical support by defining the lowest position allowed by free-weight assembly 102 (highest positions of weight-responsive engagement assemblies 117A, 117B). This method allows the operator to exert primarily horizontal forces on free-weight assembly 102 as shown by arrows 902 and a restoring force is provided by locked support of cable assemblies 115A, 115B and stack-weight pulling from cables 109A, 109B.

FIG. 9C shows yet another mode for use of apparatus 101 by connection of D-rings 901A, 901B to quick-release fasteners 805A, 805B of cables 109A, 109B. In this mode, stack-weight assemblies 111A, 111B operate independently to provide resistance to extension of cables 109A, 109B. Pulley assemblies 127A, 127B provides a means to adjust cable 109A, 109B extension/withdrawal geometry. Toggle switch 1005 provides a means to adjust the fully-retracted position of cables 109A, 109B. Mode switch 104 is placed in the independent/jamming mode to ensure engagement of weight-responsive engagement assemblies 117A, 117B.

FIG. 10 is an electrical schematic diagram of the control system 1001 of a preferred embodiment the apparatus for use with a free-weight assembly 102 or individual hand fitness components such as barbells or D-rings 901A, 901B of FIG. 9C. Contacts 191A, 191B represent engagement (closed) or disengagement (open) of the respective grip switches or grip sensors of free-weight bar 105. Contacts 191A, 191B may be discrete switches such as pressure-sensitive switches or push-button switches connected in series on bar 105, or they may be mechanical or electronic relays associated with touch sensors such as capacitance sensors as further disclosed in US Application No. 09/746,184, hereby incorporated by reference.

The series connection of contacts 191A, 191B require both grip sensors 191A, 191B to be actuated simultaneously to energize solenoids 509A, 509B on respective weight-responsive engagement assemblies 117A, 117B. Mode switch 1004, located on a convenient location such as column 143B, provides power to solenoids 509A, 509B only if in the "normal" mode as shown. In the "independent/jamming" modes, solenoids 509A, 509B of respective weight-responsive engagement assemblies 117A, 117B are inoperative even if grip sensors 191A, 191B are activated. Low voltage power supply 1001, connected to an AC power receptacle 1003, provides low voltage power for operation of the solenoids.

Toggle switch 1005 provides power to the respective "up direction" motor winding 1007 through top limit switch 1008 to raise stack-weight support brackets 185A, 185B or "down direction" motor winding 1009 through bottom limit switch 1010 to lower stack-weight support brackets 185A, 185B. In the preferred embodiments, toggle switch 1005 is a momentary SPDT switch and is located on a convenient location of frame145 such as column 143B.

Electrical connection of grip sensors 191A, 191B on weight bar 105 is made through cable attachment assembly 801A, 801B, and cables 111A1, 111B1 to respective attachment block 531A, 531B connectors 510A, 510B. In the case where grip actuators 191A, 191B are touch sensors, an input from each connector 510A, 510B is made to a touch sensor controller providing relay outputs to solenoids 509A, 509B shown in FIG. 10. Connections to solenoids 509A, 509B is made by coiled cables 512A, 512B. In the case where switch contacts such as pressure sensitive switches are used as grip actuators, both switches are connected in series on bar 105 and one connector 510A is connected to power supply 1001 and the other connector 510B is connected to both solenoids 509A, 509B of weight-responsive engagement assemblies 117A, 117B by coiled cables (not shown).

Accordingly the reader will see that the Combination Free and Stack-Weight Fitness Apparatus provides a self-spotting free-weight exercise machine that utilizes both free-weights and stack-weights to provide the desired fitness training. The device provides the following additional advantages:

- The apparatus requires that the user lift the substantial weight of the free-weight before the support cables are disengaged from the support assemblies;
- Once the free-weight is disengaged from the support assemblies, the user may

exercise the free-weight in an independent manner, allowing unrestricted vertical movement of one end with respect to the other end;

- Loosening of the grip by either hand of the user immediately engages the engagement blocks and locks the free-weight support cables to reduce the likelihood of dropping or injury;
- The operator can quickly and easily change the total weight resistance provided by the apparatus;
- The apparatus is useful for pushing or "jamming" mode training;
- Auxiliary stops provide a lower limit for free-weight travel; and
- The design allows independent training using D-rings or dumbbells.

Although the description above contains many specifications, these 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. For example, the columns of the weight support assembly may be inclined to the vertical. Or, a single support column and support cable may be used. Thus the scope of the invention should be determined by the appended claims and their legal equivalents, rather than by the examples given.

Claims

I claim:

1. A combination free and stack-weight fitness apparatus for providing resistance-training comprising:
a frame:
a free-weight assembly operatively connected to a support assembly of said frame through a weight-responsive engagement assembly, said free-weight assembly comprising a free-weight engagement element releasably engaging a selected number of free-weights to said free-weight assembly;
a stack-weight assembly comprising a plurality of vertically stacked weights disposed in said frame and comprising a stack-weight engagement element releasably engaging a selected number of stack-weights to said free-weight assembly;
wherein a total resistance force to a user of said apparatus results by a combination of a first resistance force provided by a first selected quantity of free-weights attached to said free-weight assembly and a second resistance force provided by a second selected quantity of stack-weights.

2. The combination free and stack-weight fitness apparatus of claim 1 wherein said weight-responsive engagement assembly comprises an engagement element engageable to said support assembly and comprising a shape lock-engageable by a supporting force provided to said free-weight assembly by said support assembly, and a disengagement bias element operatively connected to said engagement element selectably providing disengagement bias to said engagement element, said disengagement bias selected to require reduction of at least a portion of said total resistance force for disengagement of said engagement element from said support assembly.

3. The combination free and stack-weight fitness apparatus of claim 1wherein said free-weight assembly comprises a free-weight bar with a first end portion connected to a first

weight-responsive engagement assembly by a first cable assembly and a second end portion connected to a second weight-responsive engagement assembly by a second cable assembly.

4. The combination free and stack-weight fitness apparatus of claim 3 where said support assembly comprises a first support column engageable by said first weight-responsive engagement assembly and a second support column engageable by said second weight-responsive engagement assembly.

5. The combination free and stack-weight fitness apparatus of claim 4 wherein said free-weight engagement assembly comprises a first free-weight retainer on said first end portion of said free-weight bar and a second free-weight retainer disposed on said second end portion of said free-weight bar.

6. The combination free and stack-weight fitness apparatus of claim 4 wherein said free-weight bar of said free-weight assembly comprises a first grip actuator disposed on said first end portion operatively connected to a first disengagement bias element of said first weight-responsive engagement assembly and a second grip actuator disposed on said second end portion operatively connected to a second disengagement bias element of said second weight-responsive engagement assembly.

7. The combination free and stack-weight fitness apparatus of claim 4 wherein each of said first weight-responsive engagement assembly and said second weight-responsive engagement assembly comprises an engagement element having a shape lock-engageable by a supporting force provided to said free-weight assembly by said support assembly, and a disengagement bias element operatively connected to said engagement element and selectably providing disengagement bias on said engagement element, said disengagement bias selected to require reduction of at least a portion of said total resistance force for disengagement of said engagement element from said support assembly.

8. The combination free and stack-weight fitness apparatus of claim 3 comprising a first stack-weight-weight assembly comprising a first stack-weight engagement element operatively connected to said first end portion of said free-weight bar by a first stack-weight cable and a second stack-weight assembly comprising a second stack-weight engagement element operatively connected to said second end portion of said free-weight bar by a second stack-weight cable.

9. The combination free and stack-weight fitness apparatus of claim 8 wherein said first stack-weight cable is connected to said free-weight bar by a first quick-release fastener element and said second stack-weight cable is connected to said free-weight bar by a second quick-release fastener element.

10. The combination free and stack-weight fitness apparatus of claim 9 wherein said first stack-weight cable is routed through a first adjustable pulley assembly slideably engaged to a first front column and disposed between said first quick-release fastener element and a first fixed pulley assembly disposed on a bottom portion of said frame.

11. The combination free and stack-weight fitness apparatus of claim 9 comprising a first stack-weight adjustment assembly comprising a first stack-weight support bracket supporting a first plurality of stack-weights and operatively connected to a first height-adjustment mechanism.

12. The combination free and stack-weight fitness apparatus of claim 10 comprising a second stack-weight adjustment assembly comprising a second stack-weight support bracket supporting a second plurality of stack-weights and operatively connected to a second height-adjustment mechanism.

13. The combination free and stack-weight fitness apparatus of claim 12 wherein each of said first and said second height-adjustment mechanisms comprise a lead screw disposed vertically on said frame and engageable with a lead screw follower attached to a respective stack-weight support bracket.

14. The combination free and stack-weight fitness apparatus of claim 13 comprising a motor operatively attached to said lead screw of each of said first and said second height-adjustment mechanisms.

15. The combination free and stack-weight fitness apparatus of claim 14 comprising a stack-weight adjustment switch operatively connecting electrical power to said motor.

16. The combination free and stack-weight fitness apparatus of claim 15 comprising a mode switch operatively connected to said first disengagement bias element and said second disengagement bias element to selectively disengage said first grip actuator and said second grip actuator from said first disengagement bias element and said second disengagement bias element.

17. The combination free and stack-weight fitness apparatus of claim 1 comprising a pair of free-weight engagement elements releasably engaging a selected number of free-weights to said free-weight assembly and a pair of stack-weight engagement elements releasably engaging a selected number of stack-weights to said free-weight assembly.

18. A combination free and stack-weight fitness apparatus for providing resistance-training comprising:

a frame:

a free-weight assembly operatively connected to a support assembly of said frame by an overhead cable, said free-weight assembly comprising a free-weight engagement element releasably engaging a selected number of free-weights to said free-weight assembly;

a stack-weight portion comprising a plurality of vertically stacked weights disposed in said frame and comprising a stack-weight engagement element releasably engaging a selected number of stack-weights and attached to said free-weight assembly by a stack-weight cable;

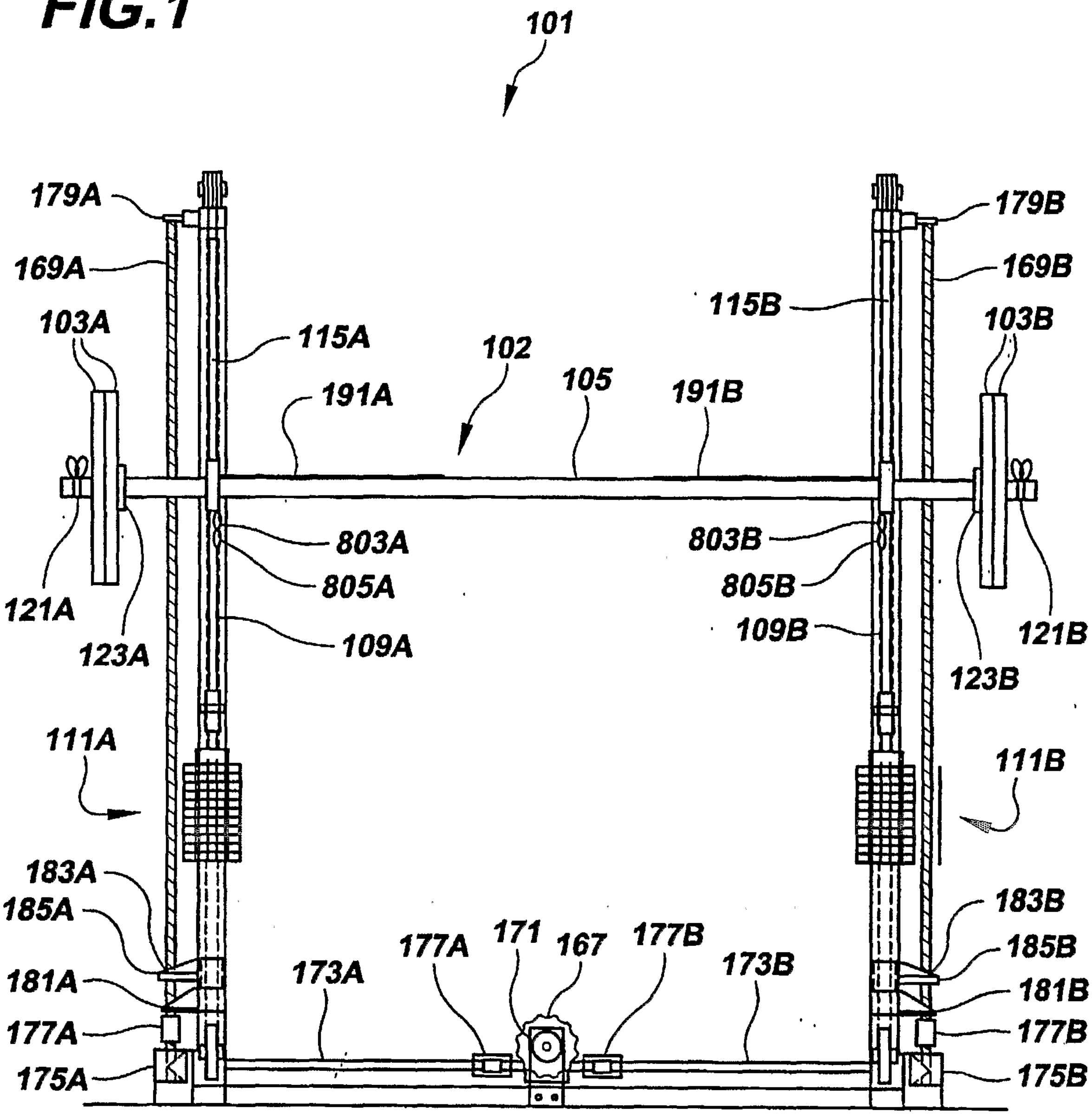
wherein a total resistance force to a user of said apparatus is a combination of a first resistance force provided by a first selected quantity of free-weights attached to said free-weight assembly and a second resistance force provided by a second selected quantity of stack-weights.

19. The combination free and stack-weight fitness apparatus of claim 18 wherein said free-weight assembly comprises a free-weight bar with a first end portion connected to a first portion of said support assembly by a first overhead cable assembly and a second end portion connected to a second portion of said support assembly by a second overhead cable assembly.

20. The combination free and stack-weight fitness apparatus of claim 19 wherein said stack-weight portion comprises a first stack-weight assembly comprising a first plurality of vertically stacked weights disposed in said frame and comprising a first stack-weight engagement element releasably engaging a first selected number of stack-weights and attached to said free-weight assembly by a first stack-weight cable with a first quick-release fastener element and a second stack-weight assembly comprising a second plurality of vertically stacked weights disposed in said frame and comprising a second stack-weight engagement element releasably engaging a second selected number of stack-weights and attached to said free-weight assembly by a second stack-weight cable with a second quick-release fastener element.

21. The combination free and stack-weight fitness apparatus of claim 18 comprising a pulley assembly positionable on said frame and defining a first position routing said stack-weight cable to said free-weight assembly from below said free-weight assembly and a second position routing said stack-weight cable to said free-weight assembly from above said free-weight assembly.

FIG. 1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123B
111A
111B
183A
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175B

FIG.2

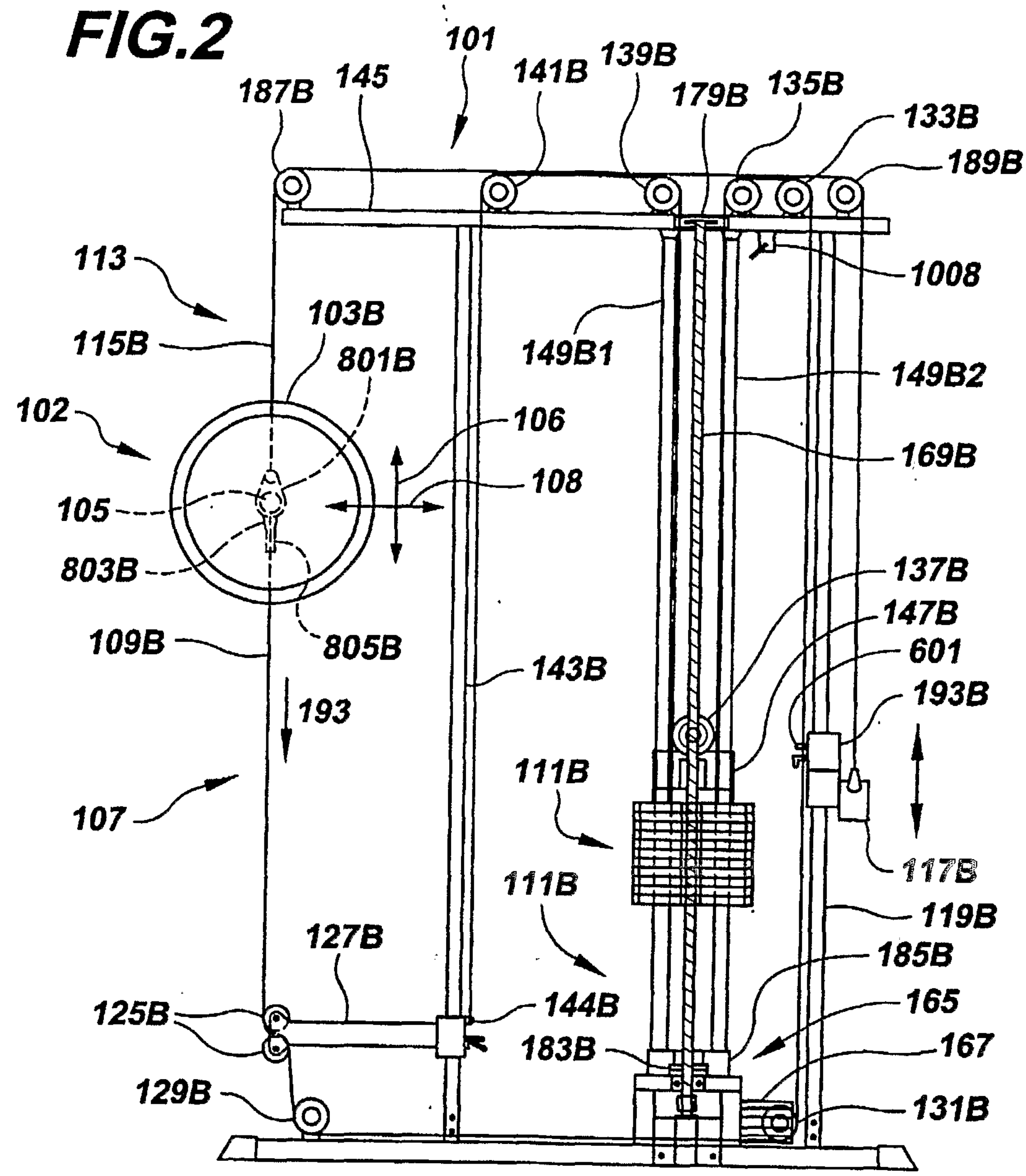
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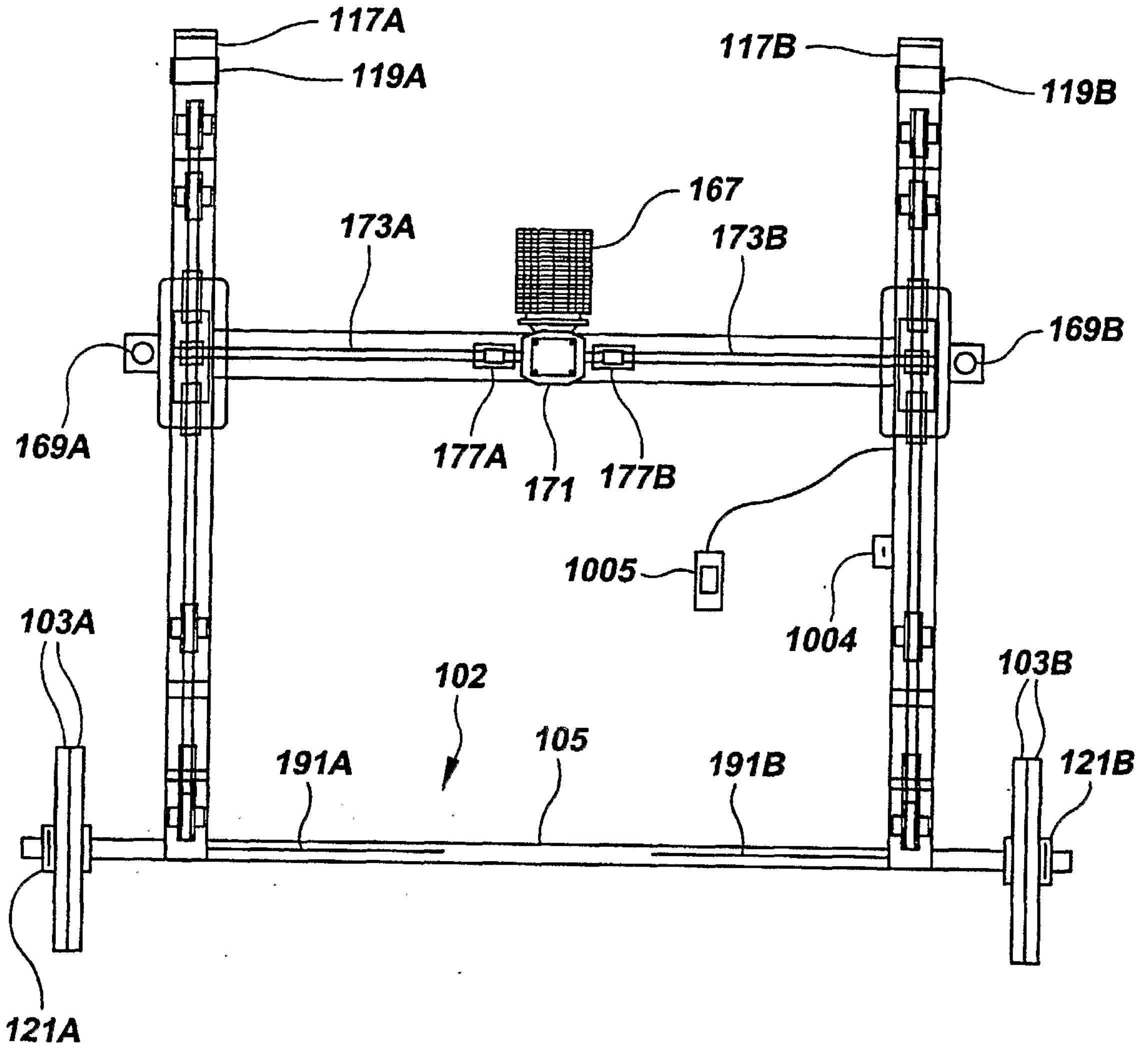
FIG.3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121A

FIG.4

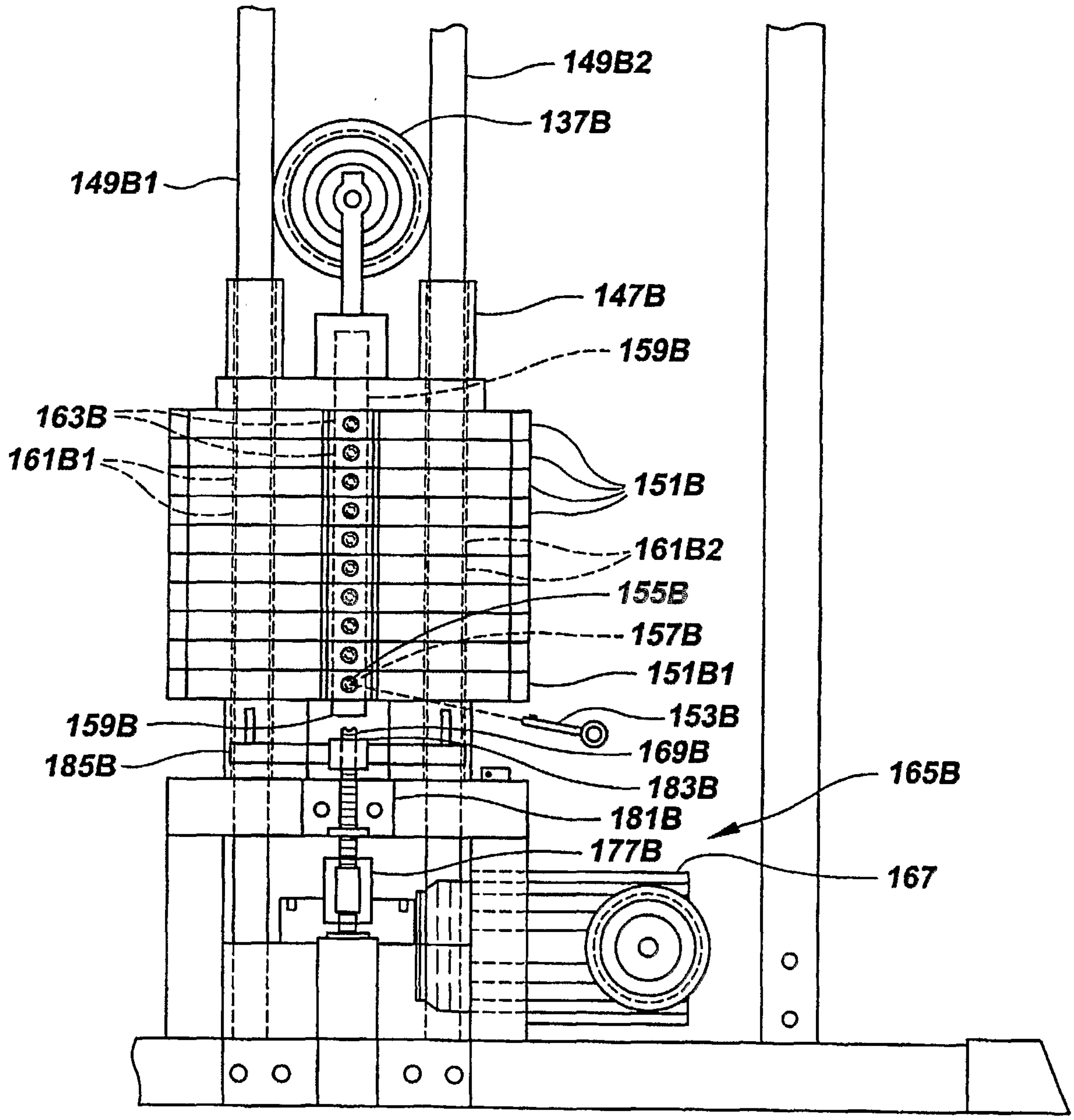
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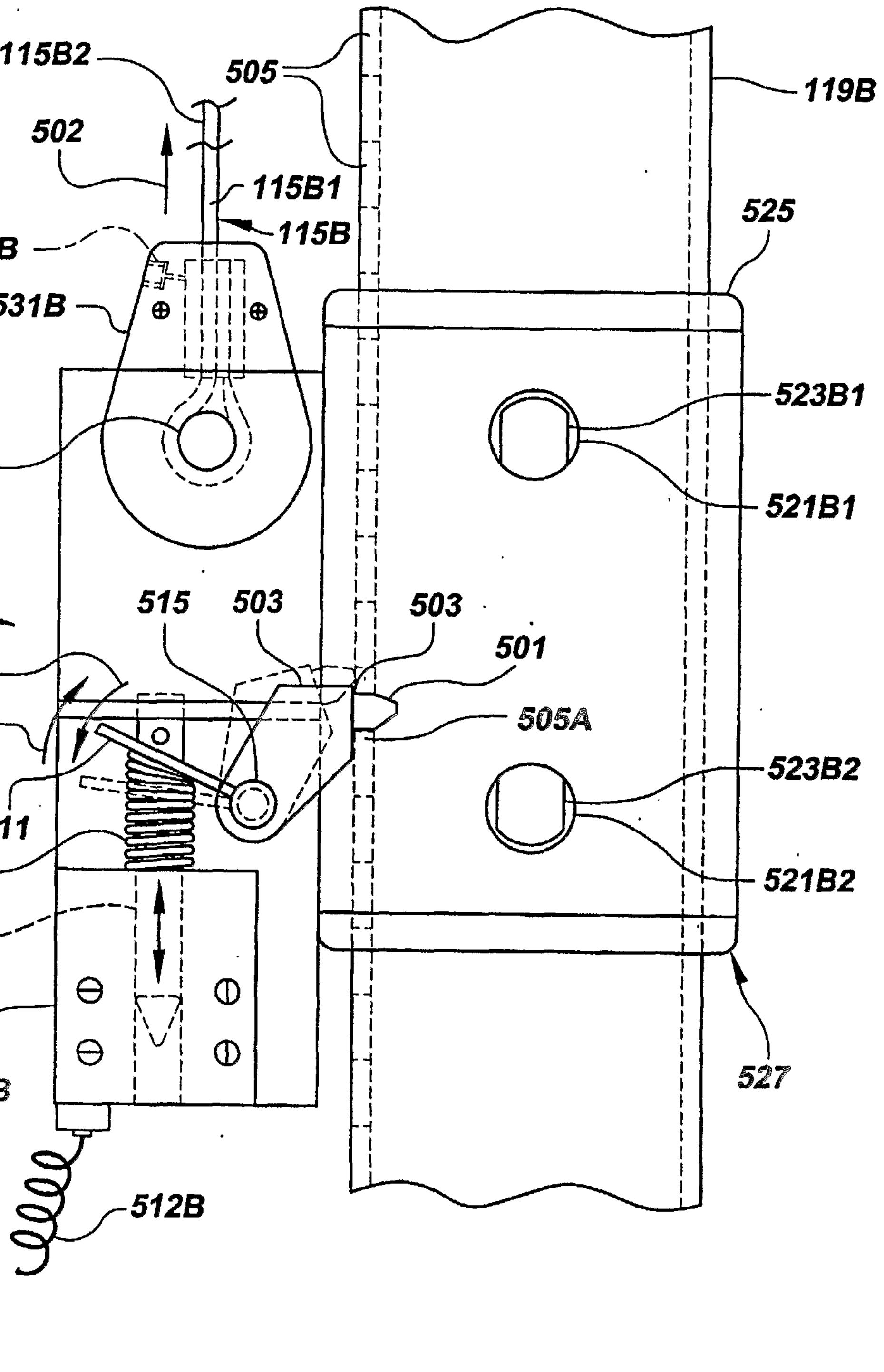
FIG.5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509B
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FIG.6A

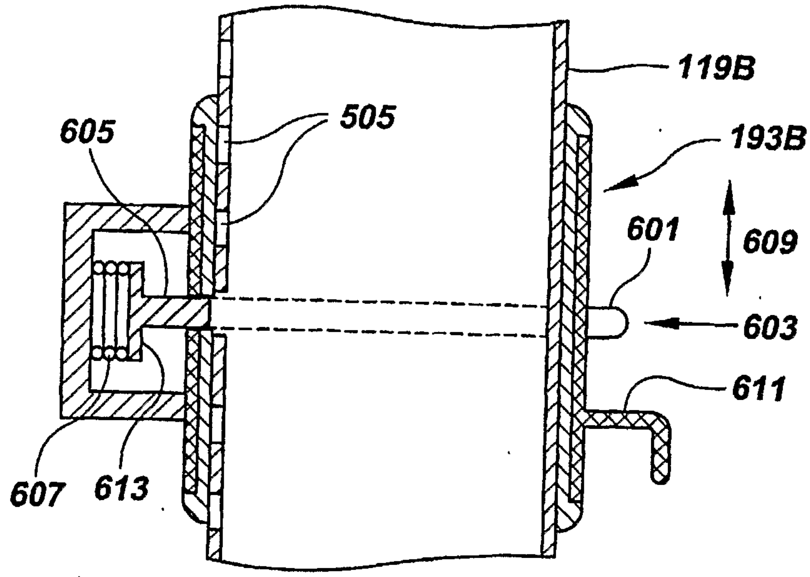
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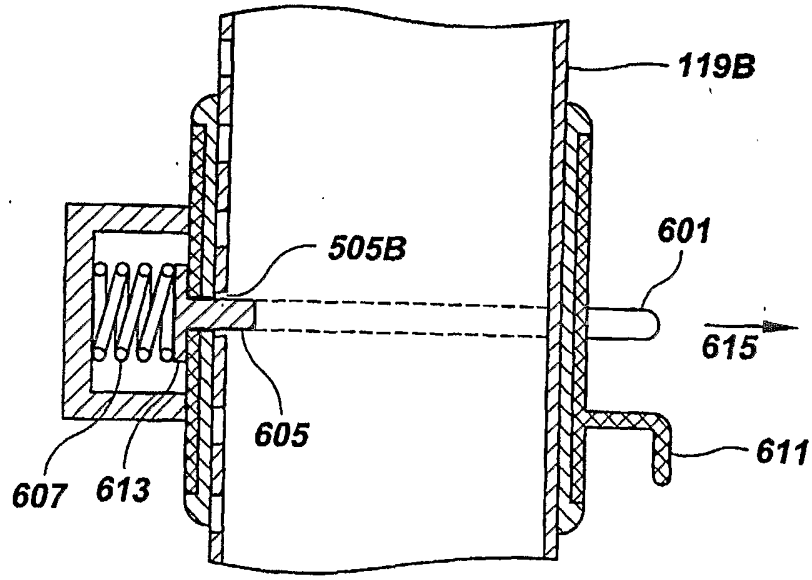
FIG.6B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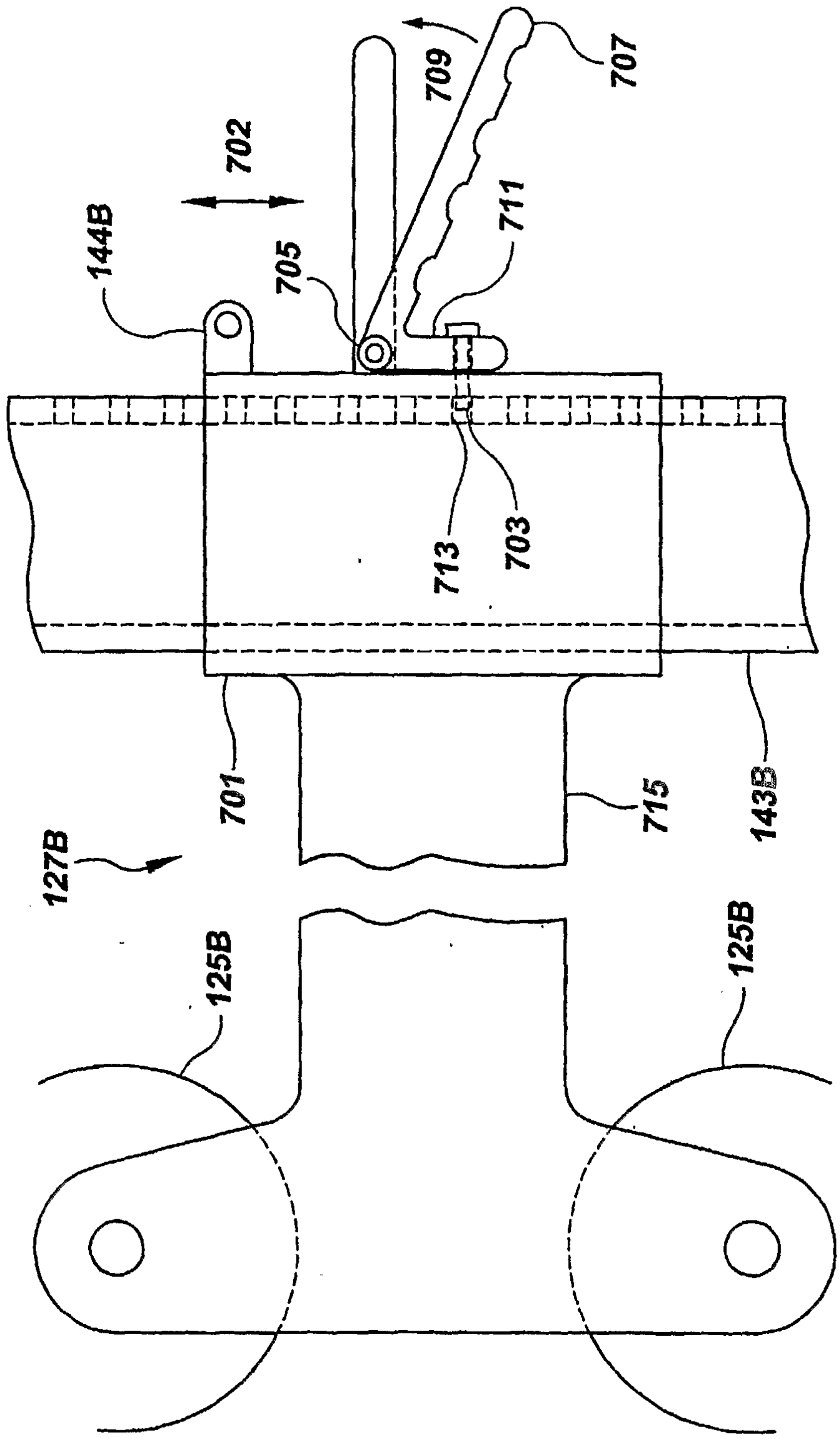
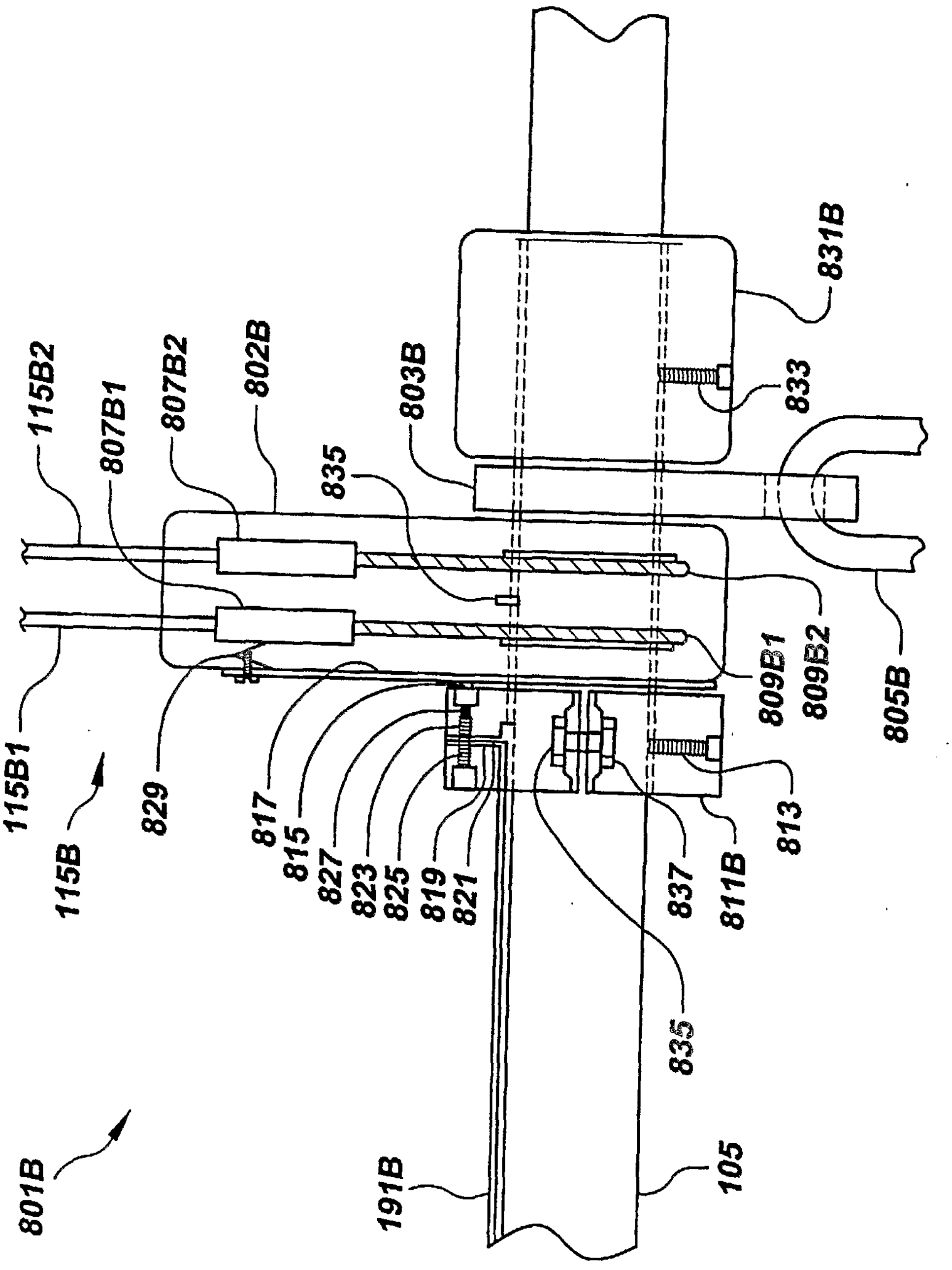


FIG.7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105

FIG.8

FIG.9A

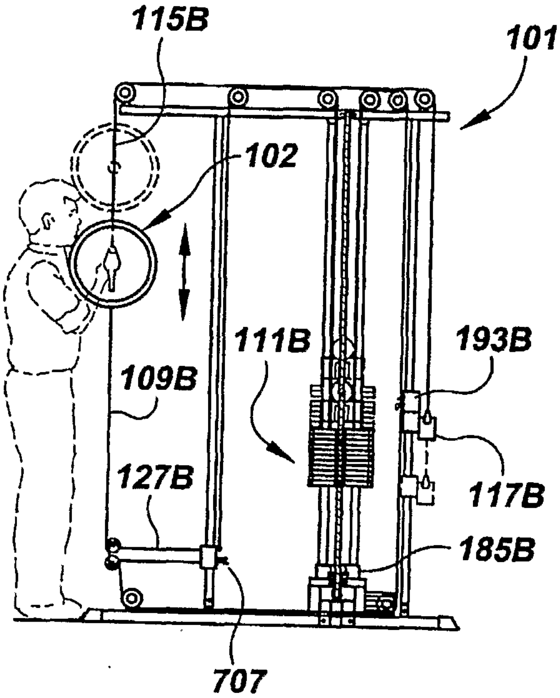


FIG.9B

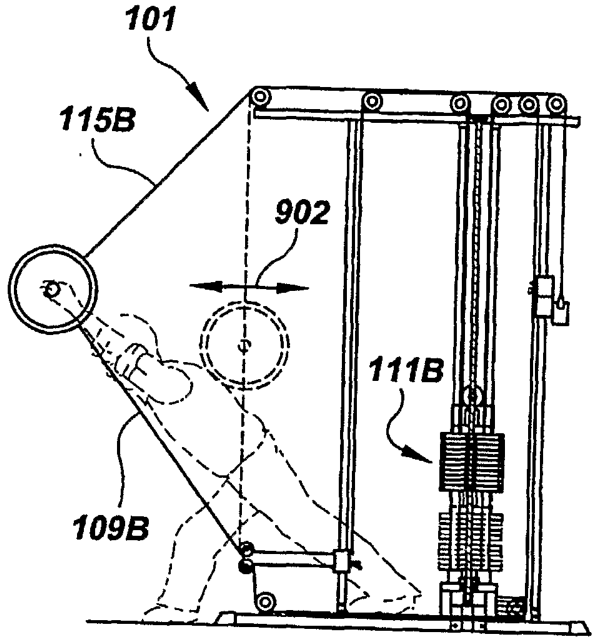
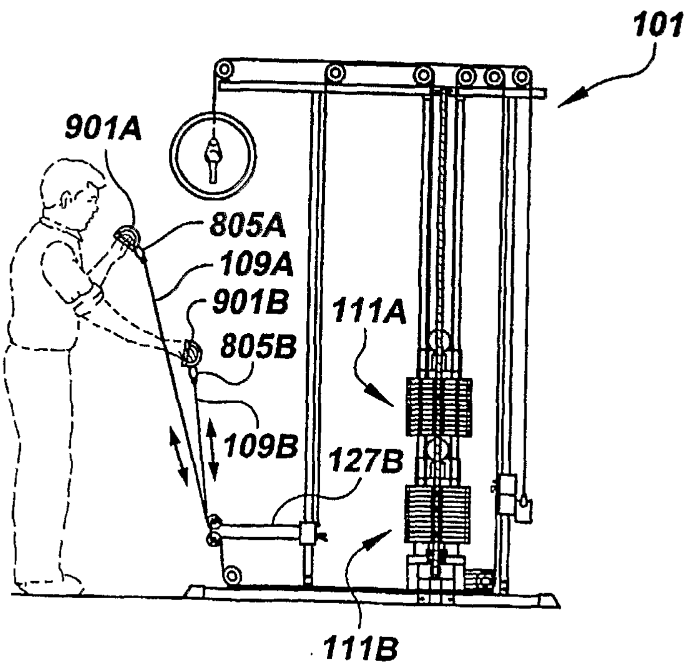
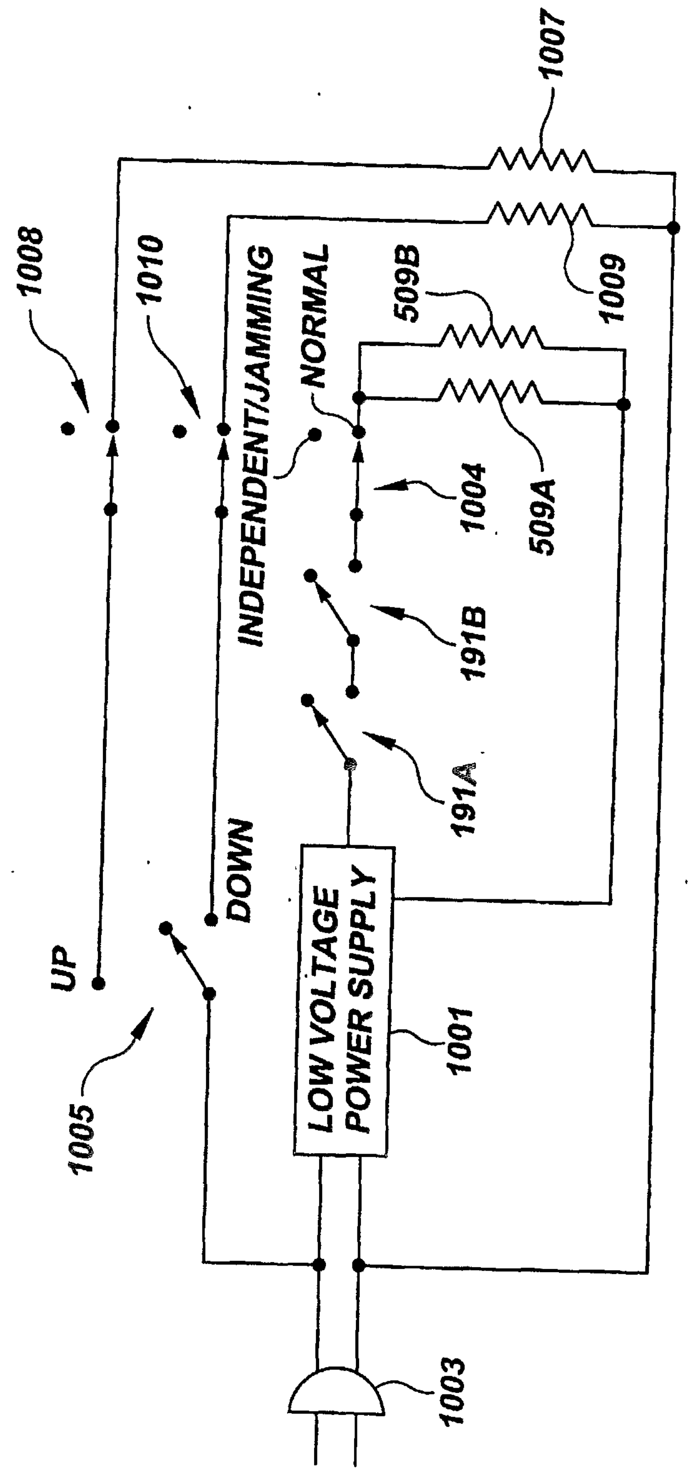


FIG.9C

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NORMAL
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1004
191B
191A
UP
DOWN
LOW VOLTAGE
POWER SUPPLY
1001
1005
1003

FIG.10